Absolutely Positively **Wellington** City Council
Me Heke Ki Pōneke

ORDINARY MEETING
OF
WELLINGTON CITY COUNCIL
SUPPLEMENTARY AGENDA

Time: 9:30am
Date: Thursday, 24 February 2022
Venue: Virtual meeting

Business **Page No.**

1. General Business

LET'S GET WELLINGTON MOVING – THORNDON QUAY HUTT ROAD SINGLE STAGE BUSINESS CASE

Kōrero taunaki

Summary of considerations

Purpose

1. This report request Te Kaunihera o Pōneke | Council to approve the Let's Get Wellington Moving (LGWM) – Thorndon Quay Hutt Road, Single Stage Business Case (SSBC).

Strategic alignment with community wellbeing outcomes and priority areas

	Aligns with the following strategies and priority areas: ☒ Sustainable, natural eco city ☒ People friendly, compact, safe and accessible capital city ☐ Innovative, inclusive and creative city ☒ Dynamic and sustainable economy
Strategic alignment with priority objective areas from Long-term Plan 2021–2031	☐ Functioning, resilient and reliable three waters infrastructure ☒ Affordable, resilient and safe place to live ☒ Safe, resilient and reliable core transport infrastructure network ☐ Fit-for-purpose community, creative and cultural spaces ☒ Accelerating zero-carbon and waste-free transition ☒ Strong partnerships with mana whenua
Relevant Previous decisions	LETS GET WELLINGTON MOVING PROGRAMME BUSINESS CASE (PBC).
Significance	The decision is **rated medium significance** in accordance with schedule 1 of the Council's Significance and Engagement Policy.

Financial considerations

☐ Nil	☒ Budgetary provision in Annual Plan / Long-term Plan	☒ Unbudgeted $2M

Risk

☐ Low	☒ Medium	☐ High	☐ Extreme

Author	Moana Mackey, Chief Advisor to Chief Planning Officer and Chief Infrastructure Officer
Authoriser	Sara Hay, Chief Financial Officer Liam Hodgetts, Chief Planning Officer

Taunakitanga

Officers' Recommendations

Officers recommend the following motion

That Te Kaunihera o Pōneke | Council:

1) Receive the information.
2) Approve the Let's Get Wellington Moving– Thorndon Quay Hutt Road, Single Stage Business Case (which is based on the preferred option being option 4A).
3) Note the next phase of the project will be to proceed to pre implementation (including detailed design and based on the preferred option identified in the Single Stage Business Case).
4) Note that certain further decisions will be referred to Council (or Committee as appropriate) including land purchase and statutory approvals through the traffic resolution process.
5) Note that Wellington City Council's partner share of costs (49% WCC, 51% Waka Kotahi) to undertake the work in the next phase and is included in the LTP.

Whakarāpopoto

Executive Summary

2. This report asks the Te Kaunihera o Poneke, Council to approve the Let's Get Wellington Moving (LGWM) – Thorndon Quay Hutt Road, Single Stage Business Case (SSBC) provided in Attachment 1 to this report. Approval from all three LGWM partners is required before moving to the next stage.
3. The Thorndon Quay Hutt Road (TQHR) project, whilst primarily concerned with Thorndon Quay and Hutt Road, includes work in three main areas that are covered in the SSBC, all at different stages of development. These areas are:
   a. The Thorndon Quay and Hutt Road corridor
   b. The 'Connection' between Hutt Road and Te Ara Tupua (Petone to Ngauranga) shared path
   c. Aotea Quay intersections
4. The TQHR corridor is strategically important as part of the Wellington transport network, providing a key connection and gateway to the central city from the north. It is the busiest bus corridor outside the city centre and the busiest cycle route in Wellington, with many more cyclists expected following the opening of Te Ara Tupua. Hutt Road is also a national freight route providing the only access to the inter-island ferry terminal at Kaiwharawhara.
5. With strong growth in Wellington's northern suburbs, travel demand along this corridor is expected to increase. Without investment, we are likely to see poor safety outcomes (particularly for people walking and cycling), slow and unreliable travel times (including for bus passengers and freight) and the aspirations to make Thorndon Quay a more attractive place to spend time won't be met.
6. To respond to future growth and meet LGWM's vision of a great harbour city, accessible to all, with attractive places, shared streets and efficient local and regional journeys – we need to increase the capacity of the corridor for moving people (rather

than vehicles) by prioritising and investing in public transport, active modes, safety and public realm improvements – and addressing alternative freight access to the ferry.

7. This SSBC presents the case for change, including the option development and assessment process that was applied to identify a preferred option. It also presents the cost estimation and economic appraisal for this option.
8. Development of the SSBC started in early 2020. The work during this phase included the development of the strategic case, a long list of options which were refined to a short-list, public engagement on the short-list and a multi criteria assessment on those options to identify a preferred option for Thorndon Quay and Hutt Road.
9. The preferred option (Option 4A) includes peak time bus lanes in both directions, upgrading and extending a two-way cycle path and dedicated footpath along the entire corridor, bus priority at key intersections, a raised median to prevent right turns between Aotea Quay and Ngauranga, bus stop optimisation, and other pedestrian safety and amenity improvements. The preferred option was endorsed by the LGWM Board in August 2021.
10. In September 2021, WCC replaced the existing angle parking with parallel parking on Thorndon Quay due to safety reasons. These parking changes are aligned with the road layout proposals in the TQHR preferred option.
11. A high-level design for the project (preliminary design) was developed following approval of the preferred option. This design has undergone a Road Safety Audit and been used to develop the project costs.
12. The SSBC has been reviewed by officers from all partner organisations and independent peer reviewers.
13. The project will deliver faster and more reliable bus journeys, improved pedestrian access and safety, encourage more cycling trips, support fewer crashes, and will improve amenity. The total benefits of the project are an estimated \$96m (BCR 1.8) under the core modelled scenario, with a range between \$20m and \$150m, depending upon the level of general traffic dis-benefits under various traffic re-routing or re-timing scenarios. The estimated cost is \$56m (P50), with a range of \$43m (base) to \$67m (P95).
14. A variation to the TQHR project has considered the ‘Connection’ between Hutt Road and Te Ara Tupua, the Petone to Ngauranga shared cycle and pedestrian path. Work on this variation has followed a similar process to that of the TQHR SSBC and is included in an Addendum to the SSBC. Two options are recommended to be progressed for the ’Connection’ until further information is obtained and trials are completed. No approval is being sought beyond the design phase at this time. This section is expected to be fully funded by Waka Kotahi.
15. Some initial design work has been progressed regarding intersections on Aotea Quay - an important pre-requisite to the TQHR proposals by providing turnaround facilities for heavy vehicles accessing Hutt Road properties and alternative ferry terminal access for freight. This has combined requirements for both the TQHR project and the Single User Terminal (catering for the new larger ferries being purchased by KiwiRail). This has highlighted the need for improvements at two intersections on Aotea Quay. Given the benefits to both projects, KiwiRail is expected to fund the signalised intersection. The additional cost range above that included in the SSBC for the roundabout is \$2m (base) to \$3m (expected, P50).
16. Expected funding envelopes for TQHR (\$59m) and the Connection (\$3m) have been estimated. This does not include implementation of the Connection or any costs

associated with the signalised intersection on Aotea Quay. Pre-implementation costs exceed the Waka Kotahi allowance in the 21-24 NLTP for the pre-implementation phase by a total of $5.6m, and Waka Kotahi will need to confirm funding alongside approval of the SSBC. Implementation costs in the funding envelopes currently exceed the WCC budget ($2m shortfall) and the Waka Kotahi allowance in the 21-24 NLTP ($9m shortfall). This is due general cost escalations, and updated cost estimates as design details are refined. LGWM will need to work with partners to which these shortfalls relate to prior to funding being sought.

17. The approval of the SSBC will release the remaining funding for the next stage(s) of the project, detailed design also referred to as pre-implementation. Implementation funding will also be released for Aotea Quay roundabout.
18. Subject to business case approval by partners and release of the remaining pre-implementation funding by the middle of March 2022, we expect that detailed design for Aotea Quay roundabout will be completed to enable construction to begin in late 2022 with Thorndon Quay and Hutt Road to commence in early 2023 once Aotea Quay roundabout is complete.
19. Integration with all adjacent projects will continue, including discussions with KiwiRail regarding funding arrangements for improvements on Aotea Quay.

Takenga mai

Background

20. LGWM is a joint initiative between Wellington WCC, GWRC and Waka Kotahi, together with Mana Whenua partners Taranaki Whānui ki Te Upoko o Te Ika and Ngāti Toa.
21. The focus of the LGWM programme is from Ngauranga Gorge to Miramar including the central city, the state highway, access to the port, and connections to Wellington Hospital and the airport. A number of core multi-modal corridors connecting the central city with suburbs to the north, south, east, and west are also covered by parts of the programme. This area has an important role for both local and regional journeys.
22. A draft LGWM programme business case was completed in 2018, which identified a Recommended Programme of Investment (RPI).
23. Discussions with central government about funding, financing, and staging led to the announcement of an Indicative Package (IP) with central government funding in May 2019.
24. On 26 June 2019, Council endorsed the LGWM long term vision and RPI, welcomed the government funding announcement as part of the IP, and agreed to move to the next stage of investigations (Council 26 June 2019). GWRC similarly endorsed the LGWM vision in June and the WK Board subsequently endorsed the programme's next steps.
25. On December 11 2019, Council (SPC) agreed the funding and partnering approach for the next phase (Strategy and Policy Committee 11 December 2019). GWRC and Waka Kotahi similarly endorsed the funding and partner agreement.
26. Since then, the next business case stages for the various packages have been significantly progressed, including a draft Indicative Business Case for both the Mass Rapid Transit and Strategic Highway Improvements packages.
27. The LGWM programme includes substantial investment in public transport, walking, cycling and amenity/place making to provide enhanced travel choice with a strong focus on the central city and effective and efficient connections between the central city and key sub-urban centres.

28. The TQHR project is one of the early delivery projects within the LGWM Three Year Programme and will contribute to LGWM's overarching vision of a great harbour city, accessible to all, with attractive places, shared streets and efficient local and regional journeys. It will improve safety, comfort and amenity for people who live and work on Thorndon Quay; will have significant benefits for people travelling to, through, and along the corridor on foot, by bike and by bus.

<u>Strategic Case</u>

29. The TQHR project aligns with LGWM's overarching vision of a great harbour city, accessible to all, with attractive places, shared streets and efficient local and regional journeys.

30. Thorndon Quay is the busiest bus route outside the city centre and the busiest cycle route in Wellington. Hutt Road provides the only access to the ferry terminal at Kaiwharawhara, a national freight route.

31. The population of Wellington City is forecast to grow, with the northern suburbs expected to increase by over 20 percent (11,000 people)[1]. Over 40% of the current 235,000 jobs in the Wellington region are in the central city. The high concentration of employment in the central city attracts commuters from the wider Wellington region placing pressure on the transport system especially for travel to and from the north of the city. Future travel demand by all modes along this corridor is projected to increase set out in Section 2.3.3 of the SSBC (refer to Attachment 1) and summarised below.

32. This predicted growth and ferry connection are important context to the investment objectives identified for the project.

33. The investment objectives that this project is seeking to achieve are to:

[1] Based on ID[3] projections (developed November 2019) https://forecast.idnz.co.nz/wellington

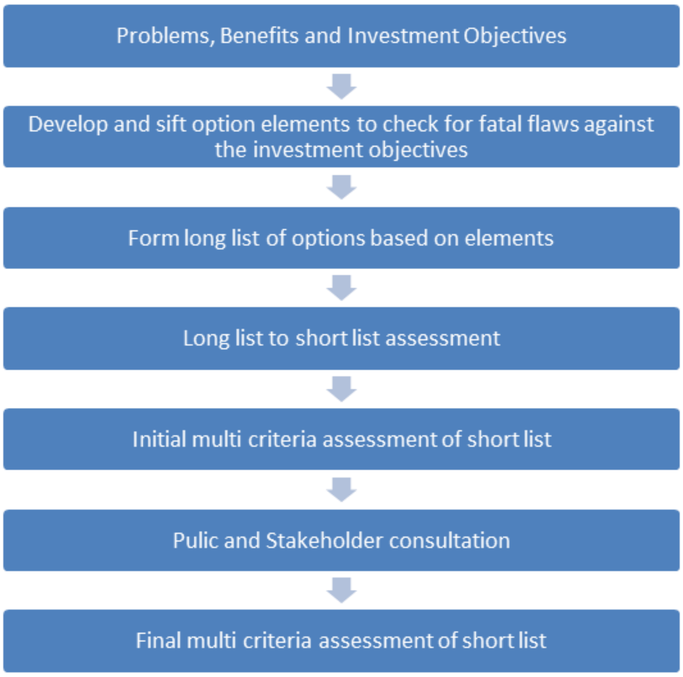
34. Table 4-3 in the SSBC (refer to Attachment 1) shows the alignment between the Thorndon Quay Hutt Road project and LGWM objectives.

35. The LGWM Programme Steering Group approved the strategic case and investment objectives in October 2020.

Kōwhiringa

Options

36. The process used to develop the short-listed and preferred options is shown below.



37. The problems, benefits, and investment objectives, as well as assessment of evidence and feedback from previous stakeholder engagement, was used to develop an initial list of potential interventions such as bus lanes, cycleway options, improvements to intersections and pedestrian crossings. These interventions were reviewed against the investment objectives and some elements were rejected if they did not contribute towards achieving these. The remaining elements were packaged into a long list of options.

38. The long list of options was assessed using a high level multi criteria assessment process to assess and compare options against a range of objectives and criteria, to arrive at four options for short list assessment. A safety assessment identified that the

provision of a bus lane or Special Vehicle Lane[2] on Hutt Road added additional risks when considering the traffic turning into and out of properties along the road. To mitigate this risk, options that included a central median and a service lane sub-option were developed. The options also included a new roundabout on Aotea Quay to provide a turnaround facility for trucks which may be impacted by the provision of a central median or service lane.

39. The short list options and sub-options are summarised below:

Option	Elements			Common elements
	Thorndon Quay bus lanes	Thorndon Quay cycle paths	Hutt Road bus lanes	
1	Southbound	Bi-directional	Southbound	Speed limit review Intersection upgrades Pedestrian crossing improvements Bus stop rebalancing Thorndon Quay amenity Hutt Road Safety Audit recommendations
2	Both directions	Uni-directional	Both directions	
3	Southbound	Uni-directional	Southbound	
4	Both directions	Bi-directional	Both directions	
Sub-options:				
A: Addition of roundabout / turning facility on Aotea Quay				
B: Addition of service lane on Hutt Road				

40. The key differences between the short-listed options were:

a. Whether bus lanes should be into the city or both into and out of the city

b. Whether the cycle path on Thorndon Quay should be bi-directional (i.e. a facility on one side of the road providing for cyclists travelling in both directions) or uni-directional (i.e. a facility on both sides of the road, each providing for cyclists traveling in one direction)

c. Whether there should be a roundabout on Aotea Quay

d. Whether Hutt Road should have a flush median, raised median or separate service lane.

41. A multi criteria assessment was completed for the short list to inform the selection of a preferred option. The main considerations in the assessment were the extent to which the option met the project investment objectives, the effects of the option, and its delivery cost/timescale/operations implications.

42. The evaluation of the short list options is shown in Tables 4 and 5 of the Alternatives and Options Report (refer to Appendix H of Attachment 1). Options 4A and 4B (with north and southbound bus lanes, bi-directional cycleway on Thorndon Quay and a raised median (A) or service lane (B) on Hutt Road) scored equally highest with strong alignment to the investment objectives. While these options scored similarly overall, the provision of a service lane (sub-option B) was discounted as being more disruptive, fits less with other regional projects and carries larger implementation risk.

43. The short-listed options were packaged together for public engagement as the emerging proposals. These proposals included all the decision elements of the short-listed options

[2] Priority lane for buses and freight

for both Thorndon Quay and Hutt Road. Public engagement on the emerging proposals was undertaken between 11th May and 8th June 2021.

44. Overall, the engagement was well received, and the feedback was supportive of the proposals. No additional options emerged from the process which had not been considered before. However many business owners and people that worked in the area felt that the changes would have a negative impact. Some local businesses and retailers along the Thorndon Quay did not support any change to the status quo (angle parking) primarily due to their concern that any changes that remove parking will be detrimental to their business. Some Hutt Road businesses were concerned with access to their properties. The project team will work proactively with business owners, stakeholders, and the community to address concerns where possible through the next detailed design phase.

45. Following stakeholder and public engagement, a second multi criteria assessment workshop was held on 30 June 2021. The purpose of this workshop was to consider the impact of engagement feedback on the interim multi criteria assessment scores, update scores based on any further information, as well as to incorporate the mana whenua values assessment into the multi criteria assessment. Option 4A was subsequently confirmed as the preferred option.

46. The key reasons for Option 4A being recommended as preferred is its strong alignment with the investment objectives:

    a. Bus lanes in both directions will improve bus travel times and reliability during peak hours, making buses a more attractive travel option and will allow for future growth and mode shift.

    b. A bi-directional cycle path on one side of TQHR will provide a consistent experience and level of service for users along the length of the corridor, including those connecting from Te Ara Tupua (Wellington to Hutt Valley) shared path to the north, and provide safer passing opportunities for cyclists traveling at different speeds.

    c. A raised central median to prevent right turns along the section of Hutt Road between Aotea Quay and Ngauranga will significantly reduce the safety risk associated with these movements, particularly for people walking, cycling and on motorbikes.

    d. Changes proposed under this option will encourage more people to walk, shop and spend time on Thorndon Quay.

    e. Safety will be improved for everyone by removing the angle parking, providing a dedicated cycle path and improving pedestrian crossings.

47. The preferred option was endorsed by the LGWM Board in August 2021.

Preliminary design

48. A preliminary design of the preferred option was undertaken to estimate likely costs and benefits; investigate linkages/dependencies with other projects; understand high level utilities interaction and identify and assess project risks for further investigation into the next phase of detailed design. The proposed road layout and associated high level plans are included in the SSBC and these will be further refined and developed in the next stage.

49. To guide the design of the preferred option, the project team has developed a Design Philosophy Statement that sets out standards, guidelines and assumptions to guide the design of the preferred option.

50. Mana Whenua has provided a set of draft cultural design values to help guide the design in the next phase of the project (refer to Appendix J of Attachment 1).
51. The key design features are:
    a. Part-time bus lanes in both directions on Thorndon Quay and extending the two-way cycle path from Hutt Road to the Lambton interchange at Mulgrave Street. Bus priority will be provided at Mulgrave Street. The footpaths and street environment will be improved to make it a more pleasant place to visit.
    b. Peak hour[3] bus lanes in both directions and bus priority at the Ngauranga/Jarden Mile intersection.
    c. The shared path between the Ngauranga/Jarden Mile intersection and Caltex will be upgraded to a two-way cycle path and dedicated footpath. The new paths will connect with the existing paths on Hutt Road and the bike path will connect with the proposed new cycle path on Thorndon Quay. There will also be a future connection to Te Ara Tupua.
    d. A raised central median between intersections is proposed to prevent right turns along this section of Hutt Road.
    e. A roundabout on Aotea Quay will provide drivers of large vehicles intending to travel north from a business on Hutt Road a safe place to turn and an alternative route (via State Highway 1) access to the ferry terminal at Kaiwharawhara.
52. Indicative cross sections for both Hutt Road and Thorndon Quay are provided as Figure 5-21 and 5-22 in the SSBC (refer to Attachment 1).
53. The next design phase will further develop the Design Philosophy Statement and refine the design in collaboration with programme partners (including Mana Whenua), public and key stakeholders.

<u>'The Connection' between the TQHR corridor and Te Ara Tupua (Petone to Ngauranga) shared path</u>

54. A variation was made to the Thorndon Quay Hutt Road project to look at the connection between the northern end of Hutt Road and Te Ara Tupua (Petone to Ngauranga) shared path. There is an existing shared path in this location (approx. 400m long) however it is not of the same width and standard of the proposed works of the projects on both sides. The current state of this shared path limits its attractiveness and may constrain future active mode uptake due to potential conflicts between users walking, cycling, travelling at different speeds, accessing the stock effluent facility, bus stop, Ngā Ūranga station, and KiwiRail yards.
55. The work on this connection has been included as an addendum to the SSBC. This work followed a similar process to the main SSBC with specific objectives identified consistent with both the TQHR project objectives and those of the Te Ara Tupua project.
56. Feedback from cycle groups was sought as input to a multi criteria assessment that was completed with officers from the LGWM partners including mana whenua, KiwiRail and the representatives from the Te Ara Tupua project.
57. Five options with three sub-options options were identified and evaluated. Four were discounted due to impacts on KiwiRail operations. It is therefore proposed to proceed with two options in parallel:

[3] It is expected that bus lanes will initially operate at peak hours in the peak direction however this will be confirmed during the next phase

a. The first includes converting the Hutt Road off-ramp slip lane from State Highway 2 at Ngauranga to provide additional width for the shared path and safety barrier. The existing exit from both the stock effluent disposal facility, and the KiwiRail laydown area would be consolidated into a single exit.

b. The second option includes providing a new underpass under State Highway 2 in the vicinity of the existing off-ramp for a separate shared path.

58. These options scored positively against the do-minimum, providing an improved connection between Hutt Road and Te Ara Tupua.

59. It is proposed to take both options forward whilst further work is undertaken to determine whether there are fatal flaws with the first option. Localised transport modelling suggests that the first option should be acceptable in terms of queue lengths on SH2 southbound, however this does not take account of wider network changes such as the Transmission Gully motorway opening and the changes to Aotea Quay. Further modelling will be undertaken, and a trial is also recommended, once Transmission Gully is open and post-COVID restrictions when general traffic is near 'normal'. This trial will be a temporary installation that can be installed and removed overnight and will not preclude any other works progressing.

60. The second option will require significant structural and constructability work to be undertaken and would take considerably longer to design and construct. It is therefore recommended to continue this in parallel with the first option to maximise time prior to Te Ara Tupua opening to work through the design, construction methodology and construction if required.

61. This approach has been endorsed by LGWM Programme Leadership Team and Programme Director.

62. Given funding constraints, it is proposed that only the detailed design phase is progressed at this time. This would result in a confirmed option and associated design which could then be implemented when funding is available.

63. 'The Connection' is expected to be fully funded by Waka Kotahi and the funding application includes costs associated with the second (most expensive) option.

Aotea Quay intersections

64. LGWM received advance funding to progress some detailed design work for Aotea Quay intersections ahead of approval of the full Single Stage Business Case. This advance work has focussed on changes to Aotea Quay for the following reasons:

a. A turning facility for large trucks will be required prior to the installation of a raised median on Hutt Road. This construction cannot occur in parallel with work on Hutt Road and Thorndon Quay without causing significant disruption to the city.

b. KiwiRail are progressing work to allow for new, larger ferries at Kaiwharawhara and the two projects need be aligned.

65. Whilst a design was proposed for the roundabout on Aotea Quay as part of the TQHR project, a functionality and design assessment was completed with project partners, KiwiRail and CentrePort considering the needs of both projects. This assessment has identified, further to the SSBC, that the intersection at the exit to the ferry should be improved and the roundabout on Aotea Quay should be larger.

66. LGWM is working with KiwiRail to determine funding arrangements for these two intersections. In the interim, funding is only being sought for the larger roundabout.

Kōrerorero

Discussion

Preferred option costs

67. An initial cost estimate for the project was provided on the basis of generic cross-sections on Thorndon Quay and Hutt Road and an existing Wellington City Council roundabout design for Aotea Quay. The cost estimate for the project has been updated following the preliminary design.

68. The table below sets out the expected cost estimate for the preferred option for Thorndon Quay and Hutt Road:

Cost source	Estimate
Pre-Implementation (Design) Phase	
Main consultancy / contract including comms and engagement	$4.3m
Internally managed costs (reviews, audits, advertising, cultural assessment, ad-hoc fees, trials, early contractor involvement)	$2.5m
Implementation (Construction) Phase	
MSQA consultancy supervision	$2.5m
Internally managed costs (consent monitoring fee, audits, reviews, advertising costs, bonus allowance for contractor)	$2.8m
Physical works	$29.7m
Property	$1.3m
Total Project Base Cost	**$43.1m**
Project Contingency (30%)	$12.8m
Total Expected Project Cost (P50)	**$55.8m**

69. This includes:

    a. An allowance of $6m for urban design and landscaping,

    b. Extra-ordinary pre-implementation managed costs for trials around vulnerable users and an allowance for early involvement of a contractor, and

    c. Extra-ordinary construction phase managed costs for a bonus payment for the physical works contractor for meeting broader social outcomes targets.

70. The cost estimate for the second (more expensive) option for the Connection is:

Cost source	Estimate
Single Stage Business Case Phase	
Main consultancy / contract and Internally managed costs (reviews, audits)	$0.2m
Pre-Implementation (Design) Phase	
Main consultancy / contract including comms and engagement	$0.9m
Internally managed costs (reviews, audits, advertising, cultural assessment, ad-hoc fees,	$0.7m

trials, early contractor involvement)	
Total Project Base Cost	**$1.8m**
Project Contingency	$0.8m
Total Expected Project Cost (P50)	**$2.6m**

71. Given funding constraints, LGWM Board have only endorsed proceeding to detailed design for the Connection element.

72. The estimated implementation cost is $12m (P50), with a range of $7m (base) to $22m (P95) (refer to Connection Addendum, Appendix A of Attachment 1). This has not been included within the expected funding envelope.

73. The cost estimate for the work on Aotea Quay roundabout is:

Cost source	Estimate
Pre-Implementation (Design) Phase	
Main consultancy / contract including comms and engagement	$0.6m
Internally managed costs (reviews, audits, advertising, cultural assessment, ad-hoc fees, trials, early contractor involvement)	$0.4m
Implementation (Construction) Phase	
MSQA consultancy supervision	$0.4m
Internally managed costs (consent monitoring fee, audits, reviews, advertising costs, bonus allowance for contractor)	$0.4m
Physical works	$4.2m
Property	$1.1m
Total Project Base Cost	**$6.9m**
Project Contingency (30%)	$3.2m
Total Expected Project Cost (P50)	**$9.0m**

74. The estimated signalised intersection cost is $6m (P50), with a range of $4m (base) to $9m (P95). This has not been included within the expected funding envelope.

Preferred option economics

75. A breakdown of the benefits associated with delivering the Thorndon Quay Hutt Road preferred option is provided below.

Objective	Benefit Stream	Estimated benefits (based on 40 year evaluation period)	Explanation
	Bus travel time savings	$20-21m	Bus travel times along the corridor of 7 minutes compared to general traffic time of 9 minutes in the AM peak period. Bus travel time savings of 8 minutes compared with a future do-minimum scenario.

	Bus reliability benefits	$9m	Based on an estimated 30 second reduction in average late time for southbound buses in the AM peak period
	Cyclists' health benefits	$72m	Based on an estimated 450 new cycle trips per day (plus a 50% increase in existing cycle demand due to the Ngā Ūranga ki Pito-One Shared Path Project)
	Crash cost savings	$6m	Crash numbers estimated to be reduced due to both the linear treatments (e.g. changing angled parking to parallel parking, raised median, etc.) and point treatments (e.g. raised safety platforms) proposed
	Pedestrian amenity benefits	$2m	A 3% growth in pedestrian demand was assumed to 2036 (tapering off after 2036 to 2046). A 3km/h reduction in average speed along the corridor was also assumed.

76. Bus travel time savings of around eight minutes associated with the dedicated peak bus lanes and priority measures under the preferred option are considered to be conservative and there are several other elements that will make travelling by bus a more attractive option. Bus stop locations along the corridor will be relocated and optimised to better balance access and travel time. Improved bus stop design will mean shorter dwell times at stops. New pedestrian crossings facilities and bus stop locations will enhance access and interchange for passengers (including at Ngauranga/Jarden Mile interchange and adjacent Aotea Quay for ferry passengers). These elements will all contribute to increased public transport benefits and mode shift.

77. It should be noted that, with the provision of a roundabout on Aotea Quay, road freight will be able to use State Highway 1 to access both the interisland ferries and therefore Hutt Road will no longer be part of the national freight route.

78. There are also expected to be dis-benefits to general traffic due to the introduction of bus lanes and reduction in general traffic capacity as part of the preferred option. The extent of rerouting on factors such as the level of congestion, location of destination in the CBD and user preferences, therefore two scenarios have been assessed to understand the range of potential impacts:

    a. Top end (Core modelled scenario) – modelled level of diversion from TQHR to SH1 and alternative routes; people travel at the same time, but some choose a different route to avoid congestion on TQHR

    b. Bottom end – no diversion from TQHR to SH1 and alternative routes; people travel at the same time and continue to take the route they currently use (Hutt Rd)

79. This analysis suggests a range of dis-benefits between -$90M (Bottom end) and -$13M (Top end) and an associated overall BCR between 0.4 and 1.8.

80. It should be noted that a 90 second increase in state highway travel time under the core scenario, in the context of an average morning peak commuter car trip between Johnsonville and the CBD taking 20 to 25 minutes with significant variability from one day to the next, would be unlikely to be perceived by the average road user.

81. Further analysis was completed to consider the effect of people who drive re-timing their trip to travel earlier or later in response to the reduced traffic capacity. This scenario assumed that there are no economic disbenefits associated with trip re-timing due to flexible working arrangements. This scenario would result in $30M general traffic benefits and a BCR of 2.7.
82. Other sensitivity testing has also been completed as shown in Table 5-9 of the SSBC. Of note are:
    a. Bus patronage. A conservative growth rate has been assumed for bus patronage of 3% between 2026 and 2036 and thereafter a 2% growth. A 20% change in this assumption will alter the BCR by +/- 0.1.
    b. Growth in people cycling. Approximately 450 new cycle trips per day have been assumed for the economics. A high cycle growth rate (900 additional trips per day) would increase the BCR to 4.5 whilst a low cycle growth rate (260 new cycle trips per day) would result in a BCR of 1.0.
83. In addition, the potential for greater levels of mode shift to bus and active modes along the corridor due to wider improvements as part of the LGWM transformation programme should be acknowledged.
84. Benefits of the 'Connection' have also been assessed. If combined with the economics for the TQHR project, this would amend the overall Benefit Cost Ratio from 1.8 to 1.6. If combined with the economics for Te Ara Tupua, the overall Te Ara Tupua Benefit Cost Ratio would remain at 1.1.

Interdependencies

85. Forecasted cycle numbers for TQHR are dependent upon the completion of Te Ara Tupua.

Whai whakaaro ki ngā whakataunga

Considerations for decision-making

Alignment with Council's strategies and policies

86. The preferred option aligns with Wellington City Council's strategies is as follows:

Strategies and Policies	Alignment
Our City Tomorrow: Planning for Growth and Spatial Plan for Wellington City	Strong
Wellington Towards 2040: Smart Capital	Strong
Te Atakura First to Zero: Wellington City's Zero Carbon Implementation Plan 2020 – 2030	Strong
Wellington City Council (WCC) Long Term Plan 2021-31	Strong
WCC Walking Policy 2008	Strong
WCC Parking Policy 2020	Strong
Paneke Poneke – Bike Network Plan	Strong

Wellington RLTP 2021	Strong
Wellington Regional PT Plan 2021	Strong
Regional Climate Emergency Declaration/ Action Plan	Strong

Engagement and Consultation

Reviews and approvals

87. The Thorndon Quay Hutt Road SSBC and Workstream Funding Approval was endorsed by the LGWM Board on 16 February 2022.
88. Standard practice for any business case of this size within Waka Kotahi is that it undergoes an internal investment quality assurance (IQA) review. The IQA process supports this SSBC.
89. The SSBC has also been independently peer reviewed and all relevant issues have been resolved. The peer reviewer supported the SSBC document.
90. The SSBC has also gone through independent transport modelling and economics peer review and their review findings support the SSBC modelling and economics.
91. The Preliminary design has also been independently safety audited and audit findings been reviewed and accepted by consultant, LGWM and WCC safety engineer.

Community and Stakeholder feedback

92. The emerging proposals were released for engagement with the public between 11th May and 8th June 2021. Wellingtonians were asked how important the changes were, if they aligned with the Let's Get Wellington Moving vision, the impacts for various modes of transport, the impacts for different users of the areas and if there was anything the proposal hadn't considered.
93. The engagement also included open days at Pipitea Marae on Thorndon Quay, and Harbourside Market, Waitangi Park and at Johnsonville Market. Ongoing discussions were held with some key stakeholders.
94. 1,613 submissions were received on the proposal with 72% of the respondents saying that it was important or very important to make improvements for people walking, riding bikes and taking the bus on Thorndon Quay and Hutt Road. 62% of the respondents said that these changes aligned with the vision of Let's Get Wellington Moving to create 'a great harbour city, accessible to all, with attractive places, shared streets and efficient local and regional journeys.
95. Walkers/pedestrians, people that used buses, bikes and e-scooters generally felt the proposed changes would have a positive impact. So did people that travel through and visit the area.
96. Submissions from people that drove cars, trucks, motorcycles, lived in the area or had a disability had a mixed response about the impact of the proposed changes.
97. Business owners and people that worked in the area felt that the changes would have a negative impact primarily due to loss of access and parking changes. A parking demand survey was undertaken and this concluded that short term parking demand could be met with the proposed option. Commuter parking would be affected by the proposed option.
98. More detailed results from the engagement are included in Attachment 9 (Appendix I).
99. A number of areas have been identified for more detailed consideration during the next phase. These include:
    a. The impacts on commercial delivery vehicles
    b. Drop-off parking to be made available
    c. Safety for pedestrians crossing the street, especially small children

d. Impact to businesses in a tough retail environment
e. Bus stop locations to be outside or close to key destinations
f. Allowing safe vehicle access into and out of properties around pedestrians and cyclists
g. Increase the width of the bike lane
h. Address concerns from businesses about how their customers will access their business if they cannot make a right turn

100. People were also asked what they would like to see designed into the streetscape. They responded that they would like bike parking, more greenery and other parking options if on street parking is reduced.
101. The next phase will involve working closely with business owners, stakeholders, and the community to address issues raised through the feedback to date and ensure the design approach is collaborative and works as well as possible for all users, local businesses and retailers.
102. Representatives from adjacent projects, KiwiRail and CentrePort have been included in assessments as appropriate.

Implications for Māori

103. LGWM has established Mana Whenua partnership working group and Iwi membership on the Governance Reference Group to incorporate Mana Whenua perspectives in the programme outcomes and support broader Iwi engagement.

104. Iwi representatives have been involved in the Thorndon Quay Hutt Road and 'Connection' multi criteria assessment options assessment processes and support the preferred option.

105. The iwi representatives have provided a set of draft cultural design values and principles to help guide the development of the project. These values, along with, Heritage landscape assessment and archaeology assessment will guide the development of the preferred option design in the next phase of the project. This design will be developed in partnership with the Mana Whenua working group.

Financial implications

106. In accordance with the Waka Kotahi Cost Estimation Manual, the estimated cost range for the TQHR project is:

Base	Expected (P50)	95th percentile (P95)
$43m	$56m	$67m

107. In accordance with the Waka Kotahi Cost Estimation Manual, the estimated cost range for the 'Connection" is:

Base	Expected (P50)	95th percentile (P95)
$2m	$3m	$4m

108. This includes detailed design only. A further funding application for implementation will be sought once detailed design is complete and funding available.

109. In accordance with the Waka Kotahi Cost Estimation Manual, the estimated cost range for the Aotea Quay roundabout is:

Base	Expected (P50)	95th percentile (P95)
$7m ($2m additional to TQHR)	$9m ($3m additional to TQHR)	$11m ($4m additional to TQHR)

110. This does not include any funding for the signalised intersection as this is expected to be funded by KiwiRail.

111. Expected funding envelopes for TQHR ($59m)[4] and the Connection ($3m)[5] have been estimated.

112. Pre-implementation costs exceed the Waka Kotahi allowance in the 21-24 NLTP for the pre-implementation phase by a total of $5.6m, and Waka Kotahi will need to confirm funding alongside approval of the SSBC.

113. Implementation costs, which are subject to confirmation, in the funding envelopes currently exceed the WCC planned values for this project ($2m shortfall) and the Waka Kotahi allowance in the 21-24 NLTP ($9m shortfall). However due to timing variances on other projects this will not exceed the total allowance for LGWM in the current NLTP period. LGWM will need to work with partners prior to funding being sought to which these shortfalls relate to and once we have certainty on costs.

Legal considerations

114. Thorndon Quay Collective have asked the High Court to review WCC's decision to replace angle parking with parallel parking on Thorndon Quay. WCC's decision was made for safety reasons and implemented in September 2021. The recommended SSBC relates to the same area, and therefore any High Court decision may have implications for this business case's implementation.

Risks and mitigations

115. The table below sets out the key risks and opportunities for the TQHR project.

Risk or opportunity	Description	Mitigation
Cost increases	There is a risk of increasing costs.	Parallel estimates of the costs have been completed and cost estimates agreed between the designer and independent parallel estimator. At preliminary level design, some risk of further cost increase remains as we cannot yet quantify the full impact of underground services, cost escalations, construction impacts and market rates. These will be managed in the next, pre-implementation, phase. Value engineering will be undertaken.
Cost contingencies	There is a risk that cost contingencies are insufficient.	The contingency allowance has been reviewed and accepted by the WK Commercial team as well as supported by the independent parallel estimator.
Scope and quality	There is a risk that the expectations from partner organisations on both scope of	The project team plan to manage this risk by keeping decision makers informed of any scope/quality creep

4 Based on TQHR and Aotea Quay roundabout P50
5 Based on Connection P50 for pre-implementation only

Risk or opportunity	Description	Mitigation
	the project, infrastructure design requirements and quality of material selection (paving type) may add costs to the project without adding transport benefits.	and to keep the project within the estimated cost of $64.8m (P50 estimate) for Thorndon Quay Hutt Road and Aotea Quay intersections. The 'Connection' estimate will be further refined when a decision is taken regarding which option is to be progressed.
Underground services	There is a risk that additional work is required to move existing underground services	Ground Penetrating radar (GPR) work to understand and assess the type and depth of underground services and their possible clash/integration with the option is being undertaken. The cost estimate includes appropriate contingency allowance to manage this risk and undertake physical location of some services, however, we will only fully understand this risk and its ramifications once this GPR survey work is completed.
Integration with adjacent projects	There is a risk of lack of integration with other projects	The project team is liaising closely with representatives from adjacent projects to ensure alignment as they develop. These projects and their current status are shown in Table 2-2 of the SSBC.
Engagement and Consultation	There is a risk of adverse stakeholder and community views resulting in media interest or judicial review	LGWM propose to engage with businesses and stakeholder groups during the detailed design to develop a design that considers the needs of everyone. This engagement may be affected by future responses to covid.
Construction impacts	There is a risk of impact of proposed construction works on the businesses and bus services on Thorndon Quay and Hutt Road and on general traffic on Aotea Quay.	It is too early to assess these effects without first understanding the construction methodology. LGWM have identified a preferred contractor to be involved early in the detailed design phase to jointly develop the construction staging plan (along with partners) and assess the impacts of disruption on the businesses and users of the surrounding transport network.
Modelling	There is a risk that modelling will continue to be difficult for the TQHR project. Modelling the TQHR corridor is difficult given the complex interdependencies between this corridor and the parallel state highway.	LGWM have engaged both a peer reviewer and a Principal's Advisor to provide robust guidance and oversight. Allowance has been made within the managed costs to retain this close oversight and carry out additional modelling if required.

Risk or opportunity	Description	Mitigation
Covid impacts	There is a risk that the project is schedule is affected by covid in terms of resources and / or materials availability (and cost escalations as above).	Priorities will be set within the project and LGWM programme if there is a need to share resources.
Bunny Street	There is an opportunity to extend the cycleway from Thorndon Quay to Bunny Street to provide connectivity through to the waterfront.	
Temporary to permanent	There is an opportunity to install some temporary changes prior to permanent changes. This would allow interactive engagement on these elements and potentially provide some benefits early.	

Disability and accessibility impact

116. In the next design phase, the project team is developing communications and stakeholder engagement plan that aims to develop design of preferred option in collaboration the Disability stakeholder groups.

Climate Change impact and considerations

117. The preferred option is expected to reduce carbon monoxide, carbon dioxide, nitrous oxide and PM10 emissions. That is, by improving public transport and active mode infrastructure and by restricting access for private motor vehicles, the preferred option is expected to help make the bus / active mode network more efficient, attractive and encourage people to switch from their private motor vehicles to more sustainable modes of travel.

118. The preferred option strongly aligns with The Te Atakura blueprint (2019) and implementation plan (2020) - commits WCC to ensuring Wellington City becomes a net zero carbon city by 2050 – including making the most significant reductions by 2030. Transport emissions are responsible for over half of Wellington's emissions – thus is a key action area.

Communications Plan

119. Once all three partners (WCC, GWRC and WK) approve the Thorndon Quay Hutt Road Single Stage Business Case, it will be released on the project website with associated key messages and high level timeline for engagement with public, stakeholders and businneses to inform the detailed design of preferred option. The engagement will include businesses on both the Thorndon Quay and Hutt Road corridor. The SSBC will be finalised after the final approval by Waka Kotahi on 2 March 2022.

Health and Safety Impact considered

120. The preferred option is expected to have positive impact on health and safety by encouraging people to active modes and public transport and by reducing reliance on private motor vehicles. Any construction phase related health and safety risks will be assessed, quantified and reported (with mitigation plan) once the next detail design phase is completed.

Ngā mahinga e whai ake nei

Next actions

121. Approval of the SSBC and funding will allow the project to move into the next phase of design (pre-implementation). This work has been split into two sections:
    1. Aotea Quay intersections; and,
    2. Thorndon Quay and Hutt Road (including the Connection).
122. Work is underway to develop and agree contracts with new suppliers for this work. Some interim work has been undertaken on Aotea Quay as outlined above.
123. A contractor has been identified (through a joint process with the Golden Mile project) to join the design teams in the next phase. This will enable the project team to jointly design the project and ensure the construction methodology is robust to minimise disruption to businesses and travelling public. This approach will also provide opportunities for potential costs savings for project due to early identification of risks and potential for design changes to mitigate these risks.
124. The next phase will have further stakeholder and community engagement at its core to ensure the design balances the needs of all users. This engagement is expected to include trials of some elements of the design. These trials are expected to be interactively developed with the community.
125. Integration with all adjacent projects will continue, including discussions with KiwiRail regarding funding arrangements for improvements on Aotea Quay.
126. Subject to business case approval by partners and release of the remaining pre-implementation funding by the middle of March 2022, we expect that detailed design for Aotea Quay will be completed to enable construction to begin in late 2022 with Thorndon Quay and Hutt Road to commence in early 2023 once Aotea Quay is complete.
127. The project team will work with WCC officers with respect to necessary traffic, parking and speed changes.

Attachments

Attachment 1.	TQHR SSBC Feb 22 and Appendix A
Attachment 2.	TQHR SSBC Feb 22_Appendix B Existing Traffic FlowsB
Attachment 3.	TQHR SSBC Feb 22_Appendix C Analysis of Bus Operating Performance
Attachment 4.	TQHR SSBC Feb 22_Appendix D Safe System Framework Assessment
Attachment 5.	TQHR SSBC Feb 22_Appendix E Summary of Evaluation of Long List Elements
Attachment 6.	TQHR SSBC Feb 22_Appendix F

Attachment 7. TQHR SSBC Feb 22_Appendix G
Attachment 8. TQHR SSBC Feb 22_Appendix H
Attachment 9. TQHR SSBC Feb 22_Appendix I
Attachment 10. TQHR SSBC Feb 22_Appendix J
Attachment 11. TQHR SSBC Feb 22_Appendix K
Attachment 12. TQHR SSBC Feb 22_Appendix L
Attachment 13. TQHR SSBC Feb 22_Appendix M

14 February 2022

Thorndon Quay Hutt Road

Single Stage Business Case

Final Report

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Appendices

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Executive Summary

Many people live and work along Thorndon Quay and Hutt Road, and the roads form an important commuter corridor. Thorndon Quay and Hutt Road are the busiest bus corridors in Wellington, outside of Wellington city centre, carrying more than 10,000 bus passengers per day. The Thorndon Quay/Hutt Road corridor is also the busiest cycle route in the city, with up to 1,300 cyclists using the route on an average weekday.

An increasing number of people are expected to use Thorndon Quay and Hutt Road in the near future, due to the growing number of people living and working in Wellington City and in the northern suburbs.

The planned shared path, Te Ara Tupua, including the section between Ngauranga and Petone, will also enable more people to walk and cycle between Hutt Valley and Wellington CBD. Improved infrastructure on Thorndon Quay and Hutt Road will help make the shared path a success.

With the expected growth in the uptake of cycling, walking and public transport over the next 20 years, and the need to change the way we travel to reduce emissions from transport, improvements are needed along Thorndon Quay and Hutt Road urgently. These are proposed as part of the Let's Get Wellington Moving (LGWM) three-year programme.

This Single Stage Business Case (SSBC) presents the case of investment in the project.

Problems, Benefits and Investment Objectives

Building on previous consultation and studies, and evidence gathered, the following problem statements were defined.

PROBLEM ONE
Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus.
PROBLEM TWO
The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists.
PROBLEM THREE
Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area.
PROBLEM FOUR
High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road.

By addressing the problems, the following potential benefits of investing in transport improvements for the Thorndon Quay and Hutt Road corridor were identified:

Five investment objectives have been identified for the project which build on the identified problems and benefits for the corridor:

i Improve Level of Service for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport

ii Improve Level of Service and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road

iii Reduce the frequency and severity of crashes

iv Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area[1]

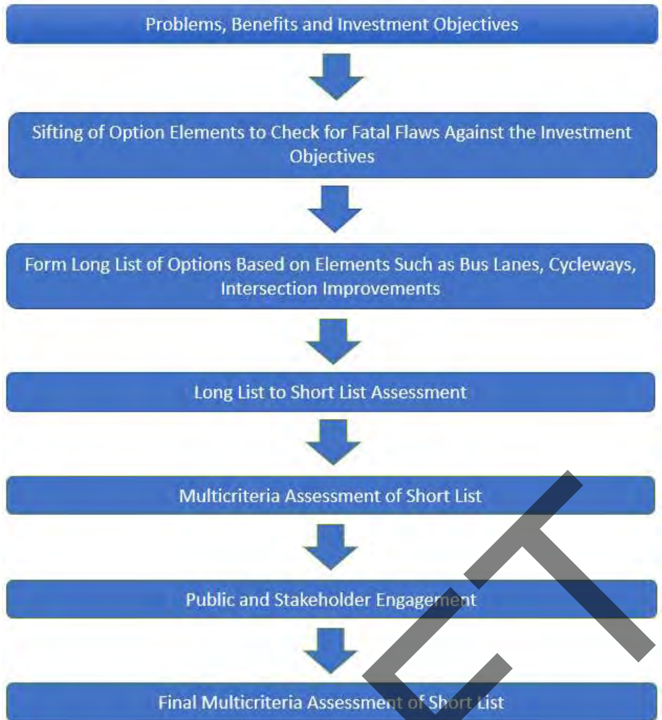
v Maintain similar access for people and freight to the ferry terminal.

The latter objective was defined in response to concerns about the adverse effect bus lanes may have on freight traffic on Hutt Road.

Options Development and Assessment Process

The Thorndon Quay and Hutt Road project used a multi-stage process to develop and assess options. This process is summarised below.

[1] Whilst the focus of the investment objective is on Thorndon Quay, there are expected to be several locations along Hutt Road that will benefit from amenity improvements through implementation of the preferred option.



Sifting of Option Elements

The problems, benefits, and investment objectives, as well as assessment of evidence and feedback from previous stakeholder engagement[2], was used to develop an initial list of potential interventions such as bus lanes, cycleway options, improvements to intersections and pedestrian crossings.

Form Long List of Options

The interventions identified were reviewed against the investment objectives and some elements were rejected if they did not contribute towards achieving these, for example:

- Removing zebra crossings and replacing them with refuge islands, since zebra crossings have greater safety benefits
- Installing traffic signals at the Davis Street intersection, as it will increase bus travel times
- Building a roundabout at the Tinakori Road intersection since it would increase bus travel times by introducing delay to flows on Thorndon Quay.

The remaining elements were packaged into a long list of options.

Long List to Short List Assessment

The long list of options was assessed using a high level Multi Criteria Assessment (MCA) process to assess and compare options against a range of objectives and criteria, to arrive at four options for short list assessment. The key elements which make up the short-listed options included:

- Bus lanes or special vehicle lanes (SVLs) in the southbound direction only or both in the northbound and southbound directions on Thorndon Quay and Hutt Road.

[2] Refer to Chapter 3

- Uni-directional or bi-directional cycleway along Thorndon Quay.

A SVL was defined as a traffic lane which can be used only by buses and trucks.[3] This option was included in response to the investment objective relating to freight access.

The assessment also identified that the provision of a bus or SVL on Hutt Road added additional risks. These include:

- An increased risk of side impact crashes - drivers will be required to cross two opposing lanes of traffic which will likely have different speeds at peak times due to the freely flowing SVL lane, thereby making it more difficult to judge safe gaps in traffic when turning
- An increased risk to motorcyclists and cyclists from turning traffic - the addition of the SVL had the potential to mask motorcyclists which may be filtering between the two traffic lanes to pass slower moving vehicles in the general traffic lane, and also cyclists riding on the shared path. Furthermore, due to congestion and the completion of the other shared path projects in the city, these users are likely to increase in number in the future, increasing the likelihood of a crash.

To mitigate this risk, options that included a central median and a service lane sub-option were developed. The options also included a new roundabout on Aotea Quay to provide a turnaround facility for trucks which may be impacted by the central median/service lane provision.

The full list of short-listed options is summarised below.

Option	Elements			Common Elements
	Thorndon Quay Bus Lanes	Thorndon Quay Cycle Lanes	Hutt Road Special Vehicle Lanes	
Option 1: Southbound bus lanes with Thorndon Quay bi-directional cycleway	Southbound	Bi-directional	Southbound	▪ Removal of angle parking on Thorndon Quay to improve safety[4] ▪ Speed limit review ▪ Intersection upgrades ▪ Pedestrian Crossing Improvements ▪ Bus stop rebalancing and layout improvements ▪ Thorndon Quay amenity improvements
Option 1A: Southbound bus lanes with Thorndon Quay bi-directional cycleway	Option 1 plus: • Left-in / Left-out on Hutt Road (central median) • Construct a roundabout on Aotea Quay			
Option 1B: Southbound bus lanes with Thorndon Quay bi-directional cycleway	Option 1 plus: • Creation of a service lane on east side of Hutt Road (between Onslow and Kaiwharawhara) • Signalise Kaiwharawhara and Onslow Road intersections			
Option 2: Southbound and Northbound bus lanes with Thorndon Quay uni-directional cycleway	Both directions	Uni-directional	Both directions	
Option 2A: Southbound and Northbound bus lanes with Thorndon Quay uni-directional cycleway	Option 2 plus the same variants as for Option 1A			
Option 2B: Southbound and Northbound bus lanes with Thorndon Quay uni-directional cycleway	Option 2 plus the same variants as for Option 1B			

[3] Allowing motorcycles to use the SVL is not recommended. This will be confirmed during detailed design.

[4] Since implemented by WCC

Option 3: Southbound bus lanes with Thorndon Quay uni-directional cycleway	Southbound	Uni-directional	Southbound
Option 3A: Southbound bus lanes with Thorndon Quay uni-directional cycleway	Option 3 plus the same variants as for Option 1A		
Option 3B: Southbound bus lanes with Thorndon Quay uni-directional cycleway	Option 3 plus the same variants as for Option 1B		
Option 4: Southbound and Northbound bus lanes with Thorndon Quay bi-directional cycleway	Both directions	Bi-directional	Both directions
Option 4A: Southbound and Northbound bus lanes with Thorndon Quay bi-directional cycleway	Option 4 plus the same variants as for Option 1A		
Option 4B: Southbound and Northbound bus lanes with Thorndon Quay bi-directional cycleway	Option 4 plus the same variants as for Option 1B		

Multi Criteria Assessment of Short List

Following the development of the short list of options, the next phase was the multi-criteria assessment (MCA) on the short list to inform the selection of a preferred option. The main considerations in the assessment were the extent to which the option met the project investment objectives, the effects of the option, and its delivery cost/timescale/operations implications.

Options were scored using an eleven-point scale (from -5 to 5), with zero being no change from current state, positive being an improvement to the current state and negative being worse than the current state. This indicated that the highest scoring options are Options 4A and 4B.

While Options 4A and 4B scored similarly overall, the provision of a service road (suboption B) was discounted as being more disruptive, fit less with other regional projects and carried larger implementation risk.

It was noted that the provision of a bidirectional cycleway (i.e. Options 1 or 4) should be aligned with the wider LGWM programme as there are bidirectional facilities planned to the north and south of the corridor. It was also noted that while both unidirectional and bidirectional cycle facilities would improve safety and level of service, unidirectional cycleways (Options 2 or 3) scored better for safety, due to less risk with cyclists travelling with the direction of general traffic.

Following the interim MCA workshop, the Technical Advisory Group met to discuss a recommended option. It supported the highest scoring option of 4A, while noting the additional safety risks inherent with bidirectional cycleways. Option 4A was recommended to be the best option to take forward as the interim preferred option. This decision was supported by the LGWM Programme Steering Group.

Public and Stakeholder Engagement

Public engagement on the emerging proposals was undertaken between 11th May and 8th June 2021. Over 1,600 responses were received, largely via an online survey. The consultation also included an open day at Pipitea Marae on Thorndon Quay, and two market days at Harbourside Market, Waitangi Park and at Johnsonville Market. Ongoing discussions were held with some key stakeholders.

Overall, the engagement was well received, and the feedback was supportive of the proposals and no additional options emerged from the process which had not been considered before. However, many local businesses and retailers along the Thorndon Quay did not support any change to status quo primarily due to their concern that any changes that remove parking will be detrimental to their business. Hutt Road businesses were concerned with restricted access to their property and additional travel times. A number of items were identified for further consideration during detailed design.

Final Multi Criteria Assessment

Following stakeholder and public engagement, a second MCA workshop was held on 30 June 2021. The purpose of this workshop was to consider the impact of engagement feedback on the interim MCA scores, update scores based on any further information, as well as to incorporate the mana whenua values assessment into the MCA.

The delivery team noted that since the interim MCA, some preliminary design of Option 4A had progressed, including more detailed evaluation of the available width on Hutt Road and desired width for the various modes. Based on this further work, the delivery team considered that the service lane 'B' suboption does not physically fit within the corridor and property acquisition would be necessary. Discussion at the workshop confirmed that the delivery score for the service lane should be reduced to -5 (the lowest score possible).

As buildings would require alteration or demolition to implement the service lane suboptions, it was agreed that the service lane options, despite the scoring, should no longer be progressed due to the disproportionate cost and effect of land acquisition.

The introduction of the mana whenua values scores and the reduction of the delivery score for the service lane suboptions changed the relativity between options compared to the interim MCA. Options 4A and 4B still scored the highest, similar to the interim MCA. This scoring does not reflect the decision that the service lane suboptions should no longer be progressed. Option 4A was therefore recommended as the preferred option for the project.

The Recommended Project

In summary, the project recommended for Thorndon Quay will provide part-time bus lanes in both directions and extend the two-way cycle path from Hutt Road to the bus interchange at Mulgrave Street. Footpaths and the streetscape will also be improved. The provision of part-time bus lanes in both directions will also future proof the corridor to cater for increased future public transport demand - with potential for longer hours of operation or full-time bus priority (or Bus Rapid Transit) in future.

Changes will allow for future growth of bus users and cyclists and encourage more people to walk, shop and spend time on Thorndon Quay. Safety will be improved for everyone by improving pedestrian crossings by making it safer and easier to cross the road and providing a dedicated cycle path. Improvements are to be made to the Ngauranga/ Jarden Mile intersection, which will lead to significant improvements for people walking and cycling in this area.

The proposal for Hutt Road includes providing part-time bus lanes in both directions and bus priority at the Ngauranga/Jarden Mile intersection. Bus lanes are proposed in both directions to improve bus travel times and reliability during peak hours, making buses more reliable and an attractive form of transport. Consideration has been given to whether other vehicles should be allowed to share the bus lane (Special Vehicle Lane) on Hutt Road such as freight. It is expected that motorcycles will not be permitted to use the lane. This will be confirmed at detailed design.

The design also includes upgrading and extending the existing shared cycle and footpath to the Ngauranga/Jarden Mile intersection. Options for upgrading the existing connection from this intersection to the Ngā Ūranga ki Pito-One (Ngauranga to Petone) section of Te Ara Tupua is not in the scope of this SSBC. This was considered in a separate study, which is included as an addendum to this SSBC.

Anticipated Benefits of the Project

The project is expected to deliver the following benefits which are consistent with the current Government Policy Statement (GPS) on Transport:

- An economic benefit to cost ratio (BCR) of between 0.4 (assuming all traffic stays on Hutt Road) and 1.8 (assuming all traffic has transferred to SH1 and has joined the back of the queue on SH1/2), depending on the assumptions made with regard to trip diversion from Hutt Road/Thorndon Quay to State Highway 1.
- A higher BCR is likely if it assumed that that all traffic transfers to SH1 but retimes to outside the peak hours.
- A reduction in the number of fatal and serious injury crashes (FSIs) from 2.6 to 1.9 per year on Thorndon Quay by 2026, due largely to the improved facilities for pedestrians and cyclists, and the predicted increase in bus use.
- Improved pedestrian and cycling amenity/level of service on Thorndon Quay and Hutt Road.
- Increased bus patronage along Hutt Road – estimated to be approximately 17% in the morning peak (two-hour period for buses travelling along Hutt Road/Thorndon Quay towards the CBD), and about 18% in the evening peak (two-hour) period for buses leaving the CBD, by 2026.
- Bus travel time savings of up to approximately eight minutes in the morning peak (two-hour) period, for buses entering the CBD, and up to approximately two and a half minutes in the evening peak (two-hour) period, for buses leaving the CBD, by 2026.
- Modest travel time savings (up to two minutes) for trucks travelling on Hutt Road.

The preferred option has been assessed using the latest Waka Kotahi Investment Prioritisation Method to understand its wider benefits and alignment with the GPS. This gives the investment proposal a priority order rating of five in the improvement category scale of one to eight, placing the project with an investment profile of HL Priority 6.

Financial Case

A risk-based cost estimate has been prepared for the recommended option. The project has an estimated cost in the range of $55.3m (P50) - $66.8m (P95). The estimates do not account for inflation or discounting and excludes any property costs apart from land associated with proposed works at Aotea Quay roundabout. The cost associated with land acquisition are estimated to be $1.8m (P50) - $2.2m (P95). Implementation of the project will also result in existing and additional assets requiring ongoing maintenance. A key risk is that the project cost exceeds the level of affordability.

Commercial Case

There is a strong motivation, need and support for LGWM to deliver the project as soon as possible. The primary activities to be undertaken during the pre-implementation phase are detailed design and construction support services and obtaining consents. It is estimated that the project will have a construction period of about 30 months.

A single professional design, engineering and consents services supplier is recommended to be utilised for the project. Given the need to accelerate the project, the option of progressing elements of pre-implementation using a direct appointment approach is recommended.

An initial assessment of delivery models indicates the project will likely be delivered via a variant of the Early Contractor Involvement (ECI) model. Works at Aotea Quay will be delivered as a separate package to ensure early completion ahead of works on Hutt Road and on Thorndon Quay.

This procuring model is appropriate due to the project complexity, uncertainty, innovation, and risk being low. It will allow the implementation phase of the project to enter the market quickly and be delivered within the anticipated timeline. It also allows for a high level of involvement and control of the project by LGWM. The recommended procurement strategy for the project needs to be communicated to the supplier market.

The project shares some similar objectives to the Waka Kotahi Ngā Ūranga ki Pito-One (Ngauranga to Petone) shared path project, such as to improve active mode facilities, connections, and accessibility for a range of customers. There will be common stakeholders, and their delivery timeframes could be similar too. Whilst both projects will be delivered independently, there are opportunities and benefits for the project teams to collaborate to share information, ideas, learnings and expertise. There may be scope advantages to seek optimisation and collaboration between the two projects, subject to the confirmation of the delivery timing of the Ngā Ūranga ki Pito-One shared path project and any funding agreements.

A project risk register has been developed and regularly reviewed throughout the SSBC process to manage risks appropriately. In the pre-implementation phase, it is likely that many of the technical risks associated with obtaining statutory approvals, will be transferred to the professional service providers on award.

A consenting strategy has been prepared which identifies project consenting, statutory approvals, environmental considerations and key mitigation areas. The strategy identifies that the works required to deliver the project will likely be permitted under the Resource Management Act 1991 (RMA)[5]. An archaeological authority is recommended to be acquired via Heritage NZ.

Management Case

Project implementation will be led by LGWM, as the project sponsor, in partnership with Waka Kotahi, WCC, GWRC and Mana Whenua. Design and construction will be undertaken by its consultants and contractors. The existing LGWM governance structure that has sat across the delivery of this SSBC is recommended to continue to co-ordinate delivery of the project in its next phase.

The development of a Communications and Engagement Plan for the pre-implementation and implementation phases of the project will form the starting point for ongoing engagement. There are diverse views and conflicting demands between different stakeholders that need to be reconciled.

Key focus areas for ongoing engagement are to seek feedback on detailed design and highlight key changes or enhancements from a design perspective. A number of the tools and processes established to date will be redeployed to address the concerns identified to date.

A detailed construction phasing strategy will need to be developed during the pre-implementation phase. Careful consideration will need to be given to the likely construction impacts of the project,

[5] A key issue is the disturbance of potentially contaminated soil that may require resource consent under the NESCS.

given the importance of keeping the corridor operational during the construction of works. Equally, construction opportunities have been identified by the Partners that will lead to efficiencies in implementation. Works at the Aotea Quay turnaround facility have been assumed to take place separately to those on Thorndon Quay/Hutt Road, in order to avoid unacceptable delays to traffic during construction.

The LGWM Project Manager is responsible for on budget delivery and the services of a Cost Manager will be necessary during implementation to manage construction expenditure. Financial management shall be undertaken in accordance with the relevant Waka Kotahi procedures.

The project will be required to report weekly into the LGWM programme through all future phases of development and delivery. Reporting and information transfer is covered with the project management plan, namely: schedule, cost, risk/issues, health and safety, resourcing, and benefits.

Next Steps

The key next steps for the project include:

- Confirming endorsement of the recommendation of this Single Stage Business Case
- Procurement of services and progress with pre-implementation, and implementation of the Recommended Option, with an initial focus on critical path activities including land acquisition and statutory approvals
- Undertaking detailed design, using the community engagement feedback received to finalise the preferred option detailed design for construction
- Engagement with the teams and governance bodies delivering parallel work around the study area.

1 Introduction

1.1 The Let’s Get Wellington Moving Programme

The Let’s Get Wellington Moving (LGWM) Programme is an ambitious $6.4 billion long-term multi-modal investment. It is a joint initiative between Wellington City Council (WCC), Greater Wellington Regional Council (GWRC), and Waka Kotahi (the New Zealand Transport Agency). The Programme objectives are summarised below.

Following significant public engagement, a Programme Business Case (PBC) developed a vision and a Recommended Programme of Investment (RPI) for LGWM to support the delivery of this vision. LGWM is a once in a generation opportunity to transform how people get around New Zealand’s Capital City. It seeks to deliver an integrated transport system that supports the community’s aspirations for how Wellington City will look, feel and function. At its heart, it seeks to move more people with fewer vehicles, provide attractive travel choices and reshape how people live. It will make the city and region more compact and sustainable, and a better place to be in.

While recognised as one of the world’s most liveable cities, Wellington’s transport system is starting to constrain the city and region’s liveability, economic growth and productivity. The Programme will provide better walking facilities, connected cycleways, and high-quality Mass Rapid Transit (MRT), along with more reliable buses, improvements at the Basin Reserve and an extra Mount Victoria Tunnel. These improvements will go hand-in-hand with planning and urban development changes. They will also help reduce emissions from road transport and our reliance on private vehicle travel.

The main geographical area of focus for LGWM is between Ngauranga Gorge and the Airport, including the Wellington Urban Motorway and its connections to the central city, hospital, and the eastern and southern suburbs.

1.2 The Thorndon Quay Hutt Road Project

The Thorndon Quay and Hutt Road (TQHR) corridor is one of the city’s most important commuter routes connecting Wellington CBD with the northern suburbs and the rest of the region. It is the busiest bus corridor outside of the city centre, and the busiest route in the city for people cycling to and from work. A Problem Definition and Case for Change was prepared for the TQHR corridor by LGWM in October 2019.

Thorndon Quay starts at the intersection of Mulgrave Street, just north of the Lambton Quay Bus Interchange at the northern edge of Wellington’s CBD (adjacent to Victoria University / Wellington Railway Station) and extends for about 1km north to the intersection of Hutt Road and Tinakori Road. Hutt Road continues north of Thorndon Quay, and is parallel to State Highway 1 (SH1) and the North Island Main Trunk (NIMT) railway line for about 4km to Centennial Highway at the bottom of the Ngauranga Gorge. The TQHR corridor is shown in Figure 1-1.

Figure 1-1 Thorndon Quay Hutt Road Corridor

With a growing number of people expected to live and work in Wellington City and the wider region, more people will want to walk, cycle or take the bus along the TQHR corridor instead of going by car. Completion of the Ngā Ūranga ki Pito-One section of Te Ara Tupua, will enable more people to walk and cycle between the Hutt Valley and Wellington. Options to upgrade the existing connection from this intersection to Te Ara Tupua is not in the scope of this SSBC, but was being considered in a separate study which is included in Appendix A.

In summary, the aim of investment in the TQHR corridor ("the project") is to provide safe and reliable travel choices for everyone and, in particular, to support more people to take public transport or use active modes by:

- Making travel by bus to the central city and through the TQHR corridor faster and more reliable, and
- Creating a safer and better environment for people walking and on bikes.

How the objectives for the TQHR project fit within the wider LGWM objectives are summarised in Figure 1-2.

Figure 1-2 Project Objectives

Liveability	• Character, place value and retail activity supproted through good urban design. • Improved amentiy for pedestrians.
Access	• Inreased carrying capacity of the corridor for buses and active modes. • Improved bus travel time reliability. • Improved access for people and freight to the ferry terminal
Reduced Car Reliance	• Improved bus patronage and reduced bus delays. • Continuous, safe and attractive cyclnig infrastructure.
Safety	• manage conflicts between all road users to improve safety for all. • Reduction in deaths and serious injuries. • Safe and appropriate speed limits and corridor design.
Resilience	• Building corridor capacity and design corridor changes to support systems resilience to unplanned events.

1.3 LGWM Early Delivery Workstream

The TQHR project is part of the three-year delivery programme which aims to develop and implement components of the LGWM programme that are capable of progressing in the short-term. These are projects that are not constrained by the scope of larger and/or more complex components of the wider programme of investment such as MRT that may be several years away from implementation. The three-year programme will help demonstrate to the community and stakeholders the direction of the wider programme.

1.4 Purpose of the Single Stage Business Case

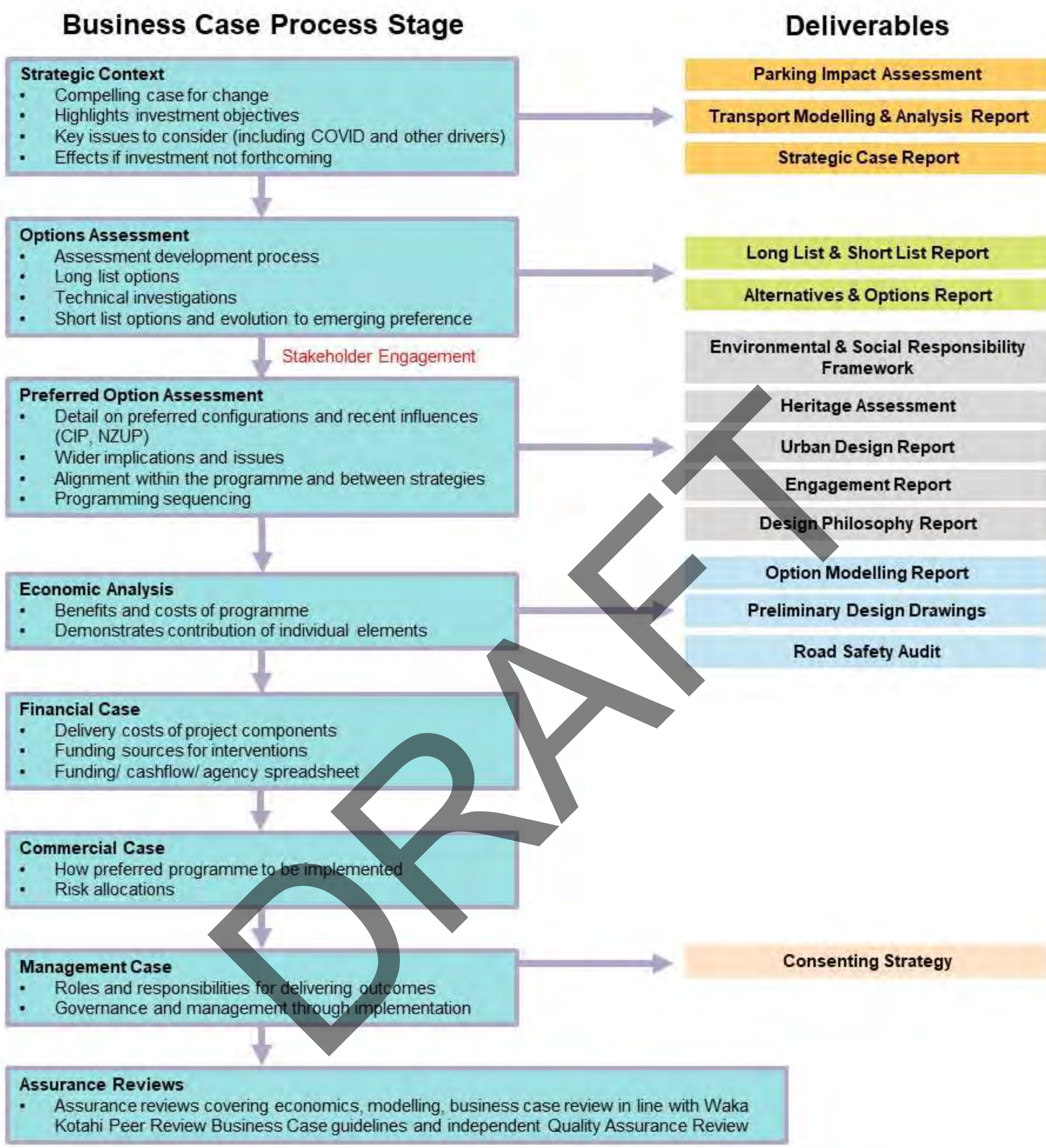
The purpose of this Single Stage Business Case (SSBC) is to build on the 'Problem Definition and Case for Change' and develop the case for investment in the project. It confirms the problems and opportunities set out in the 'Problem Definition and Case for Change' and sets out the overarching goals and objectives for investment. An optioneering process is then followed to establish a preferred option to address these problems and achieve the investment objectives.

An economic, financial, and commercial assessment is undertaken for the preferred project option. The SSBC also outlines how the preferred option can be delivered which gives effect to the desired outcomes of LGWM.

1.5 Business Case Process

The process followed to develop the business case is summarised in Figure 1-3, which includes the key deliverables. The SSBC has been developed in two distinct stages. In the first stage, a range of options were considered, and an emerging solution was identified. This solution was taken to public consultation. In the second stage, the emerging solution was developed and assessed in more detail so that a preferred option could be confirmed. Interim versions of some of the deliverables shown in Figure 1-3 were prepared to inform the earlier tasks undertaken. These are not shown on the diagram.

Figure 1-3 Single Stage Business Case Process and Deliverables



1.6 Previous Technical Work Informing this Business Case

The development of the business case was informed by the technical work undertaken for a number of earlier studies of the corridor, including:

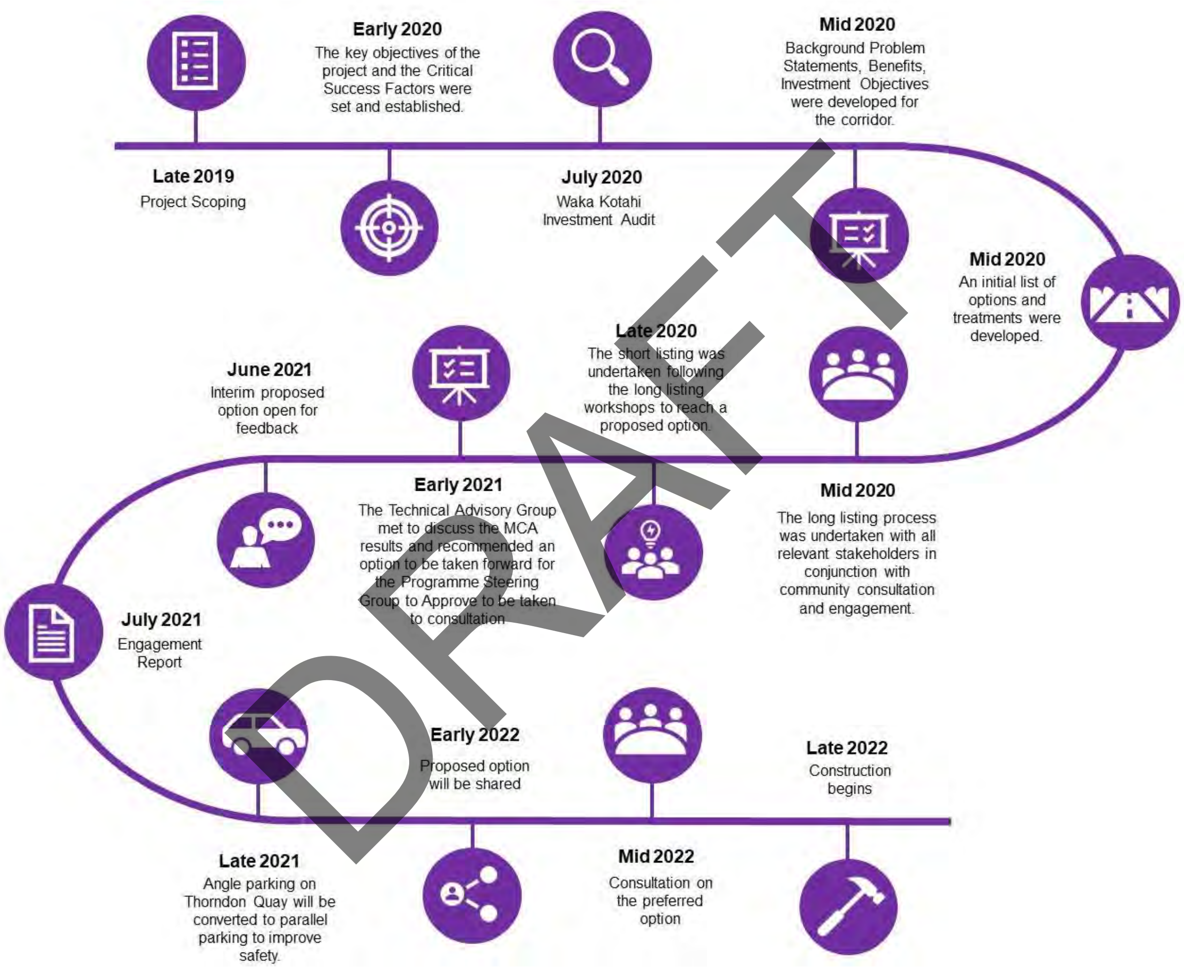
- Hutt Road Sustainable Transport Study (WCC, 2015)
- Wellington Central Business District (CBD) to Ngauranga Cycleway Indicative and Detailed Business Case (IBC and DBC) (WCC, 2016)
- Hutt Road Cycleway and Transport Improvements Committee report (WCC, 19 May 2016)
- Northern Connection: Thorndon (WCC, 2017)
- Design Report: Thorndon (WCC, 2018)

- Thorndon Quay Cycleway Committee Report (WCC, April 2018)
- Safety Audit of Hutt Road Cycleway (Stantec for WCC, January 2020)
- Wellington Multi-User Ferry Terminal PBC (June 2019).

1.7 Project Timeline

The project timeline is summarised in Figure 1-4. This shows the anticipated timescale for activities which will follow on from approval of the SSBC.

Figure 1-4 Project Timeline[6]



1.8 Project Workshops

A number of workshops and meetings with the TWG have informed and shaped the development of the SSBC. The main ones are as summarised in Table 1-1.

[6] Angle parking changes on Thorndon Quay have since been implemented since consultation in May/June 2021.

Table 1-1 TWG Workshops and Meeting

Workshop/ Meeting	Date	Purpose
Objectives, Critical Success Factors (CSFs)	28/01/20	Drive over of the corridor by bus, setting objectives and critical success factors (CSF's).
Quick Wins	05/03/20	Testing of key issues and development of quick wins with the project technical working group (TWG).
Quick Wins Shortlist Confirmation	01/04/20	Confirmation of quick wins shortlist with the TWG.
Long List Themes	12/05/20	Presentation of the corridor vision, urban design assessment and identification of long list themes and interventions.
Investment Objectives	19/05/20	Meeting to discuss and agree problem statements, benefits, investment objectives and success factors. Attended by project team members, Owner Interface Managers (OIMs) and TWG representatives.
Long List to Short List Workshop 1	10/06/20	First presentation of a multi criteria assessment (MCA) outcomes and the emerging short list.
Long to Short List Follow up Workshop (1)	16/06/20	Follow up meeting to Long List to Short List Workshop 1 to discuss the emerging short list and format for public consultation.
Long to Short List Follow up Workshop (2)	7/07/20	Meeting with TWG to discuss Hutt Road options.
Long to Short List Follow up Workshop (3)	12/08/20	Workshop with TWG members to discuss the outcome of the safety assessment.
Long to Short List Workshop 2	3/09/20	Final presentation of the MCA outcomes and the emerging short list options for public consultation.
MCA and Preferred Options Workshop 1	18/11/20	Workshop to determine the ranking of short-list options and preferred options based on the investment objectives, effects, and delivery, maintenance, and operations.
MCA and Preferred Options Workshop 2	30/06/21	Workshop to review the interim assessment identified in 2020 in the light of the 2021 engagement feedback.

Extensive stakeholder engagement has been undertaken on the LGWM programme and on the proposals for the TQHR project. The most recent consultation took place in May/June 2021.

1.9 Interim Reports

A number of interim reports were prepared following the commencement of the SSBC process, notably:

- Engagement Report (July 2020)
- Parking Impact Assessment (September 2020)
- Strategic Case Report (October 2020)
- Long List to Short List Report (November 2020)
- Transport Modelling and Analysis Report (November 2020) – informing the preferred option
- Meeting Notes from Stakeholder Briefings (Undated)
- Stakeholder Briefing (May 2020)
- Engagement Data Analysis Report (June 2021)
- Heritage Assessment (July 2021)
- Social and Environmental Responsibility Screen (July 2021)
- Consenting Strategy (July 2021)
- Alternative and Options Report (October 2021)
- Preliminary Design Philosophy Statement (PDPS) (November 2021)
- Transport Modelling and Analysis Report (February 2022).

1.10 Business Case Structure

This SSBC is structured in six chapters following this introduction, as summarised in Table 1-2.

Table 1-2 Business Case Structure

Chapter		Content
2	Context	Provides background information on the project area and surrounding area.
3	Previous Stakeholder Engagement	Provides a summary of the engagement undertaken on the project up to that reported in the July 2020 Engagement Report
4	The Case for Change	Defines the problems and opportunities, benefits of investment and summary of issues and constraints.
5	Options Development and Assessment	Outlines the process undertaken from identification of options to determining the preferred, including the Stakeholder Engagement undertaken in May/June 2021. This includes a monetary and non-monetary assessment of the preferred option.
6	Financial Case	Provides information surrounding delivery and maintenance costs and funding options with associated risks.
7	Commercial Case	Provides evidence of the commercial viability of the proposal and the consenting and procurement strategy that will be used to engage the market.
8	Management Case	Provides information surrounding the viability of delivering the proposal.

2 Context

2.1 Growth and the Transport System in the Wellington Region

In recent decades major cities, such as Auckland, Sydney and Melbourne, have dominated economic and population growth in Australasia, attracting ever greater shares of skills, business and investment. Smaller cities like Wellington have had to find ways to stand out and position themselves. What a city can offer, in terms of quality of life and quality of jobs, is the decision driver for the locations in which mobile, skilled populations would like to live in.

Wellington has a world-class quality of life, a physical environment of outstanding beauty, a highly skilled population, high incomes, healthy communities, and a reputation for creativity and quality events. This is reflected in its reputation as a liveable city.

2.1.1 Population and Employment Growth

The population of the Wellington Region currently stands at around 510,000 people. Over 40% of the current 235,000 jobs in the Wellington region are in the central city. The high concentration of employment in the central city attracts commuters from the wider Wellington region.

Intensification of both residential and commercial land use in the central city, and an increase in the number of visitors, is leading to a growth in short journeys and demand for a safe and convenient central city street network with a high level of amenity. The growth in the number of jobs in the central city is also leading to an increase in the number of longer distance commuters who need to travel into the central city at peak times. This is especially evident for those travelling from the north, where new housing development is taking place.

2.1.2 The Transport System

Growth in the Wellington region as a whole is driving demand for journeys to the central city and port. There is also a demand for journeys through the central city, to reach important destinations such as the airport and hospital. This latter demand results in increased car travel through the central city as the public transport system's design is mainly focused on moving people into and out of the CBD. These significant movements conflict with the increasing number of buses, pedestrians and cyclists accessing the central city.

The transport system has a key role to play in facilitating further growth in Wellington, supporting further intensification of the central city and the high quality of life it has to offer. Enabling more people to live and move around the central city is desirable economically, as it supports an increasingly productive economy by matching innovative businesses with a highly skilled labour pool. Good job opportunities and a high quality of life tend to attract talented and skilled people to the city. Intensification in the central city and around public transport hubs is also desirable as it reduces the environmental impacts of travel to and from the central city.

In recent years, most of the growth in travel demand to, from and within the central city has been accommodated by people choosing more sustainable ways to travel, by walking, cycling and using rail and bus services. Private vehicle activity within the central city has been held in check by constrained road corridor capacity, traffic congestion on the approaches to the central city, and the relatively high cost of commuter car parking within the central city itself.

2.2 Existing Transport and Land Use on the TQHR Corridor

2.2.1 Land Use

There is a diverse mix of land use including residential, commercial, industrial, retail and education activities on Thorndon Quay between the Lambton Quay Bus Interchange and Davis Street. Land uses on Thorndon Quay between Davis Street and Tinakori Road include a number of high turnover land uses, including cafes, day care centres, vehicle repairs, a gym, trade shops, and large format retail such as carpet stores, furniture retailers, and plumbing supplies etc. There are also some residential apartments.

Land use on Hutt Road consists of larger retail units (e.g. Kaiwharawhara Spotlight shop and Placemakers). There is only limited residential land use, although there are a number of accesses leading to Ngaio and other residential areas. From the intersection of Onslow Road into the city there are a number of large commercial units operating which have direct entrance/ exits to/ from Hutt Road. An effluent disposal point is located in close proximity to Hutt Road, and a railway station exists at Ngauranga.

Hutt Road is bounded to the west by a steep scrub covered escarpment which constrains land use. State Highway 1, the NIMT railway line and Wellington Harbour are to the east. Land use is typically concentrated on the east side of the road, due to the topography and proximity to the rail corridor. There are numerous retaining walls of various typologies along the road.

Both Thorndon Quay and Hutt Road form a central spine for traffic and public transport connecting between the central city and the northern suburbs, as well as key growth areas and areas not served by the rail network.

2.2.2 Road Classification and Posted Speed Limit

Both Hutt Road and Thorndon Quay are classified as arterial roads under Waka Kotahi one network road classification (ONRC). Arterial roads are "vital roads which provide key strategic links in urban areas and contribute to the economic and social well-being of communities and the businesses that operate within them". They are also both classified as an over-dimension route and can be used by vehicles conveying hazardous goods.

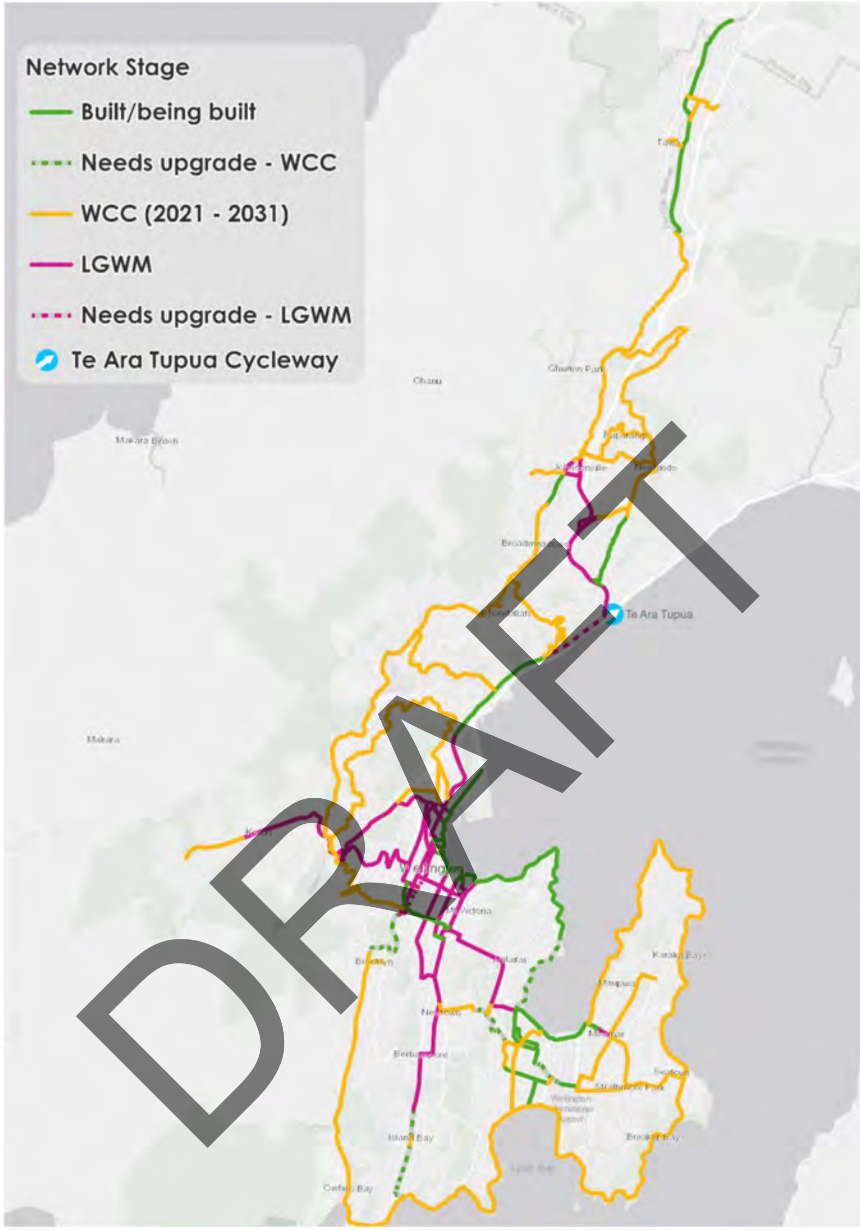
The TQHR corridor is the main route and public transport corridor between the central city and northern suburbs, a key growth area, including areas not served by the rail network. In the event of a major incident on SH1, Hutt Road and Thorndon Quay are used as an emergency detour.

The current posted speed on Thorndon Road is 50km/hr. Hutt Road has a posted speed limit of 60km/hr, which increases to 80km/h north of Onslow Road.

Figure 2-1 shows Wellington's road classification as defined by the Network Operating Framework (NOF). Figure 2-2 shows the extent of the area's strategic cycle network, including existing facilities and those planned.

Figure 2-1: Wellington Network Operating Framework

Figure 2-2: Wellington Strategic Cycle Network



2.2.3 Road Geometry

The majority of Thorndon Quay is about 24m wide from boundary to boundary. The road space is primarily allocated to general traffic lanes, however they include road cycle lanes, loading zones and metered parking spaces (some parallel, some diagonal). Footpaths are also typically 2 to 2.5m wide.

Hutt Road is predominantly 22.5m wide from boundary to boundary between Tinakori Road and the Ngauranga Gorge. This section of the corridor has a raised median in the form of a narrow-kerbed island or wide flush median and wider traffic lanes (typical in the order of 3.4m). The central median is delineated by either chevron white lining or low-profile mountable kerbing. There is a recently opened two-way off-road cycleway, and separate footpath on the eastern side of the corridor, along the section between the Caltex Station and Tinakori Road. There is a shared path on eastern side of Hutt Road from Caltex Station north, to Jarden Mile. Footpaths exist on both sides of Jarden Mile and the southbound side of Centennial Highway.

2.2.4 Bus Services

Eleven bus routes operate along the corridor from the Lambton Quay Bus Interchange (Wellington Bus Station), as shown in Figure 2-3. At peak times there are in the order of 40 buses per hour, operating along Thorndon Quay (i.e. towards the city in the morning peak and away from the city in the evening peak). There are currently typically 16 buses per hour in each direction in the inter-peak period.

Figure 2-3 Bus Routes Serving the TQHR Corridor

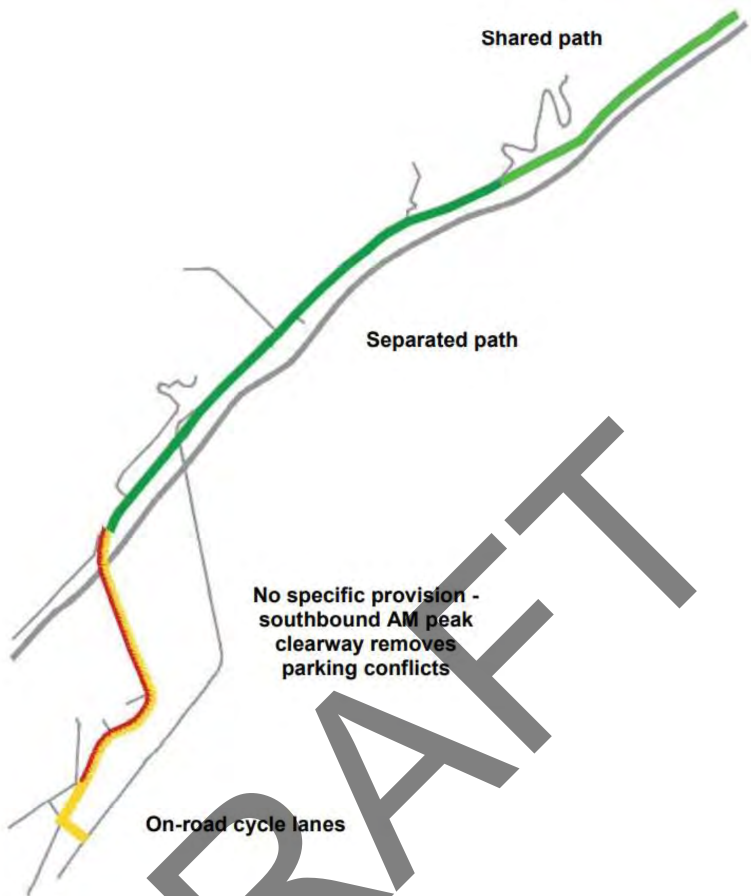
2.2.5 Cycle Facilities

Figure 2-4 summarises the current cycle facilities provided on the TQHR corridor. The existing facilities include:

- A shared walking and cycling path on Hutt Road (north of Onslow Road)
- A separated on Hutt Road (south of Onslow Road)
- On-road cycle lanes on Thorndon Quay.

The TQHR corridor is the only route for people coming from or to the Hutt Valley, and is also heavily used by people coming from / to the northern suburbs.

Figure 2-4 Cycle Facilities



2.2.6 Transport Demand

2.2.6.1 Traffic Flows

Hutt Road is the busiest section of the main route, between Kaiwharawhara Road and Aotea Quay. Traffic volumes increase from north to south along the route, until Aotea Quay where volumes decrease at both Aotea Quay and Tinakori Road, as shown in Appendix B. Traffic volumes increase again after Mulgrave Street.

2.2.6.2 Bus Use

There are approximately 10,000 bus passengers on an average day, using the corridor (two-way), making it the busiest corridor outside the city centre. A large proportion of bus travel is towards the City Centre in the morning (AM) peak period and away from the City Centre in the evening (PM) peak period. Demand is greatest at the southern end of the corridor, since more bus services join Hutt Road at Onslow Road and Kaiwharawhara Road.

Historic passenger demands in the morning peak two-hour period on Thorndon Quay, as derived from annual cordon surveys, are shown in Figure 2-5.

Figure 2-5 Bus Passenger Demand 2000 to 2019[7]

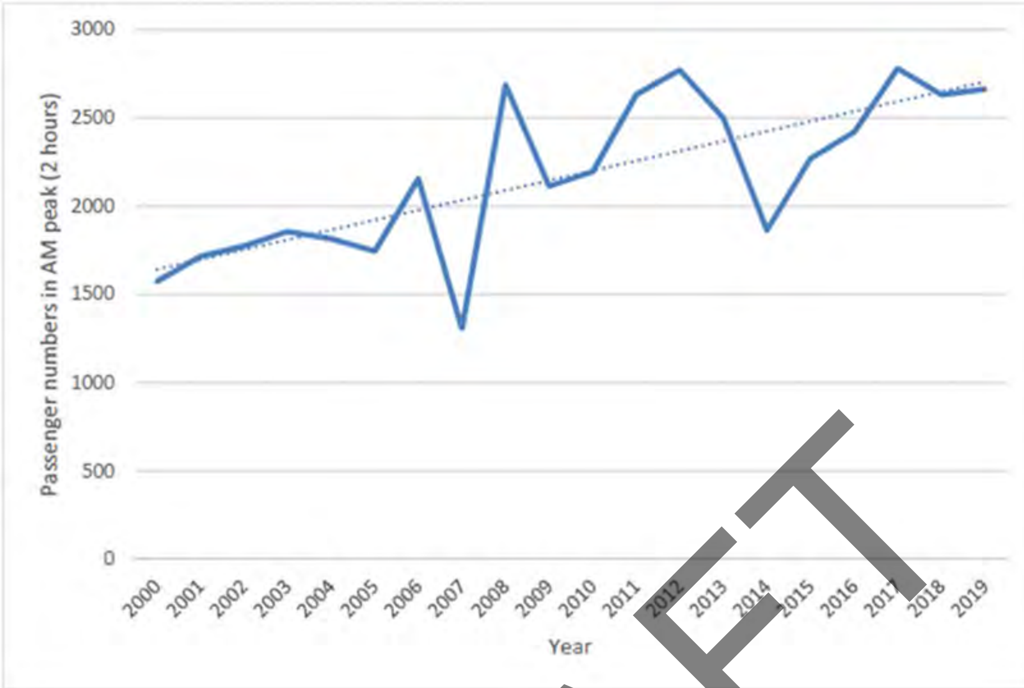
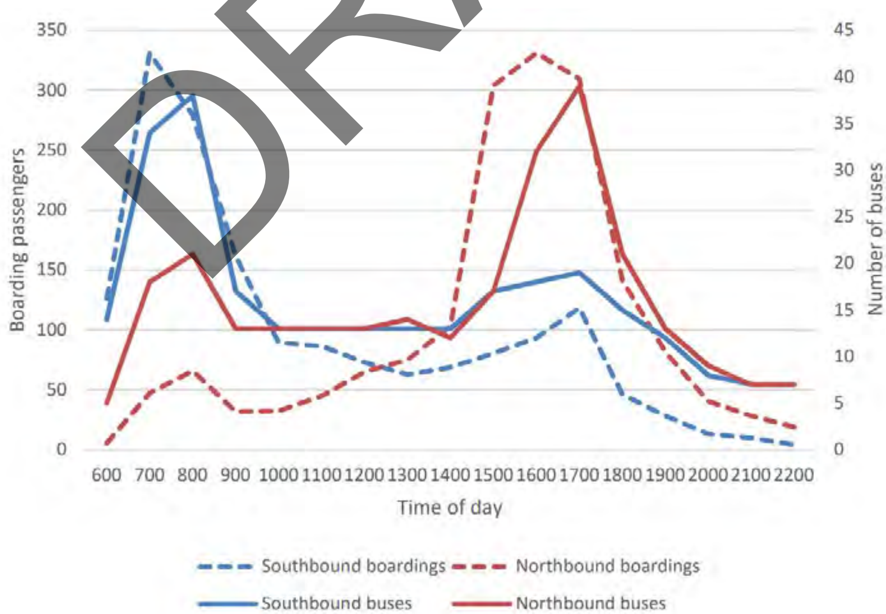


Figure 2-6 shows the number of boarding passengers and the number of buses on the TQHR corridor, by time of day and direction.

Figure 2-6 Boarding Passengers on the TQHR Corridor



[7] 2020 bus patronage data is not shown because the patronage impacts caused by Covid-19 are not considered of significant scale to affect the outcomes of this business case.

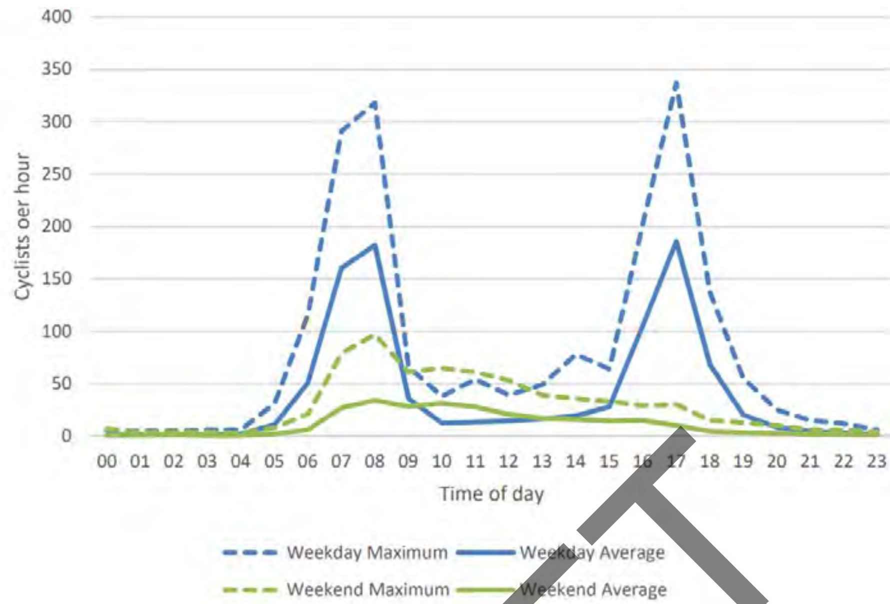
2.2.6.3 Cycle Demand

The TQHR corridor is the busiest commuter cycling route in Wellington. Figure 2-7 shows the average and maximum daily cycle demands on Thorndon Quay by month (April 2018 to March 2019[09]). The data shows that on average the weekday flow varies between approximately 700 and 1,300 cycle trips with higher demands in the warmer months. Maximum weekday flows are as high as approximately 1,600 trips per day. Weekend average flows vary between 160 and 360 cycle trips per day, with a maximum weekend flow of around 470 cycle trips per day.

Figure 2-7 Average and Maximum Daily Cycle Demands on Thorndon Quay by Month

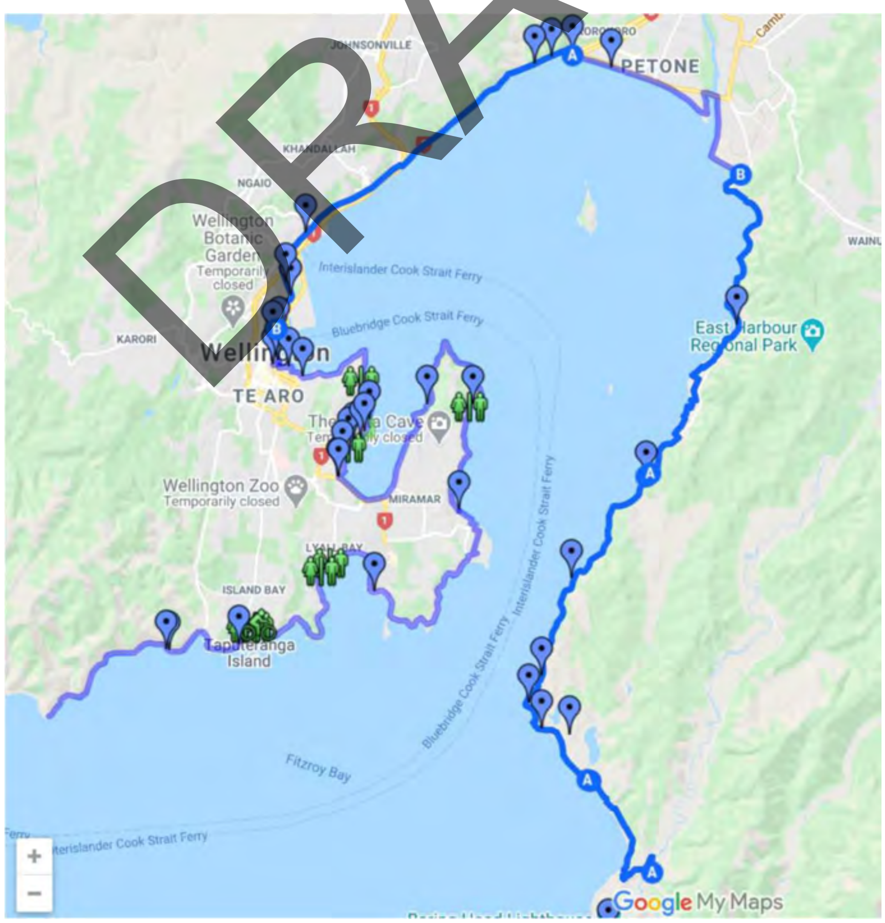
Figure 2-8 shows the average and maximum cycle demands on Thorndon Quay by hour between April 2018 and March 2019[09]. The data shows that the weekday flows are concentrated around the network peak periods with the annual average hourly peak of 180 cyclists per hour. However, maximum hourly flows are as high as 340 cyclists per hour. Weekend average peak hourly flows are around 35 cycle trips per hour, with a maximum of around 100 cycle trips per hour.

Figure 2-8 Average and Maximum Daily Cycle Demands on Thorndon Quay by Time of Day



The TQHR corridor forms part of the Great Harbour Way/ Te Aranui o Pōneke Cycle Route, shown in Figure 2-9 and also serves as a recreational cycling route.

Figure 2-9 Great Harbour Way/ Te Aranui o Pōneke Cycle Route



2.2.6.4 Pedestrian Demand

Table 2-1 shows the current approximate number of pedestrians at different locations along the corridor. This shows that pedestrian demand is greatest closest to central city and reduces with distance from the central city.

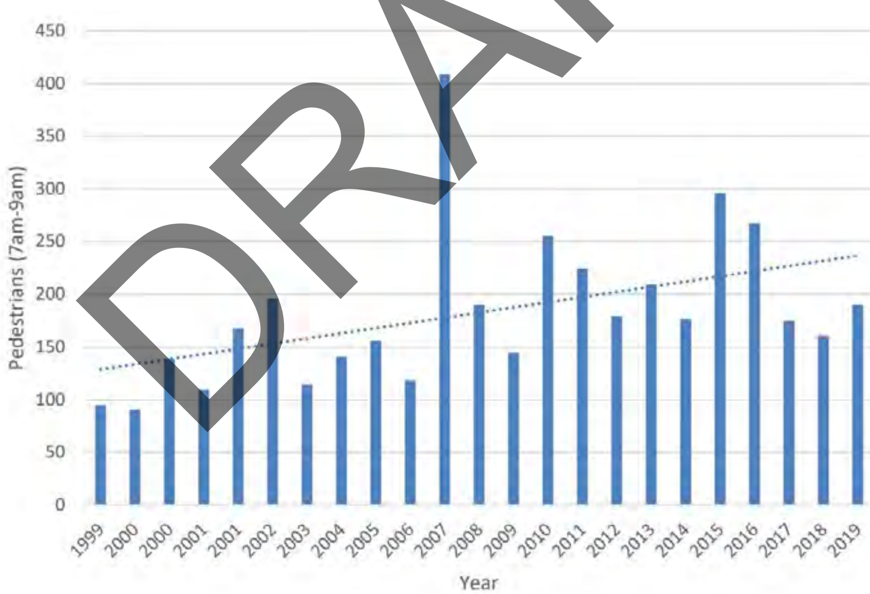
Table 2-1 Current Pedestrian Demand

Location	Peak Hour Demand	Daily Demand[8]
Hutt Road (north of Onslow Road)	5-15	50-150
Hutt Road (Kaiwharawhara Road to Onslow Road)	20-40	200-400
Hutt Road (Thorndon Quay to Kaiwharawhara Road)	50-100	500-1,000
Thorndon Quay	200-300	2,000-3,000

Pedestrian activity on Hutt Road is low to minimal, with virtually no pedestrian activity north of Kaiwharawhara Road, due to the existence of a high bluff adjacent to the road, and the railway corridor.

Figure 2-10 shows the pedestrian demand trend on Thorndon Quay in the morning two-hour peak period (7am-9am). The graph shows data from 1999 onwards.

Figure 2-10 Pedestrian Demand by Year on Thorndon Quay



2.2.6.5 Truck Movements

Hutt Road is also an important route for trucks, providing access to the existing the ferry terminal at Kaiwharawhara via the Aotea Quay interchange. This ferry is a key connection between the North and South Islands and therefore a significant economic contributor to the Wellington area and wider Aotearoa economy. Trucks comprise of up to 15% of traffic flows. Truck movements on Thorndon Quay are much lower.

[8] Assumed to be ten times the peak hour flow

2.3 Future Changes

2.3.1 Land Use

Under medium projections, the population of the Wellington Region is forecast to grow by 15% over the next 30 years, equating to 75,000 extra residents. The distribution of this growth is estimated to be as follows:

- 30% will be focused on Wellington's central city and inner suburbs
- 20% will occur in Wellington City's northern suburbs
- 13% will occur in other areas of Wellington City
- The remainder (37%) will be around urban centres outside Wellington City, relatively evenly split across the Kapiti Coast, Porirua, Upper Hutt and Lower Hutt, with a lesser amount in the Wairarapa.

The population of Wellington's northern suburbs[9] is forecast to increase from 51,600 (in 2018) to 62,000 (2043). These estimates are based on the current ID[10] projections (developed February 2016).

Employment projections show regional employment growing by between 15% and 20%, over the next 30 years. They suggest that between 55% and 60% of future growth in employment is likely to be in the central city. This growth will potentially increase the number of jobs in these suburbs, from the current 99,000 to between 114,000 and 131,000 over the next 30 years.

Land use along the TQHR corridor is expected to see transformation and intensification over the time horizon of the LGWM programme. It is anticipated that Thorndon Quay specifically, will become an increasingly sought-after edge of CBD location for high density residential, office and other commercial uses.

Light industrial, depot and warehousing activities are expected to be replaced by higher order, land use activities as land values rise. The amenity of the area is also likely to increase, especially near the CBD where residential activity will drive expectations for a better street environment.

Figures 2-11 to 2-13 show the land use plans for the corridor, as defined in the current Wellington District Plan.

9 Ngaio, Crofton Downs, Khandallah, Newlands, Johnsonville, Grenada, Churton Park, Woodridge

10 https://home.id.com.au/

Figure 2-11 Land Use Plans for the Thorndon Quay Area

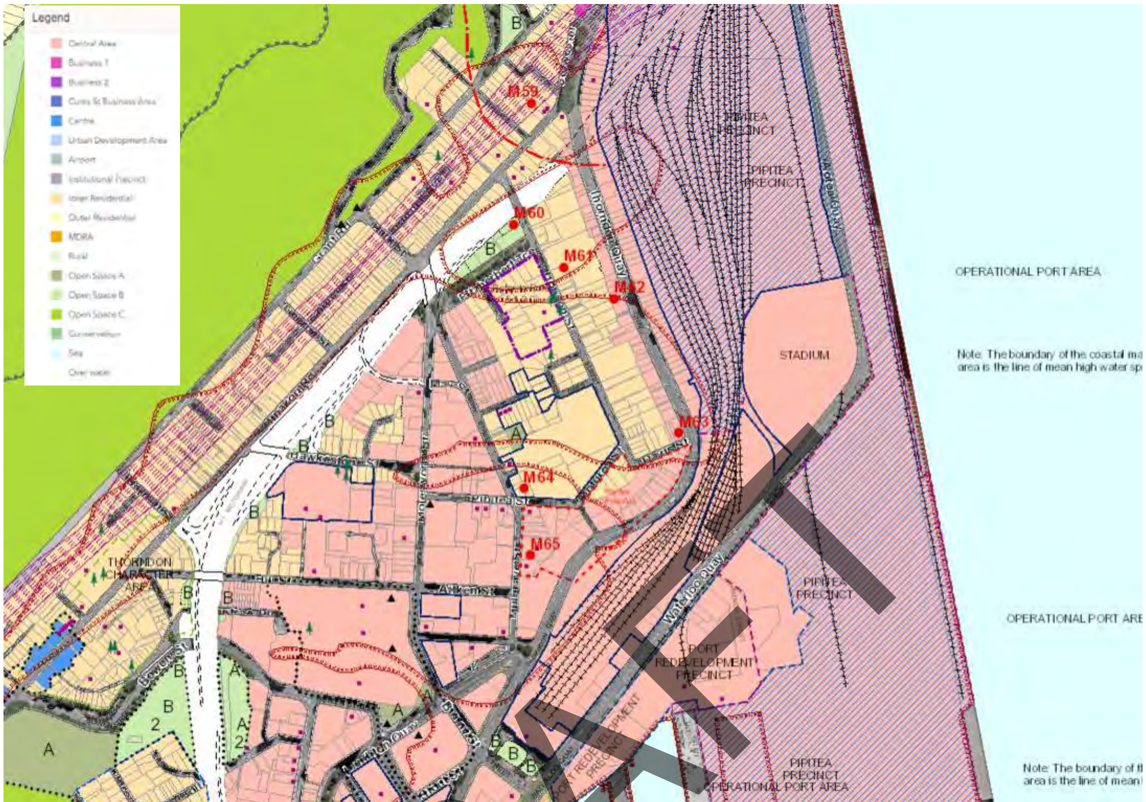


Figure 2-12 Land Use Plans for the Thorndon Quay/Hutt Road Area

Figure 2-13 Land Use Plans for the Hutt Road Area

2.3.2 Interrelated Transport Projects

There are a number of transport projects which could impact the TQHR project and have been considered in the development of options. These are summarised in Table 2-2.

Table 2-2 Future Transport Projects

Project	Timeframe	Status	Explanation/Linkage
Golden Mile (LGWM)	3-4 years	SSBC underway	Improve bus convenience, travel times and reliability in Wellington's CBD.
City Streets (LGWM)	3-10 years	Tranche 1 SSBCs commences	Reallocation of road space on streets in the central city to enable the transport system to move more people with fewer vehicles and to improve access for all modes e.g. bus priority measures.
Low Cost Low Risk (Waka Kotahi)	1-3 years	Being implemented or being consulted on / designed	Includes generally small-scale 'quick win' improvements to Ngauranga Gorge for buses and people walking and cycling.
Transitional Bike Network Programme (WCC)	0-3 years	SSBCs underway	Accelerated roll-out of interim Wellington bike network, alongside associated bus network improvements.
Street Transformation Programme (WCC)	0-10 years	Underway	Permanent upgrades to improve walking, cycling and public transport (outside of LGWM scope)

Project	Timeframe	Status	Explanation/Linkage
Ngā Ūranga ki Pito-One Shared Path (Waka Kotahi)	3-4 years	Committed	Linking Ngauranga to Petone, this project will form an improved section of the Great Harbour Way/ Te Aranui o Pōneke Cycle Route by providing a new route along the harbours edge. This links into the existing shared path that joins Hutt Road at Jarden Mile. An addendum to this SSBC is considering a potential upgrade to this existing section of shared path.
Wellington Multi-User Ferry Precinct Indicative Business Case (IBC)	3-15 years	IBC underway	A new multi-user ferry terminal is proposed to be built at Kaiwharawhara. This will be shared by Bluebridge and Interislander ferries.
Wellington Single User Ferry Terminal	2-4 years	Under design	A new wharf and terminal is planned to support KiwiRail's purchase of two new rail-enabled Interislander mega-ferries, which are significantly larger than their current fleet.
Travel Behaviour Change (LGWM)	3-10 years	SSBC Underway	A package of travel behaviour change measures which can be implemented as part of the LGWM programme to significantly contribute to the travel choice and mode shift goals of LGWM.
Mass Rapid Transit (MRT) IBC (LGWM)	3-10 years	IBC Underway	Confirming the viability of MRT as an investment solution for Wellington linking Wellington Railway station to Te Aro, Newtown, Kilbirnie, Miramar and Wellington Airport.
State Highway Improvements IBC (LGWM)	3-10 years	IBC Underway	A package of improvements on the SH1 corridor between Ngauranga Gorge and Wellington Airport.

2.3.3 Transport Demand

The land use changes will drive demand for transport to and from the area. Forecasts prepared for the overall LGWM programme in 2019 indicated the following overall annual transport demand growth rates between 2013 and 2036:

- 0 to 0.6% in the morning peak period
- 0.25 to 0.5% in the inter-peak period
- 0 0.2% in the evening peak period.

Programme wide demand forecasts prepared in 2021 by the Wellington Analytics Unit (WAU), which assume improvements to the TQHR corridor, indicated annual growth in bus patronage of 3% per annum from 2026-2036 and 2% per annum from 2036 on the TQHR corridor. In absolute terms, this is growth from around 10,000 per day at present to about 11,000 per day in 2026 and to around 15,000 per day by 2036). These forecasts reflect the limited additional capacity the rail network can provide in Wellington, and therefore much of the increase in public transport demand is forecast to occur on the bus network.

The proposed Te Ara Tupua project will provide a missing critical walking and cycling connection between Wellington and Hutt valley. It is expected to result in a step change in the demand on the corridor. Forecasts for the project indicate that during the opening year (due mid-2024), the following user demands on an average weekday are expected:

- 600 additional cyclists' trips per day (1,300 in total)
- 450 additional walker/runner trips per day (450 walkers/ runner trips in total)
- 100 additional device user trips (e.g. e-scooters, etc) per day (100 device user trips in total).

The weekend forecasts are slightly higher compared to the weekday forecasts but have less pronounced and differing peak periods. Demand is predicted to increase by approximately 10% per annum between 2025 and 2030.

This will result in a step change in cycle demand. Most of the extra cycle demand is likely to use the Hutt Road Thorndon Quay corridor and travel to Wellington's CBD. There will also be additional cyclists on TQHR corridor travelling via Ngauranga Gorge and Kaiwharawhara.

There is also potential for increased recreational walking and cycling along the TQHR corridor, however. This increase in recreational walking and cycling is difficult to quantify as the current environment and wider walking and cycling connections (to the north of Hutt Road) are not well suited to walking and cycling for leisure purposes. Many walkers and runners are likely to use only a portion of the path, predominantly starting and finishing at the Petone end.

A large increase in truck movements, potentially by as much as 50%, is expected by 2036, due to the introduction of new larger ferries.

2.4 Alignment with National, Regional and Local Polices and Plans

Investment in the TQHR corridor is aligned with national, regional and local policy plans and policies, as summarised in Table 2-3.

Table 2-3 Policy and Plan Alignment

Policy/Plan	Alignment with TQHR Project
Government Policy Statement (GPS) for Land Transport 2021/22-2031/32	The purpose of the transport system is to improve people's wellbeing, and the liveability of places. It does this by contributing to five key outcomes, identified in the Ministry of Transport's Transport Outcomes Framework. These are: ▪ Inclusive access ▪ Economic prosperity ▪ Healthy and safe people ▪ Environmental sustainability ▪ Resilience and security, GPS 2021 has four strategic priorities which will guide land transport investments from 2021/22-2030/31. These are: ▪ Safety ▪ Better travel options ▪ Climate change ▪ Improving freight connections.
Wellington Regional Land Transport Plan 2021 (adopted June 2021)	Investment in the region's transport system will be guided by the following priorities: ▪ Public transport capacity ▪ Travel choice ▪ Strategic access ▪ Safety ▪ Resilience.
Wellington Urban Growth Plan: Draft Spatial Plan	Invest in the city to deliver a: ▪ Compact city ▪ Liveable city ▪ City set in nature.
Wellington Urban Growth Plan: Planning for Growth	The plan deals with the major planning issues facing the city and region in the next two to three decades – including population growth, housing affordability, protecting the City's biodiversity, transport, climate change and natural hazards.
Towards 2040: Smart Capital, 2011	Position Wellington as an internationally competitive city with a strong and diverse economy, a high quality of life and healthy communities. Seek to make Wellington: ▪ A people-centred city ▪ A connected city ▪ An eco-city ▪ A dynamic central city. The vision would see the central city as a vibrant and creative place offering the lifestyle, entertainment and amenities of a much bigger city. The central city will continue to drive the regional economy.
Te Atakura – First to Zero	In June 2019, Wellington City Council adopted Te Atakura – First to Zero, which is a blueprint to make Wellington City a zero carbon capital (net zero

	emissions) by 2050. This blueprint outlines key activities that can help reduce our emissions in four target areas: Transport, Building Energy and Urban Form, Advocacy, and the Council.
WCC Parking Policy (June 2020)	Provides a framework to guide future decision-making on the management of all Council-controlled parking spaces. This includes off-street parking and on-street parking, both free-of-charge (unrestricted) and those which incur a user-charge. The policy sets out objectives, high level principles, a parking space hierarchy (that prioritises the types of parking in different areas), area-based parking management guidance (that prioritises how we manage supply and demand). It also provides a new approach to setting parking fees and developing area-based parking management plans.
Low Carbon Capital – a Climate Change Action Plan for Wellington 2016–2018	Greening Wellington's Growth by: ▪ Maintaining the city's liveability ‑ the features that support our high quality of life and the city's character ▪ Keep the city compact, walkable and supported by an efficient transport network ▪ Protect the city's natural setting ‑ nestled between our green hills and coastline, contributing to our distinctive character ▪ Make the city more resilient to natural hazards such as earthquakes and the effects of climate change. Changing the way we move by: ▪ Supporting car-share and electric vehicle charging ▪ Continuing to support car sharing ▪ Investing in walking, cycling and public transport modes.
Let's Get Wellington Moving Objectives	Revised objectives and proposed weightings were developed in June 2021, as follows: ▪ Liveability – Enhances urban amenity and enables urban development outcomes (20%) ▪ Access – Provides more efficient and reliable access for users (15%) ▪ Carbon emissions and mode shift – Reduces carbon emissions and increases mode shift by reducing reliance on private vehicles (40%) ▪ Safety – Improves safety for all users (15%) ▪ Resilience – Is adaptable to disruptions and future uncertainty (10%)
Innovating Streets – making safer streets for people (WCC)	Innovating Streets pilots are four of 70 throughout the country with the purpose of creating safer, healthier and more people friendly towns and cities. These projects will be done using tactical urbanism and are about co-designing quick, low-cost, scalable improvements that help to create more vibrant, people-friendly spaces in Wellington's neighbourhoods. The funded Innovating Streets pilots in Wellington city are: • Placemaking pop-ups in Newtown (along Riddiford Street between Mein and Rhodes streets, and on Hall Street), Te Aro (between Taranaki, Cuba Ghuznee and Abel Smith streets) and Allen Street (outside The Fringe Festival Box Office) • A safer connection for everyone in Wilson Street, Newtown between Constable Street and Riddiford Street • A safe cycling facility for people travelling on Brooklyn Road from Webb Street to Ohiro Road

2.5 Parties Involved in the Project

Table 2-4 summarises the main parties involved in the Thorndon Quay Hutt Road project and their strategic interest.

Table 2-4 Parties Involved in the Project and their Strategic Interest

Party	Strategic Interest

Let's Get Wellington Moving	Let's Get Wellington Moving **(LGWM)** is a multi-decade programme of investment in Wellington's transport and urban development. It is a joint initiative between five partners:
	▪ Three government (Crown and local government) agencies:
	    ▪ Wellington City Council (WCC)
	    ▪ Greater Wellington Regional Council (GWRC)
	    ▪ Waka Kotahi NZ Transport Agency
	▪ Taranaki Whānui ki te Upoko o te Ika (represented by the Port Nicholson Block Settlement Trust) and
	▪ Ngāti Toa (represented by Te Rūnanga o Toa Rangatira).
	
	The LGWM Governance Reference Group provides a critical interface between the partners at the governance level and provides advice to the programme.
	
	The LGWM Partnership Board is made up from representatives of the three funding partners and is the single point of accountability and the main decision-making body for the programme.
	
	The Programme Director, appointed by the Partnership Board, is responsible for delivering the programme, The Programme Director is supported by the Programme Leadership Team who provide advice and guidance related to key programme decisions and overarching management.
	
	The vision for the LGWM Programme is for a great harbour city:
	▪ That is accessible to all
	▪ With attractive places
	▪ With shared streets
	▪ Efficient local and regional journeys.
	
	Realising this vision will involve moving more people with fewer vehicles.

Wellington City Council	WCC is the local authority responsible for Wellington City. Its purpose is to enable democratic local decision-making and action by, and on behalf of, communities. It seeks to promote the social, economic, environmental, and cultural well-being of people that live, work or visit Wellington now and in the future. WCC invests to make Wellington more resilient, vibrant and competitive, and makes sure residents continue to have a high quality of life. The strategy and vision for Wellington is built on its current strengths but also recognises the challenges the city faces now and over the medium to long term. The Council's four goals for Wellington are: ▪ A people centred city ▪ A connected city ▪ An eco-city ▪ A dynamic central city.

Greater Wellington Regional Council	GWRC is responsible for promoting Quality for Life by ensuring the environment of the Wellington Region is protected while meeting the economic, cultural and social needs of the community. One of its responsibilities is managing public transport services across the Wellington region, including arranging funding and contracts for service delivery. GWRC activities seek to work towards the following vision: ▪ An extraordinary region ▪ Thriving environment ▪ Connected communities ▪ Resilient future.
Waka Kotahi	Waka Kotahi is the crown entity responsible for planning and investing in the land transport system. It administers the National Land Transport Fund (NLTF). Their primary objective is to contribute to an effective, efficient, and safe land transport system in the public interest. Through its various functions, Waka Kotahi is responsible for delivering on the Government's Transport Sector Outcomes to create a transport system that: ▪ Provides inclusive access ▪ Supports economic prosperity ▪ Is resilient and secure ▪ Provides environmental sustainability ▪ Supports healthy and safe people.
Mana Whenua	Mana Whenua are a key project partner. They have historic and territorial rights over the land, and a special cultural and spiritual relationship with the environment. This is a matter of national importance under the Resource Management Act. An Iwi Partnerships Working Group has been established to help the programme appropriately consider Mana Whenua perspectives and support broader Iwi engagement.

2.6 Mana Whenua Values

The following draft Mana Whenua values for the LGWM programme were used to guide the development of options considered.

2.6.1 Tahi – Whakapapa (A Sense of Place)

- Building works restore a healthy relationship with nature
- Finished projects tell the story of the place
- Native plantings
- Urban agriculture.

2.6.2 Rua - Wai-ora (Respect the Role of Water)

- Acknowledge the importance of water
- Resurrect the natural water courses
- Manage water run off to ensure only purest water flows to the harbour.

2.6.3 Toru - Pūngao-ora (Energy)

- Minimise energy use during construction
- Completed projects to aim to be energy neutral.

2.6.4 Whā - Hau-ora (Optimising Health and Wellbeing)

- Prior to construction minimise uncertainty by clear goals and timeline
- During construction minimise disturbance to neighbours
- Completed projects to use plantings and water flows to provide healthy environments.

2.6.5 Rima - Whakamahitanga (Use of Materials)

- Recycle the maximum of materials disposed of during construction
- Build with materials and methods that use the lowest energy possible
- Avoid toxic materials that may leach into air or ground water.

2.6.6 Ono – Manaakitanga (Support a Just and Equitable Society)

- Embody our values in these projects
- Work with locals to the extent possible
- Provide safe and inviting public spaces.

2.6.7 Whitu – Whakāhuatanga (Celebrate Beauty in Design)

- Design in a way that lifts the human spirit
- Incorporate public art and interpretation to tell the story of what has gone before.

2.6.8 Whakamatautautanga

- Monitoring.

3 Previous Stakeholder Engagement

Extensive engagement has been undertaken prior to and as part of developing the LGWM programme. The SSBC for the TQHR corridor has built on this, and the knowledge and relationships that have been developed.

This chapter provides a summary of the stakeholder and community engagement that has been undertaken up to and including May 2020, prior to and as part of developing the LGWM programme and to inform the option development process for the TQHR project. It includes analysis of the stakeholders who have an interest in the project and an explanation of the communication approaches and activities that have been employed to engage with them.

Stakeholder engagement undertaken in 2021 on the preferred TQHR option is summarised in Chapter 5.

The prime purpose of the consultation undertaken on the TQHR project is to enable the effective participation of individuals and communities in the decision-making process. This will enable elected representatives to make better-informed decisions on behalf of those councils they represent.

The principles guiding consultation processes set out in the Local Government Act 2002 are designed to ensure individuals and their communities have information about decisions, the opportunity to engage with their councils and make their views known.

There are six guiding principles set out in the Act:

- Councils must provide anyone who will or may be affected by the decision, or anyone who has an interest in the decision, with reasonable access to relevant information.
- These people should also be encouraged to express their views to council.
- People who are invited to present their views to council should be given clear information about the purpose of the consultation and the scope of the decisions being made.
- People who wish to present their views must be given reasonable opportunity to present them.
- Councils should receive these views with an open mind and give them due consideration when making a decision.
- The council should provide people presenting their views with information relevant to decisions and the reasons for them.

The Act also sets out processes for discussing concerns about a council with the Office of the Ombudsmen, the Office of the Auditor General or the Parliamentary Commissioner for the Environment.

3.1 2016 Engagement on the Hutt Road Shared Path

Public consultation on the recently constructed shared path on Hutt Road was held in March 2016. Two open days were held for people to come along and find out more. There were 991 submissions. Councillors heard 45 public oral submissions at the Transport and Urban Development Committee meeting on 5th May 2016.

Work on the first phase of upgrading the shared path started in October 2016, starting with replacing street lighting on the western side of Hutt Road. Preliminary construction on the new paths got under way in April 2017 and continued until mid-2018 as far as the Tinakori Road intersection. Widening the bridge over Kaiwharawhara Stream occurred in late 2019.

3.2 2017 and 2018 Engagement on Interim Improvements to Thorndon Quay

Engagement was undertaken by WCC in February 2017 with the Thorndon Quay community, regarding proposals for roadside bike lanes and associated changes to Thorndon Quay. This engagement consisted of a number of letter drops to businesses, open days and workshops, as well as consultation on some proposed interim improvements between Davis Street and Mulgrave Street. WCC received 316 submissions to this consultation, the majority of which came from people who regularly travel along Thorndon Quay.

Those who supported the proposal expressed they would like safety issues due to angle parking to be addressed. Those who did not support the proposal mostly had comments about the removal of parking.

55% of submitters who supported the proposal with changes, commented on extending the bike lanes north and making a better separation between cyclists and people in cars. 68% of submissions rated this bike connection as important or very important.

The top comment from people who thought the connection was of 'high importance', related to the safety of cyclists. The top comments from those that thought the connection was of low importance believed there were higher priorities.

An interim improvement for bikes was approved by Wellington City Councillors in 2018. This interim improvement would have converted the angle parking to parallel parking and marked on-road bike lanes between Davis Street and Mulgrave Street in order to improve the safety of this section of Thorndon Quay. It was planned this change would be made in conjunction with routine road sealing work at the end of 2018, however due to budget constraints the road sealing change was not made.

3.3 2020 Engagement on the Emerging TQHR Project Options

A stakeholder briefing on the TQHR project was held on 28th May 2020. At the time of preparing the long list of options, New Zealand had just entered into a Level 2 alert in response to the Covid-19 Pandemic. Prior to this, New Zealand had been in alert Levels 3 and 4 which prohibited normal economic activities, such as business operations, except for essential services such as supermarkets and pharmacies. The majority of the public were requested to stay at home and not to travel. As a result of the restrictions on movement and activity, engagement with stakeholder groups was limited.

Stakeholder questions and comments were collated for the project team to consider for the development of the proposal. Feedback was provided on key aspects, such as different modes and priorities.

Wider public engagement was undertaken in May and June 2020 using the online mapping tool, Social Pinpoint. Most of the feedback we received was from people who travel through the Hutt Road and Thorndon Quay area, with less from people who travel to work or have a business on Thorndon Quay or Hutt Road. Bus operators and bus drivers also gave their feedback.

648 online comments were received from 158 people, and five contact form submissions. There were around 30 comments posted on Facebook. Feedback encompassed a wide range of aspects along both Thorndon Quay and Hutt Road and has been used to inform and support the development of proposed long-term options.

The main findings of the consultation was a desire for:

- Increased safety for everyone
- Improved bus priority and reliability
- Better walking and cycling facilities
- A more attractive street environment.

Further details of the stakeholder and public issues and comments from the previous studies relating to this corridor are summarised in Table 3-1.

Table 3-1 High Level Overview of Previous Engagement Comments

Issue	Description
Facilities (or lack of) for cyclists	▪ Lack of dedicated facilities on Thorndon Quay ▪ Restricted space - cyclists forced to use traffic lane when parked cars are present ▪ Existing high volumes of cyclists is expected to grow following the completion of the Ngā Ūranga ki Pito-One section of Te Ara Tupua ▪ Cyclist safety ▪ Connection to other cycle paths.
Slow and unpredictable bus travel times	▪ Mixing with general traffic at signalised intersections ▪ Stop/ start delays at zebra crossings ▪ Pulling in/ out of bus stops which sit outside the traffic lane ▪ Side friction caused by turning traffic and parked cars.
Facilities (or lack of) for Pedestrians	▪ High volumes on some sections and large numbers crossing Thorndon Quay ▪ Lack of crossing facilities for pedestrian north of Bordeaux bakery ▪ Anticipated increased pedestrian demands ▪ Some crossing types/ forms not suitable for their location or volumes of pedestrians ▪ Lack of shade and shelter.
Road Safety	▪ High speeds and high traffic volumes on Hutt Road ▪ Cars failing to stop at red lights ▪ Lack of pedestrian crossings.
Parking	▪ Availability of parks for businesses (incorrect timeframes) ▪ Existing angle parks too steep/ hazardous.
Placemaking	▪ Lack of green spaces ▪ Lack of trees/ shrubbery ▪ Lack of shelter ▪ Too few/ No rubbish bins ▪ Dark (feels unsafe) ▪ Lack of public toilets ▪ Lack of art/ sculptures ▪ Lacking identity and connection to history.

4 Case for Change

This chapter summarises the strategic case for investment, including the problems to be addressed, the anticipated benefits of addressing the problems and the investment objectives. This builds on the Problem Definition and Case for Change Report prepared by LGWM in October 2019, and feedback from stakeholder engagement. Further details of the problems, benefits and objectives are contained in the Strategic Case report.

4.1 Problem Statement

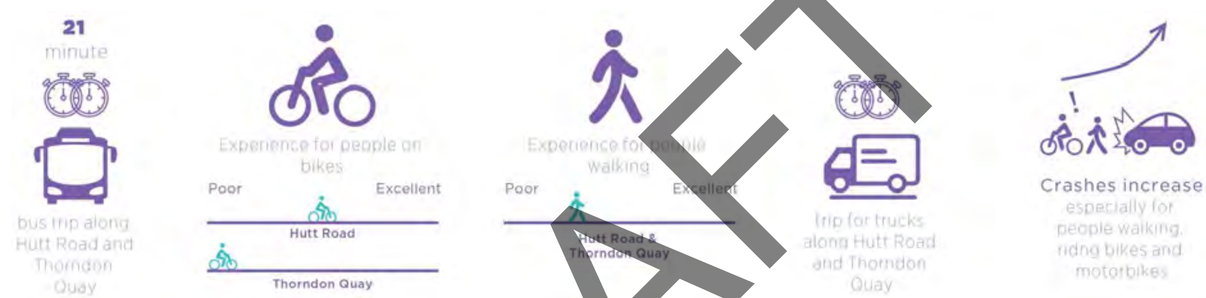
A series of problem statements were developed with project team members, OIMs and TWG representatives at an Investment Logic Mapping (ILM) workshop held on 19 May 2020. These problem statements are summarised below, with approximate weightings associated with each problem statement.

PROBLEM ONE	
Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus.	35%
PROBLEM TWO	
The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists.	30%
PROBLEM THREE	
Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area.	20%
PROBLEM FOUR	
High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road.	15%

The current and future problems to be addressed are summarised in Figures 4-1 and 4-2.

Figure 4-1 Current Problems

Figure 4-2 Future (2026) Problems if we Do Nothing



4.2 Evidence to Support Problem Statement One

Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus (35%)

4.2.1 The Cause and Effect of the Problem

PS1 - Cause and Effect

The cause of this problem is defined as buses being impeded by other traffic using the same corridor and intersection or crossing delay. The effect of this is a poorly performing bus service especially in the southbound direction during the morning peak. This makes it unattractive for users and limits the ability to grow bus travel.

4.2.2 Evidence of Traffic Congestion

Buses are often stuck behind cars on the TQHR corridor, making travelling by bus slow and unreliable. For the majority of the TQHR corridor, buses mix with general traffic and are subject to the same delays and congestion that affects general traffic. The majority of delays are associated with traffic congestion at intersections, crossings and parking, and at bus stops.

In the morning peak a clearway operates for southbound traffic, and there are often no significant delays for buses entering the CBD between bus stops, as there is generally no on-street car parking impeding bus movements. During other times of the day, buses are delayed by cars manoeuvring into and out of parking spaces. When this occurs, buses can either wait in the lane or overtake the parking car in the opposing lane / median. The ability to overtake is dependent on the road width and the traffic volume in the opposing lane.

Between 7am and 9am on weekdays, it currently takes about 13 minutes to travel by bus along the approximately 5km length of Hutt Road and Thorndon Quay from Ngauranga/Jarden Mile to Wellington railway station. Transport modelling indicated that travel by bus is expected to take up to 14 minutes by 2026, if no improvements are made. Travel times are expected to increase over a longer peak period, as demand spreads at peak times.

There will be increased travel demand as population grows. As traffic congestion increases, bus journeys will be less reliable if greater priority is not provided for buses.

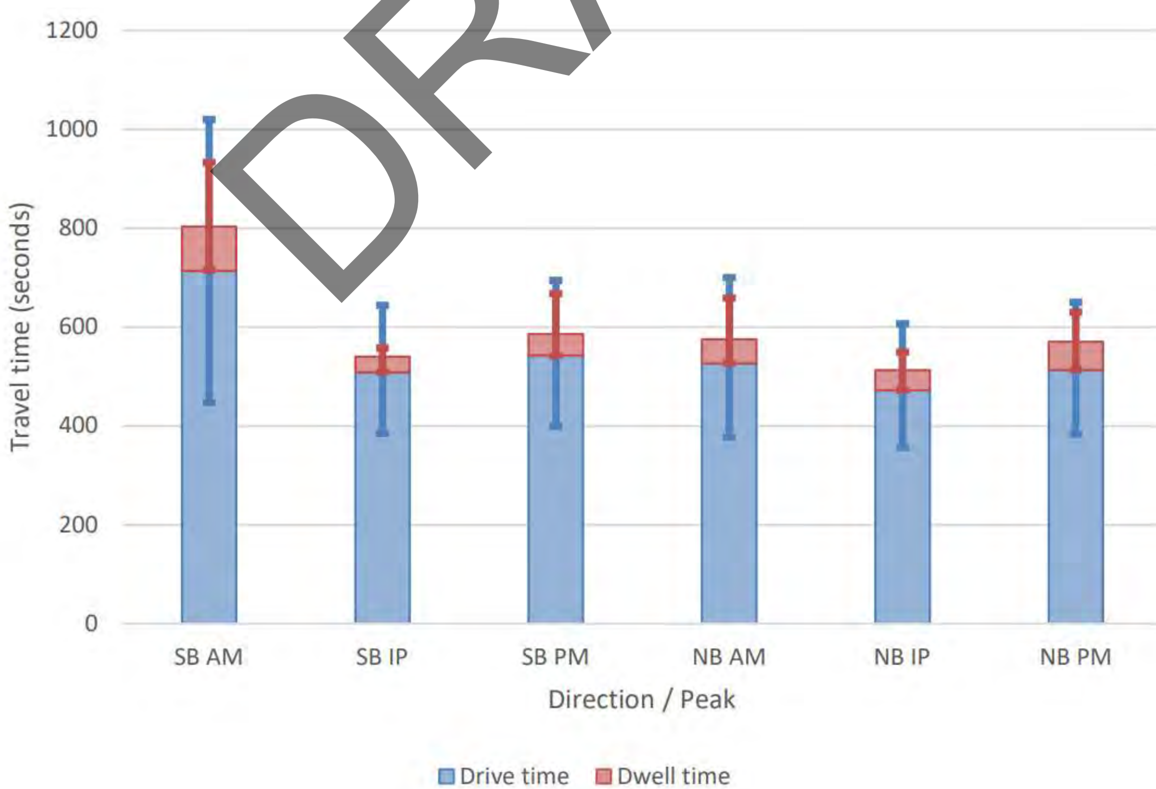
Further information on average traffic volumes, and general traffic congestion, on the corridor are provided in the Strategic Case.

4.2.3 Evidence of Variability in Bus Travel Times

Figure 4-3 shows the variability in overall bus travel time on weekdays along the TQHR corridor. These travel times include dwell time and are shown by peak/off-peak and by direction, as represented by the 15th and 85th percentile travel times. It shows that the variability in bus travel times is greatest in the morning peak period for southbound bus movements.

The majority of bus travel time is made up of drive time which includes time taken to decelerate to and accelerate from the bus stops, as opposed to dwell time at bus stops. There is significant variability in bus stop dwell times, as explained below.

Figure 4-3 Bus Travel Times by Time of Day (average with 15th and 85th Percentiles)



4.2.4 Evidence of Delays at Bus Stops

The majority of bus stops on the TQHR corridor are recessed out of the traffic lane, with substandard entry and, or exit tapers, which have the potential for delays to occur. This is particularly a problem for buses travelling southbound during the morning (AM) peak period. Delays are particularly acute at stops with angle parking adjacent, where the buses are recessed up to 5.5m instead of the typical 2.1m.

Bus stop lengths are also substandard at several locations, for example at the southbound bus stop at Capital Gateway, which is one of the busiest stops on the corridor, has a recessed length of less than 20m compared with a desirable 39m for a single bay bus stop.

Bus stop catchment areas overlap in some cases also, giving potential to rationalise the number of stops provided and therefore potentially help speed up bus services and make them less prone to delays at stops.

In some locations, bus stops are located prior to pedestrian crossings, so passengers who alight from the bus and who want to cross the main road will cross in front of the bus and hence can delay its onward journey.

Further details of the delays experienced by buses at bus stops is contained in Appendix C.

4.3 Evidence to Support Problem Statement Two

The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists (30%)

4.3.1 The Cause and Effect of the Problem

PS2 - Cause and Effect

The **cause** of this problem is defined as a growing number of cyclists travelling along the corridor without space or suitable facilities to cater for safe cycling. The **effect** of this is an increased risk to cyclists of coming into conflict with motor vehicles and limiting the uptake of cycling as a mode of travel on this corridor.

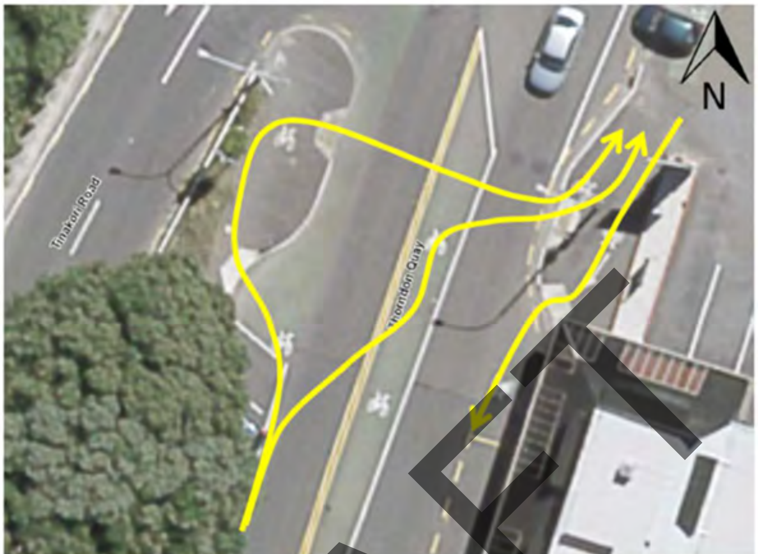
4.3.2 Evidence of Poor Cycle Facilities

There is no existing cycle path on Thorndon Quay. Although there is a dedicated two-way bike path along the majority of Hutt Road, it is not complete and provides a sub-standard level of service for cycle users (further information provided in the Strategic Case). People who may cycle into the city find their options are affected and limited due to these issues. A review of CAS data indicates suggests that there are many cycle crashes that are not captured via police records.

In the morning peak period, a clearway for southbound traffic result in reduced conflict between cyclists and parked cars compared to at other times of the day when cyclists are often forced to share space with general traffic. This has multiple effects, the first being that cyclists are at risk of collision with passing traffic, car parking and vehicle accesses. The second effect is that cyclists in the traffic lane delay through traffic, including buses.

Access from on-road cycling along Thorndon Quay to the cycle path on Hutt Road, is challenging for cyclists travelling northbound. These cyclists must find a gap in the northbound traffic flow to wait in the median before cycling across the southbound lane to join the cycle path. The current arrangement is shown in Figure 4-4.

Figure 4-4 Southern Access to the Hutt Road Cycle Path at Tinakori Road/Hutt Road Intersection



Cyclists on Thorndon Quay have to interact with vehicle traffic at intersections along the length of the road. Cyclists (and vehicles) have priority over side road traffic at all intersections except for the signalised intersections south of Mulgrave Street where they have cycle lanes and advanced stop boxes.

4.3.3 Evidence of Conflicts between Cyclists and Other Road Users

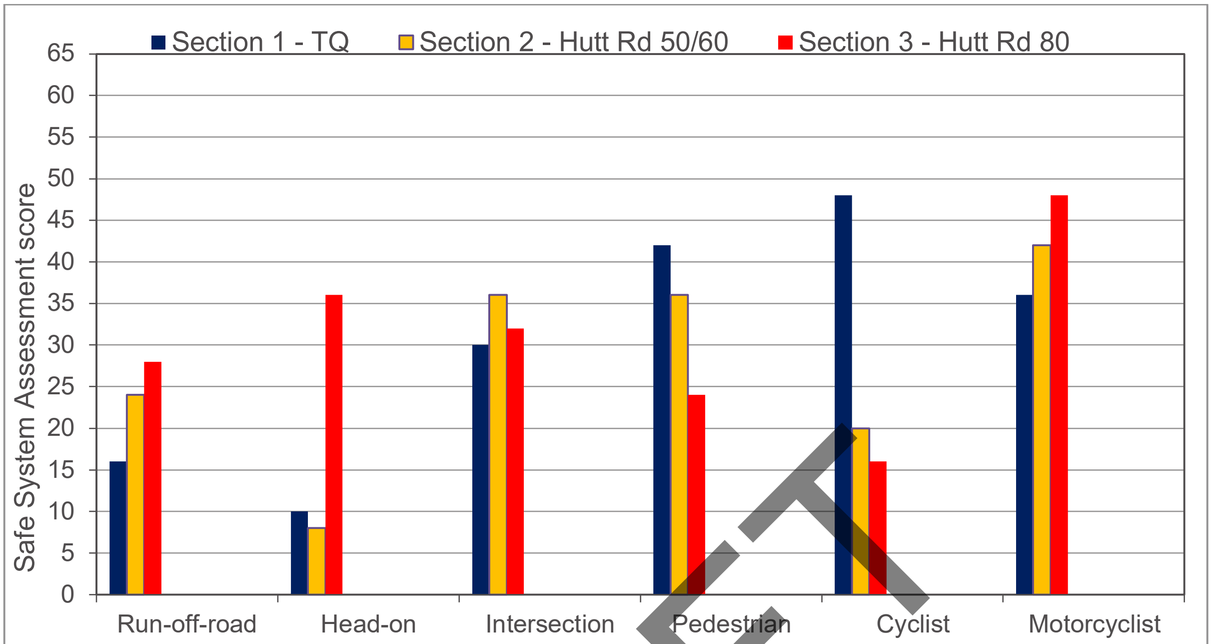
Analysis of cycle injury crash data along the corridor for the ten-year crash period (2010-2019 inclusive) indicated that:

- Cyclists are the most likely to be involved in an injury crash on the corridor, making up 45% of injury crashes (60 out of 133 crashes) and 50% of serious injuries (14/28)
- Along Thorndon Quay the most likely cause of a cyclist injury crash is the interaction with a parked or parking vehicle (26 out of 35 crashes) - this includes opening doors for parallel parks, entering/ exiting angled parks and u-turning whilst looking for a parking space
- The most likely cause of cyclist injury crashes on Hutt Road is due to a collision with vehicles at business access point across the shared path (19 out of 43 crashes)
- The most common time for a cyclist injury crash is during the morning peak period and typically involves people in the 40 to 49 age group (i.e. adult commuters).

A Safe System Assessment Framework (SSAF) was also undertaken for the corridor (refer to Appendix D), as summarised in Figure 4-5. This indicated that the safety risk for cyclists is the highest of any user group on Thorndon Quay. This is due to the lack of a separated facility, the busy nature of the road environment, poor connections to adjacent facilities, the proximity to on-street parking and the speed environment.

It is noted that most cycle crashes are not attended by Police and are not recorded in CAS.

Figure 4-5 Safe System Assessment Framework



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4.3.4 Evidence of Poor Levels of Service for Cyclists

The level of service (LOS) for cyclists on the TQHR corridor was calculated using the Danish Roadway Segment method[11]. This indicates that cyclists currently have an average to poor LOS (LOS D to F) on the different sections of Thorndon Quay and a poor LOS (F) on the on-road section of Hutt Road. The cycle path section of Hutt Road has an adequate LOS (A).

It should be noted that the Danish method does not take into account conflicts between cyclists and vehicles caused by intersections, accesses or angle parking. These are key concerns for cyclists on Thorndon Quay and Hutt Road.

4.3.5 Evidence of Deficiencies in the Hutt Road Cycleway

A number of safety issues were identified in a safety audit undertaken of the recently opened Hutt Road cycleway. The more serious issues identified from the audit relate to access/egress to businesses along the south-eastern side of the corridor. These predominantly identified issues with vulnerable users on the shared use facility and in particular for cyclists.

In relation to accesses generally, the safety audit noted that “a high level of cyclist/ vehicle and pedestrian/ vehicle conflicts were observed at major access points. In most situations, it was the exiting driver not looking for cyclists, and pulling directly in front of the vulnerable user”. The higher speed of cyclists was also observed to contribute to these conflicts.

When Te Ara Tupua is completed, it is expected there will be at least three times as many cyclists on the TQHR corridor. Growth in cycling demand will therefore not be supported by the current infrastructure.

[11] Trafitec Danish Roadway Segment Cycling LOS (2007)

4.4 Evidence to Support Problem Statement Three

Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area (20%)

4.4.1 The Cause and Effect of the Problem

The cause of this problem is defined as a lack of suitable pedestrian facilities on Thorndon Quay and Hutt Road.

The effect of this is an increased safety risk to pedestrians on Hutt Road and Thorndon Quay in particular, south of Moore Street and north of Bordeaux Bakery. There is a lack of shade and shelter, resulting in an unpleasant environment for pedestrians. This limits the attractiveness of walking as a travel choice, and is likely to be a deterrent to the predicted large increase in future pedestrian demand.

PS3 - Cause and Effect

The **cause** of this problem is defined as the poor quality of the street environment which does not make Thorndon Quay or Hutt Road an attractive or pleasant place to walk or spend time in. The **effect** of this is an increased safety risk to a growing number of pedestrians on Hutt Road and Thorndon Quay and a lack of amenity is limiting the attractiveness of walking as a mode of travel.

4.4.2 Evidence from Healthy Streets Assessment

A Healthy Streets Assessment was undertaken for the corridor and is included in the Problem Definition and Case for Change Report (October 2019). This showed that Hutt Road scored well against the metrics around the quality and separation of facilities for pedestrians and cyclists. However, did not score as well against the metrics associated with vehicle speeds, volumes and heavy vehicle proportions.

Thorndon Quay's index is very similar to that calculated for Hutt Road, with no clear strengths and the lack of shade and shelter/ things to see and do are identified weaknesses. Thorndon Quay scored well against the metrics around the quality and separation of facilities for pedestrians but did not score as well against the metrics associated with vehicle speeds, volumes, heavy vehicle proportions and cyclist separation.

4.4.3 Evidence of Poor Level of Service for Pedestrians at Intersections

The existing footpath widths and street environment on Thorndon Quay do not make it very attractive to walk, shop or spend time. Pedestrian demand is expected to increase in the future, as is the use of other mobility options such as scooters. The expected increased demand for walking will not be supported by the current infrastructure.

An analysis of pedestrian movements at signalised intersections along the corridor included in the Problem Definition and Case for Change Report (October 2019), indicated that they have small green time ratios and high delays resulting in average to poor level of service. Particular areas of concern for pedestrians are on Hutt Road, where traffic speeds are higher and there are unsuitable or a complete lack of crossing facilities. There is also a large separation between formal crossing facilities, particularly north of Bordeaux Bakery.

4.4.4 Evidence of Poor Pedestrian Safety

An analysis of crash date for pedestrians in the ten-year period from 2010 to 2019 indicated:

- Pedestrians make up a low number of injury crashes, being involved in 9% of injury crashes (twelve out of 133) and 11% of serious injuries (three out of 28)
- Of the twelve crashes, eight were located in Thorndon Quay and four were along Hutt Road
- In the Thorndon Quay section, pedestrian crashes occurred at the Mulgrave intersection, Moore Street zebra crossing and south of Tinakori Road
- Two of the four pedestrian crashes on Hutt Road occurred at the Rangiora Avenue zebra crossing

The SSAF showed that for pedestrians the safety risk is higher than vehicles in the Thorndon Quay section. The likelihood and severity of a crash along the corridor is similar. However, the provision of the shared path and the reduced number of pedestrians north, towards Jarden Mile along Hutt Road reduces the safety risk.

4.5 Evidence to Support Problem Statement Four

High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road (15%)

4.5.1 The Cause and Effect of the Problem

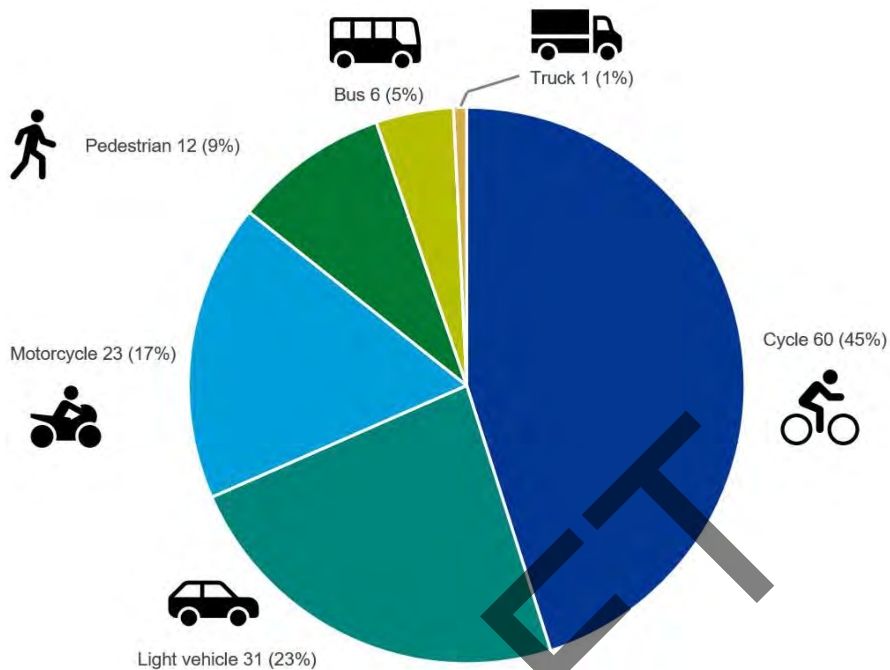
PS4 - Cause and Effect

The **cause** of this problem is high and increasing traffic volumes on a section of high speed corridor and the high number of vehicle crossing movements. The **effect** of this is an increased safety risk and crash severity for all road users on Hutt Road.

4.5.2 Road Safety Evidence

Over the past ten years, from 2010 to 2019 inclusive, there were 133 injury crashes recorded by the Police along Hutt Road and Thorndon Quay. Of these crashes, 60 involved cyclists (45%), twelve involved pedestrians (9%) while 23 involved motorcyclists (17%), as depicted in Figure 4-6. Twenty eight of the crashes resulted in serious injuries.

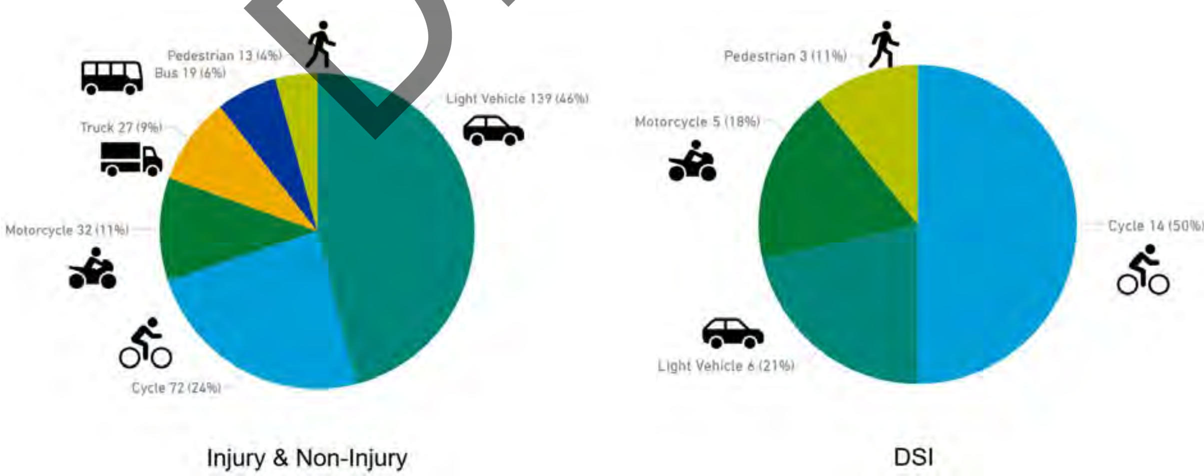
Figure 4-6 Crashes by Mode (2010-2019 inclusive)



Over 70% of crashes causing injuries to people cycling on Thorndon Quay are from people opening car doors into the traffic lane, drivers turning into or reversing out of angle parking and u-turning while looking for a car park.

The number of injury and non-injury, and deaths and serious injuries (DSIs) recorded on the TQHR corridor in the ten-year period is summarised in Figure 4-7. Vulnerable users account for 79% of all DSIs.

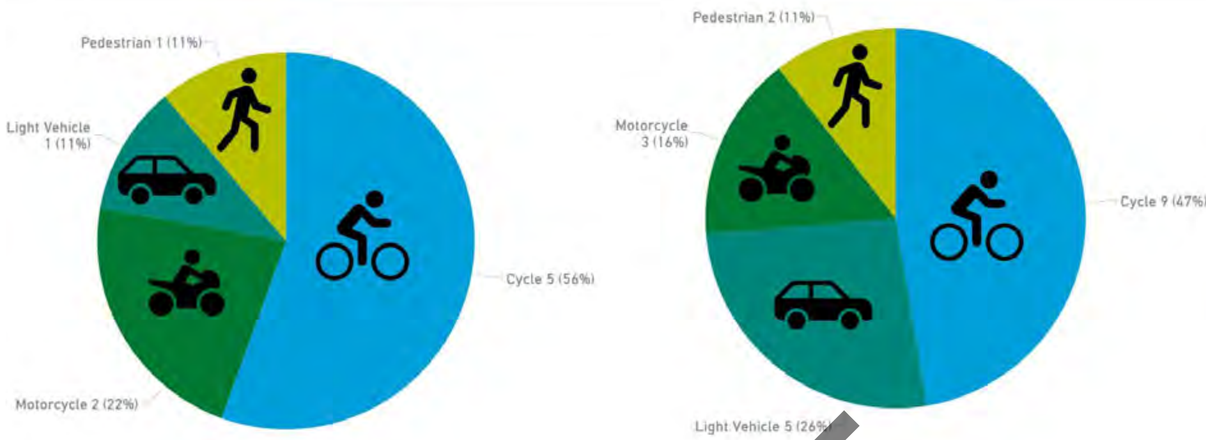
Figure 4-7 All Crashes vs DSI by Mode (Ten Year Period for Thorndon Quay and Hutt Road)



Analysis of crash data indicates that vehicles are the second likely (behind cyclists) to be involved in an injury crash. Vehicle injury crashes attribute to 23% of injury crashes (31 out of 133) and 21% of serious injuries (six out of 28) in the past ten-year period from 2010 to 2019.

The number of DSIs by mode for Thorndon Quay and Hutt Road in the ten-year period is summarised in Figure 4-8. The split of DSIs is similar on Thorndon Quay to Hutt Road.

Figure 4-8 DSIs by Mode (Ten Year Period for Thorndon Quay and Hutt Road)



In general, the two main crash types which both occur near intersections are rear end/ obstruction crashes and crossing/ turning crashes. Hutt Road makes up most of the injury crashes (22 out of 31) where the speed environment is higher, and these injury crashes are mainly located at the complex Kaiwharawhara Road and Jarden Mile intersection.

Motorcyclists are the third most likely to be involved in an injury crash, consisting of 17% of injury crashes (23 out of 133) and 18% of serious injuries (five out of 28). Along Hutt Road the crashes involving motorcycles were concentrated at intersections, being mainly rear end/ obstruction crashes and crossing/ turning crashes.

There were a low number of bus crashes (six out of 133) with no serious injuries. These mostly occur at the southern end of Thorndon Quay around Mulgrave Street and in the northern section of Hutt Road.

Along Hutt Road the most likely cause of a cyclists' injury crash is interacting with vehicles at an access point across the shared path (19 out of 43 cyclist injury crashes). Along this shared path there are numerous accesses for businesses.

Of the twelve crashes involving pedestrians, eight occurred along Thorndon Quay and four along Hutt Road. In the Thorndon Quay section, the pedestrian crashes occurred at the Mulgrave intersection, Moore Street zebra crossing and south of Tinakori Road. In the Hutt Road section, two crashes occurred at the Rangiora Avenue zebra crossing.

The most common crash type recorded for cyclists and motorcyclists combined was due to crossing/ turning at intersections or accesses. There were a total number of 22 crashes of this type. Of these crashes, 20 of them involved motor vehicles either striking vulnerable users or being struck by them, and the remaining two crashes were due to cyclists avoiding being hit by a motor vehicle.

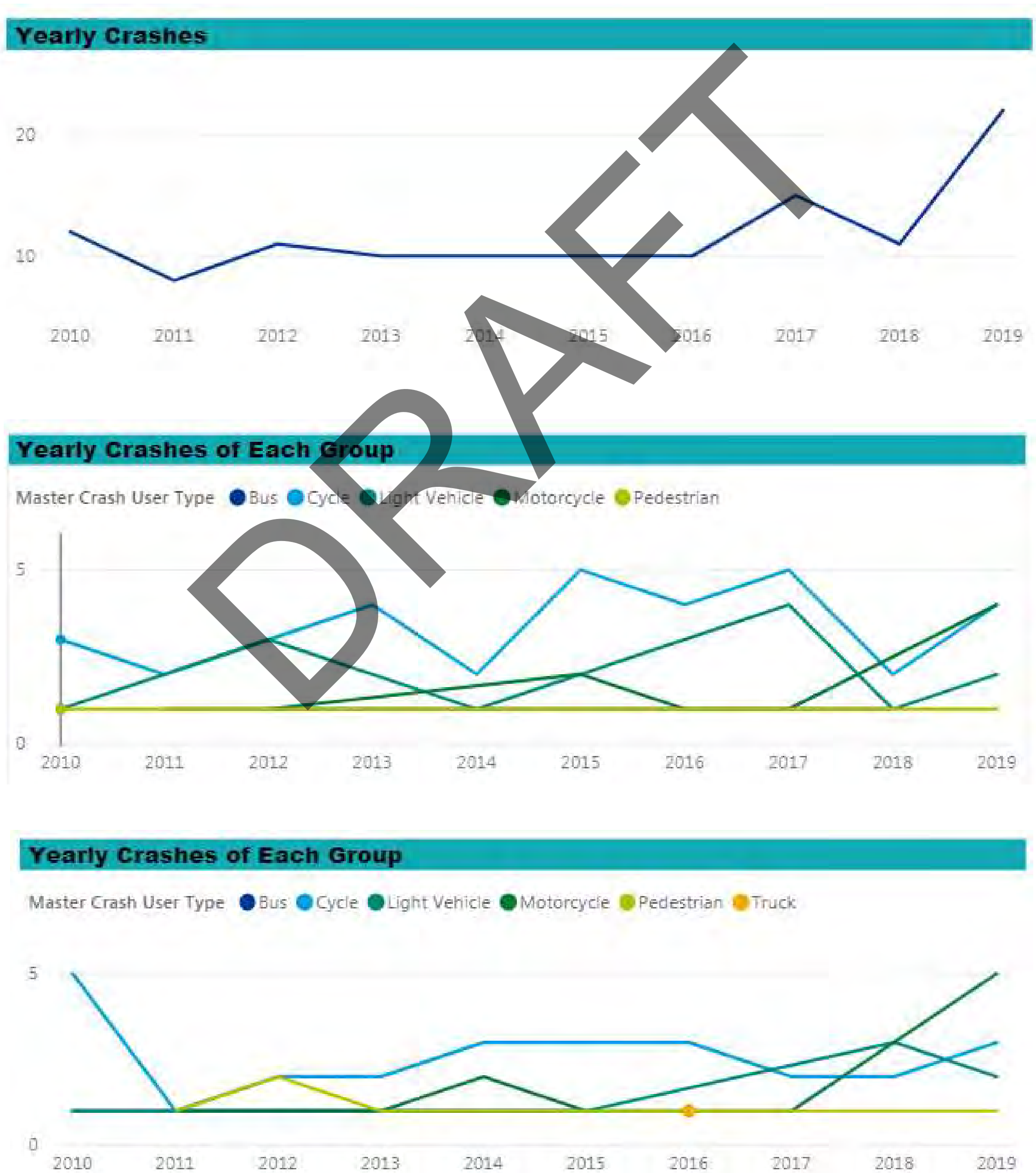
Apart from these two crashes, 20 crashes happened at the intersections/ accessways along Hutt Road, with three crash clusters identified at the accessways of Caltex, Spotlight and School Road/ Hutt Road intersection. There were three cyclist crashes at the Caltex accessways, with two of them occurring before the cycleway improvement and one during the cycleway upgrade construction.

An analysis of CAS shows that, over the 10-year period, there appears to be a rising trend in all injury crashes as well as for cycle and motorcycle crashes, as shown in Figure 4-9 (for TQHR, Hutt

Road and Thorndon Quay respectively). While the number of cycling and motorcycling crashes appears to be increasing, the sample size is relatively small and so caution should be given to drawing much conclusion from this. In addition, there has been ongoing cycling improvements during this time as well as an increase in cyclists which may affect future crash occurrence. However, at the very least, an on-going issue involving these users is apparent.

The differential between ACC claim figures and cycle crashes recorded within CAS suggests that there are a considerable number of crashes that are not reported to the police. It is also noted that as Hutt Road and Thorndon Quay are used as an emergency detour when SH1 is closed or delays occur on it, this could have a major impact on the safety along this route, particular for vulnerable road users.

Figure 4-9 Ten Year Crash Trend



4.5.3 Evidence from Safe System Assessment Framework

The SSAF analysis indicated that the key safety risks are at intersections. This is due to the frequency, complexity, speed environment and intersection form, as well as a high head on crash risk in the 80km/h section of Hutt Road.

The SSAF also showed that for pedestrians, the safety risk is higher than vehicles in the Thorndon Quay section. Along the corridor the likelihood and severity of a crash is similar, but the provision of the shared path, and the reduced pedestrian demand, as you move north towards Jarden Mile along Hutt Road, reduce the crash risk.

The SSAF indicated that motorcyclists have a similarly high safety risk level, with slight increases in risk as the speed environment increases.

4.6 Summary of the Evidence Base

The evidence base gathered to support the problems this SSBC seeks to address is summarised in Table 4-1.

Table 4-1 Summary of Evidence Base

Problem	Cause and Effect	Key Evidence
1: Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus	**Cause:** Buses are impeded by other traffic using the same corridor and intersection or crossing delay	Overall, the level of service for buses is generally poor. Potential issues/ findings highlighted by the analysis include: ▪ Relatively high growth in passenger demands ▪ High travel times and variability, particularly in the morning peak period (southbound). Key sources of delay include: – Signalised intersections – Pedestrian zebra crossings – Bus stop spacing – Parking – Bus stop congestion (includes re-entry delays and delays associated with sub-standard stop layout).
	Effect: a poorly performing bus service that often is running late, especially in the southbound direction during the morning peak. This makes it unattractive for users	▪ Evidence is strong regarding the length of time bus services take to negotiate the corridor in the morning peak period.
2: The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists	**Cause**: a growing number of cyclists travelling along the corridor without space or suitable facilities to cater for safe cycling.	▪ High growth in cycling demands. ▪ Lack of road space and route continuity along Thorndon Quay section of the route.
	Effect: Increased risk to cyclists of coming into conflict with motor vehicles and limits the uptake of cycling as a mode of travel on this corridor.	▪ The safety risk for cyclists is the highest of any user group (in the Thorndon Quay section). This is due to the non-separated facility (no shared path), the busy nature of the road environment, poor connections to adjacent facilities, the proximity to on-street parking and the speed environment (greater than 30km/h).
3: Poor quality of the street	**Cause:** A lack of suitable or inappropriate pedestrian facilities	▪ Pedestrian activity is fairly low along the whole corridor, but trending upwards.

environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area	on Thorndon Quay and Hutt Road.	▪ There are pockets or clusters of pedestrian activity along the corridor either at crossing points, bus stops or in retail/commercial areas which are not well catered for. ▪ High Speed and traffic volumes on some sections of Hutt Road ▪ Lack of crossing points north of Thorndon Quay.
	Effect: An increased safety risk to pedestrians on Hutt Road and Thorndon Quay (south of Moore Street and north of Bordeaux Bakery) and a lack of shade and shelter and things to see and do is limiting the attractiveness of walking as a mode of travel.	▪ Poor Healthy Streets Scores due to the lack of shelter and shade and things to see and do. ▪ Analysis of pedestrian movements at signalised intersection along the corridor indicate they an average to poor (LOS D-E) performance. Particular areas of concern for pedestrians are on Hutt Road where speeds are higher and there are unsuitable or a complete lack of crossing facilities. ▪ Pedestrians make up a low number of injury crashes, being involved in 9% of injury crashes and 11% of serious injuries. ▪ Of the twelve crashes, eight were located in Thorndon Quay and four were along Hutt Road. ▪ The SSAF shows that for pedestrians the safety risk is higher than vehicles in the Thorndon Quay section. Along the corridor the likelihood and severity of a crash is similar, but the provision of the shared path and the reduced number of pedestrians as you move north towards Jarden Mile along Hutt Road decrease the risk.
4: High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road	**Cause:** High traffic flows and high speeds on Hutt Road	▪ The posted speed on Hutt Road is 50 km/h from the intersection of Thorndon Quay and Hutt Road to the intersection of Aotea Quay and Hutt Road, 60 km/h to the intersection of Onslow Road and Hutt Road and 80 km/h for the rest of the section to the Jarden Mile intersection.
	Effect: Increased safety risk and crash severity for all road users.	▪ The SSAF highlighted that the key safety risks are located at intersections due to the frequency, complexity, speed environment and intersection form, as well as a high head on crash risk in the 80km/h section of Hutt Road given the limited separation.

4.7 Benefits of Investment

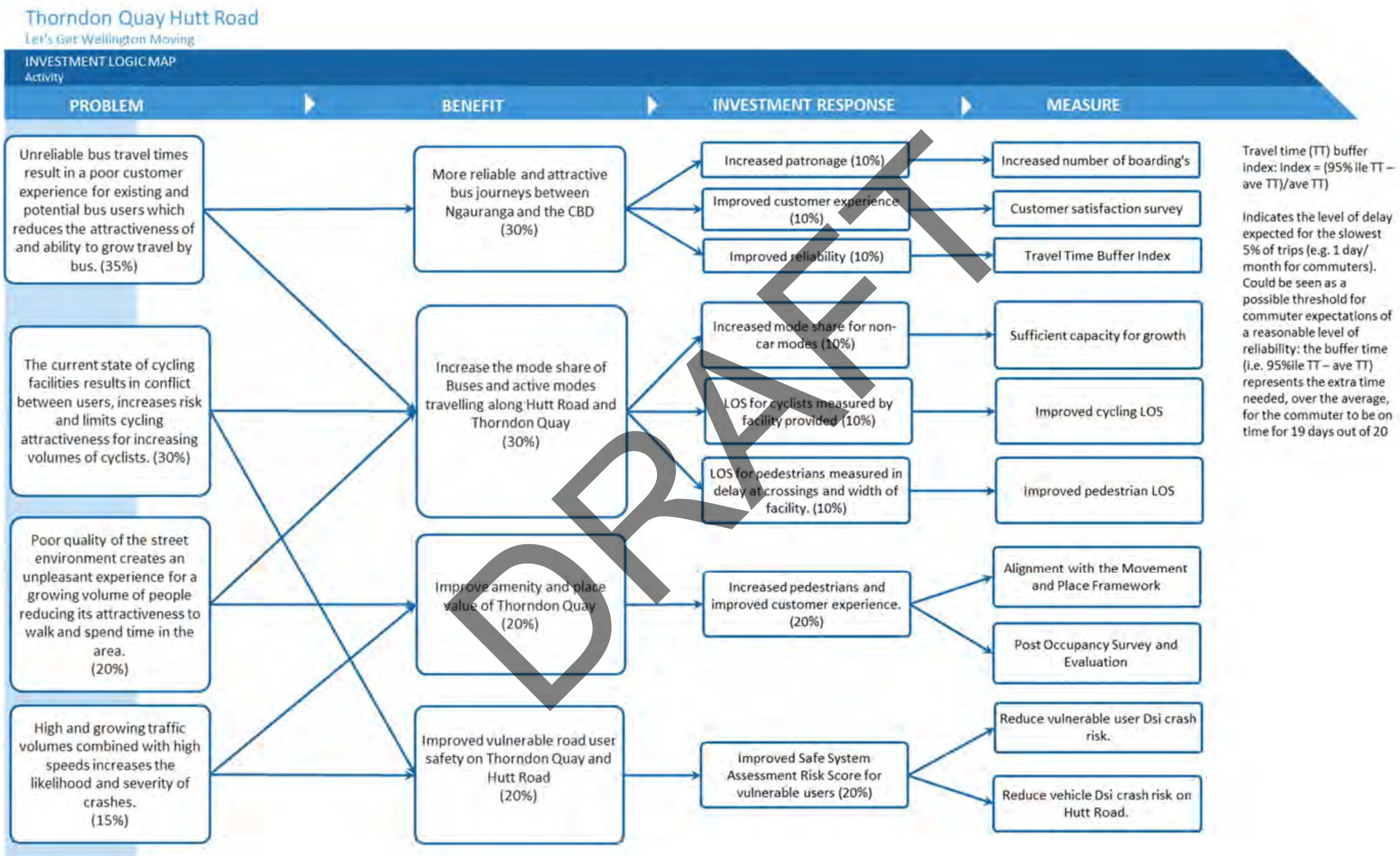
At the workshop meeting held on 19 May 2020, and at subsequent stakeholder engagement sessions, the potential benefits of successively investing in the project were identified, developed and agreed, together with weightings for each benefit statement:

- More reliable and attractive bus journeys between Ngauranga and the CBD (30%)
- Increase the mode share of buses and active modes travelling along Hutt Road and Thorndon Quay (30%)
- Improve amenity and place value of Thorndon Quay (20%)
- Improve vulnerable road user safety on Thorndon Quay and Hutt Road (20%).

4.8 Investment Logic Map

An investment logic map showing how the problem and benefits relate to each other, the investment response and measures which could be used to measure the response, is summarised in an Investment Logic Map (ILM). This is shown in Figure 4-10.

Figure 4-10 Investment Logic Map

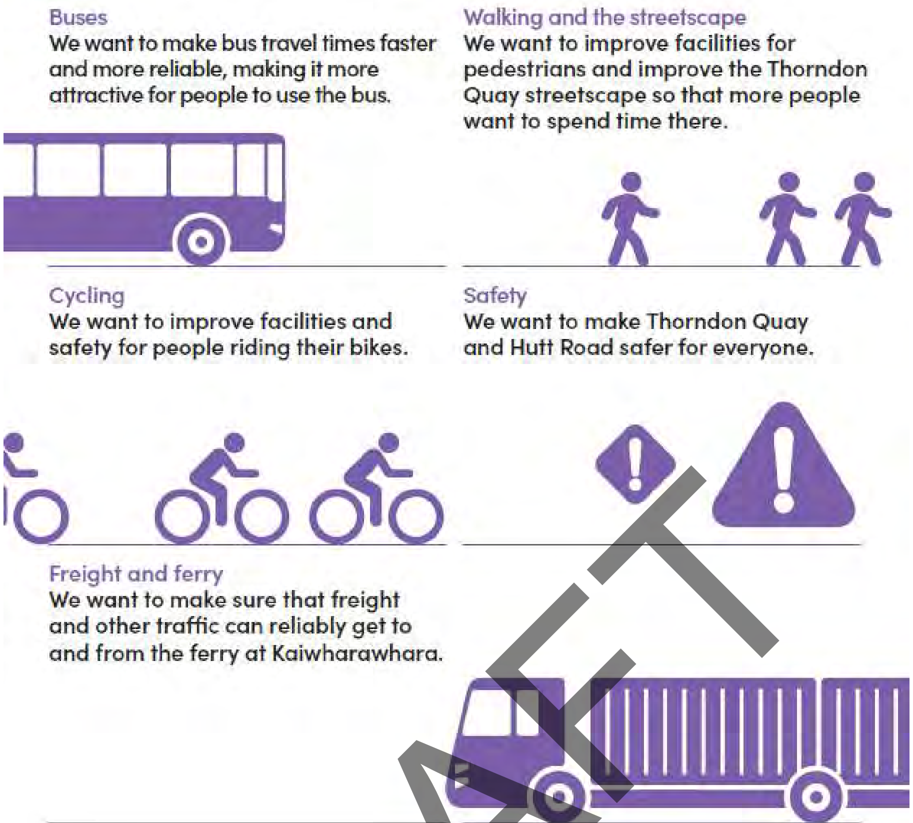


4.9 Investment Objectives

Following the definition of the problem statements and benefits, and the development of an ILM, investment objectives for this SSBC were defined. An additional objective related to maintaining access to the ferry terminal was added in response to proposals for bus priority measures being developed for Hutt Road, and the need to avoid adverse impacts of this on truck movements. The Strategic Case has more information on this.

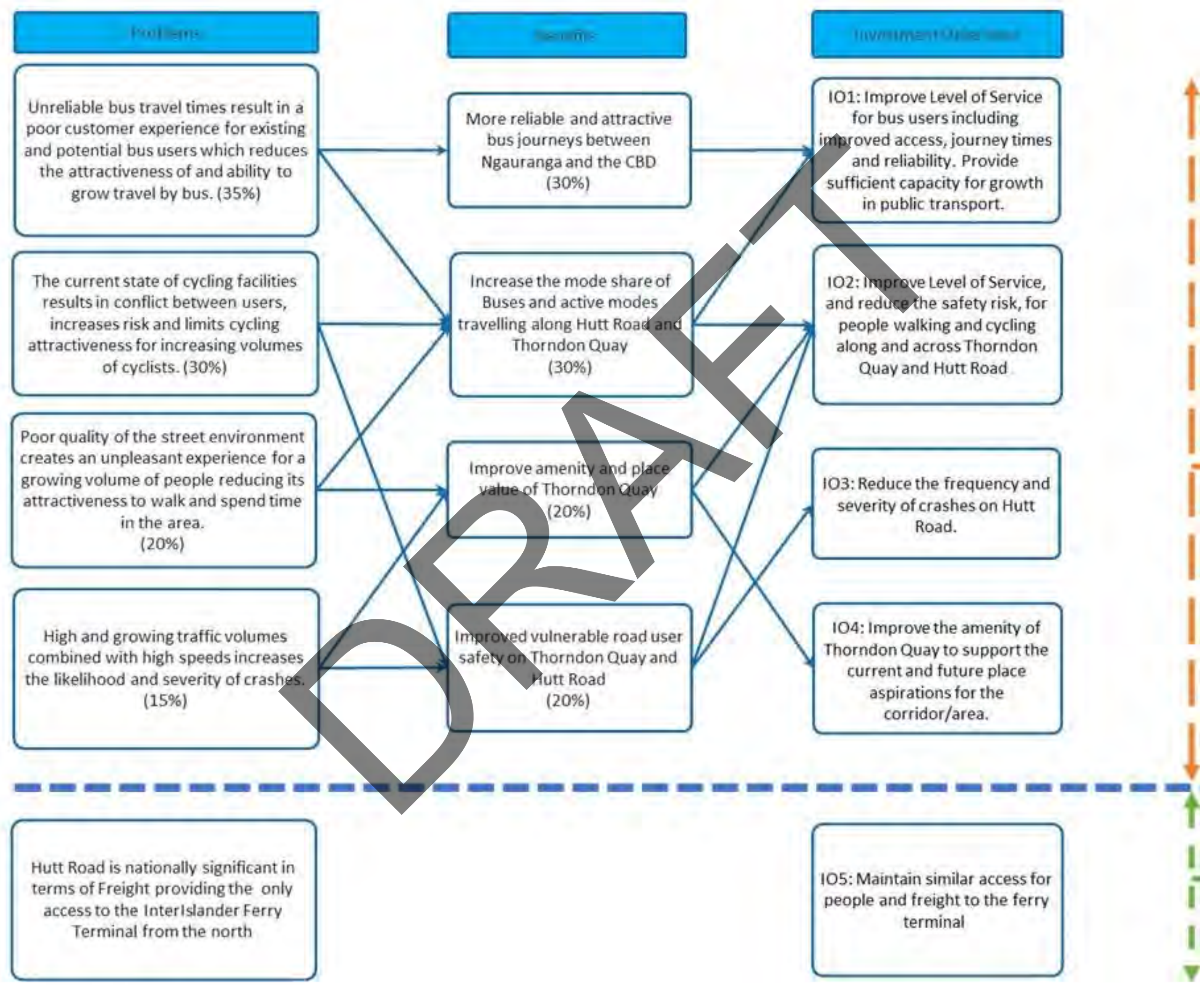
The final Investment Objective are listed below and summarised in the graphics below.

INVESTMENT OBJECTIVE ONE
Improve Level of Service for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport
INVESTMENT OBJECTIVE TWO
Improve Level of Service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road
INVESTMENT OBJECTIVE THREE
Reduce the frequency and severity of crashes
INVESTMENT OBJECTIVE FOUR
Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area
INVESTMENT OBJECTIVE FIVE
Maintain similar access for people and freight to the ferry terminal



The linkage between the problems, benefits and investment objectives is shown in Figure 4-11.

Figure 4-11 ILM With Investment Objectives



4.10 Critical Success Factors

In addition to the investment objectives, four Critical Success Factors (CSFs) were identified by the Project Partners to further inform the development of options. These are shown in Figure 4-12.

Figure 4-12 Critical Success Factors

1. Demonstrate tangible improvements for public transport, pedestrians, and cyclists within the 2018-21 / 2021-24 NLTP periods
2. Limit the impact of implementation on businesses located on Thorndon Quay and Hutt Road
3. Positive economic impact on businesses on Thorndon Quay and Hutt Road
4. Stakeholders and public feel that they have had the opportunity to contribute and understand the rationale for the recommended programme

4.11 Alignment of Benefits/Objectives with LGWM Programme

As TQHR forms part of the wider LGWM programme, the problems, benefits, investment objectives and KPI's for the LGWM programme and TQHR were assessed to determine the alignment between them. Table 4-2 summarises the alignment of the LGWM benefits/ objectives with the TQHR problem statements.

Table 4-2 Alignment of LGWM Benefits/Objectives with TQHR Problems

LGWM Problems	LGWM Benefits/Objectives		TQHR Problems	Alignment
Increasing congestion and unreliable journey times Poor and declining levels of service	A transport system that enhances the liveability of the central city	LIVEABILITY	Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus.	ACCESS, REDUCED CAR RELIANCE, LIVEABILITY
	A transport system that reduces reliance on private vehicle travel	REDUCED CAR RELIANCE	The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists.	REDUCED CAR RELIANCE, SAFETY
	A transport system that provides more efficient and reliable access for users	ACCESS	Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area.	REDUCED CAR RELIANCE, SAFETY, LIVEABILITY

Safety issues especially for active modes	A transport system that improves safety for all users	SAFETY	High traffic volumes and speeds increase the likelihood and severity of crashes.	SAFETY
Vulnerability to disruption from unplanned events	A transport system that is adaptable to disruptions and future uncertainty	RESILIENCE		

Table 4-3 shows that the TQHR investment objectives are aligned to each LGWM programme objective. In terms of resilience, the core function of the corridor was considered with respect to its critical function, the existing route designation in terms of vulnerability and its use as an alternative route to SH1. As such the most important aspect of this is to maintain the current level of access for freight and people.

Table 4-3 Alignment with LGWM Objectives

TQHR Investment Objectives	LGWM Objectives Alignment				
	LIVEABILITY	REDUCED CAR RELIANCE	ACCESS	SAFETY	RESILIENCE
Improve Level of Service for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport	●	●	●		
▪ Improve Level of Service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road	●	●	●	●	
Reduce the frequency and severity of crashes.		●	●	●	●
Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area.	●				
Maintain similar access for people and freight to the ferry terminal			●		●

In terms of alignment with the LGWM programme KPI's, Table 4-4 summarises the contribution that the TQHR project will make to these. The baselines can be derived from actual surveys and modelled data.

Table 4-4 Contribution TQHR Will Make to Achieving the LGWM Programme KPIs and Measures

LGWM IO's	LGWM KPI's		LGWM KPI Measure	TQHR Contribution (Low, Medium, High)
LIVEABILITY	KPI 1	Amenity Index - The quality of the urban environment	Amenity Index prepared specifically for LGWM	Low
	KPI 2	Transport-related CO2 emissions in the central city	CO2 emissions from VKT from model	Low
	KPI 3	Opportunities for urban development and value uplift	Qualitative assessment	Low
	KPI	Monitor traffic noise		Low
	KPI	Monitor Liveability Survey	Quality of Road Network, Quality of Public Transport (Economist Intelligence Unit Global)	Medium
	KPI	Monitor Air Quality	Particulates, NO2	Low
REDUCED CAR RELIANCE	KPI 4	Improve the system occupancy	Transport model at four cordons	Medium
	KPI 5	Delays for people walking in the central city	Qualitative assessment of 11 intersections as to whether they are likely to experience a reduction in pedestrian delay.	N/A
	KPI 6	The quality of cycling facilities	Danish midblock LoS for eight corridors	High
	KPI	Monitor mode share within CBD/VKT within the CBD		Low
ACCESS	KPI 7	The number of people living and working within 30 mins of key destinations	Census population and employment data coupled with geospatial analysis using historical data and modelled traffic. Civic Centre, Hospital, Airport and Port	Low
	KPI 8	The reliability of travel time by different modes to key regional destinations	Observed, qualitative and modelled (CoV) for a few key routes	High
	KPI	Monitor number of people travelling to CBD		Low
SAFETY	KPI 9	Deaths and serious injuries for people walking and cycling in and around the central city	CAS and estimated reductions	High
	KPI	Monitor total casualties by severity and mode		High

LGWM IO's	LGWM KPI's		LGWM KPI Measure	TQHR Contribution (Low, Medium, High)
RESILIENCE	KPI 10	Network resilience to disruption caused by large-scale natural hazards	Qualitative assessment using Regional Resilience PBC assessment	Low
	KPI	Monitor lane availability reductions due to unplanned events		N/A

4.12 Key Performance Indicators and Targets

Table 4-5 summarises the main outcomes and the baseline information and targets that have been defined for each Investment Objective. The target KPIs have been developed based on SMART principles.

Table 4-5 Investment Objectives Outcomes, Baseline and Targets

Investment Objective	Objective Description/Measurable Outcome/Baseline	Indicative Targets
1	Increase demand for bus services by 2026 and the speed of bus services by 2026. ▪ Baseline is approximately 950 passengers in the morning peak 2-hour period (southbound); and 1,000 passengers in the evening peak 2-hour period (northbound) ▪ Baseline is approximately 14 minutes travel time in the morning peak 2-hour period (southbound); and 9 minutes travel time in the evening peak 2-hour period (northbound)	▪ Increase in patronage to approximately 1,000 in the morning peak 2-hour period (southbound); and 1,100 in the evening peak 2-hour period (northbound) ▪ Reduce bus transit times by approximately five minutes in the morning peak 2-hour period (southbound) and by approximately one minute in the evening peak 2-hour period (northbound)
2	Improve Level of Service for non-car modes by 2026. ▪ Baseline Walking is LoS D (Thorndon Quay) ▪ Baseline Cycling is LoS F (Thorndon Quay) Increased cycle volumes on Thorndon Quay. ▪ Baseline is 300-1,600/day	▪ Walking – LoS (C on Hutt Road; C/D on Thorndon Quay (Northbound/Southbound) ▪ Cycling LoS (F/B on Hutt Road; F/C on Thorndon Quay). ▪ Increase cycle volumes on Thorndon Quay by at least 50%
3	Reduce the safety risk along Thorndon Quay and Hutt Road for all road users by 2026. ▪ Baseline for vulnerable users is 2.6 DSI crashes per year ▪ Baseline for all vehicles is 1.5 DSI crashes per year	▪ Reduce vulnerable user DSI crash risk by 20% within ten years using measures aligned with Safe System Principles. ▪ Reduce vehicle DSIs by 10% within ten years using measures aligned with Safe System Principles.

Investment Objective	Objective Description/Measurable Outcome/Baseline	Indicative Targets
4	Amenity index/ Healthy Streets index aligns with Movement Framework criteria for Thorndon Quay by 2026. ▪ Baseline for Thorndon Quay is M3/P1 in the Movement and Place Framework. Increased pedestrian trips/thoughput on Thorndon Quay. ▪ Baseline is 2-3,000 per day	▪ Thorndon Quay to be M3/P2 in the Movement and Place Framework by 2026 ▪ Increase pedestrian trips/throughput on Thorndon Quay by over 20% from baseline.
5	Broadly maintain truck travel times between Jarden Mile and Aotea Quay off ramp by 2026 ▪ Baseline: 7 minutes travel time in the morning peak 2-hour period (southbound); 5 minutes travel time in the evening peak 2-hour period (northbound)	▪ Maintain truck travel times.

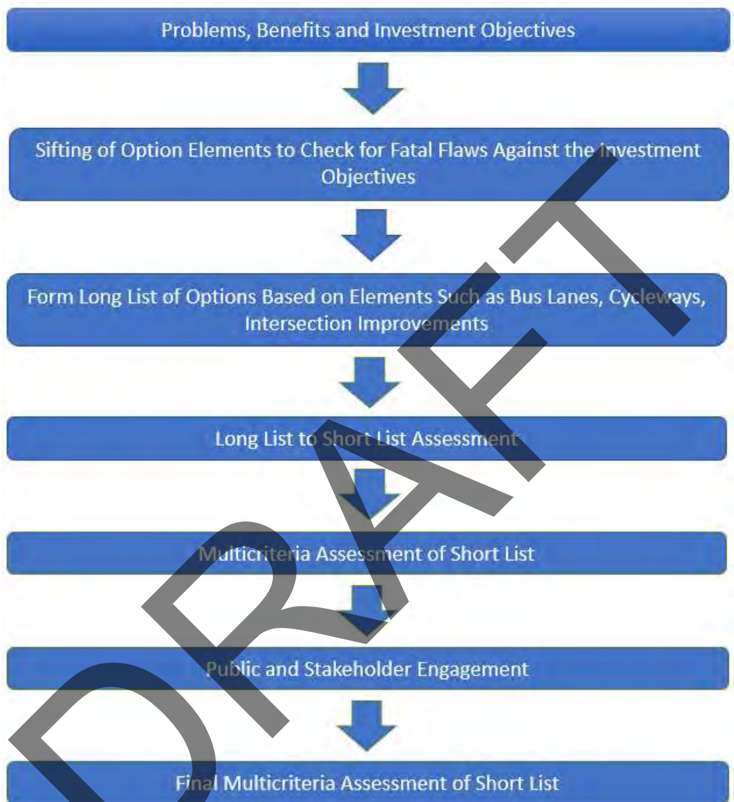
5 Economic Case – Options Development and Assessment

This chapter summarises the process undertaken to identify and refine a preferred option. Further details of the option development process are contained in the Long to Short List Report and the Options and Alternatives Report.

5.1 Option Development Process

Options were developed following the process summarised in Figure 5-1.

Figure 5-1 Option Generation to Short List Process



5.2 Reference Case

A reference (or do minimum) case was defined to provide a base case for all options to be assessed against. This assumed that the following transport projects that are already committed, funded or under construction are implemented by 2036:

- Ngauranga to Petone cycleway: A 4.5km shared path with a 5m wide sealed surface on the seaward side of the Hutt Valley Railway Line
- Transmission Gully: A 27km four-lane motorway which connects with SH1 at the existing Mackays Crossing interchange and merges with the current SH1 at Linden
- Peka Peka to Ōtaki: A bypass of Ōtaki, and the provision of a high standard four-lane expressway.

In June 2021, WCC approved proposals to changes to on-street parking provision on Thorndon Quay from angled to parallel, and they have now been implemented. This proposal addressed several safety concerns for cyclists and other road users but also would reduce parking capacity by approximately 70 spaces. As this proposal was not approved in the initial stages of the SSBC process, these changes were one of the interventions considered.

5.3 Transport Modelling

Demand forecasts and operational assessments have been undertaken for the TQHR project using both the Wellington Transport Strategy Model (WTSM 2013), the Ngauranga to Airport Aimsun Model (N2AM 2016) and a detailed Sidra model developed for this project. Further information is provided in the separate Transport Modelling and Analysis Report (November 2020).

WTSM is a four-stage demand model with the ability to respond to infrastructure or policy scenarios with trip destination and mode choice changes. It has a base year of 2013 and forecast years of 2026, 2036 and 2046. N2AM is a traffic assignment model and covers the Wellington CBD and surrounding suburbs from south of Ngauranga. It has a base year of 2016 and a forecast year of 2026.

Land use changes in line with current development plans for the Greater Wellington region are incorporated in the WTSM and N2AM models.

Sidra intersection models were developed to examine the operation of key intersections on the corridor once a preferred option was identified.

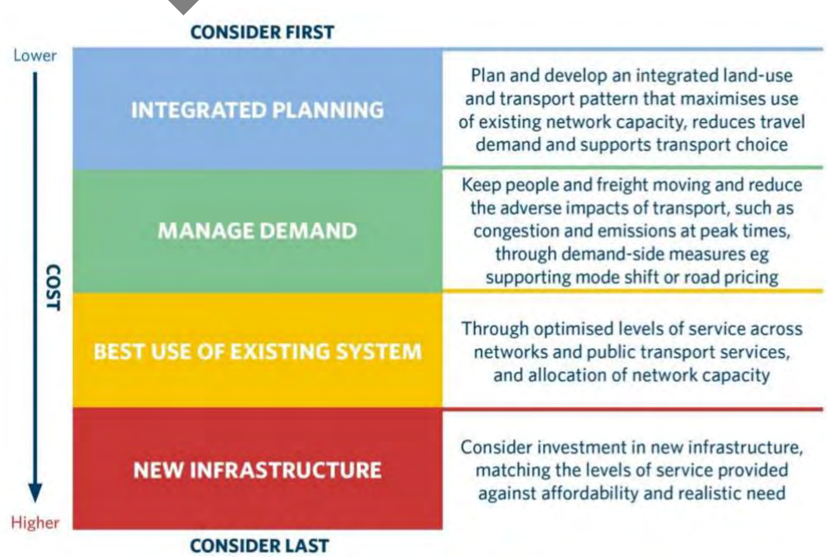
Note that further modelling will be undertaken during detailed design to optimise the design, and better understand the impacts of the preferred option, particularly on cyclists and public transport users.

5.4 Very Long List of Interventions Generation and Sifting

5.4.1 Intervention Hierarchy

Waka Kotahi developed the intervention hierarchy to ensure value for money, and that low-cost investment is considered ahead of more expensive physical infrastructure and technology investment. This is summarised in Figure 5-2 and was used to inform the development of potential treatment options.

Figure 5-2 Intervention Hierarchy



5.4.2 Options Out of Scope

Building from the PBC, several examples of options were identified as being out of scope for the TQHR corridor. This is to avoid introducing previously discounted options or activities being developed and implemented by the Project Partners through other programmes. The out-of-scope activities included:

- Consideration of MRT options
- Integrated ticketing/ off board ticketing
- Public transport fares
- Road/ parking pricing
- Park and Ride facilities
- Re-routing of bus services (including changes to the internal layout/ operation, or relocation, of the existing Lambton Quay Bus Interchange at the southern extent of the corridor)
- Reconfiguring / the optimisation of traffic signals, lane allocation and minor pedestrian and cycle improvements)
- Options which impact on listed current building consents
- Significant local road restrictions.

Travel demand management (TDM) options are also beyond the scope of this SSBC, as a separate business case is being prepared for LGWM to consider the case for region wide interventions.

5.4.3 Initial Very Long List

A large number of interventions were initially identified which sought to address the problem statements defined in the Strategic Case. The generation of interventions was informed by solutions identified in previous studies of the corridor, and the outcome of previous engagement.

The option initially identified were both stand-alone interventions, and interventions which could be combined to form larger packages. These were grouped into those which could be implemented on Hutt Road and those which could be implemented on Thorndon Quay.

The initial interventions were sifted by assessing the level of alignment or 'fit' with the Investment Objectives defined in the Strategic Case to develop a long list of options for evaluation. Sifting was undertaken on a qualitative basis by assessing whether any intervention failed to meet any of the Investment Objectives. If an option was considered to score negative against an Investment Objective, it was considered to be fatally flawed and was not progressed to the long list. However, the option was not considered to be fatally flawed if it was neutral to one or more Investment Objectives.

The sifting of options drew on the collective professional judgements of the business case team's technical specialists and was also informed by discussions held with the TQHR Technical Advisors and within the project team.

5.4.4 Interventions Not Progressed to the Long List

Based on the initial sifting, the following interventions identified for both Thorndon Quay and Hutt Road which were not progressed were as follows:

- Removing existing zebra crossings and replacing with pedestrian crossing refuges – this would have safety disbenefits to pedestrians

- Combined bus and cycle lanes – these were not progressed due to safety concerns of mixing buses with cyclists
- Mid-block vertical displacement – due to the adverse effect it would have on bus ride and passenger comfort.

Interventions for Thorndon Quay were excluded from further consideration:

- Off road cycleway at the rear of Woolstore to Davis Street
  - The proposal would require the use of the rail corridor, which is unlikely to be acceptable to KiwiRail
  - The proposal is also unlikely to be attractive to users from a Crime Prevention through Environmental Design (CPTED) perspective (a cycle facility which achieves the desired LoS for pedestrians and cyclists could not be provided due to the limited space available)
- Signalising the Davis Street intersection – this would have an adverse effect on the reliability of bus services
- Converting the Tinakori Road intersection to a roundabout – due to its adverse effect on the reliability of bus services.

5.5 Long List Options

The interventions identified from the sifting of the very long list of interventions were combined to form a series of corridor treatment options, and a number of node and intersection treatment options. These options were not considered for compatibility with the corridor theme options at this stage of the option development process.

5.5.1 Corridor Treatment Options

The following high-level corridor treatment options on Hutt Road and Thorndon Quay were identified:

- Southbound Special Vehicle Lanes (SVL) / Bus Lanes – a SVL is a traffic lane which can be used only by buses, or buses and trucks, or trucks and high occupancy vehicles (buses and cars with multiple occupancy) on a full or part time basis[12]
- SVLs/ Bus Lanes in both directions
- Bus lane in both directions on Thorndon Quay and southbound SVL on Hutt Road
- Cycle facilities (bi-directional and uni-directional)
- Footpaths and amenities – i.e. improved footpath widths and amenities
- Parking provision – i.e. changes from angled to parallel parking and removal of parking (note that these changes have now been implemented by WCC)
- Property access/ turning facilities – i.e. restrictions on access to adjacent properties (left in/ left out, the provision of alternative access roads, etc.)
- Property acquisition – the property implications of any of the above treatment options on property was also evaluated.

It should be noted that the corridor treatment options identified at this stage of the optioneering process were not mutually compatible with each other. For example, footpaths and amenity improvements can be constrained by cycle facilities, and therefore in some cases it may not be possible to provide additional footpath width in some locations. Similarly, options that involve kerb

[12] Motorcycles were assumed not to be permitted to use the proposed bus lanes/SVLs

realignment or parking space removal will be proposed only where they are as a consequence of other options, as opposed to standalone options. It should be noted that preliminary designs will be tested through developed design phase to reflect the developing LGWM UDF and the more detailed design thinking that will occur in the next phase.

5.5.2 Node and Intersection Treatment Options

The following node and intersection treatment options were identified:

- Intersection treatments:
  - Thorndon Quay/ Mulgrave Street
    - Signalise the bus movement in and out of Thorndon Quay
    - Change the form of intersection to have all traffic from Mulgrave Street use the intersection currently used by buses, thereby resulting in no conflict with Mulgrave Street traffic or bus movements
  - Thorndon Quay/ Moore Street
    - Signalise and provide a "head start" facility to allow buses to proceed ahead of other traffic on Thorndon Quay
  - Thorndon Quay/ Tinakori Street
    - Signalise and include active mode crossings and bus priority
    - Remove the merge from two lanes to one lane between Sar Street and Tinakori Road to facilitate continuous movement (e.g. a morning peak period bus lane)
  - Hutt Road/ Kaiwharawhara Street
    - Convert the slip lane into a normal left turn lane
    - Convert the existing "T" intersection to a "seagull" intersection (i.e. like Onslow Road) and provide new link from end of School Road to Kaiwharawhara Road
    - Restrict right turn access at the intersection and extend School Road across to Kaiwharawhara Road.
- Pedestrian and cycling treatments, including:
  - Providing raised platform zebra crossings on left turn slip lanes at intersections
  - Remove left turn slip lanes and incorporate left turn movements in the main intersection e.g. at the Thorndon Quay/ Mulgrave Street intersection
  - Provide a pedestrian crossing across Moore Street at its intersection with Thorndon Quay to prioritise pedestrians walking along Thorndon Quay
  - Alter the form of pedestrian crossing at the Moore Street/ Thorndon Quay intersection to reduce conflicts between movement along the corridor and movement across Thorndon Quay
  - Alter the form of pedestrian crossing at Thorndon Quay shops to better manage the conflicts between movement along the corridor and movement across Thorndon Quay
  - Provide more pedestrian crossings in the vicinity of Thorndon Quay shops to reduce the "barrier" for crossing the road
  - Provide a pedestrian crossing at the Tinakori Road intersection to facilitate pedestrians walking along Thorndon Quay
  - Provide new crossing(s) at the Tinakori Road intersection to provide access to Tinakori Road (and Sar Street), and provide better access to bus stops and cycle facilities

  - Improve the footpath from Tinakori Road to Thorndon Quay and add cycle wheel ramps beside the stairs
  - Improve crossing facilities or grade separate active modes at the Kaiwharawhara Road intersection (i.e. on the north side of intersection on Hutt Road)
  - Provide a new pedestrian crossing at the Kaiwharawhara Road intersection (i.e. on the south side of intersection on Hutt Road)
  - Extend the cycleway on Hutt Road from Jarden Mile to connect to the proposed Ngā Ūranga ki Pito-One project
  - Improve crossing facilities or grade separate active modes at the Jarden Mile intersection.
- Amenity improvements at the following locations:
  - Mulgrave Street intersection (seating/ landscaping)
  - Seating/ landscaping in the space under pohutukawa trees between the motorway overbridge and Tinakori Road
  - Lighting improvements at the motorway overbridge near Tinakori Road to create a gateway effect
  - Around cultural and heritage places e.g. streams.
- Bus operational treatments:
  - Provide a bus "head start" at the pedestrian crossing at Thorndon Quay
  - Convert kerbside lane or add a bus priority southbound lane at the Kaiwharawhara Road intersection/ convert the kerbside lane or add a lane to provide southbound bus priority
  - Provide a bus queue jump lane (northbound) at the Kaiwharawhara Road intersection
  - Provide a bus lane on southbound approach to the Jarden Mile intersection and on the ramp heading towards State Highway 2 (SH2)
  - Provide a right turn lane or dedicated facility (signal) for buses to turn right to the ramp from the left-hand side after departure from the bus stop located at the intersection of Jarden Mile
  - Revise the bus stop locations at the intersection of Jarden Mile to minimise walking distance to connecting services (e.g. relocating the stop to the north of the intersection on a triangular shaped island)
  - Restrict car parking in the vicinity of the Jarden Mile intersection, to reduce operational impediments for buses.
- Safety improvements
  - Speed limit reductions
  - Raised tables.

5.6 Long List Option Assessment Process

The long list of corridor theme, node and intersection options was scored qualitatively against the evaluation criteria by a range of specialists. This consisted of transport planning, road safety, consenting, civil engineering and landscape architecture specialists.

As the form of node and intersection treatments will be determined by the preferred corridor treatment option, node and intersection treatment options and corridor treatment options were evaluated independently of each another. It was not practical to assess the vast number of combinations of node and intersection treatment options and corridor treatment options.

5.7 Long List Assessment Results

The results of the evaluation of the long list options are summarised in Appendix E (whole of corridor treatments) and Appendix F (node and intersection treatments), including the main reasons for recommending progressing or rejecting the options. The options coloured in 'green' are those recommended to be carried forward to the shortlist, and those not recommended to be progressed to the short list are highlighted 'red'.

5.8 Options Short Listed

Based on the outcome of the long list evaluation, it was concluded that all the short-listed options should include the following key elements:

- Peak period bus priority lanes on Thorndon Quay (southbound only, or in both directions). This will maximise people throughput along the corridor, improve the level of service for bus users and allow parking to take place in off-peak periods
- Peak period SVLs on Hutt Road (southbound only, or in both directions). This will improve people throughput and the level of service for bus users, to maintain the level of service for port related freight traffic and to allow parking to take place in off-peak periods (it should be noted that the initial analysis indicated the SVLs should be available for buses and trucks only)
- Improved separated cycle facilities on Thorndon Quay (either uni-directional or bi-directional cycle lanes) to improve safety for cyclists and complement the existing bi-directional cycleway on Hutt Road
- Intersection upgrades which are consistent with the corridor treatments:
  - Hutt Road/ Jarden Mile
    - Designated pedestrian and cyclist crossing provision and increased size of islands
    - Reassignment of lanes for the northbound approaches
    - Relocation of bus stops
    - SVLs on the northbound approach to the intersection
  - Hutt Road/ Onslow Road
    - The current Seagull configuration is proposed to be fully signalised to provide a secure crossing for cyclists who are not currently catered for (this will require combining the southbound through and right movements into one lane and 'split' phasing the intersection to restrict right turn filter movements)
  - Hutt Road/ Tinakori Street
    - Raised crossings to provide a safer crossing environment for pedestrians and cyclists
  - Thorndon Quay/ Mulgrave Street
    - Full signalisation to assist bus movements in and out of the existing Lambton Quay Bus Interchange
- Amenity improvements on Thorndon Quay, notably:
  - Tree planning
  - Shade
  - Seating

    - Shelter
    - Gardens
    - Interpretation/wayfinding.
- Existing pedestrian facilities along and across the corridor to be maintained, with traffic signal control introduced at the existing crossing on Hutt Road near Rangiora Avenue (see Figure 5-3 and 5-4).
- New or relocated/revised pedestrian crossings (whether there are to be signalised or unsignalised options was considered later in the design process) at the following locations (see Figure 5-3 and 5-4):
    - Thorndon Quay – between Davis Street and Moore Street (existing zebra crossing relocated)
    - Thorndon Quay – between Davis Street and Tinakori Street (existing zebra crossing to be relocated)
    - Hutt Road at Aotea Quay ramps (new crossing facility)
- The pedestrian crossing on Hutt Road near Rangiora Avenue will be signalised.
- All angled car parking space on Thorndon Quay is to be removed and replaced with parallel car park spaces to improve safety (since completed by WCC in September 2021)
- Remove closely spaced bus stops or relocate/redesign bus stops (as outlined in Appendix G)
- Lower speed limits.

Figure 5-3 Proposed Changes to Intersections and Crossings on Thorndon Quay

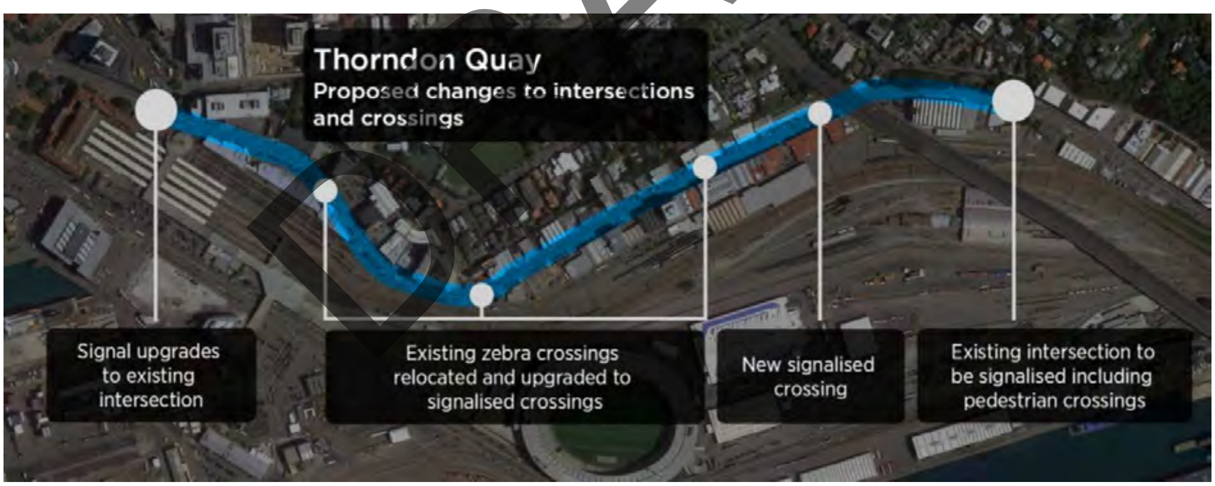


Figure 5-4 Proposed Changes to Intersections and Crossings on Hutt Road

5.8.1 Core Options

The key decisions which need to be addressed in the short list evaluation are around:

- Whether the bus lane on Thorndon Quay and the SVL on Hutt Road should be provided in a southbound direction only or in both directions
- Whether the cycleway on Thorndon Quay should be uni-directional (i.e. one direction of travel each side) or provide a bi-directional cycleway (i.e. on the eastern (seaward) side).

Four core options were therefore defined as follows:

- Option 1 – Southbound bus lane on Thorndon Quay/ SVL on Hutt Road, with a bi-directional cycleway on Thorndon Quay
- Option 2 – Bus lanes on Thorndon Quay/ SVLs on Hutt Road in both directions, with a uni-directional cycleway on Thorndon Quay
- Option 3 – Southbound bus lane on Thorndon Quay/ SVL on Hutt Road, with a uni-directional cycleway on Thorndon Quay
- Option 4 – Bus lanes on Thorndon Quay/ SVLs on Hutt Road in both directions, with a bi-directional cycleway on Thorndon Quay.

5.8.2 Sub Options

The assessment also identified that the provision of a bus or SVL on Hutt Road added additional risks. These include:

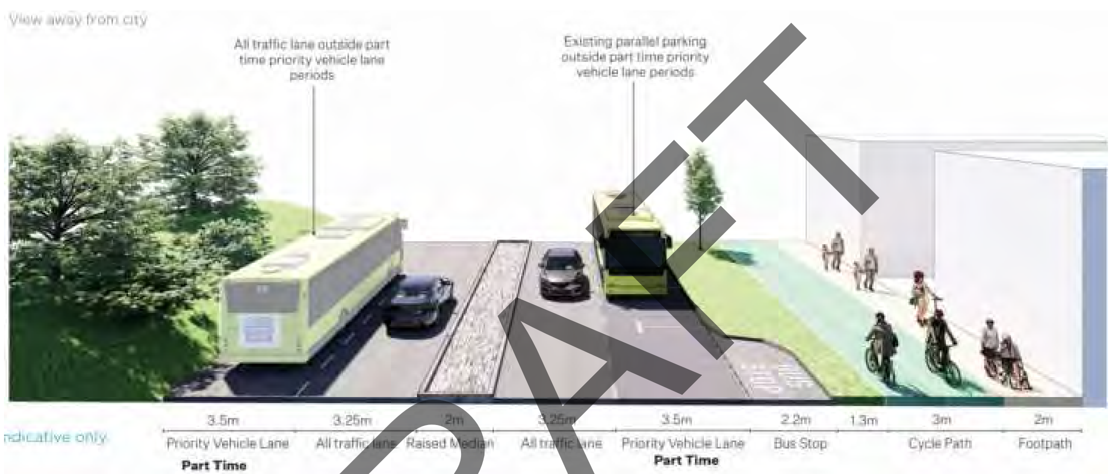
- An increased risk of side impact crashes - drivers will be required to cross two opposing lanes of traffic which will likely have different speeds at peak times due to the freely flowing SVL lane, thereby making it more difficult to judge safe gaps in traffic when turning
- An increased risk to motorcyclists and cyclists from turning traffic - the addition of the SVL had the potential to mask motorcyclists which may be filtering between the two traffic lanes to pass slower moving vehicles in the general traffic lane, and also cyclists riding on the shared path. Furthermore, due to congestion and the completion of the other shared path projects in the city, these users are likely to increase in number in the future, increasing the likelihood of a crash.

To mitigate this risk, options that included a central median and a service lane sub-option were developed:

- Sub-Option A – left-in left-out access only on Hutt Road, with some gaps in the median and at intersections for small vehicles to turn at, but requiring a new turnaround facility to be provided at Aotea Quay for longer vehicles to turn at
- Sub-Option B – a new service lane on the east side of Hutt Road (between Onslow Road and Kaiwharawhara Road) and requiring modifications to the existing Onslow Road and Kaiwharawhara Road signalised intersections.

Figure 5-5 shows an example of how a raised median can be incorporated in the design of Option 4. A raised median can be incorporated in Options 1-3 in a similar way.

Figure 5-5 Raised Median on Hutt Road

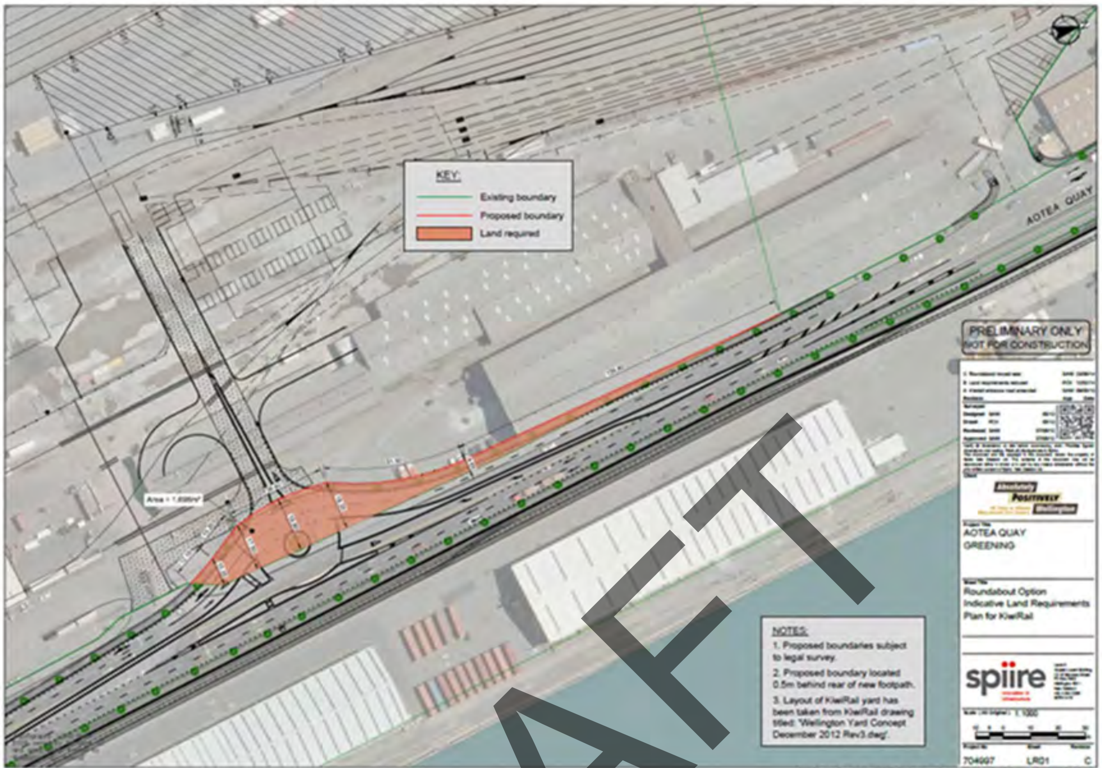


5.8.2.1 Aotea Quay Turnaround facility (Sub Option A)

A proposed new turnaround facility on Aotea Quay, at the KiwiRail container terminal entrance, would provide a safe place to turn for drivers of large vehicles intending to travel north from a business on Hutt Road. It would also reduce the amount of traffic on Hutt Road by providing alternative access to the Kaiwharawhara ferry terminal from State Highway 1.

A design for a roundabout on Aotea Quay was developed for WCC in 2014. This is shown in Figure 5-6.

Figure 5-6 Proposed Roundabout at Aotea Quay



5.8.2.2 Service Lane on Hutt Road (Sub Option B)

An indicative cross section for a service lane on Hutt Road is shown in Figure 5-7. This is shown to be incorporated in Option 1 but could also additionally be incorporated into all four options.

Figure 5-7 Service Lane on Hutt Road

5.8.3 Summary of Options and Sub Options Short Listed

The full list of options and sub-options short-listed are summarised in Table 5-1.

Table 5-1 Short Listed Options

<table>
<tr><th rowspan="2">Option</th><th colspan="3">Elements</th><th rowspan="2">Common Elements</th></tr>
<tr><th>Thorndon Quay Bus Lanes</th><th>Thorndon Quay Cycle Lanes</th><th>Hutt Road SVL(s)</th></tr>
<tr><td>Option 1: Southbound bus/SVL lanes with Thorndon Quay bi-directional cycleway</td><td>Southbound</td><td>Bi-directional</td><td>Southbound</td><td rowspan="13">▪ Removal of angle parking on Thorndon Quay to improve safety[13]
▪ Lower speed limits
▪ Intersection upgrades
▪ Pedestrian crossing improvements
▪ Bus stop rebalancing and layout improvements
▪ Thorndon Quay amenity improvements</td></tr>
<tr><td>Option 1A: Southbound bus/SVL lanes with Thorndon Quay bi-directional cycleway</td><td colspan="3">Option 1 plus:
• Left-in / Left-out on Hutt Road (central median)
• Turnaround facility on Aotea Quay</td></tr>
<tr><td>Option 1B: Southbound bus/SVL lanes with Thorndon Quay bi-directional cycleway</td><td colspan="3">Option 1 plus:
• Service lane on east side of Hutt Road (between Onslow Road and Kaiwharawhara Road)
• Modifications to the existing Kaiwharawhara Road and Onslow Road signal-controlled intersections</td></tr>
<tr><td>Option 2: Southbound and Northbound bus/SVL lanes with Thorndon Quay uni-directional cycleway</td><td>Both directions</td><td>Uni-directional</td><td>Both directions</td></tr>
<tr><td>Option 2A: Southbound and Northbound bus/SVL lanes with Thorndon Quay uni-directional cycleway</td><td colspan="3">Option 2 plus the same variants as for Option 1A</td></tr>
<tr><td>Option 2B: Southbound and Northbound bus/SVL lanes with Thorndon Quay uni-directional cycleway</td><td colspan="3">Option 2 plus the same variants as for Option 1B</td></tr>
<tr><td>Option 3: Southbound bus/SVL lanes with Thorndon Quay uni-directional cycleway</td><td>Southbound</td><td>Uni-directional</td><td>Southbound</td></tr>
<tr><td>Option 3A: Southbound bus/SVL lanes with Thorndon Quay uni-directional cycleway</td><td colspan="3">Option 3 plus the same variants as for Option 1A</td></tr>
<tr><td>Option 3B: Southbound bus/SVL lanes with Thorndon Quay uni-directional cycleway</td><td colspan="3">Option 3 plus the same variants as for Option 1B</td></tr>
<tr><td>Option 4: Southbound and Northbound bus/SVL lanes with Thorndon Quay bi-directional cycleway</td><td>Both directions</td><td>Bi-directional</td><td>Both directions</td></tr>
<tr><td>Option 4A: Southbound and Northbound bus/SVL lanes with Thorndon Quay bi-directional cycleway</td><td colspan="3">Option 4 plus the same variants as for Option 1A</td></tr>
<tr><td>Option 4B: Southbound and Northbound bus/SVL lanes with Thorndon Quay bi-directional cycleway</td><td colspan="3">Option 4 plus the same variants as for Option 1B</td></tr>
</table>

13 Since completed by WCC in September 2021

Figure 5-8 is a schematic diagram of the four core options. Indicative cross sections for the options are shown in Figure 5-9 to 5-16. It should be noted that the dimensions on the cross sections are indicative only and are not necessarily consistent between different options.

Figure 5-8: Indicative Plans Option 1 to 4

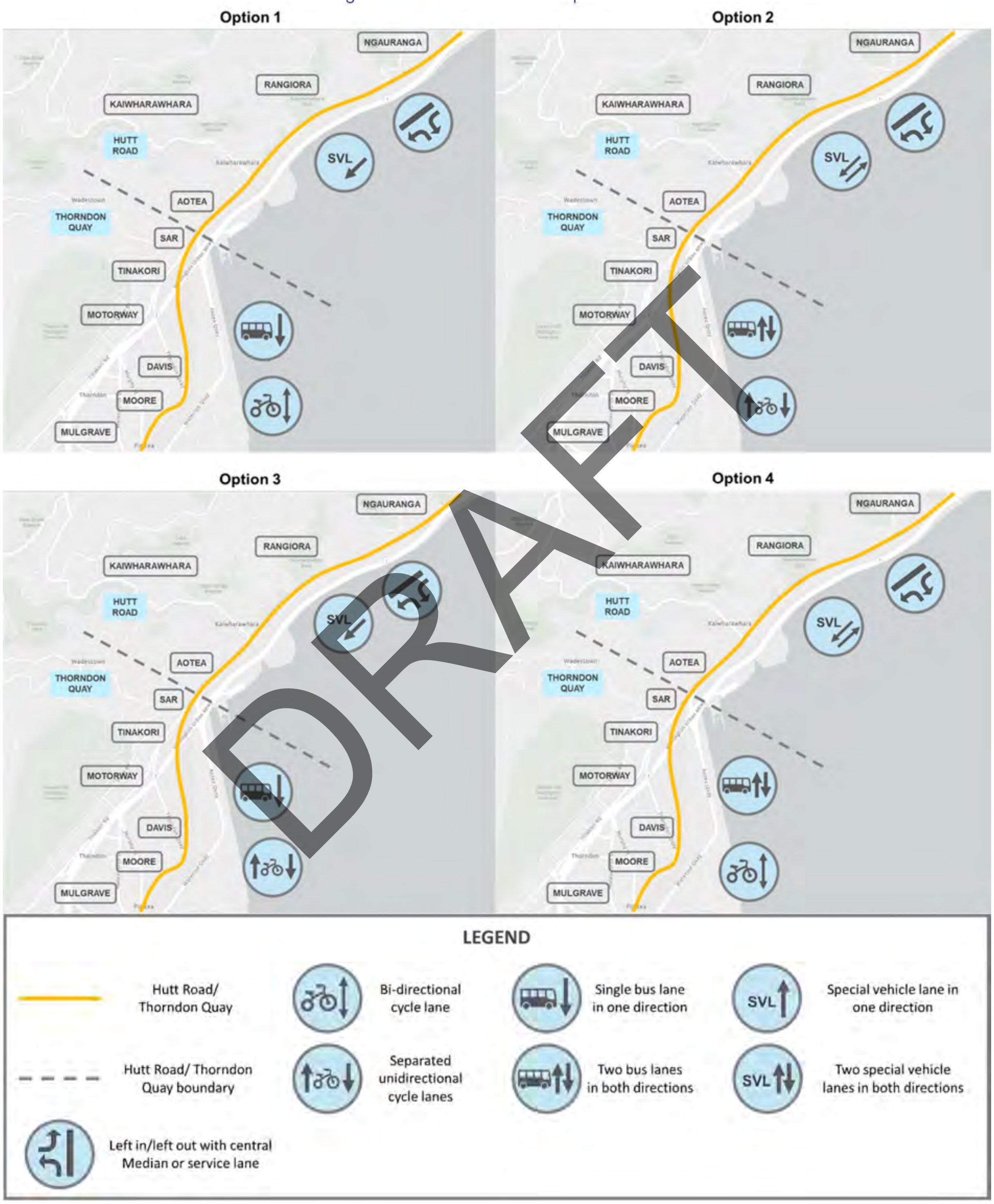


Figure 5-9 Option 1 – Thorndon Quay Indicative Plan and Cross Section

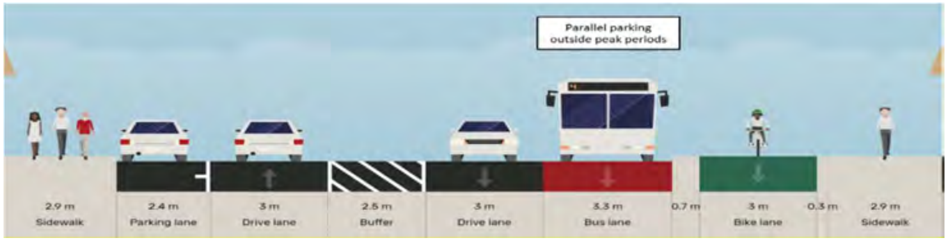


Figure 5-10 Option 1 – Hutt Road Indicative Plan and Cross Section

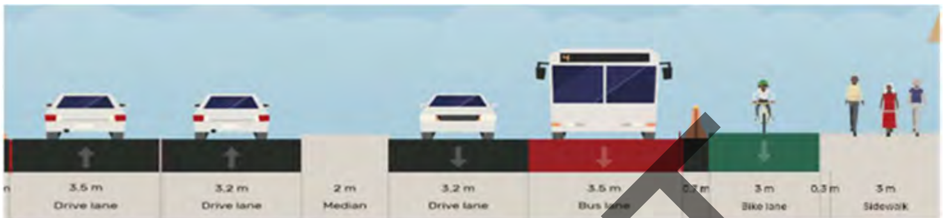


Figure 5-11 Option 2 – Thorndon Quay Indicative Plan and Cross Section

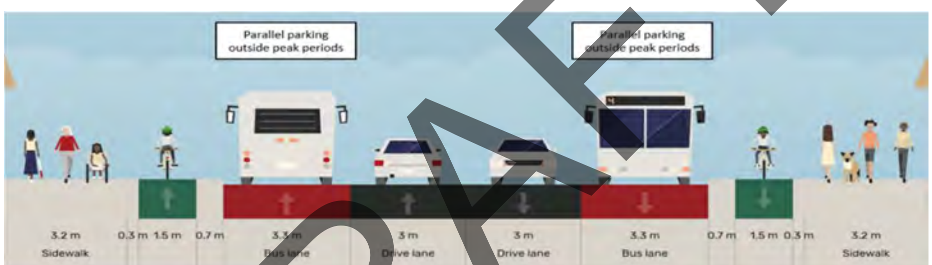


Figure 5-12 Option 2 – Hutt Road Indicative Plan and Cross Section

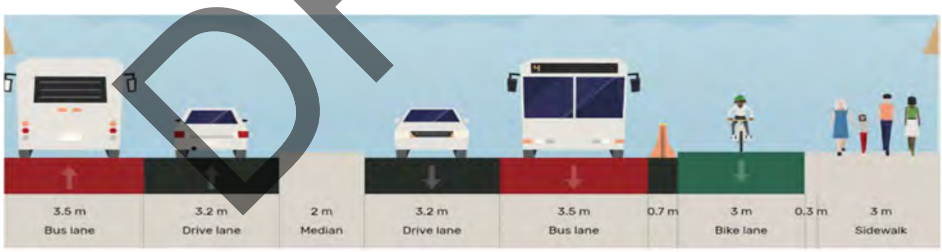


Figure 5-13 Option 3 – Thorndon Quay Indicative Plan and Cross Section

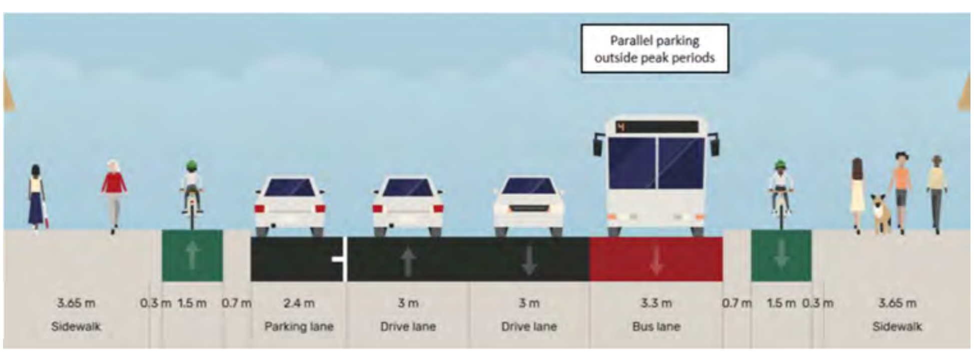


Figure 5-14 Option 3 – Hutt Road Indicative Plan and Cross Section

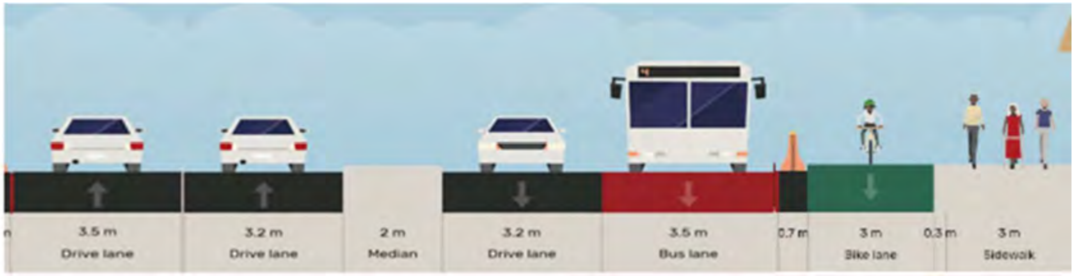
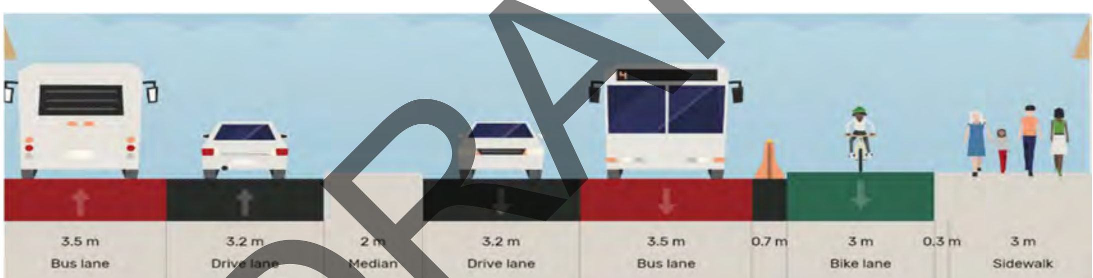


Figure 5-15 Option 4 – Thorndon Quay Indicative Plan and Cross Section

Figure 5-16 Option 4 – Hutt Road Indicative Plan and Cross Section



5.9 Long to Short List Assessment Process

In order to determine a preferred option, the short-listed options and sub options were subjected to a multi criteria assessment (MCA) process. The assessment process aims to highlight the differences between the options, the similarities and the trade-offs of choosing one option over another. A number of other technical tasks including transport demand/ operational modelling and cost estimation were adopted to determine the preferred option.

An assessment framework was developed based on an MCA framework developed by LGWM, however, was additionally adapted to the needs of the TQHR project.

5.9.1 Safe System Assessment

A Safe System Assessment was undertaken for the purposes of understanding the risk elements in infrastructure that are known to be a major contributor to deaths and serious injuries (DSI) on our roads. This approach uses the safe system principles and thinking which underpin the Government's Road to Zero Strategy.

The SSAF is used to understand the underlying high-risk infrastructure elements, inform safer design options and demonstrate the risk reduction achieved. It can also be used to highlight areas where there is less Safe System alignment requiring further consideration and mitigation. The SSFA is based on the guidance contained with Austroads Research Report AP-R609-16 Safe System Assessment Framework.

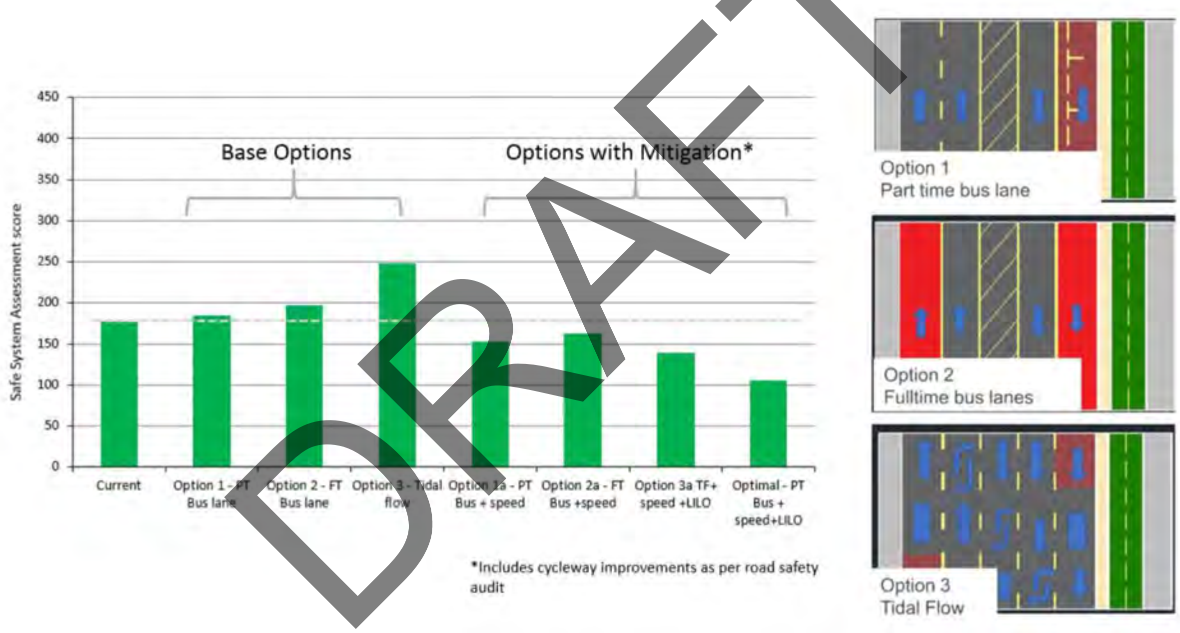
Alongside the current situation early options were assessed including:

- Four lanes (i.e. two in each direction) including one southbound part-time morning peak period bus lane
- Four lanes (two each direction) including a full-time bus lane in each direction
- Five lanes with tidal flow arrangement with three lanes provided in the morning and evening peak period respectively (including a part-time bus lane in each direction).

Further options were also assessed which included potential mitigation measures for further exploration by the project team.

It can be seen in Figure 5-17 that the Safe System Assessment score overall was higher than the current situation for all the base options and a tidal flow option in its base form being the least safe. Noting a higher score indicates less alignment with the safe system approach and hence, would be expected to be less safe.

Figure 5-17 Overall Safe System Scores



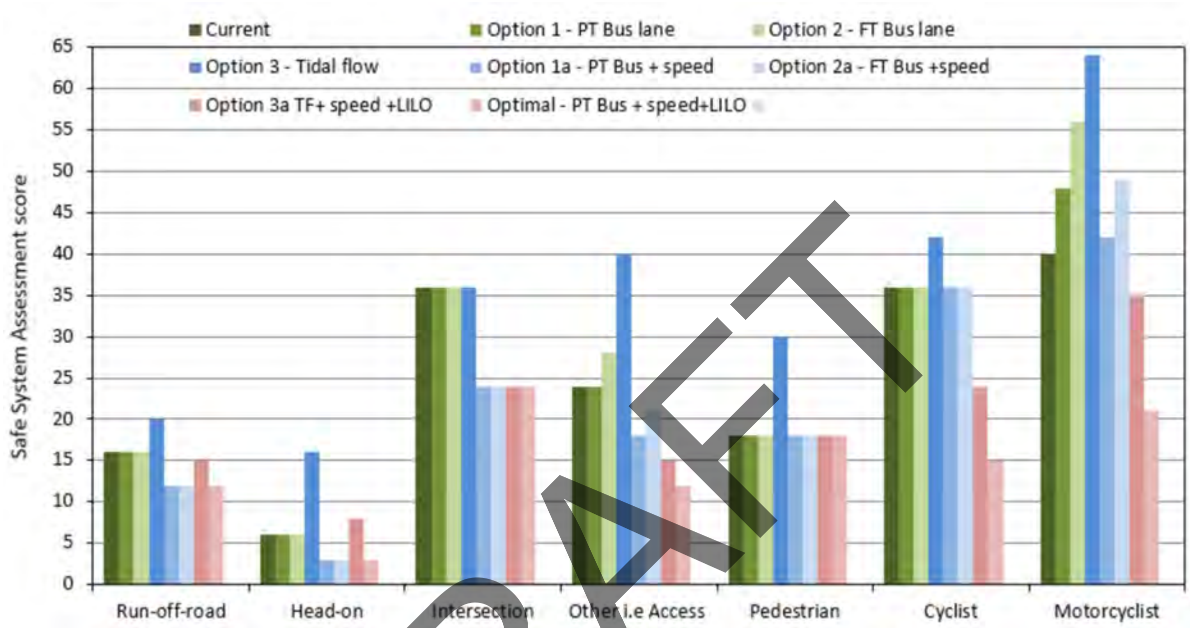
The key underlying issues noted in the assessment giving rise to higher risk were:

- Difficulty obtaining a suitable gap in traffic across multiple lanes to turn right (in or out) of accesses)
- Differential traffic speeds across the lanes making it difficult to judge a safe gap to turn (in or out) of accesses
- Masking of motorcyclists in bus lanes/ filtering lanes by other traffic presenting issues with right turning traffic
- Masking of cyclists using the shared path by multiple lanes of traffic for right turning traffic
- Less awareness of cyclists due to drivers focusing on attaining a gap in traffic.

It is noted that the current situation also exhibits issues with turning traffic conflicting with cyclists using the shared path.

It can be seen in the overall assessment (Figure 5-17) that with the addition of speed reduction (reducing potential impacts closer to safe system speeds) and/ or a left in/ left out arrangement it is possible to reduce the overall safe system score to below what is seen currently. However, when reviewing the detailed risk scores by each key user/ crash type (Figure 5-18) it is noted that the risk is not significantly different to affect the score for cyclists and does not significantly improve the risk score for motorcyclists through the addition of speed reduction alone.

Figure 5-18 Detailed Scores by User/ Crash Type



Overall, there is an increasing trend in crashes and a high proportion of cyclist and motorcyclist crashes which also make up the majority of serious crashes along this section of the corridor. While there have been ongoing cycling improvements, the increase in cyclist numbers expected will likely increase future crash occurrence. In the case of motorcyclists, increasing congestion on the route and the wider Wellington region is likely to result in an increased uptake which may in turn increase the number of crashes involving these users. Due to their vulnerability, cyclists and motorcyclists are at an elevated risk of increased serious injuries in the event of a crash which is evidenced in the crash history. The installation of further lanes without mitigation was concluded to likely exacerbate the existing crash risks.

The SSFA also highlights this as a key risk alongside that of motorcyclists. It also highlights intersection and access risk as being elevated, being the primary common factor in these risks are those associated with turning traffic. Only the options which include restrictions to access through the removal/ rationalisation of right turn movements by vehicles, reduce the safety risk significantly.

In addition to these issues, further mitigations not explicitly considered at this stage, were explored for the design of the preferred option, such as improvements to pedestrian crossing facilities or intersection refinements.

5.9.2 LGWM Multi Criteria Assessment Framework

A multi criteria assessment (MCA) framework[14] was produced by LGWM in 2020 to provide direction and promote consistency in the assessment of other projects being considered in the LGWM programme. The framework sets out the recommended process to be followed in the assessment of options, including the criteria to be assessed and the scoring scales to be used.

The framework gives flexibility in the assessment approach by recognising that each project may apply effects or design and delivery criteria specific for the corridor/ issues being investigated. The framework can also help differentiate between options.

An eleven-point scoring scale was used, as recommended in the LGWM MCA process, and is summarised in Figure 5-19.

Figure 5-19 Long to Short List MCA Scoring Scale

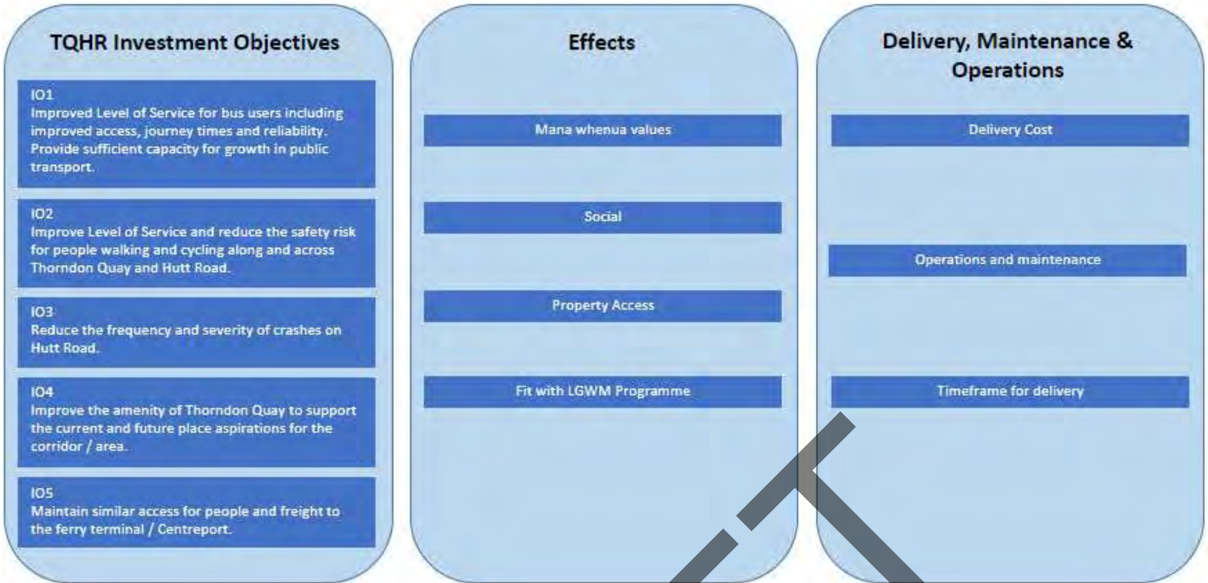
Score	Scoring Description
5	Substantial benefits and a high degree of confidence of benefits being realised and/or long term / permanent benefits
4	High extent of benefits and confidence of benefit being realised and/or medium - long term benefits
3	Good benefits and/or medium term
2	Low or localised 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

5.9.3 MCA Criteria

The LGWM MCA framework was tailored to be used for the assessment of the short-listed options identified for the TQHR corridor. The key criteria adopted for the short list assessment was the contribution of the options to the investment objectives, the effects and to delivery, maintenance and operations, as shown in Figure 5-20. The interpretation of each criterion has been tailored so that the evaluation will highlight the differences between the options.

[14] Let's Get Wellington Moving - Proposed Multi Criteria Analysis Framework , May 2020

Figure 5-20 MCA Criteria



5.9.3.1 Effects Criteria

The main effects considered were:

- Tangata Whenua values
- Social: Effects on social and economic opportunities along and adjacent to the corridor
- Property Access: Effect of access for all modes on and to properties along the corridor
- Fit with LGWM Programme: Alignment with other committed projects, such as the Golden Mile project.

5.9.3.2 Delivery, Maintenance and Operations Criteria

The main delivery, maintenance and operations criteria considered were:

- Delivery Cost: considering the expected duration of construction of the project, and any impacts on businesses and the community during construction phase.
- Operation and Maintenance Costs: including the effect of the project on the operation of emergency services
- Timeframe for construction (delivery).

5.9.4 MCA Scoring

Each evaluation criteria were ‘owned’ and scored by a number specialists. They used various input information, including site assessments, information provided by stakeholders, calculations and data. The main information used is summarised in Table 5-2.

Wherever possible, assessments were based on available information and work already completed. A “rules based” assessment was incorporated within the methodology where possible.

Specialists collaborated and shared information with partner organisations and between one another for consistency. Individual meetings with the equivalent members of the partner organisations were held to promote this dialogue and to feed back into a series of MCA workshops. The workshop enabled challenge and questioning of each specialist. The specialist was given the opportunity to reconsider their score if new information became available at the workshop. The workshop enabled team members and LGWM officers to develop a deeper understanding of the key factors that differentiate the options and the conclusions resulting from the evaluation findings.

As part of option development and refinement, alternatives for avoiding significant adverse effects were considered and additional mitigation that may be required were identified. These additional mitigations were discussed in a workshop setting with all specialists being given the opportunity to determine whether the inclusion of the proposed mitigation could change their score and whether it should be considered further. If an alternative or option had any negative effects on vulnerable social groups (elderly, low income, disabled etc), the project team considered whether additional measures were needed to avoid, remedy or mitigate this.

Consideration was also given to the success factors when scoring the options against the criteria. It was important to understand how short-listed options perform against the success factors, and ensure this is reflected in the MCA scores, even if the option was unable to achieve them.

Table 5-2 MCA Considerations and Inputs

Criteria	Assessment Considerations	Inputs
Investment Objectives		
Investment Objective One: ▪ Improve level of service for bus users including improved access, journey times and reliability ▪ Provide sufficient capacity for growth in public transport	▪ Reduction in bus travel times (peak periods) ▪ Reduction in bus travel time variability (peak periods) ▪ Increased people carrying capacity of the corridor ▪ Reduction in distance to a bus stop ▪ Reduction in footway crowding at bus stops ▪ Legibility of bus stop locations and spacing	▪ Bus Spreadsheet Modelling outputs ▪ Aimsun modelling outputs ▪ Bus stop catchment modelling ▪ Site visit to identify effective width, pinch points etc, space at bus stops
Investment Objective Two: ▪ Improve level of service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road	▪ Danish LOS measure ▪ Increase pedestrian level of service – crossing delays (signal controlled and uncontrolled) ▪ Wider footpaths ▪ Capacity for cycling growth ▪ Reduction in the likelihood of pedestrian and cyclist crashes (change in level of conflict) ▪ Reduction in the expected severity of pedestrian and cyclist crashes	▪ Healthy Streets Index ▪ Austroads Part 6 ▪ SSAF ▪ Analysis of CAS data ▪ Safe and Appropriate Speed (SAAS) assessment ▪ High level safety review of options ▪ Waka Kotahi Ngauranga to Petone cycleway demand forecasts ▪ Traffic flow data ▪ Traffic speed data ▪ Aimsun modelling outputs
Investment Objective Three: ▪ Reduce the frequency and severity of crashes on Hutt Road	▪ Reduction in the expected frequency and severity of crashes	▪ SSAF ▪ Analysis of CAS data ▪ SAAS assessment of short-listed options ▪ High level safety review of options ▪ Bespoke / targeted crash history analysis Various data ▪ Traffic flow data ▪ Traffic speed data ▪ Aimsun modelling outputs
Investment Objective Four; ▪ Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area	▪ Effect on character and place value ▪ Amenity ▪ Increased opportunity to enhance character and place value ▪ Increased opportunity to create vibrancy and human level street activity[15]	▪ Surveys to identify location / amount of street furniture, planting, street art ▪ Traffic flow data

15 feels safe, relaxed, provides for dwelling, seating, events, identity contributors (like art works or celebrating heritage places), space for hospitality)

Criteria	Assessment Considerations	Inputs
	▪ Improved environmental comfort (i.e. noise, air quality, adjacent motor vehicle volume, amount of vegetation) ▪ Changes in the likelihood of or consequences of crime	
Investment Objective Five: ▪ Maintain similar access for people and freight to the ferry terminal	▪ Effect of options on freight movements versus existing situation ▪ Consider future effects of options plus Single User Ferry Terminal ▪ Consider people movement to the ferry terminal	▪ Forecast freight data ▪ Single User Ferry Terminal PBC ▪ WAU strategic transport model outputs ▪ Business surveys
Effects		
Social	▪ Effect on equitable[16] access[17] to social and economic opportunities such as employment, retail, health and cultural opportunities ▪ Effect on social connectedness	▪ Stakeholder inputs
Property access	▪ Effect on access to and servicing of private building (i.e. deliveries, removals, building maintenance) – long term	▪ Discussions with building owners ▪ Stakeholder feedback ▪ Loading bay / service requirements surveys
Fit with LGWM Programme	▪ Alignment with linked projects such as Golden Mile and City Streets ▪ Flexibility to integrate with linked projects ▪ Ability to deliver the option incrementally ▪ Ability to scale the level of intervention	▪ LGWM Project Lead inputs
Mana Whenua Values	▪ Seven values	
Delivery, Maintenance and Operations		
Delivery	▪ Duration of delivery ▪ Effect on pedestrians	Emerging preliminary design

[16] Considered different sectors of society, including mobility impaired, income groups, age groups etc.

[17] Considered the likely changes in the number and location of mobility parks, bicycle parks, motorcycle parks, public on-street car parks, public off-street car parks, bus stop locations

Criteria	Assessment Considerations	Inputs
	▪ Effect on cyclists ▪ Effect on bus operations ▪ Effect on retail ▪ Effect on parking ▪ Effect on access to and servicing[18] of private building (i.e. deliveries, removals, building maintenance)	
Operations and maintenance	▪ Effect on public operational costs (maintenance, refuse collection, street cleansing, landscape maintenance) ▪ Effect on ability to accommodate utilities and services repairs and renewals ▪ Effect on ability to re-route bus services due to major planned and unplanned events ▪ Effect on the flexibility of future corridor use (movement and place) ▪ Effect on emergency services response times / effectiveness ▪ Qualitative assessment of effect on operational cost	▪ Discussions with WCC, service providers, utility providers and others
Timeframe for delivery	▪ Ability to demonstrate tangible improvements (outputs) within the 2018-21 / 2021-24 period ▪ Ability to demonstrate tangible improvements (benefits) within the 2018-21 / 2021-24 period	Emerging preliminary design

[18] Considered the number and location of loading bays

5.9.5 High Level Cost Estimates

In order to inform the selection of the preferred option, high level (Indicative Business Case Estimates) (IBEs) were prepared for the four core options in November 2020. An estimate was also prepared for a variant of Option 4 (Option 4A), which include a left-in/ left-out access arrangement and some gaps in the median for cars to turn on Hutt Road, as well as alterations to the existing Aotea Quay to allow trucks to turn round. The cost estimates (IBEs) were prepared in accordance with the Waka Kotahi Cost Estimation Manual and are summarised in Table 5-3.

Table 5-3 Indicative Business Case Estimates of the Shortlisted Options (2020)

Option	Expected IBE Cost ($000s)
1	$25,400
2	$27,700
3	$23,800
4	$28,100
4A (i.e. Option 4 with left-in / left-out access on Hutt Road and Aotea Quay Roundabout)	$33,100

The estimates indicate that cost is not significantly different between options and is therefore not a major factor in the option selection process.

5.9.6 High Level Economic Analysis

This preliminary economic analysis was undertaken to provide an indicative understanding of the economic efficiency outcomes for the options assessed. This was undertaken simply to provide a high-level understanding of the economic efficiency outcomes for the options and help establish that the overall benefits of the TQHR project could exceed the costs. The analysis was based on a corridor model that was developed to provide an indication of changes in vehicle speeds based on the level of congestion (using volume/capacity speed flow curves) and intersection delays.

The economic analysis was undertaken in accordance with Waka Kotahi Economic Evaluation Manual (EEM)[19], using a 40-year evaluation period and a 4% discount rate. This was the recommended approach at the time this analysis was undertaken. As the vehicle volumes differ slightly between options for similar sections, a variable trip evaluation method was applied to account for the change in road user surplus and resource cost correction.

From the corridor modelling outputs, the following primary transport impacts were assessed:

- Travel time and congestion costs and benefits
- Vehicle operating costs and benefits
- Active mode/ health costs and benefits
- Emission costs and benefits.

[19] EEM was used as the SSBC process commenced prior to it being replaced by the Monetarised and Non-monetarised Benefits Manual

Further modelling will be done during subsequent phases of the project to inform the detailed design process.

5.9.6.1 Travel Time and Congestion Costs and Benefits

The travel time and congestion costs were assessed for each of the sub-sections of the corridor for the morning and evening peak periods. These were individually assessed for each user group (i.e. bus passengers, trucks, single occupant, two occupant and three occupant vehicles).

5.9.6.2 Vehicle Operating Costs and Benefits

Base vehicle operating costs were assessed based on the average speeds estimated for each sub-section and by vehicle type.

5.9.6.3 Active Mode Benefits

The active mode benefits have been estimated based on bus passengers walking and assumed an average length of 280m.

Cycle mode share was assumed to increase by 2%, based on the forecast increase in cycle mode share from northern suburbs to central area prepared by WCC. A conservative 30% of the health benefits was assumed from the estimated demand.

5.9.6.4 Emission Costs

Emission costs were estimated based on the vehicle type emission tonnage predicted from the base vehicle operating costs applied with the costs of CO_2 emissions.

5.9.6.5 Safety Benefits

A high-level safety benefits assessment was undertaken. This was based on baselining the safety impacts that are common across all the short-listed options (e.g. speed reduction), then accounting for differences between the options.

For this preliminary assessment, the total social crash costs were estimated to be around $2.98 million per annum, or approximately $80 million over a 40-year period. The short-listed options were estimated to reduce crashes by approximately 20% to 30%.

5.9.6.6 Summary of Economic Analysis

The results of the preliminary economic analysis for the four core options and Options 4A are summarised in Tables 5-4 and 5-5.

Table 5-4 Preliminary Economic Benefits for the Shortlisted Options (2020)

Option	Travel Time and Congestion Costs/Benefits ($m)		Safety Benefits ($m)	Active Mode Benefitss ($m)	Other (VOC, CO2 etc) Benefits ($m)	TOTAL DISCOUNTED BENEFITS ($m)
	Public Transport	Other Vehicles				
1	$25.4	$0.4	$18.2	$23.6	$4.5	$72.1
2	$42.1	-$25.4	$20.2	$23.6	$3.9	$64.5
3	$25.4	$0.4	$23.4	$23.6	$4.5	$77.3
4	$42.1	-$25.4	$13.0	$23.6	$3.9	$57.2
4A	$42.1	-$61.8	$20.2	$23.6	$8.5	$32.6

Table 5-5 Discounted Costs and Economic Benefits, and Overall Benefit to Cost Ratio for the Core Options

Option	Discounted Costs ($m)	Discounted Benefits ($m)	Benefit to Cost Ratio (BCR)
1	$27.8	$72.1	2.6
2	$23.5	$64.5	2.7
3	$22.6	$77.3	3.4
4	$23.9	$57.2	2.4
4A	$27.9	$32.6	1.2

In summary, the results of the preliminary economic analysis were found to be:

- The BCRs for the short-listed options ranges between 1.2 and 3.4
- Travel time savings for public transport users outweighs the disbenefits for other vehicle users.

It should be noted that this analysis was refined for the preferred option, as is explained later in this chapter of the SSBC.

5.10 Short List Assessment Conclusions (Prior to Stakeholder and Public Engagement)

Prior to receiving feedback from stakeholder and public engagement, and scores on the effects on mana whenua values, the highest scoring options from the MCA were Options 4A and 4B (see Alternative and Options Report in Appendix H for further details).

The MCA considered, amongst other things, the economic benefits generated from each option but only considered these at a high level (using coarse cost estimates). However, the economic performance of options did not determine the selection of the preferred option alone.

While Options 4A and 4B scored similarly overall, the provision of a service road (suboption B) was discounted as being more disruptive, fit less with other regional projects and carried larger implementation risk.

The provision of bidirectional or unidirectional cycling facilities was also discussed. It was noted that the provision of a bidirectional cycleway (i.e. Options 1 or 4) should be aligned with the wider LGWM programme as there are bidirectional facilities planned to the north and south of the TQHR corridor. This would provide a consistent cycle path and ease of connection.

It was also noted that while both unidirectional and bidirectional cycle facilities would improve safety and level of service, unidirectional cycleways (Options 2 or 3) scored better for safety, due to less risk with cyclists travelling with the direction of general traffic.

Following the interim MCA workshop, the Technical Advisory Group (TAG) met to discuss a recommended option. The TAG supported the highest scoring option of 4A while noting the additional safety risks inherent with bidirectional cycleways which will require consideration in the design phase.

The TAG recommended that Option 4A was the best option to take forward as the interim preferred option. This decision was supported by the LGWM Programme Steering Group.

5.11 Public Engagement on the Interim Preferred Option

Public engagement on the proposed changes to TQHR was undertaken between 11th May and 8th June 2021. Over 1,600 responses were received, largely via an online survey, which is considered as an adequate response rate.

The consultation also included an open day at Pipitea Marae on Thorndon Quay (on Friday 21st May and Saturday 22nd May 2021), which was attended by approximately 50 people, and two market days at Harbourside Market, Waitangi Park (on Sunday 23rd May 2021) and at Johnsonville Market (on Sunday 30th May 2021). Ongoing discussions were held with some key stakeholders.

Overall, the engagement was well received, and the feedback was supportive of the proposals, though there certainly were some views that we need to be very mindful of. For example, there was some strong opposition to the removal of angled parking, particularly from the business community, and some concern existed around the possible removal of trees. Some people's opposition to the proposals did reduce once the proposals had been explained to them in more detail.

A lot of feedback related to issues that will be addressed in the next phase of the design process such as safety aspects (children moving around, etc.) was received.

No fatal flaws were identified, though the Sky Stadium did say they need the ability to stop traffic for evacuation purposes. Hence, if a roundabout is implemented on Aotea Quay, it will require signalisation.

No additional options emerged from the process which had not been considered before. There were no options which had been rejected but some details that need to be considered further.

A report providing more details of the engagement findings was published in July 2021. A summary of this is provided in Appendix I.

5.11.1 Revisions to the MCA Following Stakeholder and Public Engagement

Following the close of stakeholder and public engagement, a second MCA workshop was held on 30 June 2021. The purpose of this workshop was to consider the impact of engagement feedback on the interim MCA scores, update scores based on any further information, as well as to incorporate the mana whenua values assessment into the MCA.

The implementation of a bus lane on the southbound side was preferred over both directions as the benefits were higher. Without the northbound bus lane, this would provide more ability to influence the design of the footpath on the northbound (or 'beach' side). Mana whenua noted that most of their land interests along the corridor were along this historical beach side.

The 'B' sub-options all scored higher than the 'A' and base options as they were considered to provide an opportunity to improve access and create a neighbourhood space for those properties along Hutt Road.

Mana whenua supported the bi-directional cycleway on the harbourside as it is consistent with other cycle projects north and south of Thorndon Quay and Hutt Road. It should be noted that the change to angle parking to parallel was not considered in their scoring as WCC had already voted in favour of the change at the time of scoring the options.

The delivery team noted that since the interim MCA, some preliminary design of Option 4A had progressed, including more detailed evaluation of the available width on Hutt Road and desired width for the various modes. Based on this further work, the delivery team considered that the service lane 'B' suboption does not physically fit within the corridor and property acquisition would be necessary. Discussion at the workshop confirmed that the delivery score for the service lane should be reduced to -5 (the lowest score possible).

As buildings would require alteration or demolition to implement the service lane suboptions, it was agreed that the service lane options, despite the scoring, should no longer be progressed due to the disproportionate cost and effect of land acquisition.

The discussion at the workshop noted that the Thorndon Quay Collective submission raised concerns about loss of parking and economic impact. It was noted that the submission addressed the loss of parking issue but did not offer other submissions that would differentiate between options. As all options involve the loss of and reconfiguration of on-street parking, the submission did not offer differentiators between the options and the scoring did not change from the interim MCA.

While the scoring for the MCA criteria did not change from the interim MCA as a result of engagement, the workshop noted that there were many detailed points to further discuss with stakeholders and property owners during design. It is anticipated that dialogue between LGWM and stakeholders will continue through the conclusion of the business case and into the design phase so that stakeholders, users and property owners can influence the design as it develops.

The introduction of the mana whenua values scores and the reduction of the delivery score for the service lane suboptions changed the relativity between options compared to the interim MCA. Options 4A and 4B still scored the highest, similar to the interim MCA. This scoring does not reflect the decision that the service lane suboptions should no longer be progressed. Option 4A is therefore recommended as the preferred option.

Table 5-6 summarises the final results of the MCA assessment of the options.

Table 5-6 Final MCA Scoring Summary

Option	Contribution to Investment Objectives					Contribution to Effects				Contribution to Delivery, Maintenance and Operations			Total	Option Rank
	IO1 – Bus Reliability / Attractive-ness	IO2 – Walking & Cycling	IO3 – Hutt Road Safety	IO4 – Thorndon Quay Amenity	IO5 – Similar Freight Access*	Mana whenua values	Social	Property Access	Fit with LGWM Programme	Delivery	Operations & Maintenance	Timeframe for Delivery		
Option 1: Southbound bus lanes with Thorndon Quay bi-directional cycleway	3	1	1	3	2	3	3	-3	3	-1	-1	2	**16**	7
Option 1A: Southbound bus lanes with Thorndon Quay bi-directional cycleway	3	2	3	3	2	4	3	-2	4	-2	-2	0	**18**	3
Option 1B: Southbound bus lanes with Thorndon Quay bi-directional cycleway	3	2	3	1	2	5	3	4	2	-5	-2	-1	**17**	4
Option 2: Southbound and Northbound bus lanes with Thorndon Quay uni-directional cycleway	4	3	1	1	3	1	4	-3	3	-3	-2	0	**12**	11
Option 2A: Southbound and Northbound bus lanes with Thorndon Quay uni-directional cycleway	4	4	3	1	3	2	4	-3	4	-4	-3	-2	**13**	9
Option 2B: Southbound and Northbound bus lanes with Thorndon Quay uni-directional cycleway	4	4	3	1	3	3	4	4	2	-5	-3	-3	**17**	4
Option 3: Southbound bus lanes with Thorndon Quay uni-directional cycleway	3	3	1	2	2	2	3	-3	2	-4	-1	0	**10**	12

Option	Contribution to Investment Objectives					Contribution to Effects				Contribution to Delivery, Maintenance and Operations			Total	Option Rank
	IO1 – Bus Reliability / Attractive-ness	IO2 – Walking & Cycling	IO3 – Hutt Road Safety	IO4 – Thorndon Quay Amenity	IO5 – Similar Freight Access*	Mana whenua values	Social	Property Access	Fit with LGWM Programme	Delivery	Operations & Maintenanc e	Timeframe for Delivery		
Option 3A: Southbound bus lanes with Thorndon Quay uni-directional cycleway	3	4	3	2	2	3	3	-2	3	-4	-2	-2	**13**	9
Option 3B: Southbound bus lanes with Thorndon Quay uni-directional cycleway	3	4	3	1	2	4	3	4	1	-5	-2	-3	**15**	8
Option 4: Southbound and Northbound bus with Thorndon Quay bi-directional cycleway	4	1	1	4	3	2	3	-3	4	-1	-1	0	**17**	4
Option 4A: Southbound and Northbound bus lanes with Thorndon Quay bi-directional cycleway	4	2	3	4	3	3	3	-2	5	-2	-2	-2	**19**	**1 Equal**
Option 4B: Southbound and Northbound bus lanes with Thorndon Quay bi-directional cycleway	4	2	3	3	3	4	3	4	3	-5	-2	-3	**19**	**1 Equal**

*the assessment scores assume that only buses and trucks are permitted to use the proposed peak period SVLs on Hutt Road.

5.12 The Preferred Option

5.12.1 Thorndon Quay

The proposal for Thorndon Quay will provide part-time bus lanes in both directions and extend the two-way cycle path from Hutt Road to the bus interchange at Mulgrave Street. Footpaths and the streetscape will also be improved.

Changes will allow for future growth of bus users and cyclists and encourage more people to walk, shop and spend time on Thorndon Quay. Safety will be improved for everyone by improving pedestrian crossings and providing a dedicated cycle path.

5.12.1.1 Changes for people living, working, or owning a business:

- The streetscape will be improved to make it more pleasant for people to visit and spend time here
- Between 100 and 130 on street parking spaces will be available at all times
- Between 220 and 240 on street parking spaces will be available when bus lanes are not operating, which is more than the current peak demand for parking spaces
- Safety will be improved for everyone.

5.12.1.2 Changes for using the bus:

Bus lanes will be provided in both directions because it improves bus travel times and reliability during peak hours, encouraging more people to take the bus.

- During the morning peak period, there will be a dedicated bus lane into the city, which means buses will be able to bypass any morning peak traffic congestion, improving bus reliability and reducing travel time
- In the evening peak, there will be a dedicated bus lane out of the city
- At all other times of the day, buses will travel with other traffic (cars/ vans/ motorcyclists etc.)
- Priority will be given to buses at Mulgrave Street to improve journey times
- Some bus stop locations and layouts will be adjusted to better balance local walking access and travel time for people on the bus
- The streetscape will be improved to make it more pleasant when you are waiting for a bus
- Pedestrian crossings will be improved to make it safer to get to and from bus stops
- Changes for people living, working or owning a business.

5.12.1.3 Changes for people riding bikes

A two-way cycle path is proposed on the east side of Thorndon Quay as it will provide improved connectivity to Wellington city, allow space for people riding at different speeds, minimise conflict at the bus interchange and avoid intersections.

- There will be a new two-way cycle path on one side of the street connecting with the cycle path on Hutt Road
- The cycle path will be as wide as the space allows and will be separated from the footpath, to provide dedicated space for cyclists
- The design of the cycle path will make vehicle crossing points as safe as possible
- Signalised cyclist crossings will be included at signalised pedestrian crossings
- The streetscape will be improved, making cycling journeys more pleasant.

5.12.1.4 Changes for people walking, using skateboards, scooters or other mobility devices

- A footpath will be provided on both sides of the road; expected to be at least 2m wide
- The footpath will be separated from the cycle path to provide dedicated space
- The streetscape of the area will be improved with planting, seating, lighting, different surfaces
- Pedestrian crossings will be improved, including new crossings, making it safer and easier to cross the street.

5.12.1.5 Changes for people driving

- One lane of general traffic will be maintained in each direction at all times
- Lane widths will generally be at least as wide as they are now
- Angle parking will be converted to parallel parking making it safer to drive along Thorndon Quay (now implemented by WCC)
- Intersections will be improved at Mulgrave Street and Tinakori Road.

5.12.1.6 Changes for people parking

- On-street angle parking will be converted to parallel parking making it safer to park on Thorndon Quay (now implemented by WCC)
- When the bus lanes are not operating, between 220 and 240 parallel parking spaces will be available (this is more than the current peak demand for parking spaces)
- With one bus lane operating in the peak period direction, between 100 and 130 parking spaces will be available.

These changes have been informed by a parking utilisation study survey that was conducted earlier in the business case process. It is recommended that, alongside these changes, WCC undertake a parking management plan. The detailed design process will determine the precise number of on-street car parking spaces that will be removed.

5.12.2 Hutt Road

The proposal for Hutt Road includes providing part-time SVLs in both directions and at the Ngauranga/ Jarden Mile intersection. The SVLs will provide priority for buses and trucks. This decision, and whether or not other vehicles will be permitted to use the SVLs, will be confirmed during detailed design, informed by further transport modelling.

SVLs are proposed in both directions because this will improve bus and truck travel times and reliability during peak hours, and help make buses more reliable and attractive. The proposed changes to the intersection are also expected to increase the attractiveness of walking and cycling through increased safety and access.

The design also includes upgrading and extending the existing shared cycle and footpath north to the Ngauranga/ Jarden Mile intersection. This will provide a connection to the existing shared path that connects to Te Ara Tupua and the proposed cycle path on Thorndon Quay into the city. Options to upgrade the existing connection to Te Ara Tupua are being considered under a separate study which will be an addendum to this SSBC.

A significant safety risk for people walking, cycling or riding motorbikes and for vehicles on Hutt Road is people turning right across traffic to enter and leave properties.

To improve safety on this road, a central raised median is proposed to prevent traffic making right turns. A turnaround facility on Aotea Quay is required to provide a safe turning location for large vehicles wanting to travel north from a property on Hutt Road. This provides additional benefits of reducing traffic, in particular trucks, on Hutt Road through the provision of an alternative access to the ferry terminal at Kaiwharawhara.

5.12.2.1 Changes for people living, working or owning a business

- Provide approximately ten parking spaces outside Storage One that will be available at all times
- Between 100 and 130 additional parking spaces will be available when the bus lane into the city is not operating
- Safety will be improved for all users
- Accessing properties may mean using a different route and increasing your journey time.

5.12.2.2 Changes for people using the bus

- During the morning peak period, there will be a bus lane/SVL into the city, which means buses will not be caught in morning peak traffic congestion, improving bus reliability, and reducing travel time
- In the evening peak, there will be a bus lane/SVL out of the city
- At all other times of the day, buses will travel with other traffic (cars/ vans/ motorcyclists etc.)
- Priority will be given to buses at the Ngauranga/ Jarden Mile intersection to improve journey times
- Some bus stop locations and layouts will be adjusted to better balance local walking access and travel time for people on the bus
- Some bus stops will be improved to make it more pleasant to wait for a bus
- Pedestrian crossings will be improved to make it safer to get to and from bus stops.

5.12.2.3 Changes for people riding bikes

- The existing two-way cycle path will be extended to the Ngauranga/ Jarden Mile intersection and connected to the existing shared path that connects to Te Ara Tupua and the proposed cycle path on Thorndon Quay
- Safety improvements will be made to the existing cycle path
- Cyclist crossings will be included at intersections including the Jarden Mile intersection, as well as at pedestrian crossings, making it safer to cross the road
- Motor vehicles will not be able to turn right into and out of properties on Hutt Road north of the Aotea Quay ramps, to make it safer when riding over vehicle crossing points
- With the introduction of a turnaround facility on Aotea Quay, less freight and other traffic will need to use Hutt Road to access the ferry terminal, ensuring a safer and more pleasant journey.

5.12.2.4 Changes for people walking, using skateboards, scooters or other mobility devices

- The existing shared cycle and footpath will be upgraded and extended north to the Ngauranga/ Jarden Mile intersection
- Pedestrian crossing improvements will make it safer to cross the road
- Pedestrian crossing facilities will be installed at Jarden Mile making it safer to cross the road
- Safety will be improved as motor vehicles will not be able to turn right into and out of properties on Hutt Road, north of the Aotea Quay ramps, due to the proposed raised median
- Less freight and other traffic will need to use Hutt Road to access the ferry terminal at Kaiwharawhara due to the introduction of a turnaround facility on Aotea Quay, which will create

a more pleasant and safer corridor along Hutt Road for people to walk, skate, scoot or otherwise.

5.12.2.5 Changes for people driving

- One lane of general traffic will be maintained in each direction at all times
- Improvements will be made to the intersections at Tinakori Road, Rangiora Avenue and Onslow Road
- Vehicles will not be able to turn right into properties across Hutt Road along the section of corridor between the Aotea Quay ramps and the Ngauranga/ Jarden Mile intersection, to increase safety for all road users (turnaround locations for smaller vehicles will be considered during the next phase of design).

5.12.2.6 Changes for freight and delivery vehicles

- Alternative access to the ferry terminal at Kaiwharawhara from SH1 will improve resilience to retain reliable access to the ferry
- Large vehicles will need to use the new turnaround facility on Aotea Quay or the existing turn-around facility, directly north of Ngauranga intersection, to turn around if required.

5.12.2.7 Changes for people parking

- Approximately ten parking spaces will be available at all times
- Between 100 and 120 additional parking spaces will be available when the bus lane into the city is not operating.

5.13 Development of the Preferred Option

A preliminary design was prepared following the confirmation of the preferred option, and further traffic modelling was undertaken to confirm the operation of key intersections. Separate transport modelling is being undertaken in conjunction with Waka Kotahi and KiwiRail on the turnaround facility on Aotea Quay to consider all potential changes in this area.

The key design parameters and assumptions used in the development of the preliminary design for the preferred option are contained in the Preliminary Design Philosophy Statement (PDPS (Appendix J). This includes details of the minimum and desirable widths for traffic lanes, bus lanes, cycleways, streetscape and landscape design elements and other infrastructure. It also provides details of any departures from design standards which are required.

A Road Safety Audit was completed on the preliminary design and changes incorporated into the design for the SSBC.

5.13.1 Key Design Features

The key design features of the preliminary design include:

- SVLs in both directions on Hutt Road and bus lanes in both directions on Thorndon Quay
- A bi-directional cycleway (i.e. off road) on Thorndon Quay to complement the existing bi-directional cycle path on Hutt Road and provide a link to the Te Ara Tupua (Wellington to Hutt Valley walking and cycling link)
- Improvements to the existing bi-directional cycle path on Hutt Road, as recommended in the Hutt Road Safety Audit
- A median on Hutt Road to address the safety issues caused by turning movements for property access

- A turnaround facility on Aotea Quay to permit traffic to turn around after the installation of a median on Hutt Road
- A speed review to consider lower posted speeds on Thorndon Quay (40km/hr), Hutt Road (50km/h south of Onslow Road and 60km/h north of Onslow Road) and Aotea Quay (50km/h)
- Intersection upgrades and pedestrian crossing improvements
- Bus stop rationalisation or rebalancing, as described in Appendix G
- Significant amenity improvements on Thorndon Quay, with some improvements to Hutt Road also, noting the opportunities to improve the experience are generally less than for Thorndon Quay.

The preliminary design is discussed in more detail below.

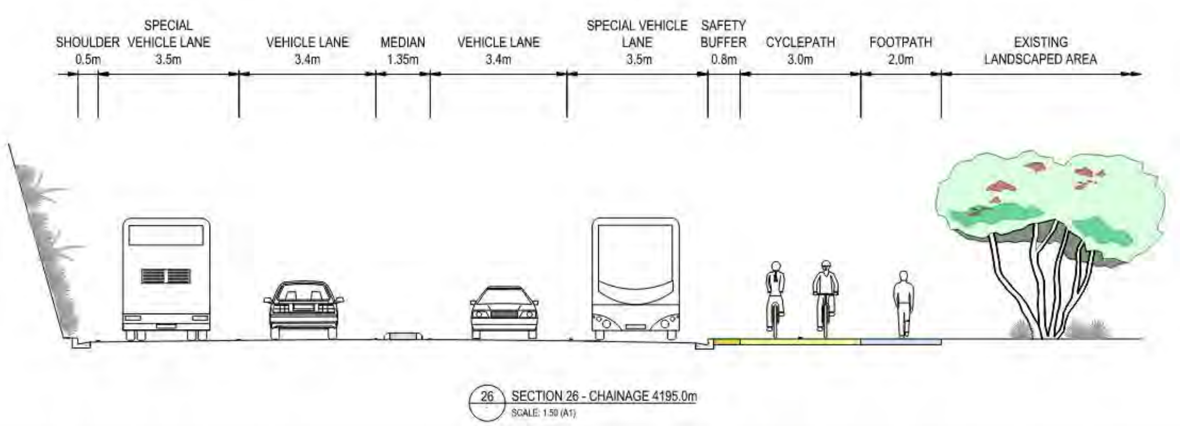
5.13.1.1 Hutt Road Design

The key elements of the project along Hutt Road are:

- One general traffic lane in each direction
- An SVL for buses and freight in the northern section (Aotea Quay to Jarden Mile) (note that the implications of this for buses and the legal and enforcement implications of this will be considered further during detailed design, and further modelling will be undertaken to inform this)
- A peak period bus lane in the southern section (Tinakori Road to Aotea Quay), which is available for on street parking during the off-peak period
- A raised central median to restrict right turns, except at clearly defined and controlled locations
- A 0.8m safety buffer, typically, to protect vulnerable users from traffic, from the wind blasts from large vehicles and from doors opening direct into the cycle path
- Widened cycle and pedestrian lanes tying into the newly constructed lengths at the southern end of Hutt Road, proposed to be at the same level along Hutt Road
- A 1.8m footpath and 3m minimum cycleway is proposed, but this is not possible at some pinch point locations (though this does not compromise the overall project).

The proposed typical cross section for Hutt Road is shown in Figure 5-21.

Figure 5-21 Proposed Hutt Road Cross Section



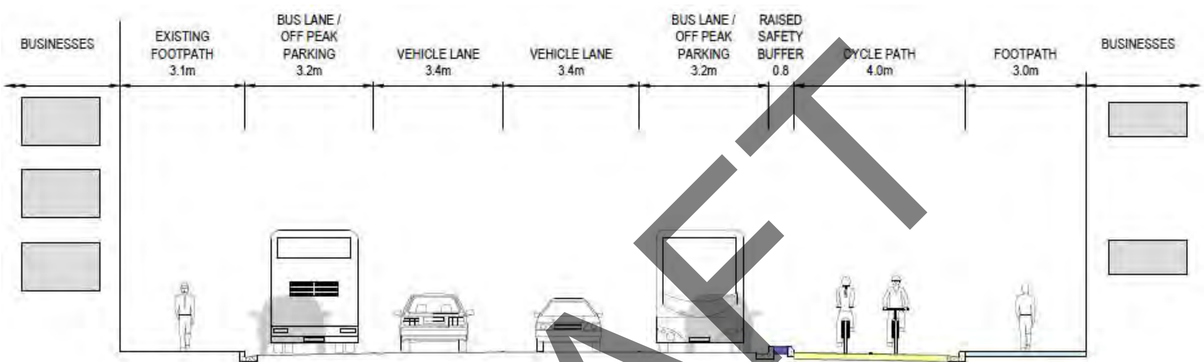
5.13.1.2 Thorndon Quay Design

The general proposal for Thorndon Quay is to reallocate road space to provide:

- One general traffic lane in each direction
- A peak period bus lane in each direction which will be available for car parking in off peak periods
- A dedicated, off-road cycle path on the eastern side
- Raised buffers and amenity areas.

The proposed typical cross section for Thorndon Quay is shown in Figure 5-22.

Figure 5-22 Proposed Thorndon Quay Cross Section



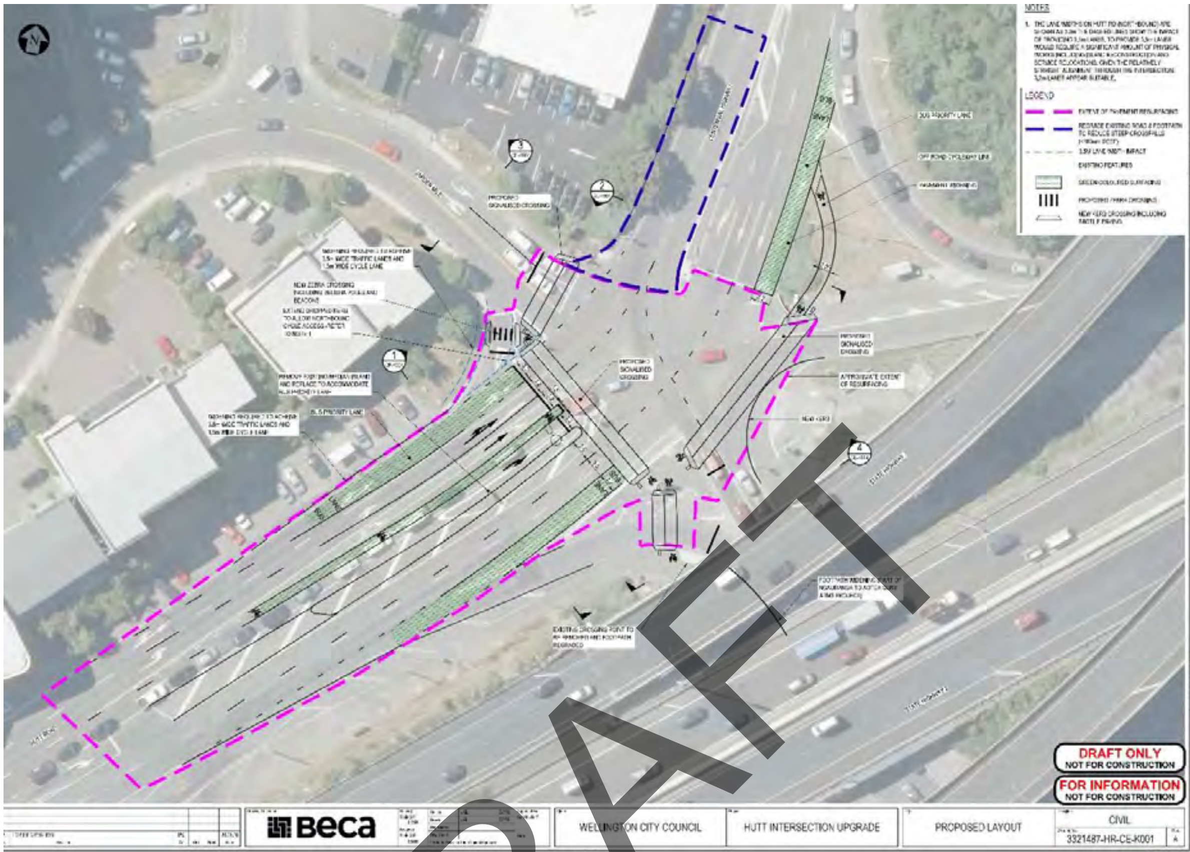
Pedestrian and cycle crossings of Thorndon Quay will also be improved (incorporating raised signalised crossings), as well as the addition of landscaping and other amenity improvements. The precise design of the crossings will be reviewed during detailed design.

The locations of most pedestrian crossings will tie in with relocated bus stop locations. The crossings are proposed to will be located prior to the bus stop in each direction. This results in passengers crossing behind the buses and hence reducing potential delays to the onward journeys of the buses once those passengers have alighted. This will also improve safety, as it makes pedestrians more visible as they cross and are not hidden by the departing buses. To improve the attractiveness and experience of waiting times, increased amenity around bus stops will be provided where possible.

5.13.1.3 Hutt Road/ Jarden Mile Intersection Upgrade

The preliminary design for the upgrade of the Jarden Mile intersection was based on a specimen design of the Hutt Road interchange prepared for WCC in 2016. This is shown in Figure 5-23.

Figure 5-23 Specimen Design for the Hutt Road / Jarden Mile Intersection



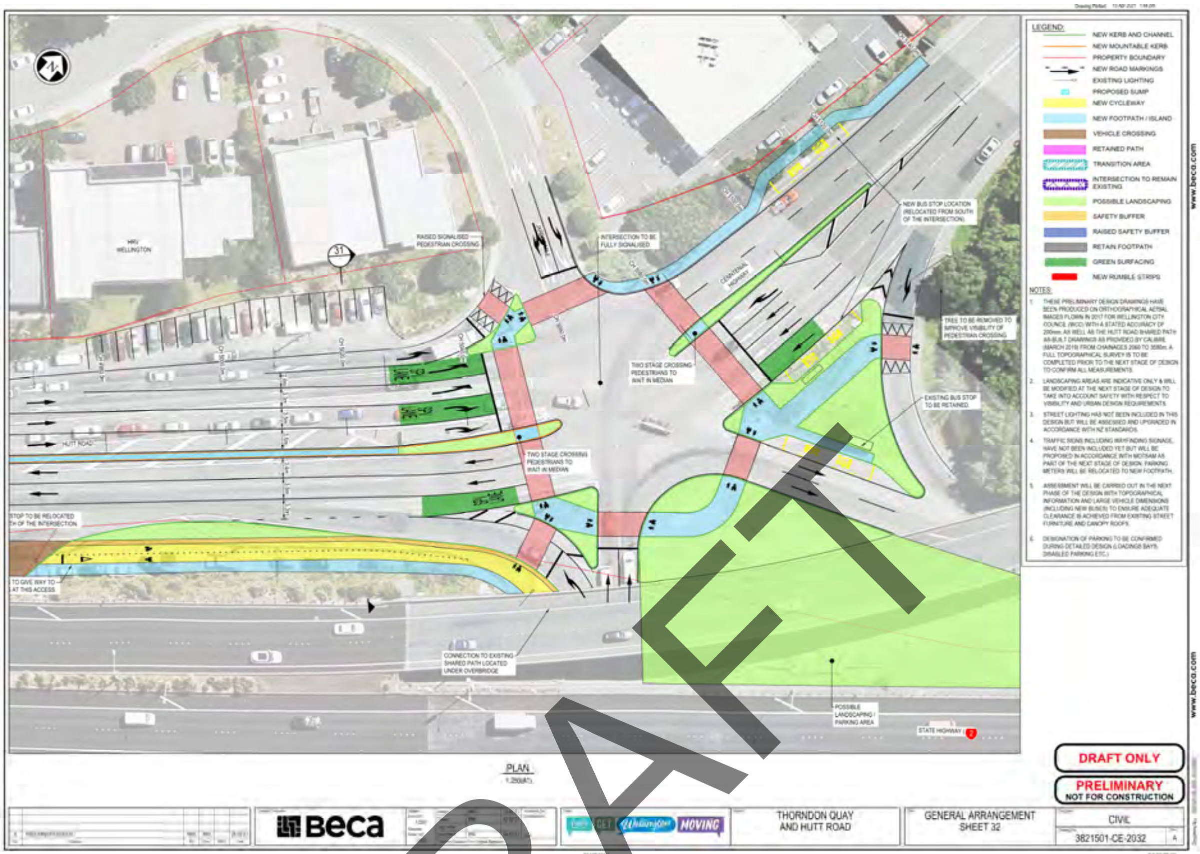
This design was reviewed to check for consistency with the current proposals for the corridor, and a number of revisions made as follows:

- Bus stops relocated
- The northbound approach lanes were reassigned, including the removal of the central cycle lane converting to a bus lane
- Pedestrian and cyclist crossing facilities have been improved by providing designated crossings and increasing the sizes of the islands
- The northbound SVL lane on Hutt Road was terminated approximately 200m prior to the intersection, to allow for safe lane changing/weaving prior to the development of the multiple lanes at the intersection.
- Raised crossings have been incorporated in the design.

The revised design proposed is shown in Figure 5-24. It should be noted that consideration will be given to making the pedestrian crossings on Hutt Road and Centennial Highway staggered in detailed design. This is to reduce the risk of a pedestrian or cyclist on the crossing proceeding straight through from one half to the other thinking that it was a continuous crossing.

The decision on whether a raised crossings are to be provided, how this is best done (e.g. raising individual crossings or raising the whole intersection), and a consideration of any safety consequences of the changes, will be considered further during detailed design.

Figure 5-24 Proposed Preliminary Design for the Hutt Road / Jarden Mile Intersection



5.13.1.4 Hutt Road/ Onslow Road Intersection

The current seagull layout at the Onslow Road intersection is proposed to be fully signalised providing a secure crossing for cyclists who are currently not catered for. This will address safety issues associated with the right-hand merge with southbound traffic. The revised design will provide a secure crossing for cyclists who are currently not catered for. The main cycle/ pedestrian pathway will also be widened.

It is proposed to combine the southbound through and right movements into one lane since space at this intersection is constrained. Split phasing will be necessary at the intersection to restrict right turn filter movements. Further design and discussions will need to take place during next phase of design to confirm this arrangement is safe and explore whether a right-turn lane could be retained by narrowing the shared path through the intersection.

The intersection requires future-proofing to enable a future pedestrian connection to the pedestrian footpath further up Onslow Road. Connecting Onslow Road footpaths is currently being investigated by WCC, and is a high priority project in its Long Term Plan.

5.13.1.5 Hutt Road/ Tinakori Road Intersection

Raised crossings are proposed at the Tinakori Road intersection to provide a safer crossing environment for both pedestrians and cyclists.

5.13.1.6 Mulgrave Street/ Thorndon Quay/ Thorndon Quay Intersection

This intersection is proposed to be fully signalised, in order to reduce the safety risk for the currently unsignalised left turn movement from Mulgrave Street to Thorndon Quay which has reduced visibility due to the acute angle of the intersection as well as mature trees. The proposed revisions will also assist bus movements in and out of the adjacent Lambton Quay Bus Interchange.

5.13.1.7 Aotea Quay Turnaround Facility

A roundabout on Aotea Quay is proposed to allow trucks to turn around following installation of the median on Hutt Road which will restrict the ability for all traffic to turn right.

An existing WCC proposal for a roundabout design (see Figure 5-25) was reviewed to check if there are any issues that may impact upon the integration into the preliminary design. This identified that there is no space to provide a footpath on the seaward side of the road/ roundabout, as the fence line is hard up to the existing road with rail sidings on the other side. There were also safety concerns associated with the seagull configuration due to the nature of the vehicles that will be pulling into the fast, through lane.

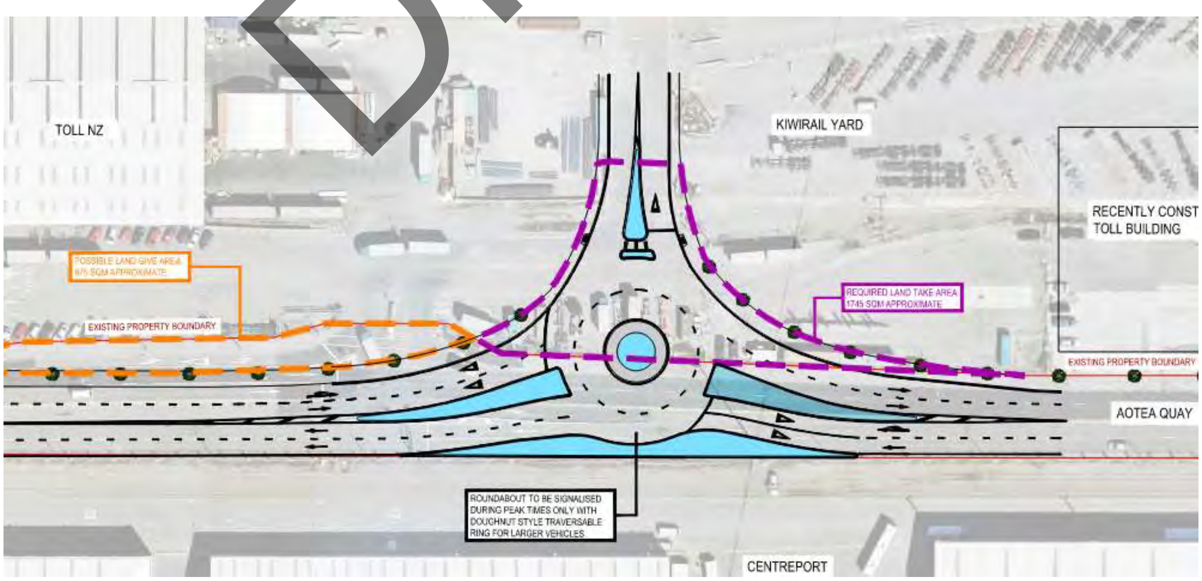
A full roundabout design controlling all movements is therefore proposed, as shown on Figure 5-25. A speed review will be undertaken during detailed design to confirm whether the posted speed limit along Aotea Quay should be reduced from the current 70km/h to 50km/.

The roundabout design will incorporate part-time traffic signals which will typically only be used when emergency events take place at the nearby Sky Stadium. The requirement to stop traffic is understood to be an existing emergency management operation. Pedestrian crossing provision will be determined during detailed design.

Changes to Aotea Quay will be done in conjunction with KiwiRail and Waka Kotahi, to align with the Single User Terminal project. It is possible that an alternative turn around facility is adopted if this is found to be a better overall solution.

The exact design of the roundabout will be confirmed in detailed design. There may be opportunities to change to a hook turn arrangement or other solution. As part of the detailed design, pedestrian facilities will also be confirmed.

Figure 5-25 Proposed Aotea Quay Roundabout (Revised Design)



5.13.1.8 Improvements to Pedestrian Crossing

It is proposed that all existing pedestrian crossings on Hutt Road will be raised. The locations of most pedestrian crossings will be adjusted to tie in with the relocated bus stop locations. As part of these improvements, it is envisaged that sufficient space for pedestrians waiting to cross be made.

The existing pedestrian crossing on Hutt Road near Rangiora Avenue is proposed to be signalised and have a raised pedestrian crossing.

5.13.1.9 Improvements to the Hutt Road Cycleway

The potential conflict between cyclists on the cycleway and vehicles entering/ leaving properties on the eastern side of Hutt Road is a key issue that has been considered during the preliminary design phase. A number of serious or significant issues as well as minor issues were identified in the recent WCC safety audit of the Hutt Road cycleway. The more serious issues focused on access/ egress to businesses along the south-eastern side of the corridor. These predominantly identified issues with vulnerable users on the shared use facility and for cyclists.

One of the key recommendations in the Hutt Road cycleway safety audit was to investigate improving cyclist safety at accesses through the installation of passive and active warning measures to raise awareness and mitigate the risk. Identifying and improving visibility lines has also been a key consideration. This issue will be addressed by limiting all vehicles exiting the businesses units along the south-eastern side of the corridor to turn left only. U turns will only be permitted at designated locations, where designated right turn lanes are provided within the central median. Vehicle tracking indicates that only a car with a trailer can perform U turns, whereas an 8m rigid truck would not be able to perform this manoeuvre.

It is proposed to retain the flush median from Sar Street to Aotea Quay. A raised median is proposed from Aotea Quay through to Jarden Mile with strategically placed breaks to allow for business access and to control the locations of U-turns. The U-turning risk could potentially be mitigated further through the use of electronic warning signs triggered by the presence of vehicles in the U-turn bays.

5.13.1.10 Structures

No additional structures are currently proposed, and the proposed design does not impact on these structures. It is proposed to have only a single lane under the overbridge section at the Aotea Quay overbridge.

5.13.1.11 Land and Property Acquisition

All road design changes are proposed to take place within the existing legal boundary of the road, with the exception of works on Aotea Quay. Hence no land or property acquisition is required for the majority of the project.

5.13.1.12 Parking Provision

The removal of existing angle parking on Thorndon Quay and replacing with parallel parking has now been implemented. The project will involve some further reduction in the number of, and changes to the design of, existing on street parking.

The overall effect of the project on the number of parking spaces in the future is estimated to be:

- Thorndon Quay – 382 spaces (i.e. prior to the recent WCC angle parking changes which removed around 140 spaces) / proposed 250-260 spaces
- Hutt Road – existing 133 spaces / proposed 110-130 spaces.

Analysis of demand for parking provision prior to the removal of angle parking in Thorndon Quay indicated the reduction in provision would be accommodated. The number of spaces provided will be confirmed after detailed design is completed. It is anticipated these changes will be supported by a parking management plan.

5.13.1.13 Urban and Landscape Design Considerations

LGWM is currently developing a programme wide Urban Design Framework (UDF) that will be developed in parallel to the TQHR masterplan work being undertaken through detailed design. The urban and landscape masterplan for TQHR will be important to guiding solutions to meet the project's intent and vision.

The preliminary design proposals will need to be tested through the next design phase to reflect the developing LGWM UDF, as well as the more detailed thinking that will occur in detailed design.

The UDF will not be completed in full prior to detailed design starting. Therefore, the designers will be required to work collaboratively with LGWM and its partners to ensure adequate urban design and landscape elements have been considered throughout the design process including the early phases.

Urban design, landscape and aesthetic considerations will need to be developed through solutions that deliver value for money through detailed design. CPTED, Safety in Design, Maintenance in Design and Whole of Life Costs (i.e. not just capital costs) will also need to be considered within the urban design and landscape detailed design process.

The detailed design will need to be prepared in accordance with contract requirements.

5.14 Construction Methodology

The nature of the works primarily consists of the relocation of kerb lines, some patch structural changes to suit the new alignments, followed by the resurfacing and new lining. As such it should be relatively easy to split the works into linear sections for phasing.

The key constructability issues will exist around accommodating and managing high traffic volumes expected during construction. The project is likely to be broken up into construction areas such as the upgrade of existing roads/ intersections (Thorndon Quay), and the upgrade of existing roads/ intersections (Hutt Road) with associated tie-ins to existing roads. Works on Aotea Quay are anticipated to be constructed first, prior to works on Thorndon Quay or Hutt Road, in order to minimise impacts on traffic operations during construction. Night construction will take place on Aotea Quay, where this is practical and cost effective.

Performance criteria can be set for all traffic management plans including for sealing surfaces, minimum paved width, maximum delays for all traffic, particularly the traffic on SH1 and minimum standards for pedestrian and cyclist facilities in conjunction with the LGWM partners.

A workable construction sequence including temporary intersection and road arrangements will be developed at the detailed phase to demonstrate the feasibility and set baseline performance criteria for traffic management.

5.15 Property Impacts

It is currently proposed to keep within the existing legal boundary of Thorndon Quay and Hutt Road. The proposed Aotea Quay roundabout will extend outside the existing road boundary. No land acquisition is considered necessary other than at this location.

The impact on Crown Land currently held by KiwiRail and extents needed to implement works on Aotea Quay will be determined as the overall design progresses. The current defined impact is indicated on the preliminary design drawings.

5.16 Performance of the Preferred Option Against Investment Objectives

The performance of the preferred option has been considered against the Investment Objectives and associated KPIs defined in Chapter 4. This is summarised in Table 5-7 and indicates that the project will largely achieve the investment objectives.

Table 5-7 – Performance of the Preferred Option Against Investment Objectives

Investment Objective	Measure	Baseline	Target	Predicted Impact	Achieves Investment Objective?
1	Increased demand for bus services by 2026	950 passengers in the morning peak 2-hour period (southbound), and 1,000 in the evening peak 2-hour period (northbound)	1,000 passengers in the morning peak 2-hour period (southbound), and 1,100 in the evening peak 2-hour period (northbound)	1,100 passengers (a 17% increase) in the morning peak 2-hour (southbound), and 1,190 (an 18% increase) in the evening peak (northbound)	Yes
	Improved bus service travel times by 2026	14 minutes travel time in the morning peak 2-hour period (southbound) and 9 minutes travel time in the evening peak 2-hour period (northbound) n.b. These times exclude bus stop dwell time	Reduce by 5 minutes in the morning peak 2-hour period (southbound) and by 1 minute in the evening peak 2-hour period (northbound) n.b. These times also exclude bus stop dwell times	8 minutes in the morning peak 2-hour period (southbound) and 9 minutes in the evening peak 2-hour period (northbound) *A further 2.5 minutes time saving at bus stops is predicted to occur in the morning and evening peak 2-hour periods*	Yes (when bus stop time savings are included)
2	Improved Level of Service for non-car modes by 2026	LoS D for walking	LoS C on Hutt Road; LoS C/D on Thorndon Quay (Northbound/Southbound)	LoS C on Hutt Road; LoS C/D on Thorndon Quay (i.e. Northbound/Southbound)	Yes
		LoS F for cycling	LoS F/B on Hutt Road (Northbound/Southbound); LoS F/C on Thorndon Quay (Northbound/Southbound).	LoS F/B on Hutt Road (Northbound/Southbound); LoS F/C on Thorndon Quay (Northbound/Southbound).	Yes
		300-1,600 cyclists/day on Thorndon Quay	50% increase	1200-3,000 cyclists/day on Thorndon Quay	Yes
3	Reduce the safety risk along Thorndon Quay and Hutt Road for all road users by 2026	2.6 DSI crashes per year for vulnerable users	Reduce vulnerable user DSI crash risk by 20%	1.9 DSI crashes per year (28% reduction)	Yes
		1.5 DSI crashes per year for all vehicles	Reduce vehicle DSI crash risk by 10%	1.3 DSI crashes per year (10% reduction)	Yes
4	Improved Amenity/ Healthy Streets index by 2026	M3/P1	M3/P2	MP3/P2	Yes
		2-3,000 pedestrians/day on Thorndon Quary	20% increase	Likely to be a 30-50% increased on Thorndon Quay	Yes
5	Broadly maintain truck travel times between Jarden	7 minutes travel time in the morning peak 2-hour period (southbound); 5 minutes travel	Maintain	5 minutes in the morning peak 2-hour period (southbound); 5	Yes

Investment Objective	Measure	Baseline	Target	Predicted Impact	Achieves Investment Objective?
	Mile and Aotea Quay by 2026	time in the evening peak 2-hour period (northbound)		minutes in the evening peak 2-hour period (northbound)	

5.16.1 Economic Analysis of the Preferred Option

An economic appraisal of the preferred option has been undertaken in accordance with the Waka Kotahi EEM procedures (2019 Update)[20]. The appraisal also incorporates key changes included in the new Waka Kotahi Investment Decision Making Framework (IDMF), which consists of the Monetised Benefits and Costs Manual (MBCM). The purpose of the economic evaluation is to calculate the benefit to cost ratio (BCR) for the project.

The further transport modelling and analysis which formed the basis of the economic evaluation is described in the report contained in Appendix K. The assumption which underpin the results summarised below are explained in Appendix L. The following key benefit streams have been assessed for the recommended option:

- Cyclist crash cost savings
- Health benefits for cyclists
- Vehicle operating cost (VOC), travel time and bottleneck delay savings for all motorised vehicles on the corridor, as well as those diverting onto alternative routes
- External delays for southbound traffic in the morning peak period associated with increased traffic on the re-routing onto SH1 which is currently at capacity (the average delay has been attributed to all SH1 for the purposes of simplifying the assessment)
- Travel time savings for existing and additional bus users using bus lanes/ SVLs and from the improved bus stop designs and reduction in the number of bus stops
- Bus reliability benefits
- Pedestrian amenity benefits.

It should be noted that there are anticipated benefits associated with the expected increase in theoretical capacity of the corridor resulting from a greater number of people moved along the corridor (in particular via public transport). However, these benefits have not been formally calculated as it falls outside of the MBCM framework, and would require consideration of wider network issues.

The economic analysis has been undertaken based on the modelling outputs where there is no change in trip departure time for traffic travelling on SH1 between the SH1/SH2 interchange and the Hawkestone Street off-ramps over the modelled AM peak periods (6am-10pm). The cost of this additional delay has been accounted for as part of the external delay assessment and added to SH1 traffic. This represents the “opportunity cost” for someone travelling earlier / later than their ideal departure time. In reality, these trips may be undertaken earlier or later than the current traffic flow profile in order to avoid the peak where SH1 is at capacity.

It is anticipated that traffic will re-route from TQHR to SH1 as a result of the reduction in capacity on TQHR. The extent of the re-routing will be dependent on factors such as the level of congestion, location of destination in the CBD and user preferences, therefore two scenarios have been assessed to understand the range of potential impacts:

- ‘Top End’ Scenario – modelled level of diversion from TQHR to SH1 and alternative routes; people travel at the same time, but some choose a different route to avoid congestion on TQHR

[20] Waka Kotahi NZ Transport Agency have released updated economic guidance as of August 2020. This business case uses the previous EEM procedures, as per recommendations from Waka Kotahi.

- 'Bottom End' Scenario – No diversion from TQHR to SH1 and alternative route; people travel at the same time and continue to take the route they currently use (Hutt Road).

Table 5-8 summarises the total discounted benefits predicted for the preferred option and indicates that the BCR sits between 0.4 and 1.8. This range represents the likely lower and upper bound assessments of the project.

Table 5-8 Benefit Streams and Overall Benefit to Cost Ratio (Based on a 40-year evaluation period)

Benefit Stream	'Bottom End' Scenario ($M) unless otherwise stated	'Top End' Scenario ($M unless otherwise stated)
Crash cost savings	5.5M	5.5M
Cyclists' health benefits	72.2M	72.2M
General traffic travel time and bottleneck delay savings – Thorndon Quay Hutt Road	-87.8M	79.8M
General traffic travel time and bottleneck delay savings – SH1 + Alternative Routes	0	-105.8M
General traffic VOC savings	-0.6M	13.4M
Bus travel time savings	20.3M	20.9M
Bus reliability benefits	8.7M	8.7M
Pedestrian amenity benefits	1.7M	1.7M
Total Benefits (NPV)	**20.0M**	**96.4M**
Total Costs (NPV)	**54.8M**	**54.8M**
First-Year Rate of Return (FYRR)	**-0.7%**	**4.2%**
Benefit to Cost Ratio (BCR)	**0.4**	**1.8**

A BCR of 0.4 is considered to be conservative, as some diversion away from Hutt Road is to be expected, given the congestion that is predicted to occur (along Hutt Road) if no rerouting occurs. The travel time forecasts also do not reflect any significant mode shift (i.e. the demand assumed is fixed), which is also likely to result in an underestimate of economic benefits.

5.16.1.1 Wider Economic Benefits

WEBs refer to the indirect impacts of transport improvements on economic productivity and output that are additional to benefits that accrue directly to transport users. They may include agglomeration benefits brought about by providing a quality cycle route into Wellington and benefits from increased spend on accommodation, food, and other activities by tourists.

WEBs have traditionally not been measured for projects which provide bus lanes/ SVLs and walking and cycling improvements. This project is likely to support some WEBs, such as improved agglomeration economies and increased labour supply benefits, however, they have not been quantified. If they were included, this would only increase the BCR, it is therefore a conservative assumption to exclude these benefits. It should also be noted that LGWM are currently examining WEBs at a programme wide level.

5.16.1.2 Sensitivity Testing

Whilst the modelling and economics has used 2026 as the primary evaluation year, the transformational nature of the LGWM programme, and the resulting land use change in the CBD (i.e. more residential/employment use and less parking provision) is also likely to further encourage greater use of bus services. A number of other potential 'up-side' factors exist, with the expected wider network improved level of bus service, land use change, e-bike uptake, TDM tools like pricing and parking supply etc. It is likely therefore that the benefits of the whole (the LGWM programme) will be greater than the benefits from the sum of the parts (of which TQHR is just one part).

Sensitivity tests have been undertaken of the evaluation of the preferred option as per the modelled results (i.e. 'Top End' scenario only), and these are summarised in Table 5-9.

The sensitivity testing suggests that there is a strong likelihood that the recommended option would retain a positive BCR under the sensitivity testing scenarios considered. If there were greater benefits or reduced costs, an increased BCR can be achieved.

It is acknowledged that the connection to Te Ara Tupia is currently unfunded and is not provided for within the funded Ngā Ūranga to Pito-one project. This lack of connection could therefore potentially reduce the growth in the number of cyclists which have been assumed to use the TQHR project.

It should be noted that, even if multiple down-side risk materialised, such as lower growth in bus patronage, lower growth in cycle demand, or even slightly negative general traffic benefits, the BCR is likely to still remain above one. Conversely, a BCR well in excess of five could arise if multiple up-side risk materialised.

Table 5-9 Sensitivity Test Results – Impact on BCR

Sensitivity Test	BCR
Base BCR for 'Top End' Scenario (see Table 5-8)	1.8
95th Percentile Capital cost	1.6
High cycle growth / Low cycle growth	4.5 / 1.0
Bus patronage (+/-20%)	1.9 / 1.7
25% reduction in traffic diverting to SH1	1.5
60 year evaluation period	2.1
3% discount rate / 6% discount rate	2.1 / 1.3

5.16.1.3 Additional Sensitivity Test of Effect of Potential Changes in Trip Departure Time

The economic analysis has been undertaken based on the modelling outputs where there is no change in trip departure time for traffic travelling on SH1 (i.e. the 'Top End' scenario). The cost of this additional delay has been accounted for as part of the external delay assessment and added to SH1 traffic. However, in reality, these trips may be undertaken earlier or later than the current traffic flow profile in order to avoid the peak where SH1 is at capacity. An additional sensitivity test has therefore been undertaken such that trips are delayed to a time where there is no impact of external delays on the scheme (i.e. there is no additional cost associated with spreading the peak). This additional sensitivity test is summarised in Table 5-10.

Table 5-10 Additional Sensitivity Test for Trip Departure Time Changes

Benefit Stream	'Top End' Economic Analysis ($M)	No Costs Associated with Peak Spreading ($M)
Crash cost savings	5.5M	5.5M
Cyclists' health benefits	72.2M	72.2M
Non bus travel time and bottleneck delay savings – Thorndon Quay Hutt Road	79.8M	79.8M
Non bus travel time and bottleneck delay savings – SH1 + Alternative Routes	-105.8M	-53.2M
Non bus VOC savings	13.4M	13.4M
Bus travel time savings	20.9M	20.9M
Bus reliability benefits	8.7M	8.7M
Pedestrian amenity benefits	1.7M	1.7M
Total Benefits (NPV)	**96.4M**	**148.9M**
Total Costs (NPV)	**54.8M**	**54.8M**
First-Year Rate of Return (FYRR)	**4.2%**	**8.6%**
Benefit to Cost Ratio (BCR)	**1.8**	**2.7**

5.16.1.4 Additional Sensitivity Test of SH1 Travel Time Changes

Given the potential range of diversion for SH1 traffic, a further additional sensitivity test has been undertaken on the external delay for SH1 traffic required to result in a BCR of 1.0. The results of this additional sensitivity test is provided in Table 5-11. The indicates that on average approximately 150 seconds of external delay is required for all SH1 traffic is required to result in a BCR of 1.0. This equates to approximately a 35% additional travel time between the SH1/SH2 interchange and Hawkestone Street off-ramps during the modelled AM peak (6am-10am).

Table 5-11 Sensitivity Test of SH1 Travel Time Changes – Impact on BCR

Benefit Stream	'Top End' Scenario ($M)	SH1 Travel Time Increased to BCR=1.0 ($M)
External delay for SH1 traffic	*90 seconds*	*150 seconds*
Crash cost savings	5.5M	5.5M
Cyclists' health benefits	72.2M	72.2M
Non bus travel time and bottleneck delay savings	-26.1M	-52.9M
Non bus VOC savings	13.4M	0
Bus travel time savings	20.9M	20.9M
Bus reliability benefits	8.7M	8.7M
Pedestrian amenity benefits	1.7M	1.7M
Total Benefits (NPV)	**96.4M**	**56.1M**
Total Costs (NPV)	**54.8M**	**54.8M**
Benefit to Cost Ratio (BCR)	**1.8**	**1.0**

It is important to note that that average delay has been apportioned to all SH1 traffic during the modelled AM peak (6am-10pm), whereas, in reality this delay would only be experienced by those during the peak periods when SH1 is at capacity resulting in greater potential delays than stated for these vehicles.

It should also be noted that a 60-90 second increase in SH1 travel time, in the context of a 30-minute trip that has highly variable travel times on a day-to-day basis, is considered to be so small that it would not be perceived by the average road user. Conversely, if travel times were to increase by ten minutes for a journey that currently takes 20 minutes, then this would be material.

5.16.2 Investment Profile

When evaluating the investment case for this project, the GPS requires Waka Kotahi and those applying for Waka Kotahi funding to demonstrate how investment shows alignment with the outcomes and priorities sought through the GPS. The Waka Kotahi Investment Prioritisation Method (2021-24) has been used for this assessment.

5.16.2.1 GPS Alignment

Results alignment is an assessment against the outcomes sought from the GPS. There are four rating bands – Low, Medium, High, and Very High – each with criteria specific to the activity class. Given the multi-modal nature of the project. the improvements have been assessed against several activity classes including public transport, walking, and cycling. The results alignment is summarised in Table 5-12.

Table 5-12 GPS Results Alignment

GPS Strategic Priority	Assessment
Safety	**High** - The Recommended Option will provide both pedestrians and cyclists with dedicated facilities that will increase safety and improve the level of service and in effect attractiveness and convenience of these modes. This will contribute to eliminating pedestrian and cycling interactions with higher-speed traffic volumes and reduce the likelihood and severity of incidents.
Better travel options	**High** - An assessment of existing Level of Service and future Level of Service under the Recommended Option was undertaken to understand how the option will contribute to addressing several objectives including perceived deficiencies. The Recommended Option addresses these deficiencies as part of the design and process, and significant gaps prioritized for delivery.
Climate change	**High -** As detailed in the Economic Case, the Recommended Option is forecast to generate a growth in cycling numbers from the current situation.

5.16.2.2 Scheduling

Scheduling indicates the criticality or interdependency of the proposed activity or combination of activities with other activities in a programme or package or as part of a network. Table 5-13 shows the assessment against the Recommended Option.

Table 5-13 Scheduling Assessment

	Assessment
Criticality	Medium - Need to undertake this activity in order to deliver/ prepare for remainder of programme/package where its implementation is to begin in 2024 NLTP
Interdependency	Medium - Activity/combination of activities is part of a programme, package or another investment, but relies on the delivery of another phase or activity in the 2021 NLTP period before being actioned • Non-delivery of proposed activity in the 2021

5.16.2.3 Cost-Benefit Appraisal

The IAF 2018-21 classifies BCR ratings into the following bands:

- Low (BCR of between 1 to 2.9)
- Medium (BCR of between 3 to 4.9)
- High (BCR of between 5 to 9.9)
- Very high (BCR of 10 and above).

The preferred option has an overall BCR of between 0.4 and 1.8, classifying it as Low against these criteria if the 'Top End' scenario is assumed.

5.16.2.4 Overall Priority

The preferred option has been assessed as having a high results alignment in accordance with Waka Kotahi's IPM, scheduling assessment of Medium, and is forecast to have a low BCR rating. This gives the investment proposal a priority order rating of six in the improvement category scale of one to eight, placing the project with an investment profile of HM Priority 6.

6 Financial Case

The financial case outlines the costs and funding requirements for the preferred option of the TQHR project. It provides assurance that this option is affordable, considering all potential funding sources, and highlights what elements will be funded by the partnering organisations. A cost peer review has been undertaken on the findings presented.

6.1 LGWM Context

Following the development of the RPI for the LGWM programme in October 2018, financial analysis was undertaken by LGWM to understand if the full RPI was affordable in the medium term. While the full programme was supported as a long-term vision, this analysis showed it was not likely to be affordable and would need to be staged.

An Indicative Package (IP) of work was developed for the first stage of the programme, following discussion between the funding partners and the Crown. This IP represented a $3.7b capital investment and a $6.4b funding requirement including operating and financing costs (before accounting for Council financing costs) over 30 years.

In March 2019, the IP was endorsed by the Cabinet and in May 2019 the IP was announced by the Minister of Transport supported by the Mayor of Wellington and the Chair of the GWRC.

The March Cabinet paper anticipated detailed business cases would be developed. It made a range of assumptions which would need to be explored in more detail through the subsequent phases, including:

- A cost share of 60% central government and 40% local government
- The central government share was anticipated to come from the NLTF
- Financing was anticipated for the MRT project
- NLTF funding projections included petrol excise duty and road user charges increasing broadly in line with inflation over the 30 years.

6.1.1 Funding Partner Affordability

Due to the scale of the LGWM programme, and other financial pressures facing the partners, it is anticipated affordability will be reassessed at each phase as the programme progresses. The two funding partners, WCC and Waka Kotahi, will fund this project under the interim RFA arrangements being used.

The indicated total cost range exceeds the funding partners budgeted allowance. Both partners will need to confirm how and if this project can be funded.

The indicated costs do not include costings for any upgrades to the existing shared path connecting Hutt Road to Te Ara Tupua. None of the programme's funding partners have made budgetary allowance for this upgrade, so this element remains undeliverable without funding approval.

6.1.2 Financing

The LGWM programme is not the only funding pressure which funding partners have, and hence, funding partners will need to make wider decisions around their cashflow and financing.

For the projects within the three-year programme, of which the TQHR project is one, a central financing mechanism operated by LGWM programme is not intended to be used. This may be revisited as the programme progresses through later phases.

Therefore, the cash funding required of each funding partner will be provided, and it will be up to that partner to determine the financing arrangements for their own cashflow management, if any.

It is expected Councils will debt fund the next phase and Waka Kotahi use the NLTF on a pay-go basis.

6.1.3 Funding

The LGWM programme has completed a comprehensive inventory of funding tools in use across the globe. This includes funding tools which fall under the broad categories of “value capture” and “user charging”.

Any use of new funding tools will need to go through the appropriate approvals and in some cases legislative change. No decisions about any potential new funding tools are expected at this stage. It is expected that further investigations into new funding tools will occur ahead of the start of construction. This will involve investigating higher cost components of the programme, as part of clarifying the level of spend the funding partners can commit to.

The Council partners have included funding for the next phases of work expected over the next few years in their long-term plans using their existing rating tools. Sufficient pre-implementation costs are within the Council partners allowance, but implementation (and any upgrades to the connection to Te Ara Tupua) costs are not. WCC will need to confirm if implementation (and upgrades to the Te Ara Tupua connection) costs can be funded.

Waka Kotahi is expected to fund the central government share from the NLTF for the next phase of work. Insufficient funding has been allowed for the costs indicated in the SSBC and Waka Kotahi will need to confirm if both pre-implementation and implementation can be funded. Similarly, no allowance has been made for upgrades to the connection between Hutt Road and Te Ara Tupua.

6.1.4 Funding Partner Cost Shares

Project costs need to be allocated to funding partners, including each local Council (the split of which was not determined for each Council at the IP stage). This allocation sets out what each funding partner must fund and over what period. Cost shares may vary by phase (e.g. business case development, implementation and on-going). A final decision on cost allocation, across the programme, has not yet been made.

There is an explicit LGWM programme work stream to provide funding partners with analysis to assist them in agreeing on the more enduring arrangement for cost allocation. This analysis and partner agreement is expected to be developed using the SSBC analysis once preferred options have been identified. This cost allocation is expected to consider the implications for various groups, including who benefits and who should bear costs.

For the next phase of work the programme will use the interim agreed funding arrangement documented in Schedule 5 of the 2020 LGWM Relationship and Funding Agreement (RFA) to allocate cost shares to funding partners. The RFA is used to allocate costs to partners, on an interim basis, for early delivery programme. For pre-implementation and implementation costs the asset owner bears the project costs with normal FAR (Financial Assistance rates) applying. The split is 49%:51% WCC: Waka Kotahi. Property costs fall to the asset owner, so WCC will fund 100% of property costs.

6.2 Project Delivery Costs

A risk-based cost estimate has been prepared for the recommended option. The financial analysis for the project has been developed in accordance with the Waka Kotahi Project Cost Estimation Manual. The costs have also been subject to a parallel cost estimation review.

The cost estimate for the project in base year values (2021) is summarised in Table 6-1 and in more detail in the Cost Report in Appendix M. This shows that the project has a pre-implementation/ implementation cost in the range of \$55.3m (P50) to \$66.8m (P95).

Table 6-1 – Summary of Capital Costs

Description	Cost ($)
Property Costs	1,260,000
Pre-Implementation Costs	6,800,000
Base Implementation Fees	4,720,000
Base physical works	29,730,000
Total Base Estimate	**42,510,000**
Contingency (Analysed/Assessed)	12,753,000
Total Expected Estimate (P50)	**55,263,000**
Funding Risk (Analysed/Assessed)	11,550,520
Total 95th Percentile Cost Estimate (P95)	**66,820,000**

The estimate includes a notional $1.260m (base estimate) ($1.755m including contingency(P50) / $2.106m including contingency and an allowance for funding risk (P95)) for property acquisition in the vicinity of the Aotea Quay roundabout. The cost estimate excludes:

- GST
- Escalation from May 2021
- Major market fluctuations
- Central LGWM programme and cross-programme costs (i.e. costs shared across all projects during the business case development and implementation).

6.3 Ongoing Maintenance Costs

These ongoing maintenance costs are additionally captured in the programme level model to provide consistency of assumptions and take account of the additional maintenance cost imposed by the programme on partners and factor into the cost sharing arrangements.

Any lost parking revenue is excluded for this estimate. Who bears the on-going costs will be factored into the final cost sharing agreement between the LGWM partners.

6.4 Cashflow

Costs have not been scheduled in detail, at this stage. The anticipated cashflow for construction of the project is summarised in Table 6-2 (base estimate only). This projection assumes that construction starts in the financial year of 2022/ 23 and takes two years to complete construction.

Cash funding forecasts and requests to the funding partners will need to be developed further during detailed phase of the project. The timing of these funding requests should be manageable, given the relative size of this project to the funding partners' working cashflows.

Table 6-2 Project Capital Funding Plan ($ Millions)

	2022/23	2023/24	2024/25	TOTAL
Base Estimate	11,274,000	18,735,000	12,501,000	**42,510,000**

7 Commercial Case

The commercial case for implementing the preferred option involves commercial and financial analysis considering the capacity demand and attractiveness, accessibility and network linkages, affordability of delivering the option and the associated implications. The commercial case is underpinned by the implementation, procurement, and consenting strategies for the project.

7.1 Implementation Strategy

It is recommended that there is a robust pre-implementation phase to confirm procurement and the implementation strategy, including considering staging options if financial constraints dictate. There is a strong motivation, need and support for LGWM to deliver the project as soon as possible, and the implementation strategy will consider how this can be achieved most effectively and efficiently. The strategy will also consider how to gain community support for the project.

The project will need strong ongoing local support throughout implementation. Design and construction will need to commence within the 2021/ 24 NLTP funding round.

The primary activities to be undertaken during the pre-implementation phase are:

- Detailed design and construction support services
- Consenting and traffic resolutions
- Collaboration with Waka Kotahi regarding interface with the Te Ara Tupua Cycleway.

It is estimated that the project will have a construction period of no more than 30 months. This assumes that changes to Aotea Quay are constructed separately to improvements to Thorndon Quay and Hutt Road, in order to avoid unacceptable disruption to traffic operations.

7.2 Implementation Options Considered

Two main implementation options are likely to be practical:

- Full delivery of the entire project (with works on Aotea Quay being constructed separately)
- Staged delivery, such as constructing improvements to Hutt Road ahead of improvements to Thorndon Quay.

A staged approach provides an opportunity to decouple the risks associated with each stage, as delays or issues in one stage would not impact on the other. However, a staged delivery approach could take longer to construct, increases the risk that the project may not have the continuity, and could be more costly due to the doubling up of some services and materials. As such, with the exception of works on Aotea Quay, staged delivery is not recommended unless funding constraints dictate the need for this.

A single professional design, engineering and consents services supplier is recommended to be utilised for project. Pre-implementation services would have a duration in the order of twelve months from the award and will be required to provide design information to support the statutory applications.

7.3 Procurement Strategy

The procurement for the TQHR project is based on LGWM's Three-Year Programme Procurement Strategy, which has been developed by LGWM's Procurement Team. A key focus of the current procurement approach is to ensure the pre-implementation phase progresses with speed, so the LGWM programme timeline can be met.

7.3.1 Pre-Implementation Procurement Options

In accordance with LGWM's Procurement Strategy, the preference of procurement pathway options is to look to vary existing contracts where services are similar, prior to approaching the market.

The right to vary subsequent phases was signalled in the original SSBC contract, subject to a number of caveats (supplier performance, timing and expected cost of projects, market conditions approved funding). Outside of enacting this option, direct appointment of the pre-implementation phase is also a viable option, due to market conditions and the need to accelerate due to the construction start timeframes late-2022.

Improvements to Aotea Quay will be carved off from the TQHR scope and procured as a separate package to ensure the pre-implementation is progressed independently of the main contract.

WCC will be the Procuring Party and Principal for the pre-implementation contract. The recommended pre-implementation procurement pathway will be confirmed in a separate procurement memo to WCC's Delegated Authority.

7.3.2 Implementation Procurement Options

An initial assessment of delivery models indicates the project will likely be delivered via a variant of the Early Contractor Involvement (ECI) model. Suppliers will be selected based on quality and price through the Price Quality Method.

Aotea Quay will be delivered as a separate package to ensure early completion ahead of works on Hutt Road and Thorndon Quay.

The implantation procurement details are further outlined in LGWM's Golden Mile and TQHR Procurement Plan.

7.3.3 Interdependencies and Risks

The project shares some similar objectives to the Waka Kotahi Ngā Ūranga ki Pito-One (Ngauranga to Petone) shared path project, such as to improve active mode facilities, connections, and accessibility for a range of customers. There will be common stakeholders, and their delivery timeframes could be similar too. Whilst both projects will be delivered independently, there are opportunities and benefits for the project teams to collaborate to share information, ideas, learnings and expertise. There may be scope advantages to seek optimisation and collaboration between the two projects, subject to the confirmation of the delivery timing of the Ngā Ūranga ki Pito-One shared path project and any funding agreements.

7.3.4 Communication

The Procurement Plan for the project needs to be communicated to the supplier market. This will aid with obtaining early involvement of contractors both into the early design requirements as well as enabling them to plan adequately to resource the delivery.

An Advanced Notice was advertised on the Government's Electronic Tenders System (GETS) late August 2021 to advise of the upcoming procurement opportunity.

7.3.5 Contract Management

The contracts for pre-implementation and implementation shall be managed in accordance with WCC's standard for of contract.

7.3.6 Consenting Strategy

A consenting strategy has been prepared which identifies project consenting, statutory approvals, environmental considerations and key mitigation areas.

The strategy identifies that the works required to deliver the project will likely be permitted under the Resource Management Act 1991 (RMA). However, the disturbance of potentially contaminated soil could require resource consent under the National Environmental Standards for Assessing and Managing Contaminants in Soil for the Protection of Human Health (NESCS). The use of potentially contaminated soil could require resource consent under Rule 32.2.1 of the WCDP. A site-specific contaminated land investigation at detailed design will confirm this.

Traffic Resolutions and a formal review of speed limit changes will need to be prepared during detailed design.

Further public engagement and public participation on the proposed design will assist LGWM in determining how any adverse effects could be mitigated. It is also recommended that the detailed design is discussed with Mana Whenua to provide a better understanding of any potential cultural effects associated with the proposals.

7.4 Property and Land Acquisition

There is no property acquisition required, other than land to implement the proposed changes to Aotea Quay. A draft property agreement exists between WCC and KiwiRail for the original design of the Aotea Quay roundabout. The land is identified as being Crown land. Further assessments on property acquisition will be undertaken at pre-implementation.

8 Management Case

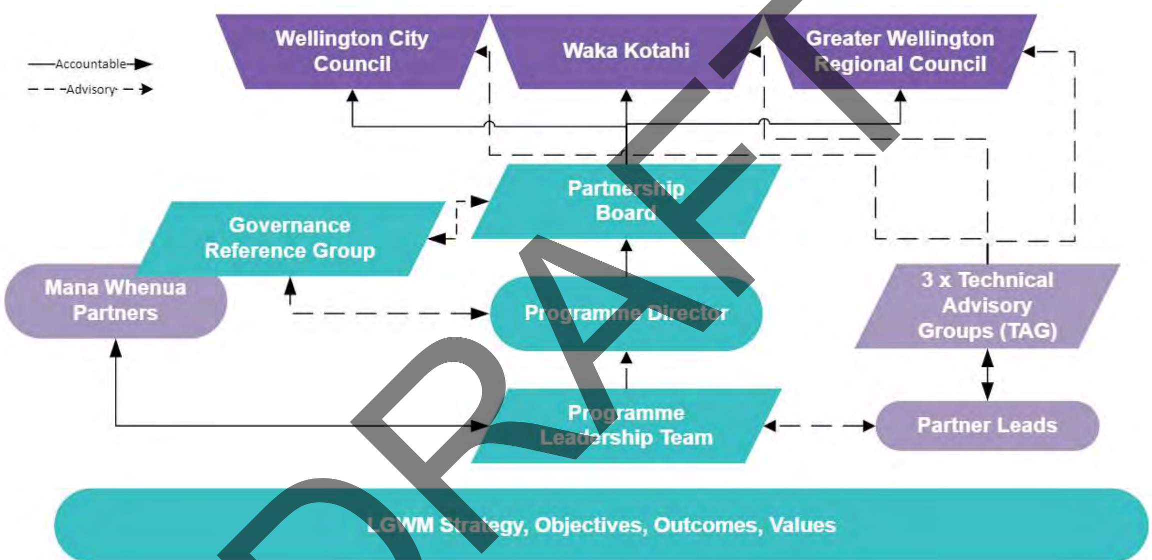
The management case addresses the achievability of the investment proposal and the planning management required to ensure successful delivery, and to manage project risk. It provides the proposed programme, intended governance structure and key project activities through to implementation. Within the broader intent of the project, the planning and project management will align with and adopt the practices within the LGWM programme.

This management case details the arrangements that will be put in place to successfully deliver the preferred option. These have been developed from the LGWM Programme that considers the planning, development and delivery elements of the TQHR project.

8.1 LGWM Governance and Management

The LGWM governance structure is set out in Figure 8-1.

Figure 8-1 LGWM Governance Structure



The LGWM Three-Year Programme Director reports to the Programme Director and is a member of the Programme Leadership Team. The Programme Director is responsible for overseeing the delivery of the LGWM programme.

The TQHR Project Manager reports to the LGWM Three-Year Programme Director and is responsible for the delivery of the project.

8.2 Implementation Programme

A construction phasing strategy will need to be developed during detailed design. Careful consideration will need to be given to the likely construction impacts of the project given the importance of keeping the TQHR corridor operational during the construction of works. As the only full diversionary routes available is the motorway, complete closure of the corridor will be extremely problematic. Works on Aotea Quay will be constructed separately from the works on Thorndon Quay and Hutt Road.

Night-time working will be considered, and may be a cost effective option for works at the Aotea Quay roundabout and some parts of Hutt Road, but is unlikely to be necessary for most of the works.

Consideration will need to be given at later phases of project to details of the vehicles permitted to use the SVL, the operational and enforcement arrangements, and how it will be delivered. Further traffic modelling will be undertaken to inform this matter.

An indicative programme, which is the basis of the Financial and Management Case, is summarised in Table 8-1.

Table 8-1 Project Programme

Activity	Completion Date
LGWM Board Approval of SSBC	Q1 2022
Detailed Design commences	Q1 2022
Apply for RMA statutory approvals (including traffic resolutions)	Q4 2022
Detailed Design complete and statutory approvals approved	Q1 2023
Construction starts	Q4 2022 for Aotea Quay and Q1 2023 for TQHR
Implementation complete (to practical completion)	Q1 2023 for Aotea Quay and Q1 2025 for TQHR
Implementation phase complete (including 1-year defects liability period)	Q1 2024 for Aotea Quay and Q1 2026 for TQHR

8.3 Ongoing Engagement

The development of a Communications and Engagement Plan for the pre-implementation and implementation phases of the project will form the starting point for ongoing engagement. There are diverse views and conflicting demands between different stakeholders that need to be reconciled. A high level of awareness of these potential interactions is necessary, particularly with the business community.

The project will continue with the approaches established to support this SSBC process, developing these further for the pre-implementation phase. These plans remain living documents and will be amended in response to information gathered through stakeholder, partner and community related engagement.

Key focus areas for ongoing engagement are to seek feedback on detailed design and highlight key changes or enhancements from a design perspective. As part of the implementation phase, it considers how the final design will be presented back and seeking additional feedback on how the proposed construction activities approach and timeframes would occur. It also provides for testing how well certain treatment and responses inter-play.

A number of the tools and processes established will be redeployed for future phases to address the concerns identified to date, particularly the pre-implementation phase, this includes:

- Briefings and presentations
- Updating the LGWM project webpage
- Distribution of information packs
- Advertising and hosting information sessions
- Preparation and distribution of media releases.

8.3.1 Other Projects

When detailed design for the project is progressed, liaison with the project team involved in engagement on a number of current projects, notably the Low Cost Low Risk projects on Ngauaranga Gorge, Single User Terminal and the City Streets project, needs to occur.

Consideration needs be given to catering for cycle movements to/from the Wakely Road path, and take into account previous investigations into the provision of raised tables at the SH2 intersection slip lane. Engagement with Waka Kotahi's safety team will also need to consider how best to address issues with drivers jumping the queue and turning left avoiding the slip lane across the path of cyclists in the detailed design phase.

8.4 Assurance and Acceptance

Waka Kotahi has documented processes and policies for independent road safety audits, design reviews, etc. These will be used where appropriate in detailed design.

8.5 Contract Management

Contract Management will be undertaken by the obligations set out in the relevant Contracts. These will combine requirements from both WCC and Waka Kotahi contracts as appropriate. On-going contracts will be procured by WCC on behalf of LGWM.

8.6 Cost Management

The LGWM Project Manager is responsible for on budget delivery and the services of a Cost Manager will be necessary during implementation to manage construction expenditure.

Financial management shall be undertaken in accordance with the relevant procedures. As a minimum the consultant/ contractor shall provide the following information in each month of the respective contract(s) for the LGWM Project Manager to update internal financial systems (e.g. SAP) and to support its claims:

- Budgeted cashflow
- Value of work completed in the preceding month and contract to date (including rates and quantities for all items within the contract)
- Forecast value of work completed and revised cashflow through to project completion
- Exception reports outlining the reasons for not meeting any financial targets.

The anticipated target performance measures, on a monthly basis, are that the claim should be within +/- 5% from the previous month's forecast and within the boundary of the agreed cash flow.

8.7 Project Risks and Mitigation Measures

Risk management is a dynamic process throughout the life of a project. A project risk register has been developed and regularly reviewed throughout the SSBC process to manage risks appropriately. This was undertaken in accordance with the General and Advanced Approach of Minimum Standard Z/44 of Amendment 8 of SM030. A risk workshop was held in February 2021 to identify and agree key risks to guide the development of the preliminary design. Project risks were populated as far as possible in real time during the workshop and then finalised following the workshop. A key output of this workshop was identifying and agreeing risks that stakeholders see as being of main concern.

Risk pricing has been undertaken in the @Risk software, using Monte Carlo analysis technique.

The preliminary design was developed following the Waka Kotahi Safety in Design (SiD) guidelines. A SiD workshop was held on 29 April 2021 during the preliminary design phase. A SiD register has been prepared and updated regularly and is included in the Design Philosophy report.

In the pre-implementation phase, it is likely that the majority of the technical risks associated with obtaining statutory approvals will be transferred to the professional service providers on award. The transfer of risk for detailed design and implementation phases will be determined in the project planning and the finalised in the Procurement Strategy.

The main risks associated with the project, and the current status of mitigation/ treatment, is contained in the risk register included in the PDPS in Appendix J and summarised in Table 8-2. A key risk is that the project cost exceeds the level of affordability.

Table 8-2 Key Project Risks

Risk	Rating	Risk Type	Treatment
Stakeholder	High	The perceived impacts of the project such as visual impacts, proximity to private property, concerns around on-street car parking removal could affect ongoing support for the project.	Ongoing engagement with stakeholders to understand concerns and continue to explore avenues to address community concerns
Financial	High	There is a risk that funding is insufficient for the project. This could be due to assumptions included in the estimate being incorrect; errors or omissions; and/or due to changes in market conditions (including potential Covid related supply chain issues).	Cost estimates have been developed in accordance with Waka Kotahi standards (SM014 and Z/44). Estimate have been independently assessed through a parallel estimate on commencement of detailed design
Operations/ Enforcement of Cycle lanes, bus Lanes and SVLs	Medium	There are risks associated with providing a safe and appropriate environment for a cycle lane and bus lane/SVL users associated with keeping customers informed and managing safe operations and access.	An Operations Plan will need to be developed in the pre-implementation phase. Further transport modelling will be done in detailed design to inform operational decisions of the SVL.
Design	Low	Partners not agreeing on sub-standard designs e.g. due to limited corridor width and range of strategic uses along the corridor.	Detailed design process to identify early on any impingements to design process by corridor width/required departures from minimum standards.
Design uncertainty	Low	There are several areas of uncertainty that require more attention at/before next phase - corridor operation, signal operation, any upgrades to the connection between Hutt Road and Te Ara Tupua and Jarden Mile signal operation and design, modelling revision, and freight in bus lanes.	Detailed design to address uncertainty issues.
Construction	Low	There is a threat that unforeseen issues are discovered during construction. A potential cause of this risk is that incorrect as-built information or insufficient investigation completed. The consequence of the threat is the project cannot be constructed in	Ongoing engagement and consultation with key stakeholders to present construction methodology and identify and resolve issues early. Communication with the public via open days, media coverage and

		accordance with the resource consent with associated delays, negative media coverage and additional cost	consultation to present construction methodology.
Modelling	Medium	Transport modelling identifies operational/safety issues that require late changes to design, causing additional late costs for rework or construction, unsafe solutions on the corridor, reputational impacts.	Review the intersection design model, design approach is agreed / compliance to required standards within limited corridor widths - gain approvals.

It is recommended that further work be undertaken to address these risks and maximise the successful delivery of the project in detailed design. The Project Manager will be responsible for managing project risk and will maintain the risk register. Risk will need to be managed in accordance with the LGWM programme management plan and will allow for any specific requirements for risk management planning and reporting.

It is anticipated that as part of pre-implementation phase, risk will be managed in accordance with the LGWM project risk framework. A risk workshop and comprehensive risk register will be developed and then maintained for the duration of the project. Risk activities include:

- Risk evaluation (matrix)
- Risk treatment and treatment planning
- Risk escalation, reporting and monitoring
- Integration with WCC's project management systems.

8.8 Change Control and Issue Management

LGWM has documented procedures on scope change with defined financial delegations. These change control will be adhered to during the delivery of the project. Escalation to LGWM project governance will be undertaken as required to ensure that any initiated scope change is given full value-for-money considerations.

Change control and issues register shall operate as an extension to the risk register and track issues as they arise. It is anticipated that a change control and issues management process will be included in the contract documents for the project. Change control and issues management will be undertaken in accordance with the:

- LGWM Programme Management Plan
- Conditions of contract for project-specific issues.

Each issue shall be logged in an issue register, which includes the following information:

- Title and description of the issue
- Date raised
- Status (open, escalated, transferred to the risk register, resolved)
- Primary impact area for the issue (project, personnel, health and safety, corporate risk, stakeholder management etc.)
- Delegated authority for closing out the issue
- Whether the issue is a project-specific issue or another issue
- Level of significance
- Whether the issue requires transferring to the project risk register

- Remedial action proposed to address the issue
- The date that the issue has been resolved.

8.9 Benefits Realisation and Performance Management

Table 8-3 shows the proposed Benefits Realisation Management Plan. This is aligned to the LGWM Programme plan. It is expected that benefit owners form part of the existing partner group, therefore for consistency, it is proposed that the approach for measuring and realising benefits through and post the project is agreed at pre-implementation phase.

Consideration should be given to integration of benefits realisation reporting with existing reporting and the reporting of other projects being implemented on or adjacent to the TQHR corridor. Reporting of the proposed SVLs, which are a relatively new concept for New Zealand, will be valuable for the wider industry to understand.

Table 8-3: Benefits Management Plan

KPI Measure	Baseline	Expected Outcome	Monitoring	Achieved by
Increase demand for bus services by 2026 and the speed of bus services by 2026.	950 passengers in the morning peak 2-hour period (southbound); 1,000 passengers in the evening peak 2-hour period (northbound)	1,000 in the morning peak 2-hour period (southbound); and 1,100 in the evening peak 2-hour period (northbound)	Post-implementation via boardings data	2026
Increase demand for bus services by 2026 and the speed of bus services by 2026.	14 minutes travel time in the morning peak 2-hour period (southbound); 9 minutes travel time in the evening peak 2-hour period (northbound)	Reduce bus transit times by 5 minutes in the morning peak 2-hour period (southbound) and by 1 minute in the evening peak 2-hour period (northbound)	Post-implementation via journey time data	2026
Improve Level of Service for non-car modes by 2026.	▪ Baseline Walking LoS D ▪ Baseline Cycling LoS F ▪ Baseline Cycling Demand on Thorndon Quay of 300 -1,600/day	▪ Walking – LoS (C on Hutt Road; C/D on Thorndon Quay (Northbound/Southbound) ▪ Cycling LoS (F/B on Hutt Road; F/C on Thorndon Quay). ▪ Cycle Demand on Thorndon Quay of 1,200-3,000/day	Post-implementation qualitative assessment / Cycle demand surveys	2026
Reduce the safety risk along Thorndon Quay and Hutt Road for all road users by 2026.	▪ Baseline for vulnerable users is 2.6 DSI crashes per year ▪ Baseline for all vehicles is 1.5 DSI crashes per year	▪ Reduce vulnerable user DSI crash risk by 20% within ten years using measures aligned with Safe System Principles. ▪ Reduce Vehicle DSIs by 10% within ten years using measures aligned with Safe System Principles.	Post implementation review of CAS data	2026
Amenity index/ Healthy Streets index aligns with Movement	▪ Baseline for Thorndon Quay is M3/P1 in the Movement and Place Framework.	▪ Thorndon Quay to be M3/P2 in the Movement and Place Framework by 2026	Post-implementation qualitative assessment of amenity /	2026

KPI Measure	Baseline	Expected Outcome	Monitoring	Achieved by
Framework criteria for Thorndon Quay by 2026.	▪ Pedestrian demand on Thorndon Quay of 2-3,000 per day	▪ Pedestrian demand on Thorndon Quay likely to be 30-50% higher	pedestrian demand surveys	
Maintain truck travel times between Jarden Mile and Aotea Quay off ramp by 2026	▪ Baseline: 7 minutes travel time in the morning peak 2-hour period (southbound); 5 minutes travel time in the evening peak 2-hour period (northbound)	▪ Maintain truck travel times.	Post-implementation via journey time data	2026

8.10 Lessons Learned

Lessons learnt from the project will be fed back into the LGWM project development and delivery lifecycle through several mechanisms and levels of project and LGWM management. It will be the responsibility of the LGWM project manager for this SSBC to complete these reviews with the respective suppliers.

8.11 Reporting Arrangements

The project will be required to report weekly into the LGWM programme through all future phases of development and delivery. Reporting and information transfer is covered with the project management plan, namely: schedule, cost, risk/ issues, health and safety, resourcing, and benefits. On a monthly basis the project manager will provide updates.

8.12 Next Steps

The following elements have been identified as the key next steps for the project:

- Confirming endorsement of the SSBC for the TQHR project
- Procurement of services and progress with pre-implementation, and implementation of the Recommended Option, with an initial focus on critical path activities including land acquisition and statutory approvals
- Engagement with owners and occupiers of properties regarding the proposed changes and engagement feedback
- Undertaking detailed design, including details of accessways and turning points
- Consideration of consider all of the community engagement feedback received and use it to inform the preferred option detailed design
- Engagement with the teams and governance bodies delivering parallel projects which may impact on this project, in particular the Single User Terminal for work on Aotea Quay
- Further modelling/analysis on the potential use of SVLs on Hutt Road prior to implementation
- Confirming the bus lane/SVL times of operation

Appendix A

Connection to Te Ara Tupua

8 February 2022

Thorndon Quay and Hutt Road The Connection

SSBC Addendum

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1 Introduction

The scope of this addendum involves the consideration of options for improving the interface between two shared path projects to be constructed in the near future, the Let's Get Wellington Moving Thorndon Quay and Hutt Road project (TQHR), and the Waka Kotahi Ngā Ūranga ki Pito-one (Ngauranga to Petone) shared path. The two paths will connect together, but the current configuration will not cater for the increased number of users. The assessment has been undertaken utilising the business case approach in order to understand the key problems to be addressed, and the relative performance of each of the options.

Currently the scope excludes the consideration of urban design, crime prevention through environmental design, and accessibility elements. These will be included in the scope for the following phase to ensure that 'The Connection' aligns with the overall vision for Te Ara Tupua, and meaningful engages with mana whenua through the partnership mechanisms in place through the Let's Get Wellington Programme, and the Ngā Ūranga ki Pito-one delivery alliance.

The Thorndon Quay and Hutt Road project is being delivered under the Let's Get Wellington Moving programme and will deliver corridor improvements for bus public transport and active mode travel to and from the central city. The Hutt Road section of the project starts at the Ngā Ūranga (Ngauranga) intersection just before where the entrance to the Ngā Ūranga ki Pito-one (Ngauranga to Petone) shared path would be created. The current estimated construction start date for the Thorndon Quay and Hutt Road project is 2022.

At the eastern side of the Ngā Ūranga intersection is the start of the Ngā Ūranga ki Pito-one shared path, currently being designed and delivered by the Te Ara Tupua Alliance. The shared path provides for a new foot / cycle bridge across the rail corridor to access the shared path on the seaward side of the rail line. Construction for this project is estimated to be completed in 2025.

The purpose of this Addendum is to consider 'The Connection' between the two projects, as currently the two active mode paths in each project connect to each other, but the standard of the access will not accommodate the forecast user demand. The location under consideration is shown in Figure 1. It includes parts of the scope area for the Thorndon Quay and Hutt Road project and the Ngā Ūranga ki Pito-one shared path where they will interface. The wider importance of 'The Connection' for these shared paths is illustrated in Figure 2.

Figure 1: Scope area

Figure 2: Project Interface with the Thorndon Quay and Hutt Road (labelled Wellington to Ngā Ūranga) and Ngā Ūranga ki Pito-one projects

2 Context

2.1 Thorndon Quay Hutt Road Project

The Thorndon Quay and Hutt Road Single Stage Business Case (SSBC) has considered the best options for the corridor to facilitate growth in bus and active mode travel to / from and through the central city, whilst also accommodating the many people who live and work in the area. Thorndon Quay and Hutt Road is a critical commuter route; it's the busiest bus route outside of the city centre and the busiest cycle route in the city with more than 10,000 bus passengers and up to 1,300 cyclists on an average weekday.

The Thorndon Quay and Hutt Road project (TQHR) begins just north of the Lambton Quay bus interchange on Thorndon Quay and runs for approximately 1km north to the intersection with Tinakori Road where Hutt Road begins. Hutt Road runs parallel to State Highway 1 and the railway corridor for approximately 4km to the bottom of the Ngā Ūranga Gorge where State Highway 1 and 2 splits (Ngā Ūranga intersection).

With growing numbers of people living and working in Wellington City, the northern suburbs and Hutt City, more people will soon be using Thorndon Quay and Hutt Road to commute by bus / public transport, active modes, and private vehicles. Within the next 30 years, another 130,000 to 200,000 people are forecasted to live in the Wellington Region.

The key objectives for the Thorndon Quay and Hutt Road project include:

- Improving the level of service for bus public transport and providing capacity for growth
- Improving the level of service and reducing the safety risk for people walking and cycling along and across Thorndon Quay and Hutt Road
- Reducing the frequency and severity of crashes
- Improving the amenity of Thorndon Quay to support the current and future place aspirations for the corridor / area
- Maintaining similar access for people and freight to and from the ferry terminal.

2.2 Te Ara Tupua

Te Ara Tupua consists of upgraded walking and cycling facilities between Wellington and Melling in Hutt City and will enable more people to walk and cycle along the Hutt Valley and Wellington transport corridor. The key projects include the walking and cycling upgrades along Thorndon Quay Hutt Road, the new shared path from Ngā Ūranga to Pito-one, and the Pito-one to Melling cycle path (Figure 2).

The improvements along Thorndon Quay and Hutt Road will play a part in helping connect the central city from the Ngā Ūranga interchange area for active modes and bus public transport. With the forecasted growth in cycling (facilitated further through the evolution of e-bikes), walking, micro mobility devices such as e-scooters, and bus public transport use over the next 30 years, the changes to Thorndon Quay and Hutt Road will facilitate the additional capacity for active modes and public transport to accommodate this growth in population and commuting trips. This project will also help to achieve Let's Get Wellington Moving's vision of moving more people with fewer vehicles.

The Ngā Ūranga to Pito-one section of Te Ara Tupua will be built on the harbour's edge from Ngā Ūranga to Honiana Te Puni Reserve in Petone connecting to the Pito-one to Melling section (currently under construction) with a new foot / cycle bridge crossing over the rail lines north of Ngā Ūranga interchange. Funding has recently been approved, and Te Ara Tupua Alliance has been formed to design and construct the project. The project is forecast to be open by 2025.

By 2035, it is estimated that there will be on average over 2800 trips undertaken by bike on the path each weekday, as well as 465 walking or running trips and around 290 trips on e-scooters or other devices. By 2050 it is estimated that there will be on average over 3,800 trips by bike on the path each weekday, 630 walking or running trips and 500 trips on e-scooters or other devices. Recreational use will see even more people walking, running and enjoying the path at weekends. The growing use of e-bikes is expected to contribute additional users classed as cyclists using the shared path due to e-bikes being used for longer commuting trips and the tendency for e-bike owners to bike longer distances and take more trips per week (compared with conventional cycle owners).

2.3 The Connection between Ngā Ūranga ki Pito-one and TQHR

Linking the Ngā Ūranga to Pito-one section with the upgraded active mode facilities proposed on Hutt Road is key to ensuring a safe and seamless transition between the two projects. The interface between the two projects when completed will not be of a standard to cater for the increased number of users.

Once Ngā Ūranga to Pito-one is constructed and the changes to Thorndon Quay and Hutt Road are implemented, there will be several significant changes to how people travel through the area. The shared path will permit two-way travel by pedestrians and cyclists along Hutt Road, and Ngā Ūranga to Pito-one. This will significantly reduce any demand for cyclists to travel along SH2 north/southbound using the shoulder. It also means that the current configuration which only provides for southbound cyclists to enter Hutt Road will be a significant constraint for a two-way continuous shared path.

2.4 Current Location Configuration

The area where the two active mode paths will join is complex as shown in Figure 3. Currently the separated cycle path alongside SH2 south exits alongside the SH2 southbound offramp and people cycling can continue along Hutt Road along the existing shared path or must negotiate the junction area to travel to the shared path that runs along the highway to the north.

The lane configuration from SH2 is a single exit off ramp that then splits into three lanes. These lanes pass under the overbridge with the left lane providing a dedicated free left turn onto Hutt Road. The other two lanes end at a signalised intersection allowing traffic to enter SH1 northbound towards Johnsonville, Jarden Mile and/or back onto SH2 towards Petone.

Located off Hutt Road and near to the SH2 southbound offramp, is the entrance to a stock effluent disposal facility. The facility is available for disposing of stock effluent, and effluent from self-contained campervans. An underpass provides access to the effluent disposal facility on the seaward side of the state highway(s). Vehicles using the facility then circle back to the SH2 southbound offramp. It is a popular facility as it is the only effluent disposal site in Wellington, and is used prior to accessing the ferries, or the port.

Ngā Ūranga is a key industrial and commercial land-use area. Due to demand, a bus stop is located immediately beside the stock effluent disposal facility entrance on Hutt Road (southbound) and the Ngā Ūranga train station is located on the seaward side of the stock effluent disposal facility site. This bus stop is serviced by both Wellington northern suburbs and Hutt Valley to Wellington City services. The train station is serviced by the Hutt Valley and Melling train services.

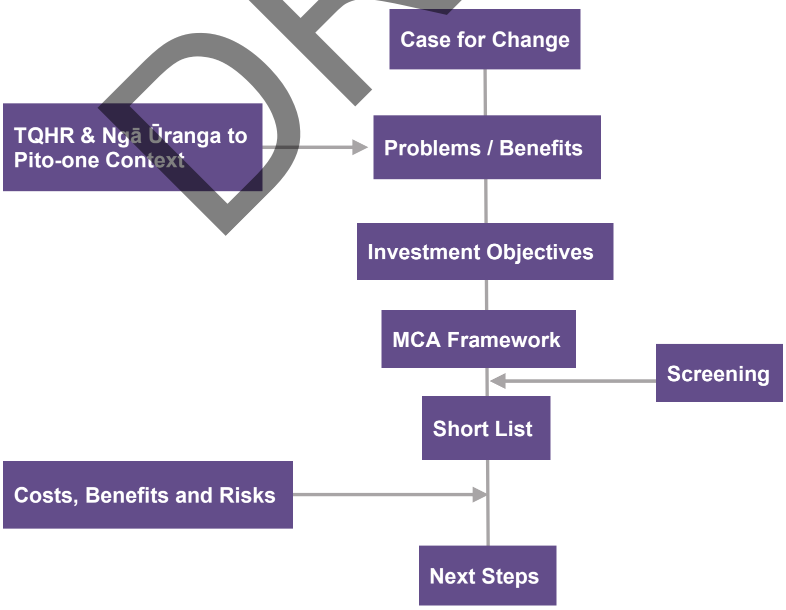
No parking is available at the Ngā Ūranga Station. Pedestrians need to access the station by following the existing Hutt Road shared path, under SH2 / alongside the SH2 Ngauranga southbound offramp. The path extends to a subway that provides access to the station platform underneath the up main rail line.

Figure 3: Current Site Arrangement

2.5 Process

The process for undertaking this business case assessment is outlined below in Figure 4.

Figure 4: Process Chart



3 The Connection Problems, Benefits and Project Objectives

3.1 Key Problems

Three key problems were initially identified with the Let's Get Wellington Moving Technical Advisory Group to be addressed for 'The Connection': These identified problems with reduced active user demand resulting from the poor state of the facility, increased safety risk due to the difference in speed between people cycling and pedestrians, and safety risks with the conflicting uses in the project area. These three problems had similar characteristics that ultimately impacted active mode user demand and so they were consolidated into a single problem statement:

Key Problem - The current state of the existing active mode facility combined with the variability in speeds between active modes and vehicle access results in increased conflict between users, increases real and perceived safety risk and limits attractiveness to increase volumes of active mode users.

The evidence supporting this problem statement is summarised below.

a. **Current Standard of the facility**

A review of the Crash Analysis System data for the previous five years that showed one on-road minor injury crash involving a person cycling on the road in the area. There was one other recorded non-injury active mode crash within the area of 'The Connection' on the current path, or the shared path along Hutt Road. It is expected that incidences could be higher due to under-reporting for crashes on these facilities.

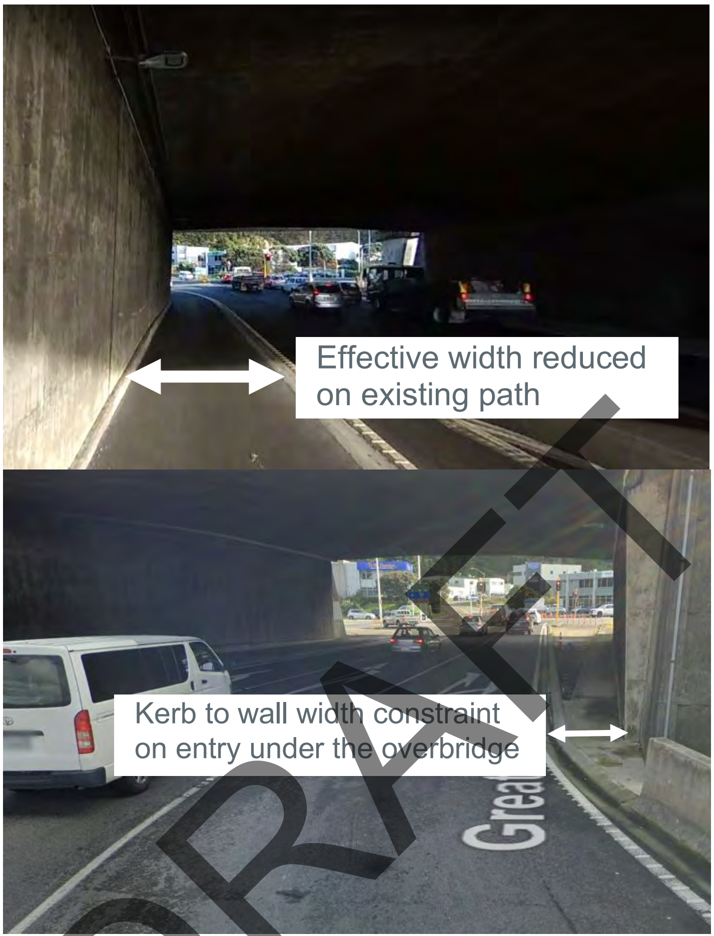
The area linking the Thorndon Quay and Hutt Road shared path and the Ngā Ūranga to Pito-one shared path is a significant constraint for the forecasted volumes of users. The existing path under the SH2 overbridge at Ngā Ūranga is too narrow for bi-directional travel of high volumes of people cycling with an effective width less than 2.5 metres due to the retaining wall and the traffic lanes running parallel to the path (Figure 5).

For a regionally significant shared path with anticipated high future use, the current effective width is significantly less than the typical widths specified in the Austroads standards of between 3.0m and 4.0m and wider where the numbers of cyclists and pedestrians are very high or there is a high probability of conflict between users (e.g., people walking dogs, in-line skaters etc).

This constraint escalates the perceived and real risks of using the shared path to connect and maintain a continuous shared path. The risk has the potential to limit the attractiveness of the facility for new users.

Figure 5 also shows the constraint on the northeast side of the overbridge. A path previously located on the northwest side of the overbridge has been closed and removed because of the safety risks. The safety risk was exacerbated by the narrow width between the kerb and the wall on the northeast side of the overbridge. This width constraint is a key consideration in the identification of suitable options as this will limit the extent to which lane width can be configured under the overbridge.

Figure 5: Width Constraints Under SH2 Overbridge



b. Difference in Speeds

Due to the range of users that will be permitted to use the shared paths, the constrained area along 'The Connection' will create a significant risk for different users on the shared path. The mix of users will result in a speed range averaging for pedestrians at 4-5km/h, cyclists at 15-35 km/h depending on ability, e-bikes and other micro mobility devices such as e-scooters and e-skateboards at 20-40 km/h, and mobility scooters at 12-15 km/h. These speed differentials, combined with the constrained environment at the Ngā Ūranga intersection increases the perceived and real safety risk of the existing narrow path, that may discourage future users.

c. Conflict Areas

The area is complex and is a high conflict area noting the forecast number of users of the new shared paths and vehicles travelling through to access key destinations. The key destinations include the stock effluent disposal facility, the existing bus stop (Figure 6), Ngā Ūranga Station, Jarden Mile businesses and for KiwiRail work vehicles requiring access to the sidings along the Hutt Valley Line, in addition to the SH1 / SH2 interchange. With the forecast growth in users along the shared paths, the level of conflict will increase with the exposure risk for active modes increasing.

The evidence highlights the complex nature of the area around 'The Connection', as well as the key changes to be implemented through changes to the shared paths. This complexity results in a significant amount of conflict that could deter new users and impact the safe and efficient use of the shared paths at 'The Connection' point between Hutt Road and the Ngā Ūranga to Pito-one project.

Figure 6: Bus Stop, Entrance and Exit for the Stock Effluent Disposal Facility

3.2 Benefits

The key benefit of successfully investing to address these problems with 'The Connection' have been identified as:

- Improved safety and perception of safety for all users, which is a catalyst for increased active mode users, and thus active mode share.

In achieving this benefit two following benefits aligned to the Thorndon Quay and Hutt Road, and Ngā Ūranga to Pito-one projects will also be enhanced:

- Health benefits from increased active mode share.
- Resilience benefits from creating an additional transport link (additional to the existing road and rail modes) that could also be used in emergencies.
- Access to Public transport (rail via Ngā Ūranga station and bus stops on Hutt Road) between the Hutt Valley, Wellington CBD and locations further north via the Ngā Ūranga Gorge.

4 Evaluation Criteria

4.1 Investment Objectives

In order to effectively assess the different options available for 'The Connection' the following investment objectives were developed:

Investment objective 1: To increase the number of active mode users between Wellington and the Hutt Valley by improving the level of service and perceived safety for active modes;

Investment objective 2: Improve Safety for all users;

Investment objective 3: To improve the connections and integration of active mode infrastructure to public transport and the strategic cycling and walking networks.

These align with the objectives for the Thorndon Quay Hutt Road project:

4.2 Critical Success Factors

In developing and assessing the options for 'The Connection' several critical success factors were identified. These were considered alongside the Investment Objectives as outcomes to progress further for assessment.

- Maintain access to the stock effluent disposal facility and Ngā Ūranga Station area.
- Ensuring that the queue length of the SH2 southbound offramp does not reduce the safety for vehicular drivers.
- Ensure the timing of improvements to 'The Connection' is coordinated with other wider network improvements, such as Aotea Quay Roundabout, Te Ara Tupua etc, as the network will be operating differently on their completion.

4.3 Other Criteria

To ensure consistency of evaluation with the LGWM programme the following additional criteria were included in the evaluation:

- Social, environmental and economic effects.
- Feasibility / delivery / operational characteristics.

4.4 MCA Scoring Methodology

To assess the merits of each option, a multi-criteria analysis was undertaken scoring all the related criteria against identified options. For this assessment a scoring scale of -5 to +5 was used with the guidance in Figure 7 provided to inform the score. Where the benefits truly are marginal and not differentiators, then a score of 2 across options was justified. Scores were then moderated in a workshop to ensure consistency.

Figure 7: MCA scoring guidance

Score	
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/ long term / permanent

5 Options Development

5.1 Options Identification

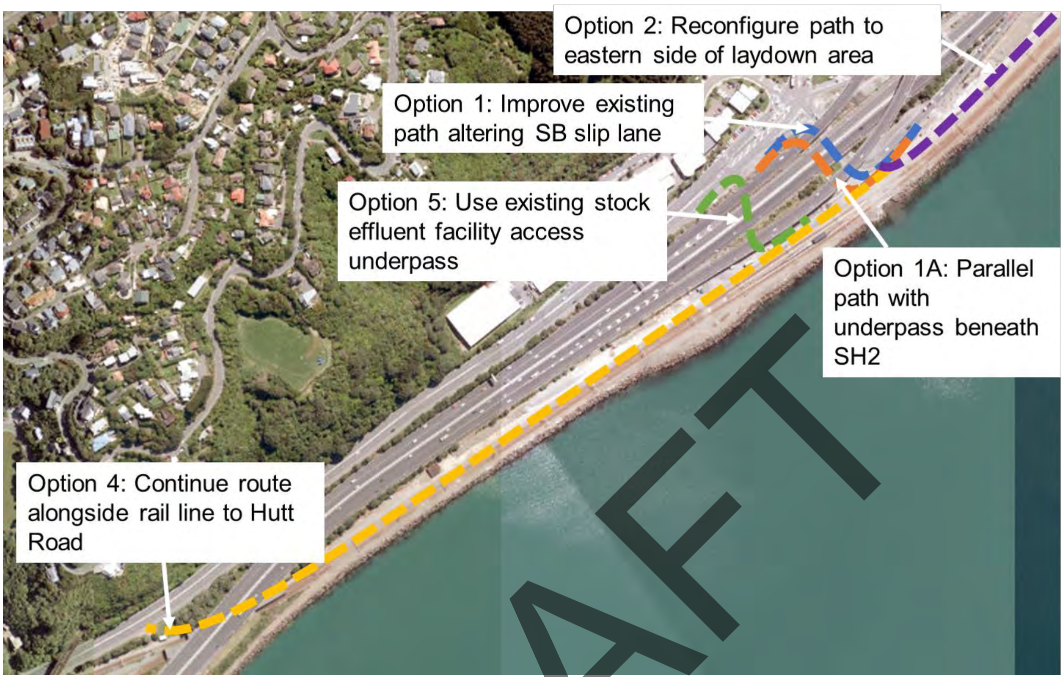
An initial longlist of options was considered, noting that significant changes to the Ngā Ūranga to Pito-one section of Te Ara Tupua were excluded as it has been consented based on its current design. The Do Minimum option for this project was leaving the current link unchanged, or a ‘do nothing’ option. The options are summarised in Table 1 and shown in graphically in Figure 8.

Table 1: Options considered

Option	Description
Option 1	Improve existing path through altering the existing SH2 southbound offramp slip lane onto Hutt Road
Option 1A	New parallel shared path with underpass beneath the state highway
Option 2	Proposed shared path on the eastern side of the laydown area with tie-in into the Ngā Ūranga to Pito-one overbridge, and either the improved existing path on the southbound slip lane (Option 1), or the underpass beneath the state highway (Option 1A).
Option 4	Continue proposed shared path alongside rail line to Hutt Road

Option 5	Use existing stock effluent disposal facility access

Figure 8: Options considered

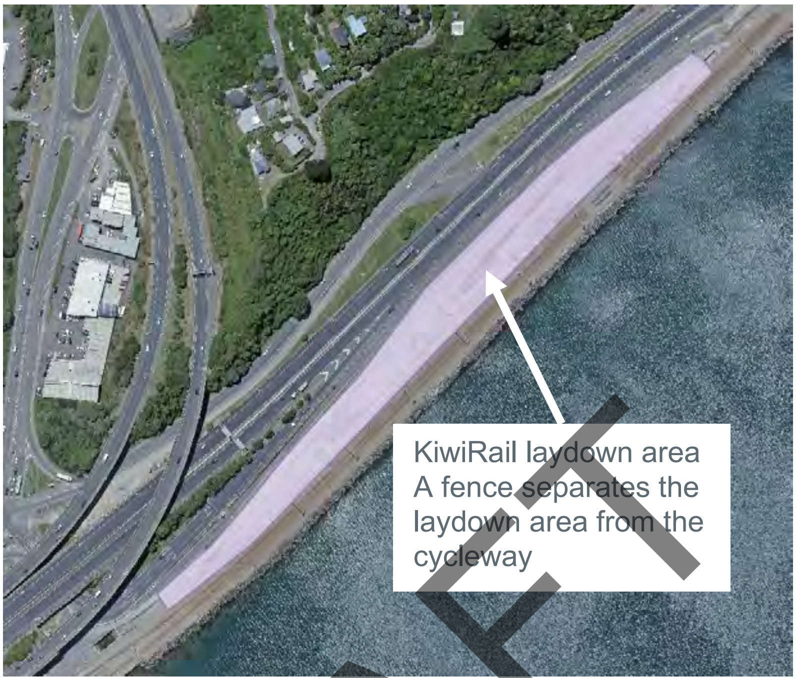


Within these five initial options different permutations for the alignment and facilities were considered (refer to Appendix A). These were generally considered as a different sub-option in order to understand the benefits and risks for each sub-option.

Common elements of all options include:

- Adopt a 4m safety zone running parallel to, and measured from, the centre of the closest rail line plus a 3m wide maintenance track for KiwiRail maintenance vehicles.
- That the existing KiwiRail laydown area will remain operational. This laydown area provides KiwiRail with land within the rail designation to store materials, equipment etc for rail activities. This is shown in Figure 9.
- Have lighting to P3 standard, which is similar to the lighting of SH2, with pole heights in keeping with Te Ara Tupua, Petone to Melling shared path projects and the Thorndon Quay Hutt Road project.
- Provision for CCTV to ensure safety for people using the area.

Figure 9: KiwiRail Laydown Area



5.2 Options Assessment

5.2.1 Multi-criteria Analysis

To undertake the multi-criteria analysis a Lead Assessor and Subject Matter Experts were assigned to each of the assessment criteria. The assignment of the Lead Assessor and Subject Matter Experts were based on their expert knowledge for the assessment criteria, and knowledge of the project area. The people engaged were drawn from Let's Get Wellington Moving, Waka Kotahi, Greater Wellington Regional Council, Wellington City Council, as well as the Beca and AECOM consultant team.

Key considerations for scoring each assessment criteria were provided for guidance. This was to ensure consistency of approach when scoring, but also to highlight what key considerations could affect the scores assigned to each option. The scores assigned to each of the options is included in Appendix A.

The multi-criteria criteria analysis was undertaken using several steps:

1. A meeting was held with all assessors to brief them of the project and the requirements for scoring.
2. The assessors then went and scored the options independently.
3. A workshop was held for the assessors to discuss the scoring, the reasons why they gave that score and to seek other feedback from the representation at the workshop to moderate and finalise the score.

The moderation workshop was held with representatives from Let's Get Wellington Moving, Waka Kotahi, Greater Wellington Regional Council, Wellington City Council, KiwiRail, Mana Whenua, Beca, and AECOM on the 1st September 2021. The purpose of the workshop was to obtain a moderated score across the different criteria for the options being considered.

Taking both the Lead Assessors and Subject Matter Expert's scoring into account by averaging the score between them for each category and each option, gave the following ranking shown in Table 2 using the overall score from highest to lowest.

Table 2: Multi-criteria analysis ranking

Rank	Option	Score
1st	Option 1 Lane space reallocation	8
2nd	Option 1A New shared path underpass	3
3rd	Options 2 and 2A Shared path on the eastern side of the KiwiRail laydown area	-10
4th	Option 4 Continue route alongside rail line to Hutt Road	-11
5th	Option 1C Slip Lane remains open. (a sub-option of Option 1 reducing cost of slip road retaining wall alterations).	-12
6th	Option 5 Use existing stock effluent disposal facility access	-35

5.2.2 Fatal Flaws Assessment

As part of the assessment of the various options the partners to the business case identified fatal flaws in some of the initial options, which excluded them from further assessment. The options where fatal flaws were identified are summarised in Table 3.

Table 3: Options Excluded

Option	Reason for exclusion
Options 2 and 2A Shared path on the eastern side of the KiwiRail laydown area	Options that generally impacted the KiwiRail laydown area, either through a reduced area for operation, or impedance for KiwiRail equipment and vehicles were considered a fatal flaw. KiwiRail indicated that separation of their laydown area from the rail tracks by the cycleway was not acceptable operationally and for land ownership reasons.
Option 4 Continue route alongside rail line to Hutt Road	This option would require use of the tunnel at the southern end to connect shared path users with Hutt Road. However, on the basis of KiwiRail wanting to use the tunnel at the south end for bringing together the upmain and downmain lines, the conflict with shared path users would be too great to overcome and was discounted.
Option 5 Use existing stock effluent disposal facility access	This option was not considered feasible. The current geometry of the underpass is too narrow to safely accommodate both heavy vehicles and campervans, and shared path users. These safety concerns were considered too great to overcome unless the stock effluent disposal facility was moved to an entirely new location, which is also considered to be unfeasible due to the extreme difficulty in finding a new location suitable for this type of facility.

5.2.3 Short-list Options

On the basis of the MCA analysis, and the views of KiwiRail on the impacts on their operations, two short-list options were identified, being Options 1 and 1A. During the cost estimating process of these options, a third option (Option 1D) was identified, which was a variation to Option 1, resulting in a reduction in cost to Option 1.

i. Options 1 – SH2 southbound offramp lane space reallocation

The reallocation of lane space on the SH2 southbound offramp (reference Option 1) would provide additional width for a bi-directional shared path connection with the Ngā Ūranga to Pito-one shared path through the closure of the dedicated left-hand turn lane on the SH2 southbound offramp. This lane area would be reallocated to shared path users, increasing the current effective width under the overbridge to meet current standards. Some widening would be required for the existing cycle path in order to accommodate the width for a bi-directional shared path. The existing egress from both the stock effluent disposal facility, and the KiwiRail laydown area would be consolidated into a single lane egress.

ii. Option 1A – New shared path underpass

The second option (reference Option 1A) would install a new underpass beside the existing path under the state highway overbridges for connecting the shared paths. Some widening on the rail side would be required to the existing SH2 cycle path, adjacent to the SH2 southbound offramp, in order to accommodate the width of a bi-directional shared path. The egress for the KiwiRail layover area would be moved to the southern end of the site. The existing lane configuration on the SH2 southbound offramp would remain unchanged.

iii. Option 1D – Lane space reallocation

Option 1D is a variation to Option 1 in that the space required for widening the existing path adjacent to the SH2 southbound offramp would come from land on the rail side of the existing path, thereby negating the need to relocate an existing gantry and to re-build an existing retaining wall. Closure of the dedicated left turn lane on the SH2 southbound offramp would still be required.

The concept drawings for Option 1, Option 1A and Option 1D are shown below in Figure 10, Figure 11, and Figure 12. These concept drawings can be viewed in more detail in Appendix C.

Figure 10: Option 1 - Improve existing path altering SB slip lane

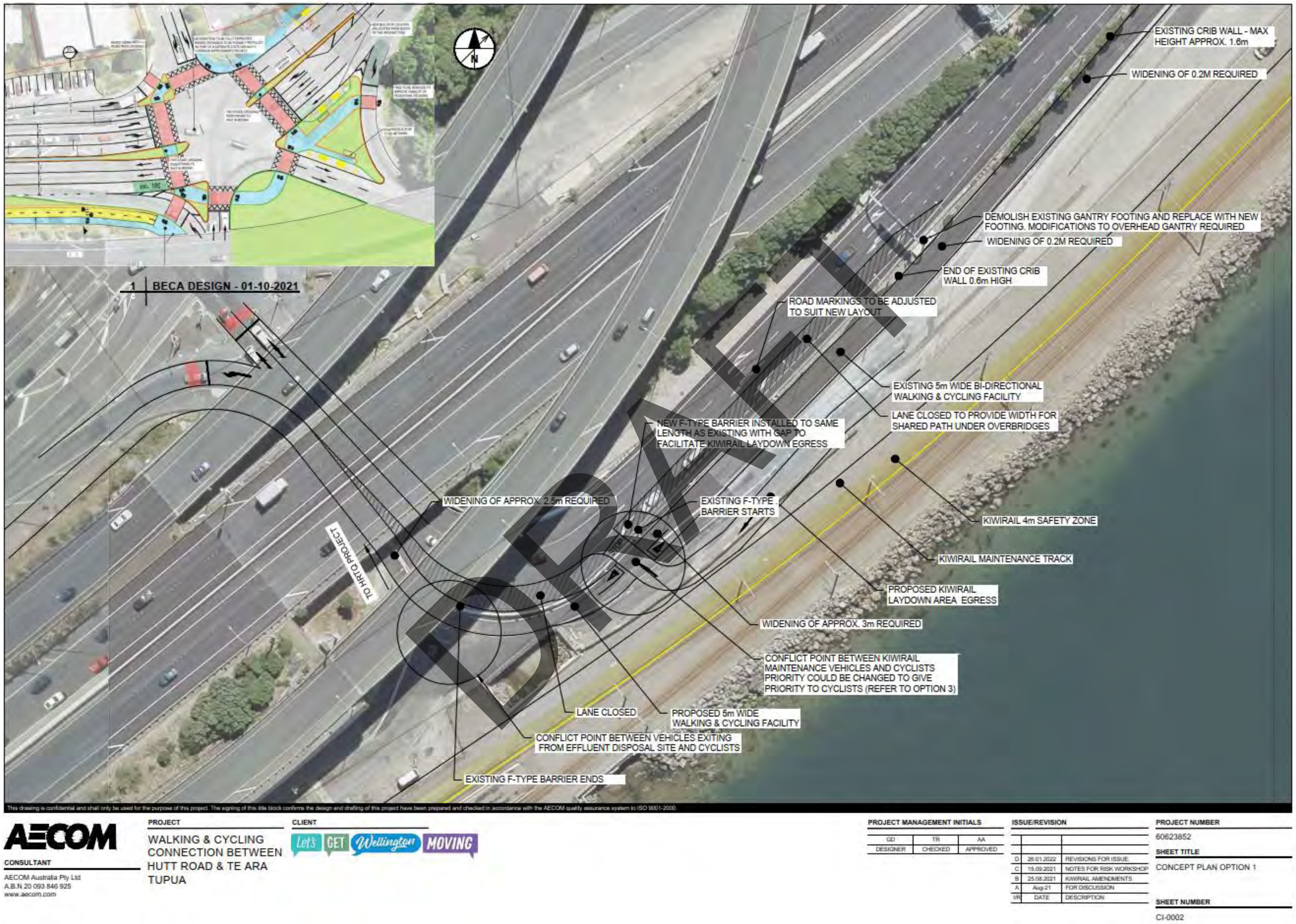


Figure 11: Option 1A Parallel Path with Beneath SH2 Overbridge

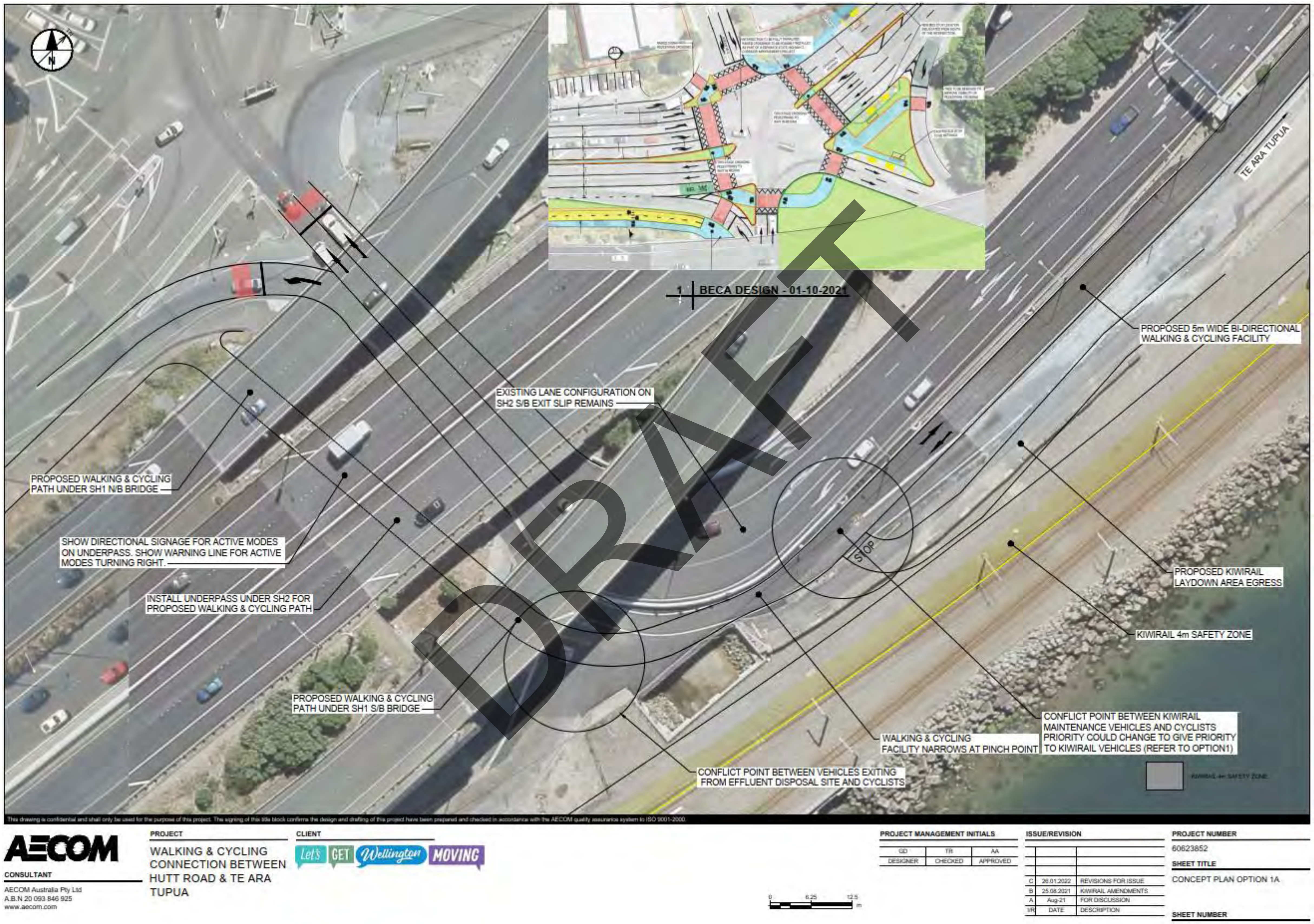
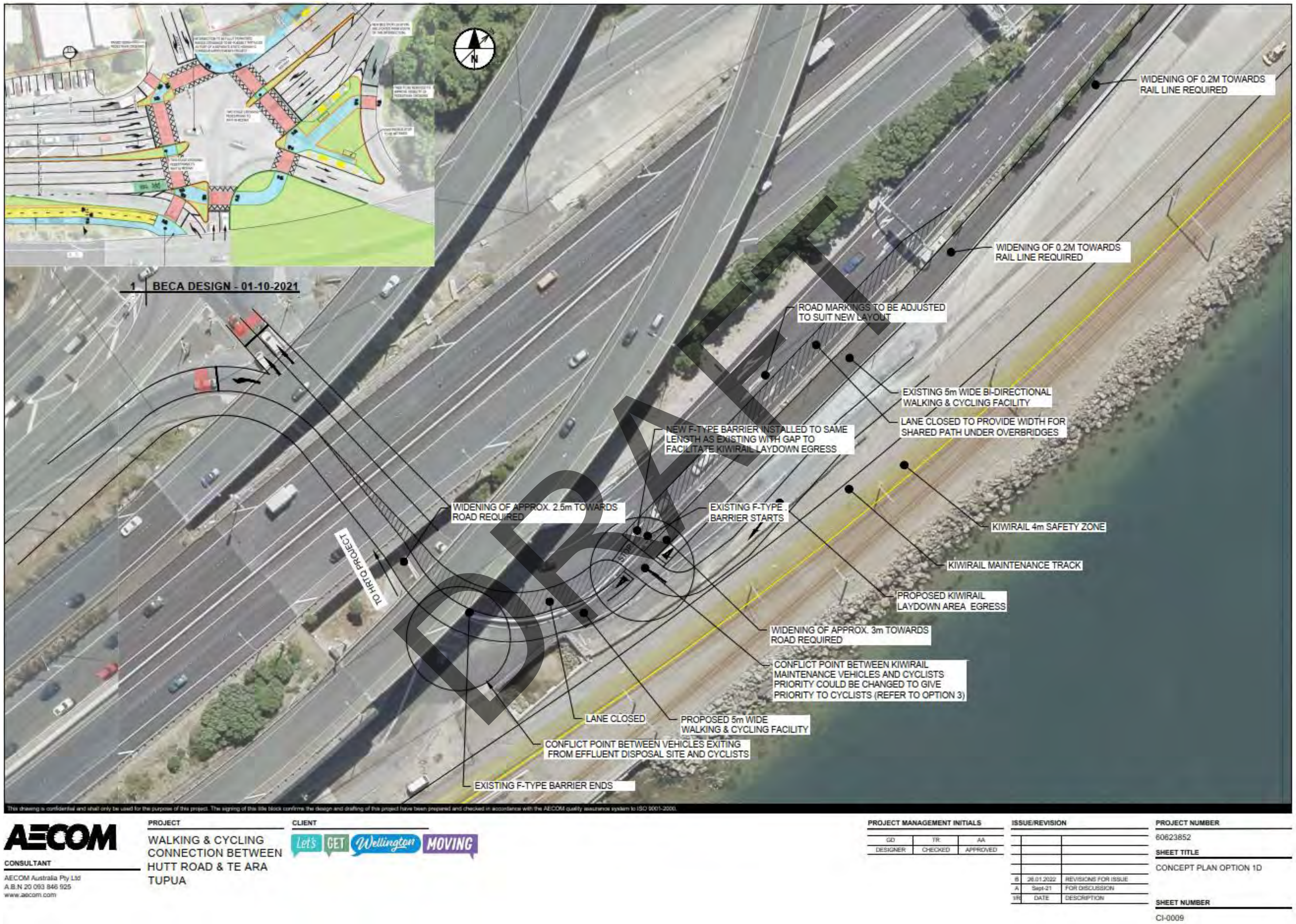


Figure 12: Option 1D - Variation to Option 1 to Improve Existing Path Altering SB Slip Lane



5.3 Short-list Options Assessment

5.3.1 Costs

Indicative Outturn Cost Estimates for Option 1, 1A and 1D were prepared following the Waka Kotahi Cost Estimate Manual SM014:

- Option 1 - Lane space reallocation - $4,750,000
- Option 1A - New shared path underpass - $12,880,000
- Option 1D - Lane space reallocation - $3,468,000.

Out-turn costs for the indicative estimates include property costs, consultant costs and fees and client managed costs for the remaining phases of work. The SM014 cost estimates can be referenced in Appendix D. The cost estimate informing Option 1A has been derived from the parallel cost estimate.

The parallel cost estimate noted that further engineering inputs are to develop the cost estimate for Option 1A. The inputs are required to understand the complexity of the tunneling below the state highway without major disruption, and the location of the underpass to the existing crib walls and abutments.

5.3.2 Benefit Cost Ratio

Preliminary health benefits for 'The Connection' project have been estimated based pro rata on the length of the Te Ara Tupua economics for Option 1 (and by inference Option 1D), and Option 1A. The pro-rata length of 'The Connection' is 400 metres, with the new active mode users derived from the estimated users of the Ngā Ūranga to Pito-one section to Hutt Road. Table 4 shows that the estimated NPV benefits and disbenefits for each option.

Health benefits are similar for both Options 1 and Option 1A. This is based on the length of the facility, and the number of new users that are anticipated as a result of its construction.

Disbenefits for each option are different across the benefit categories. Option 1A being the underpass has a neutral benefit against Travel Time and Safety costs for traffic, but the monetised disbenefit for Traffic Disruption is based on the likely length of closure of the motorway in order to construct the facility. Option 1 has a neutral impact on traffic disruption, but instead has disbenefits for traffic and safety. Traffic will have some additional delays through queuing resulting from the removal of the left-turn slip lane. Safety disbenefits are associated with a higher incidence of rear-end crashes through the increased length of queues.

Table 4: Net present value (NPV) health benefits

Option	Health Benefits (NPV)	Travel Time	Safety	Traffic Disruption
Option 1 – lane space reallocation	$ 10.9M	-$ 7.24M	-$ 0.2M	-
Option 1A – new underpass	$ 10.9M	-	-	-$ 5.6M

The costs, benefits and disbenefits for the two options have been evaluated and combined with the BCR analysis for the TQHR project. The combined BCR is summarised below in Table 5. The overall BCR is similar with the difference between the overall costs and benefits for the two options.

Table 5: TQHR and The Connection Combined Options BCR

Option	NPV Benefits	NPV Costs	BCR
TQHR + Option 1 – lane space reallocation	$ 96.1M	$ 59.6M	1.6
TQHR + Option 1A – new underpass	$ 101.6M	$ 63.3M	1.6

The two options are expected to have no significant impact on the overall BCR for the Wellington to Hutt Valley / Te Ara Tupua facility. An initial analysis against the Wellington to Hutt Valley / Te Ara Tupua economics for the two options result in no change to the BCR of 1.1.

Intrinsically however 'The Connection' will further the key benefits of the Te Ara Tupua facility. These include providing a high quality shared path for people of all ages and abilities to use, promoting healthy lifestyles, and more sustainable and affordable transport choices. Supporting increasing numbers of users will further contribute to shifting people from vehicles to walking and cycling reducing traffic congestion and emissions. For the economy a high-quality facility supports tourism-related cycling and boosts the Wellington regional economy.

5.3.3 Traffic Impacts

The impacts on traffic for the lane space reallocation options (Options 1 and 1D) were considered through traffic modelling using SIDRA. The two options involve the closure of the left-hand slip lane of the SH2 southbound offramp, with the reallocation of the lane space to shared path users. It was necessary to understand at this stage what the impact for queue lengths on the offramp could be with the left-hand slip lane being closed to traffic.

A summary of the modelling assumptions and results are included in Appendix E.

The SIDRA modelling shows a reasonable probability of lane spill from the SH2 southbound offramp into the main SH2 lanes occurring out to 2031. Lane spill from queuing during the peak period has the potential to exacerbate existing delays along SH2 southbound in peak periods. The corridor is sensitive to disruption, and impacts can be potentially severe for motorists commuting during the peak periods in additional delay, and safety risk. The average queues will remain within the length of the slip lane, but the modelling shows the potential for brief periods when the back of the queues beyond the length of the slip lane, and into the SH2 southbound lane.

The modelling assessment was carried out on pre-Covid traffic volumes and didn't consider the Thorndon Quay and Hutt Road project as modelling was still underway. In addition, further assessment is being carried out on the freight movements by a third party and this was not available at the time. The traffic impacts need to be considered in the next phase when all modelling work is finalised. This will help to understand the impacts on different types of users including bus public transport, and freight travelling to the ferries from SH2. In particular, the freight movements to Aotea Quay will be influenced by the changes proposed by TQHR to remain on the state highway reducing these demands on the slip lane.

The extent to which safety impacts can be managed or mitigated will be considered in the next phase. Additional modelling will be able to define more accurately the frequency and impact of queues extending in the SH2 southbound lanes from the lane closure option, combined with optimisation of the intersection. The management or mitigation of these safety risks can then be considered alongside the general impacts for vehicle travel times, and the broader objectives for mode shift and emissions reduction that Te Ara Tupua is looking to achieve.

5.3.4 Risk Assessment and Safety in Design

A Risk Workshop and a Safety in Design (SiD) Workshop was held on 20th September 2021 attended by subject matter experts from Let's Get Wellington Moving, Waka Kotahi, Greater Wellington Regional Council, Wellington City Council, KiwiRail, the Te Ara Tupua Alliance, Beca and AECOM.

The following risks were identified in Table 6 and Table 7, assessed for likelihood and consequences and mitigation actions suggested. The full risk register is attached in Appendix B.

Table 6: Critical Risks

Risk Description	Likelihood Pre mitigation	Consequence	Risk Level	Mitigation Actions
There is a threat that a reduction in the 3 lanes on the off ramp to 2 causes queueing back onto the State highway creating unmanageable safety concerns, or travel time delays.	Likely	Severe	Critical	Construct new underpass if funding available. Alternative is to monitor and manage the slip road. Undertake further modelling. Consider extending VMS on SH2. Consider reducing speed limit on off ramp.
There is a risk that the speed differential on the slip lane will be large leading to increase in crashes.	Likely	Severe	Critical	Maintain 3 lanes if possible. Enforce speed limits to reduce speed. Look at separation between cyclists and pedestrians. Consider different types of signage. Manage as demand grows.
There is a risk that there is a level of uncertainty about what the future traffic patterns will be.	Likely	Severe	Critical	Undertake further modelling. Monitor traffic once COVID restrictions lifted
There is a risk that construction of the underpass under the State highways is not feasible due to construction restraints, or significant risks around the length of state highway closure.	Likely	Extreme	Critical	Obtain As-Built information from Waka Kotahi archives. Consider jacked installation and ground freezing, use steel cables to lubricate jacking and hand auger. Use existing path. Look at compromise solution.
There is a risk of unforeseen obstacles to construction of the underpass (e.g.) MSE behind the crib wall.	Likely	Severe	Critical	Obtain As-Built information from Waka Kotahi archives. Undertake Geotechnical site investigation
There is a safety risk around using the existing facility (blind corner on the western side).	Likely	Severe	Critical	1) Design with good geometrics 2) Waka Kotahi and Austroads design guidelines. 3) Markings (Yellow double line). 4) Second tunnel (one bound direction per tunnel). 5) Wayfinding signs. 6) Information signs
Covid19 impacts on supply chains and construction price	Likely	Severe	Critical	Considered in the next phase where the impacts can be more fully determined based on the design, and where the allocation of risk can be considered in the commercial, financial and management cases.

Table 7: Safety in Design Risks

Safety Risk Description	Likelihood Pre mitigation	Consequence	Risk Level	Mitigation Actions
There is a threat that the level of service for cyclists would be significantly decreased during the construction phase.	Possible	Moderate	High	1) Ensure some cycling facility during the construction phase. 2) Monitor and manage.
There is a risk that a large amount of construction will happen in the small area during the same time.	Possible	Severe	High	1) Need to check the swept paths for HCVs as part of the construction considerations. 2). Expected that the construction for Option 1/1D takes a couple of months. Option 1A will have a longer construction period. Need to avoid cyclists mixing with trucks and buses. 2) Construction could be as part of the Alliance contract.

6 Recommendations and Next Steps

Based on the assessment it is recommended that both the emerging preferred Option 1/1D providing lane space reallocation under the overbridge to the shared path through closure of the left slip lane, and Option 1A providing the new underpass through the SH2 embankment be investigated further in parallel.

These options were ranked the highest based on the average scores between Lead Assessors and the Subject Matter Experts, and they are acceptable to KiwiRail. The next phase for TQHR is the Pre-Implementation phase and the recommendation is that both options for 'The Connection' are progressed further as part of this contract until any potential fatal flaws for the options are closed out and the preferred option confirmed.

The following should be included in the scope of the Pre-Implementation phase for further investigating the options:

1. Additional modelling will need to be undertaken incorporating the changes to traffic movements after the opening of Transmission Gully, and a normalised post-covid traffic volume through the area has been established. The traffic modelling will provide a better understanding of the options impacts, in particular the queue delays for the slip lane based on Options 1 and 1D. The modelling will allow for optimisation of the intersection and approaches to be assessed, as well as the management or mitigation of any safety and travel time impacts resulting from queues extending into the southbound SH2 lanes.

2. Design considerations in the Pre-Implementation will consider the impact of both options for transport users. Design considerations include managing sightline constraints, potential conflicts between different users such as mobility scooters, urban design, and assessing the land requirements needed for path widening beside the rail corridor and the existing road carriageway.

   Sightline constraints and visibility will be assessed for each option at the interface with Hutt Road. The Pre-Implementation will need to consider the design measures each option can provide for improving sightline visibility along Hutt Road from the shared path. Improving sightline visibility will provide safety benefits for all users of the shared path with differences in speed of travel.

The design concept plans note areas where space constraints require attention, including potential widening of 0.2 metres for the existing cycling path for Options 1 and 1D. These will be confirmed in the detailed design.

3. Feasibility of different construction methodologies for Option 1A, the underpass, should be further investigated due to the significant structural and constructability constraints for the option. Currently anticipated closures of the motorway are based on standard cut and cover methods for underpass installation. Examples of alternative more innovative construction methodologies could include ground freezing and thrusting techniques which have the potential for minimising closures and therefore lessening impact on motorway users.

   Continuing the investigation of the underpass in parallel with Option 1 will maximise the time available prior to Te Ara Tupua opening. Sequencing of the changes around ‘The Connection’ need to align with the opening of the TQHR, and Ngā Ūranga to Pito-one projects that are forecast to be completed in 2024 and 2025 respectively. This time will be maximised by developing the design, construction methodology and time to construct for the underpass due to any fatal flaws in Option 1 being identified.

4. A key objective for ‘The Connection’ is to contribute to the overall increase of active mode users attracted to Te Ara Tupua. To understand the impact of each option sensitivity testing of the benefits from ‘The Connection’ will be assessed.

5. A temporary lane closure on the SH2 southbound offramp should be trialed in the next phase to better understand the traffic impacts on the southbound offramp, and queues. The trial should be undertaken once the Transmission Gully project is open to traffic and traffic movements have become consistent. The trial can incorporate traffic signal changes at the intersection to inform the approach to optimisation.

6. The delivery mechanism for ‘The Connection’ will be considered as part of the Commercial and Management cases. A number of different mechanisms for constructing ‘The Connection’ are available, including aligning with either the delivery of TQHR, the Alliance delivering Ngā Ūranga ki Pito-one, the Wellington Transport Alliance maintenance contractor, or alternatively a separate procurement approach for delivery. The advantages and disadvantages of the different approaches would be investigated, and an approach to delivery recommended.

Appendix A

Workshop MCA Scores and Rankings

	Option 1 - Lead Assessor	Option 1 - SME	Option 1A - Lead Assessor	Option 1A - SME	Option 1C - Lead Assessor	Option 1C - SME	Option 2 - Lead Assessor	Option 2 - SME	Option 2A - Lead Assessor	Option 2A - SME	Option 4 - Lead Assessor	Option 4 - SME	Option 5 - Lead Assessor	Option 5 - SME
Overall Score	+3	+17	-3	+13	-3	-7	+5	-7	-1	-3	-6	+3	-25	-47
Overall Score based on average between Lead and SMEs	+8		+3		-12		-10		-10		-11		-35	
Ranking based on average between Lead and SMEs	1		2		6		3		3		5		7	
Ranking after fatal flaws identified	1		2		NA		NA		NA		NA		NA	

NA = Not applicable

Appendix B

Risk Register

	Project/Contract Description	*Thorndon Quay Hutt Road - The Connection*		NZTA Lead	*Hannah Hyde*
	Contract ID	*To be inserted*		Supplier Lead	*Graeme Doherty*
	Contract Value	*Up to $10M*		Supplier Risk Management Specialist (if applicable)	*Adam Ashford*

Contract Risk Register

Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to	Planned Risk Treatment Actions *Note: If more than one treatment action, either:*	Treatment Owner(s)	Planned Treatment Implementation	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
2	3/17/2020	There is a threat that approvals take longer than planned	The cause of the threat is that the TWG and/or OIMS have a large number of projects requiring input and the TQHR project engagement is less than ideal.	The consequence of the threat is additional effort to chase TWG & OIM's, additional engagement, poor feedback or inputs, wrong decisions made, poor benefits / outcomes	LGWM	Hannah Hyde	17/04/20 - TWG / OIMS spreadsheet setting out workshops and deliverable reviews so that TWG and OIMS can manage their workload 1/12/20: TWG and OIM's now have a comments prioritisation register	Unlikely	Moderate	Delivery	Medium					20/7/7 - HH has been proactively managing input from OIM's and TWG. Raised today that there is a possibility of a new group called 'TAG' which may have approval rights. 1/12/20: There is now a TAG group, but we don't need their formal endorsement.	Unlikely	Moderate	Medium	Live-Treat	20/6/7 - risk description updated
10	3/17/2020	There is a threat of a cost increase for the project and whole of life costs	The cause of the threat is changing the funding priority (Covid, etc); market uncertainty (Covid), people availability, high post lockdown gear-up constraints, change of market forces (reduced construction resources in the market due to increased shovel ready programme), change in political funding decisions..	The consequence of the threat is some aspects not having adequate funding, project does not proceed, increased costs, programme delays, benefits not realised, reputational impacts, safety benefits not realised	LGWM	Hannah Hyde	25/05/20 - Robust business case methodology with input from stakeholders and partners. Knowledge of market costs. Contractor relationships	Likely	Minor	Cost	Medium		01/05/20 - ACTION: Eric Whitfield to speak with QS team, to understand market forces impact on business case economic case. SSBC to consider and document possible impacts	Eric Whitfield	6/30/2020	20/7/7 - feedback is that market remains competitive, shovel-ready and other stimulus projects are slow to come to market.	Unlikely	Minor	Low	Live-Treat	16/04/20 - Linked to RID6, RID10, RID59 1/12/20: this risk will be reviewed for whole of project costs at next risk workshop 12/05/20 - RID6, RID59 combined 20/7/7 - residual risk likelihood reduced
16	3/17/2020	There is a threat the preferred option is not aligning with the Placemaking Framework and Amenities Strategy / Urban Design	The cause of the threat is that placemaking has not been given priority and the project options have an engineering focus, rather than aligning with city aspirations. Recognition of different areas of character in different ways, the various projects do not have a consistent placemaking and amenities strategy, poor comms, poor decision making, poor engagement, strategy not used	The consequence of the threat is public complaints, difficulty for approval, benefits not realised, future network impacts and maintenance issues, programme delays, costs, reputational impacts, cultural and community amenities benefits not realised	Beca / WAM	Shannon Joe	25/05/20 - Engagement with partners on placemaking strategy. Urban design and placemaking input at early in options development	Almost certain	Moderate	Cost	High		02/03/21 - ACTION: Develop with Key stakeholder engagement, the placemaking/urban design framework for TQHR, Feed into the Prelim Design	Eric Whitfield & Shannon Joe		20/7/7 - Shannon Joe has met with WCC urban design team to discuss placemaking and amenity on the project. WCC support short list options. Further engagement necessary during recommended option development	Almost certain	Moderate	High	Live-Treat	16/04/20 - Linked to RID17 08/05/20 - RID16, RID17 combined 20/06/07 - changed owner to project team 1/12/20: no agreed placemaking strategy. 'amenity' costs included in cost estimates. Category changed to cost
38	3/17/2020	There is a threat of lack of coordination with other regional projects having an effect on the programme progression of the corridor.	The cause of the threat is the wider effects in the area of the reassignment traffic to other/alternative routes during the gorge lane closure.	The consequence of threat is programme delays, complaints, reputational impacts, safety impacts for road users	LGWM	Hannah Hyde	25/05/20 - Coordination with other Waka Kotahi and partner programmes.	Possible	Moderate	Delivery	Medium		02/03/2021 - Progress C&E with other project s/ programmes; share information and design outcomes early; assess journey outcomes implications	Eric Whitfield	5/30/2021		Unlikely	Moderate	Medium	Live-Treat	12/05/20 - Risk owner changed from Tim Brown to Hannah Hyde as per Eric Whitfield instructions Linked to Risk 117
41	3/17/2020	There is a threat of other project changes having an impact of final results.	The cause of the threat is the possible changes to the Interisland ferry terminal, change in government funding / priorities post Covid, lack of clarity re other capital projects scope and interdependencies to TQHR, Kiwirail/Centreport Future Developments, Lambton bus interchange, WCC coordination with Wellington Water, roading maintenance, GasCo, TelCo, etc, mis-communication re maintenance programmes	The consequence of the threat is public complaints and reputation damage. Redesign needed, additional effort & rework, programme delays and cost impacts, benefits not optimised or realised..	LGWM	Hannah Hyde	25/05/20 - Coordination with LGWM and partner programmes.	Likely	Moderate	Stakeholders	High						Unlikely	Moderate	Medium	Live-Treat	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83 20/6/7 - owning org changed to LGWM
55	3/17/2020	There is a threat the business case justification does not meet expectations of all LGWM partners	The cause of the threat is inadequate data analysis, lack of detailed (deep dive) investigations, lack of site or ground investigations at the correct phases, in accurate data, data gaps	The consequence of the threat is the business case is not based on sound information, incorrect assumptions are made, the project outcomes / benefits are not realised, additional effort and rework, cost & programme impacts, reputational impacts, potential RMA breaches, property acquisitions issues	LGWM	Hannah Hyde	25/05/20 - Follow the Waka Kotahi business case development process. Engagement with partners, OIMs, IQA 08/07/2020 - Ongoing data analysis, stakeholder engagement; Strategic Case approved; IQA	Unlikely	Moderate	Delivery	Medium		1/5/20 - ACTION - Neil Trotter to define the extent of any additional data requirements for the SSBC 1/12/20: manage scope to established process. Note need to satisfy TWG	Neil Trotter	6/30/2020	20/7/7 - project team continue to follow the published guidance.	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID54, RID56, RID57, RID58 08/05/20 - Related risks combined and closed, RID55 open
62	3/17/2020	There is a threat the Marae parking arrangements does not meet the user requirement	The cause of the threat is informal parking arrangements with WCC would be affected by the project, the new facilities are not designed to user requirements, insufficient funds to provide all user requirements (compromises), gaps in requirements data, lack of stakeholder engagement with both Iwi and Councils and Roading authority	The consequence of threat is unhappy stakeholders and complaints, infringement notices, harm to users, future remedial works (cost and programme), reputation	Beca	Nathan Baker	09/07/20 - SEB Bishop LGWM leading IWI engagement, including Pipitea Marae	Likely	Minor	Stakeholders	Medium		25/05/20 - ACTION: engagement with iwi and the council (progressing) 1/12/20: we need to determine what their requirements are	Nathan Baker	7/30/2020		Possible	Moderate	Medium	Live-Treat	17/04/20 - Transferred from Rachel Dahlberg to Nathan Baker 1/12/20: likelihood changed to high, consequence minor
65	3/17/2020	There is a threat of a delay to the programme due to poor engagement with iwi.	The cause of the threat is a lack of engagement with Iwi in early stages of the programme; delay in engagement with Mana Whenua, due to being slower than other stakeholders; Pipitea Marae is on the corridor as well as existing relationships with WCC.	The consequence of threat is programme delay and key engagement information is lacking. Also public complaints, design may not include engagement from Mana Whenua - redesign required	LGWM	Hannah Hyde	25/05/20 - comms and engagement plan developed and implemented 09/07/20 - Seb Bishop LGWM leading IWI engagement, including Pipitea Marae	Unlikely	Moderate	Stakeholders	Medium		1/12/20: there has been meeting with iwi partnership working group				Possible	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID63, RID64 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks - Combined RID63, RID64, RID65 20/6/7 - risk description updated 6/7/21: likelihood lowered as LGWM now involved in engagement, assessed options against mana whenua values
67	3/17/2020	There is a threat of RMA / construction delays	The cause of the threat is a lack of engagement with Heritage NZ & IWI, lack of archaeological &Iwi expertise impacts into business case & early investigations, key significance areas not identified (including notable trees, and features around Mulgrave Street, cultural areas, historical features)	The consequence of the threat is a delay to the programme, breach of RMA, Waitangi commitments not met, cultural friction, rework of C&E and investigations, cost and programme delays, reputational impacts	LGWM	Hannah Hyde	25/05/20 - RMA considerations in options assessment	Unlikely	Severe	Environmental	Medium		08/05/20 - ACTION - Emily Alleyway to speak with Mark Lindsey at WCC regarding the RMA requirements to support the development of the business case 20/7/7 - ACTION - update social and env screen in Stage 2, for recommended option	Eric Whitfield	5/30/2020	20/7/7 - social and env screen completed on short list options. No significant RMA issues are expected at present. Detailed assessment will be completed on recommended option.	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID67 12/05/20 - RID 66 Combined 1/12/20: review at beginning of stage 2, next risk workshop
70	3/17/2020	There is a threat of the corridor not being adequate for the specialist users of the corridor (Wellington Free Ambulance and Fire Station, Over width vehicles, police, accident response etc)	The cause of the threat is the corridor does not provide sufficient width for various vehicle user types, lack of stakeholder requirements gathering, lack of data, not captured in BC, not captured in design development	The consequence of threat is safety issues for road users, compounding access issues, complaints, costs to remedy, ongoing future issues, reputational impacts	LGWM	Hannah Hyde	25/05/20 - use of industry practice design standards.	Unlikely	Severe	Stakeholders	Medium		25/05/2020 - ACTION - Engagement with emergency service providers	Hannah Hyde	7/30/2020	20/7/7 - continue to engage with emergency services during the development of a recommended option.	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID68, RID69
87	3/17/2020	There is a threat of community and stakeholder expectations are not met or unrealistic	The cause of the threat is a lack of consideration of previous information and engagement, focus on only opportunities, and problems not being confirmed, lack of or too much engagement, certain stakeholders have a greater influence than most (loudest voice), extent of engagement doesn't follow AP2 principles.	The consequence of the threat is a time delay to the programme, and information being duplicated, higher costs, problems and opportunities not being accurately identified, not meeting the expectations/needs of all stakeholders - retailers high risk; public confusion, long term options not suitable	LGWM	Hannah Hyde	25/05/20 Review of previous engagement processes and outcomes and incorporation into the project comms and engagement plan and strategic case 09/07/20 - Engagement strategic progressing with LGWM to support July shortlist public engagement activity	Likely	Moderate	Public/Media	High					20/7/7 - There is a plan in place for the upcoming engagement round, including the type of and scale of information to be included, as well as visualisations 20/2/11 - shortlist option engagement delayed until March/April 2021 1/1220: there are ongoing discussions about engagement strategy and material with partners	Possible	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID78, RID79, RID80, RID81, RID84, RID85, RID86 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID78, RID79, RID80, RID84, RID85, RID86, RID87

Project/Contract Description	*Thorndon Quay Hutt Road - The Connection*		NZTA Lead	*Hannah Hyde*
Contract ID	*To be inserted*		Supplier Lead	*Graeme Doherty*
Contract Value	*Up to $10M*		Supplier Risk Management Specialist (if applicable)	*Adam Ashford*

Contract Risk Register

Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to	Planned Risk Treatment Actions *Note: If more than one treatment action, either:*	Treatment Owner(s)	Planned Treatment Implementation	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
89	3/17/2020	There is threat that the extent of stakeholder engagement is not as planned	The cause of the threat is that not all groups have been represented. and there has been a lack of engagement with a number of groups - eg, advocacy groups not invited to PRG, engagement fatigue, engagement approach not reaching the intended audience	The consequence of threat is public complaints and programme delay due to the design not being fully informed, missed opportunities for user improvements - quick wins -"great journeys" and urban design	LGWM	Hannah Hyde	25/05/20 - comms and engagement plan developed and implemented. Engagement with LGWM comms team re strategy 09/07/20 - progressing strategy with LGWM, Public engagement planned for July	Unlikely	Moderate	Public/Media	Medium		25/05/20 - Continue to monitor the situation re COVID-19, ongoing engagement with LGWM comms team, consider online events	Eric Whitfield	Ongoing	20/7/7 - There is a plan in place for the upcoming engagement round which will be public, plus a stakeholder briefing. 20/2/11 - shortlist option engagement delayed until March/April 2021	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID71, RID72, RID88, RID90 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID71, RID72, RID88, RID89 20/7/7 - residual likelihood reduced to possible due to scale of upcoming engagement 1/12/20: likelihood changed to possible
91	3/17/2020	There is a threat of opposing feedback and a delay to the programme.	The cause of the threat is that residents or stakeholders are not supportive of the design solutions EG: parking, bus stop and bus shelters, Not In My Back Yard (NIMBY)/ Negative Public Reaction; Objections to the Cycleway outside Businesses; issues outside the project influence (bus routes); loss of car parking; the design solution does not accommodate easy access into businesses to do "trade"; lack of engagement, poor	The consequence of threat is public complaints and reputation, reconsult, redesign, delays to programme, additional funding / costs, solutions not aligned to need (loudest voices win), community support reduced/lost reputational impacts, loss of trade for local business owners along the corridor wider area	LGWM	Hannah Hyde	25/05/20 - comms and engagement plan developed and implemented. Engagement with LGWM comms team re strategy. Review of and incorporation of previous engagement feedback 09/07/20 - progressing strategy with LGWM, Public engagement planned for July - 3 options to consult on.	Likely	Moderate	Public/Media	High		25/05/20 - ACTION: Implement engagement as per comms and engagement plan.	Eric Whitfield	Ongoing	20/7/7 - undertake engagement as per plan and reassess risk following engagement feedback 20/2/11 - shortlist option engagement delayed until March/April 2021. This increases the risk of opposing feedback delaying the programme	Likely	Moderate	High	Live-Treat	16/04/20 - Linked to RID76, RID14, RID73, RID91, RID13, RID77 20/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined 1/12/20: likelihood changed to likely. 6/7/21: consequence lowered. There is currently a risk of JR from TQ Collective
92	3/17/2020	There is a threat of negative stakeholder and public feedback from mismanagement of project information	The cause of the threat is that project information is not released in a timely manner to other projects and the public, incorrect information or confidential information being released, property acquisition information not managed correctly; OFIR's not managed within legislated requirements	The consequence of the threat is reputational impacts, property acquisition issues - additional costs, benefits lost, scope and solution confusion, OIR breaches	LGWM	Hannah Hyde	25/05/20 - Existing procedures regarding the control and release of official information. Comms and engagement team review	Possible	Moderate	Public/Media	Medium		25/05/20 - ACTION - Comms and engagement team review of information	Hannah Hyde	7/30/2020	20/7/7 - procedures are in place. No OIA's received to date. Engagement will commence end of July which could trigger requests for information	Possible	Severe	High	Live-Treat	17/04/20 - Transferred from Hannah Hyde to Eric Whitfield 12/05/20 - Transferred from Eric Whitfield back to NZTA (They release information for OIA Process) 1/12/20: consequence changed to moderate
99	12/1/2020	There is a threat that the current recommended option does not proceed	The cause of the threat is project cost exceeds programme budget expectations	Project does not proceed or is scaled down	LGWM	Hannah Hyde		Rare	Severe	Stakeholders	Low		1/12/20: peer review of the costs, value engineering prior to pre-imp if required				Possible	Moderate	Medium	Live-Treat	
103	3/2/2021	There is a threat Utilities / Underground services are not identified	The cause of the threat is due diligence not completed, inaccurate As Built data, new assets included over course of project delivery	The consequence of the threat is design rework for new assets to "accommodate" UG services, relocation of services to accommodate design requirements, lost costs, reduces safety benefits of a compromised solution, reputation, delays to programme	LGWM	Hannah Hyde	02/03/21 - Services investigations progressing with design development	Likely	Moderate	Cost	High		02/03/21 - ACTION: LGWM Team to provide data, and then progress further assessments as design progresses	Blaise Cummins	5/30/2021	28/06/2021 - Services information still pending	Possible	Moderate	Medium	Live-Treat	
104	3/2/2021	There is a threat of conflict access points onto the corridor	The cause of the threat is the number and nature of business driveway / accesses on the corridor cross over other modes - conflict of modes	The consequence of the threat is vehicle / ped / cycle crashes as business owners access their premises cross in the path of cyclists	LGWM	Hannah Hyde	02/03/2021 - Corridor and access ways design reviews, HSID reviews - identify access way clashes to design safe access solutions	Possible	Moderate	Delivery	Medium		02/03/21 - ACTION: Progress design HSID access to design solution access points that do not clash with other modes such as Peds / cycle / bus	Blaise Cummins	5/30/2021		Unlikely	Moderate	Medium	Live-Treat	
105	3/2/2021	There is an opportunity to improve the Hutt Road and Thorndon Quay Egress / access	The cause of the opportunity is to gain landowners agreement to combine business accessways	The consequence of the opportunity is reduced access points, improved safety for other modes, improved traffic flows	LGWM	Hannah Hyde		Possible	Minor	Delivery	Medium		02/03/21 - ACTION: Progress assessment of area, progress improved design solutions for access way points	Blaise Cummins	5/30/2021		Likely	Moderate	High	Live-Treat	Linked to RID 70 Specialist users access on corridor (Fire, Ambulance, first responses, wide vehicles)
106	3/2/2021	There is a threat the solution does not enable safe access / egress to existing key assets/facilities (pump stations, fire station) for maintenance and emergency response	The cause of the threat is the lack of investigation, stakeholder engagement / feedback, lack of HSID design assessment, poor design solutions	The consequence of the threat is the restriction of access to key facilities; time / costs to move assets (pump stations or the like), rework designs to accommodate assets; programme delays and costs, reputation, poor safety outcomes	LGWM	Hannah Hyde	02/03/21 - Early identification of key assets / facilities; HSID design reviews, stakeholder engagement	Unlikely	Severe	Delivery	Medium		02/03/21 - ACTION: Progress design investigations for facilities on the corridor; investigate "future consented" new assets / buildings that may be built on the corridor between now and future construction	Blaise Cummins	5/30/2021		Unlikely	Moderate	Medium	Live-Treat	Linked to RID 70 Specialist users access on corridor (Fire, Ambulance, first responses, wide vehicles)
108	3/2/2021	There is a threat the intersection design approach / philosophy changes	The cause of the threat is the intersection modelling identifies design issues that require late design changes	The consequence of the threat is incorrect design assessments in the model, future design phases incorrect, additional late costs for rework or construction, unsafe solutions on the corridor, reputational impacts	LGWM	Hannah Hyde	02/03 - Design approach in review, pending outcome / decision	Unlikely	Severe	Delivery	Medium		02/03/21 - ACTION: Review the intersection design model, design approach is agreed / compliance to required standards within limited corridor widths - gain approvals	Blaise Cummins	5/30/2021		Rare	Moderate	Low	Live-Treat	
109	3/2/2021	There is a threat of data gaps - such as lack of survey data; Ped counts; Business economics data / Metrics	The cause of the data gaps is insufficient information provided to the project team from external sources, lack of budget to fund investigations / on site surveys at the Prelim stage of delivery, old / historic data provided no longer relevant	The consequence of the threat is the design does not tie-in with the existing on-site reality; incorrect assumptions made in the business case, designs incorrect or does not meet demands; later costs to correct during construction & additional construction costs	LGWM	Hannah Hyde		Possible	Moderate	Delivery	Medium		02/03/21 - ACTION: progress investigations / source required information; document information gaps & assumptions made; identify in future project phases	Blaise Cummins	5/30/2021		Unlikely	Minor	Low	Live-Treat	
111	3/2/2021	There is an opportunity to improve the Jardin Mile area outcomes	The cause of the opportunity is to improve the urban design solution to the design process	The consequence of the opportunity is Improved safety outcomes for users and amenity usability	LGWM	Hannah Hyde		Possible	Minor	Stakeholders	Medium		02/03/2021 - ACTION: Review the Jardin Mile area to assess further urban design and safety requirements to increase amenity outcomes	Blaise Cummins	5/30/2021		Likely	Moderate	High	Live-Treat	
113	3/2/2021	There is a threat critical heritage buildings, places of significance, cultural, protected flora / fauna species are not identified & managed	The cause of the threat is lack of cultural investigations, lack of council plans inputs / assessments or data provided, lack of user requirements assessments, lack of archaeological investigation during design phase	The consequence of the threat is breach of consents, / regulations / legal requirements; impact of value of buildings; cultural value impacts to key stakeholders; loss of critical historical values; loss of historical earth deposits of significance in key locals, reputation & cost impacts, delays to safety outcomes	LGWM	Hannah Hyde	GIS Model layer to ringfence heritage , cultural values, Social and environment screening, heritage assessment in scope	Possible	Moderate	Legal/Compliance	Medium		02/03/21 - ACTION: Investigate the shared path - does this now go on the southern side of Hutt Road towards the Onslow Rd connection?; Investigate historic horse trough that juts out into the road berm at this point on the northern side- and is quite rare. Investigate archaeological authority to modify the wall around it or the trough itself. Review historic images of the trees and street views to understand setting and space around the buildings (curtilage) for design inputs Investigate further any historic deposits turn up during earthworks- e.g. archaeological or cultural material for design inputs or future consenting requirements	Eric Whitfield	5/30/2021		Rare	Moderate	Low	Live-Treat	Linked to RID 89 - lack of stakeholder engagement for specialist groups Note: We can mitigate this to a large extent by doing assessments of historic, archaeological and cultural heritage once we have a preferred option/alignment and earthworks design. But can't totally mitigate the unknown inground materials that may turn up along the old shoreline here. That's why we will likely need an archaeological authority for the project so the earthworks can be monitored.
114	3/2/2021	There is a threat the current corridor configuration will change before design & construction completed	The cause of the threat is changing assets on the corridor including changes to quake prone buildings, new buildings / infrastructure already consented is built	The consequence of the threat is late corridor design changes; impacts to asset owners; cost; reputation; programme delays	LGWM	Hannah Hyde		Possible	Moderate	Delivery	Medium		02/03/21 - ACTION: Review known information for new asset plans, quake prone building changes; speak with councils & source any new building / asset information on proposed corridor Investigate additional GIS layer in model to identify clashes / impacts on design	Blaise Cummins	5/30/2021		Unlikely	Moderate	Medium	Live-Treat	
115	3/2/2021	There is a threat other transport mode requirements are omitted from the project	The cause of the threat is lack of stakeholder engagement and user requirements, poor design investigations, changes of requirements during design stages	The consequence of the threat is different user types can not use the corridor safely, complaints, costs and delays to remediate design, potential construction cost increases	LGWM	Hannah Hyde	02/03/21 - Survey of "access requirements " completed	Unlikely	Severe	Public/Media	Medium		02/03/21 - ACTION: Progress further investigations to corridor solutions accommodate other transport modes	Blaise Cummins	5/30/2021		Rare	Minor	Low	Live-Treat	
116	3/2/2021	There is a threat the Cost Estimates for Business Case not accurate to support funding application	The cause of the threat is insufficient design to inform costs / lack of investigation & stakeholder engagement to confirm requirements, lack of agreed solutions increased egress / access	The consequence of the threat is incorrect funding / business case decisions, design solutions compromised to reduce costs late in the design process, reputational impacts	LGWM	Hannah Hyde	02/03/21 - design development and stakeholder requirements feeding into funding case	Unlikely	Severe	Cost	Medium		02/03/21 - ACTION: Progress further investigations to manage cost estimate to the level of accuracy required for the business case	Blaise Cummins	5/30/2021	Costings based on preliminary design, risk items have been discussed and considered	Unlikely	Moderate	Medium	Live-Treat	Linked to RID 10 - Project and whole of life funding
121	9/20/2021	There is a threat that the funding isn't available	The cause of the threat that funding has yet to be approved for the project and there is a shortage of funding from the NLTF.	The consequence of the threat is we don't get funding from the project or it is delayed and the benefits from the project do not eventuate or are delayed and opens after Te Ara Tupua.	LGWM	Hannah Hyde	Waka Kotahi funding assessment and funding prioritisation procedure.	Likely	Severe	Delivery	Critical		Ensure robust evidence is available for IQA purposes to support funding application. Consider funding from Te Ara Tupua as a variation.	Graeme Doherty			Possible	Severe	High	Live-Treat	

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Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to	Planned Risk Treatment Actions *Note: If more than one treatment action, either:*	Treatment Owner(s)	Planned Treatment Implementation	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
123	9/20/2021	There is a risk that the improved connectivity to the rail station is not achieved even though it was a project objective,	The cause of the threat is that it may not have been included in the scope off the project scope. And funding is constrained	The consequence of the threat is that the Connection project objective of improved PT connectivity is not achieved and demand for Te Ara Tupua is reduced..	AECOM	Graeme Doherty	PT Rail station design guidance. Project scope definition	Possible	Moderate	Cost	Medium		It is assumed that all options would include improvements to PT connectivity. This needs to be shown on the drawings and included in the option cost estimates..	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
124	9/20/2021	There is a threat that a reduction in the 3 lanes currently on the off ramp to 2 causes queueing back onto the State highway.. Also AOTEA and TG (Hannah)	The cause of the threat is that the traffic on the right two lanes is pretty much saturated through the lights every phase. There has been an increase in demand especially in the evening peak between the Hutt area and the Petone area since COVID. If left turners are included in the two lanes it reduces the saturation and increases the queue length.	The consequence of the threat is an increase in in safety risks due to the risk posed by queues onto the Expressway.	AECOM	Graeme Doherty	Waka Kotahi and Austroads design guidelines.	Likely	Severe	Health & Safety	Critical		Construct new underpass if feasible and funding is available.. Alternative is to monitor and manage the slip road. Undertake strategic modelling. Depends on intersection treatment of pedestrians and cyclists. To reduce flow breakdown on SH2 consider extending VMS through to Petone. Could speed limit be reduced on slip road? Use technology (Speed cameras) to enforce..	Graeme Doherty			Possible	Severe	High	Live-Treat	
125	9/20/2021	There is a risk that the speed differential on the slip lane will be large.	The cause of the threat is that in the evening the inbound flow into Wellington is much higher speed. At the moment the in lane flares to 3 lanes and the queue is rarely long enough to block the left turn lane. We understand SH68 improvements not going to take pressure off this roue.	The consequence of the threat is reduced safety due to higher speed differentials.	AECOM	Graeme Doherty	Waka Kotahi and Austroads design guidelines.	Likely	Severe	Health & Safety	Critical		Maintain 3 lanes if possible. Ways to minimise injuries. Make people go at speed limit. Consider separated facilities. Make sure there are good sightlines. Keep left signs. Road humps. Short high narrow humps. Narrow. Centrelines work well. Manage as demand grows.	Graeme Doherty			Possible	Severe	High	Live-Treat	
126	9/20/2021	There is a risk that there is a level of uncertainty about what the future traffic patterns will be.	The cause of the threat is that the modelling is based on assumptions about the future which may turn out to be incorrect.	The consequence of the threat is future demand is uncertain.	AECOM	Graeme Doherty	AIMSUM Modelling allows us to look at the effect of assumptions and what may happen. SIDRA modelling has been done. Some risk that outputs aren't reliable - depends on the inputs.	Likely	Severe	Health & Safety	Critical		Undertake further modelling. Monitor traffic once COVID restrictions lifted	Graeme Doherty			Possible	Severe	High	Live-Treat	
127	9/20/2021	There is a threat that people wouldn't use the connection if the LOS was poor and that the poor safety and reputation would mean cyclists stay on SH	The cause of the threat is if The Connection has poor LOS then the user experience would be poor.	The consequence of the threat is some people (about ~50 users per day) might stay on the State highway and the anticipated volumes of users would be less. It is also not a good look having made a substantial investment. Safety could reduce and reputation could suffer.	AECOM	Graeme Doherty		Possible	Moderate	Cost	Medium		In terms of width Pinch points or use existing facility. Put up physical barriers, fencing. Is it feasible with Kiwrail Access. Bridge takes cyclists onto slip road.	Graeme Doherty			Possible	Minor	Medium	Live-Treat	
128	9/20/2021	There is a threat that the Te Ara Tupua and TQHR lane markings lines may not be consistent.	The cause of the threat is that Te Ara Tupua assumes pedestrians on seaward side. TQHR assumes pedestrians are on the east side. Doesn't tie in with the design which assumes that all the southbound users were on the east side and all the northbound users are on the West side.	The consequence of the threat is there is a safety issue which will flow on into lower uptake of the cycleway.	AECOM	Graeme Doherty		Possible	Moderate	Health & Safety	Medium		Need crossovers between modes to be limited in final design.	Graeme Doherty			Likely	Minor	Medium	Live-Treat	
129	9/20/2021	There is a risk that in the future there might be a need to do some kind of physical separation of the mode in the future	The cause of the threat is that Accessible Streets is considering a default national speed limit on shared paths, and if that goes ahead then we may need to have a separation between the modes in order to allow cyclists to travel at higher than the standard shared path speed limit of might be 25 kph might be 30 kph. Which will be low enough to be safe for shared paths in general and low enough to be discouraging for long distance cycle commuters	The consequence of the threat is more width may be required to accommodated physical separation or if the higher speeds are not dealt with there may be a safety issue, leading to a reputation issue and lower uptake.	AECOM	Graeme Doherty		Likely	Moderate	Health & Safety	High		Physical separation between modes including tactile markings. Keep pedestrians on one side of path. Is there detail - different surfaces. Separation. Hutt Road has asphalt. TAT asphalt throughout. Tactile delineator. Plastic extruded? AT detail has been agreed with Disability Sector. Markings used to help visually impaired people? Hutt Road trial - was too slippery. Need at least 5m to do that - 3m Cycling, 2m Pedestrians.	Graeme Doherty			Possible	Minor	Medium	Live-Treat	
131	9/20/2021	There is a risk around who gives way at the intersection between the shared path and KiwiRail vehicles in the laydown area	The cause of the threat is that the give way priority is shown differently in the two options. If KiwiRail vehicles have priority their speed may be unsafe at the intersection.	The consequence of the threat is there is a potential for collisions at the intersection.	AECOM	Graeme Doherty		Possible	Severe	Health & Safety	High		Correct drawings to show Give Way priority to shared path users	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
132	9/20/2021	There is a risk that construction of the underpass under the State highways is not feasible.	The cause of the threat is that disruption to traffic caused by construction may not be acceptable or that geotechnical conditions such ads presence of MSE straps means may feasible.	The consequence of the threat is delays to the construction of the underpass and cost increases. Or it may not be possible to construct it all.	AECOM	Marcus Brown		Possible	Extreme	Cost	Critical		Consider jacked installation and ground freezing, use steel cables to lubricate jacking and hand auger. Use existing path. Look at compromise solution.	Graeme Doherty			Unlikely	Extreme	High	Live-Treat	
133	9/20/2021	There is a risk of unforeseen obstacles to construction of the underpass (e.g.) MSE behind the crib wall	The cause of the threat is lack of Structures As Bult information	The consequence of the threat is an increase in cost	AECOM	Graeme Doherty		Likely	Severe	Cost	Critical		Obtain As Built information from Waka Kotahi archives. Undertake Geotechnical site investigation	Graeme Doherty			Possible	Severe	High	Live-Treat	
134	9/20/2021	There is a risk that construction is delayed and cost increase about unknown services.	The cause of the threat is lack of As Build information about existing services e.g. Substation. Water main.	The consequence of the threat is an increase in cost	AECOM	Graeme Doherty		Likely	Moderate	Cost	High			Graeme Doherty			Possible	Moderate	Medium	Live-Treat	
135	9/20/2021	There is a safety risk around using the existing facility (blind corner on the western side).	The cause of the threat is the existing blind corner at the western side of the underpass, which leads to conflict points.	The consequence of the threat is that it puts stress on people and increases the chances of head-on crashes.	AECOM	Simon Kennett		Likely	Severe	Health & Safety	Critical		1) Design with good geometrics 2) Waka Kotahi and Austroads design guidelines. 3) Markings (Yellow double line). 4) Second tunnel (one bound direction per tunnel). 5) Wayfinding signs. 6) Information signs.	Graeme Doherty			Possible	Severe	High	Live-Treat	
136	9/20/2021	There is a risk that the existing Hutt Road facility on the eastern side pathway will provide an inadequate Level Of Service .	The cause of the threat is the existing pathway is too narrow and cannot accommodate the future level of pedestrians, cyclists, scooters and etc.	The consequence of the threat will lower the user experiences of the pathway. Pedestrians, cyclists, scooters and etc cannot go through the pinch point simultaneously, which can cause safety issues (bumping and knocking over).	AECOM	Simon Kennett		Likely	Moderate	Health & Safety	High		Markings could be used. Second tunnel could separate north and south bound users. Use self explaining design. Follow desire lines. Wayfinding signs. Will people use it. Depends on where signs are placed. Is it in a high cognitive space? Petone Ngauranga users. Wil they be tempted to use existing path? .	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
138	9/20/2021	There is a threat that cyclists would not use this new cyclist facility	The cause of the threat is due to the potential poor connections of the new cycle facilities to other facilities and destinations.	The consequence of the threat is that it could cause cyclists to avoid this new cycle facility and use other routes that provide better connections. This could also negatively affect the community acceptance of funding for cycling facilities as few cyclists would be using this new facility.	AECOM	Sharleen Hannon		Possible	Severe	Public/Media	High		Ensure there is a good standard of cycling facility during the construction phase. Ensure high level of service is provided for the Connection consistent with Te Ara Tupua and TQHR	Graeme Doherty			Possible	Moderate	Medium	Live-Treat	
139	9/20/2021	There is a risk around the level of usage of the Kiwirail maintenance yard by vehicles.	The cause of the risk is that dependant on the use of the Kiwirail maintenance yard (staging of construction, storing materials and etc) the maintenance area's traffic volume could change.	The consequence of the threat is that it could increase the traffic volume of the area increasing conflict with cyclists and pedestrians using the Connection.	AECOM	Shaun Bullard		Possible	Moderate	Health & Safety	Medium		Liaise with Kiwirail regarding the maintenance yard.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	

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140	9/20/2021	There is a risk of using the existing cycleway due to light levels that could impair the vision of cyclists.	The cause of the threat is cyclists travelling between light and dark areas (underpass and the two shared areas). The existing pedestrian hold bar is also obstructing cyclists.	The consequence of the threat is that it could be a safety hazard causing collisions. In addition, this pedestrian hold bar also increases the risk of collision with cyclists.	AECOM	Kylie Hook		Likely	Moderate	Health & Safety	High		1) Design with good geometrics 2) Waka Kotahi and Austroads design guidelines. 3) Monitor and manage.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
141	9/20/2021	There is a threat that there could be sun strike early in the morning.	The cause of the threat is due to the direction of travel in the morning.	The consequence of the threat is that it could impair the vision of cyclists and become a safety hazard.	AECOM	Graeme Doherty		Possible	Moderate	Health & Safety	Medium		1) Design with good geometrics 2) Waka Kotahi and Austroads design guidelines. 3) Monitor and manage.	Graeme Doherty			Possible	Minor	Medium	Live-Treat	
142	9/20/2021	There is a threat that the sightlines are below standard	The cause of the threat is the geometry of the site which can affect the sightlines for active mode users.	The consequence of the threat is that it could negatively affect safety and cause conflicts.	AECOM	Lorelei Schmitt		Possible	Moderate	Health & Safety	Medium		1) Design with good geometrics 2) Waka Kotahi and Austroads design guidelines. 3) Monitor and manage.	Graeme Doherty			Possible	Minor	Medium	Live-Treat	
143	9/20/2021	There is a threat that there might be a conflict between PT and active mode movement.	The cause of the threat is conflict in movement between the people exiting the tunnel and people travelling along the footpath outside the tunnel's exit (e.g. people getting off the bus stop and along Hutt Road).	The consequence of the threat is that it could become a safety hazard as people exiting the tunnel could collide with the people travelling along.	AECOM	Graeme Doherty		Likely	Moderate	Health & Safety	High		1) NZTA public transport design guideline (still in draft version). 2) Maintain good slightlines. 3) Road marking to reduce speed (e.g. keep left, slow down and centre lines). 4) Monitor and manage.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
144	9/20/2021	There is a threat that the existing bus shelter could conflict with the sightlines.	The cause of the threat is due to the location of the bus shelter and stop. The bus stop is also potentially in the way of the cycle lane.	The consequence of the threat is that the bus shelter could conflict with the sightlines and therefore become a safety hazard. The existing bus stop is a pull in bay which is also a safety hazard for cyclists that will use the cycle lane.	AECOM	Alex Campbell		Likely	Moderate	Health & Safety	High		NZTA public transport design guideline (still in draft version). The intent will be to design the bus shelter consistent with the latest public transport design guidance incorporating bus stop bypass designs. This includes working with the relevant SME's (e.g. Simon Kennett/Lorelei Schmitt) and GW to check design risks are well managed in the detailed design.	Graeme Doherty			Unlikely	Minor	Low	Live-Treat	
145	9/20/2021	There is a threat that the level of service for cyclists would be significantly decreased during the construction phase.	The cause of the threat is that the existing cycling facility (e.g. existing on-road cycle lane) will be removed to accommodate for construction traffic during the construction phase.	The consequence of the threat is it will reduce the demand for existing cyclists.	AECOM	Matt Shipman		Almost certain	Moderate	Health & Safety	High		1) Ensure some cycling facility during the construction phase. 2) Monitor and manage.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
146	9/20/2021	There is a threat of stormwater flooding issues on the western side.	The cause of the threat is that the grading of the intersection tends to be towards one side of the intersection and can cause flooding issues during a heavy storm.	The consequence of the threat is that the puddling from a heavy storm can become a safety hazard for vehicles drive through it.	AECOM	Kylie Hook		Possible	Moderate	Environmental	Medium		Using CCTV to identify the issue.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
147	9/20/2021	There is a threat of unplanned parking on the berm on the western side.	The cause of the threat is that some people tend to be parking on the berm on the western side and crosses the road unsafely.	The consequence of the threat is that people are crossing the road unsafely and becoming a safety hazard for others.	AECOM	Graeme Doherty		Possible	Moderate	Health & Safety	Medium		1) Existing parking up south Hutt Road. 2) Yellow line marking to enforce no parking. 3) Create parking on KiwiRail maintenance yard	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	Issue for TQHR to address if outside The Connection area / scope.
148	9/20/2021	There is a threat of funnelling of the wind through the tunnel.	The cause of the threat is that cyclists could experience extreme wind conditions when cycling through the tunnel.	The consequence of the threat is that the extreme wind may cause cyclists to lose control.	AECOM	Hannah Hyde		Possible	Moderate	Health & Safety	Medium		1) Warning system for high wind (VMS, social media and etc). 2) Wind break structure.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	
149	9/20/2021	There is a threat of northwestern wind going through the tunnel.	The cause of the threat is the occasionally northwestern wind going against the cyclists when cycling through the tunnel.	The consequence of the threat is that the northwestern makes it challenging to cycle through and can cause cyclist to lose control.	AECOM	Hannah Hyde		Possible	Moderate	Health & Safety	Medium		1) Warning system for high wind (VMS, social media and etc). 2) Wind break structure.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	
150	9/20/2021	There is a threat of sea level rise.	The cause of the threat is that global warming causes the rise of sea level.	The consequence of the threat is that the rise of sea level could flood the tunnel.	AECOM	Adam Ashford		Possible	Moderate	Environmental	Medium		Design to Ministry of Environment suggested future sea level.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	
151	9/20/2021	There is a threat that the tunnel attracts unsavoury activities to the area.	The cause of the threat is that the area becomes a pleasant and enclosed area and therefore may attract unsavoury activities.	The consequence of the threat is that people start to feel unsafe crossing through the area.	AECOM	Lorelie Schmitt		Possible	Minor	Health & Safety	Medium		1) Strong lighting. 2) CCTV. 3) Design for passive surveillance. 4) Maintenance. 5) Place making. 6) Graffiti Guard.	Graeme Doherty			Rare	Minor	Low	Live-Treat	
152	9/20/2021	There is a risk that the use of the Effluent station going to be changed.	The cause of the threat is that the use of the Effluent station may change.	The consequence of the threat is that more traffic might be generated in the area.	AECOM	Graeme Doherty		Unlikely	Moderate	Cost	Medium		Liaise with the Effluent station operators.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	
153	9/20/2021	There is a threat that motorised vehicles will be using the connections.	The cause of the threat is that access for motorised vehicles is not controlled.	The consequence of the threat is that it could become a safety hazard for other active mode users.	AECOM	Graeme Doherty		Possible	Moderate	Health & Safety	Medium		1) Enforce by-laws. 2) Road marking. 3) Geometrics.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	
154	9/20/2021	There is a risk that trail bikes will be access the Connection as seen in the Hutt River area.	The cause of the threat is the use of trail bikes around the Hutt area.	The consequence of the threat is that it could become a safety hazard for other active mode users.	AECOM	Matt Shipman		Possible	Moderate	Health & Safety	Medium		1) Enforce by-laws. 2) Road marking. 3) Geometrics.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	
156	9/20/2021	There is an opportunity to bring iwi Mana Whenua urban design into the project.	The cause of the opportunity is that there is currently a lack of urban design in the area.	The consequence of the opportunity is that it can increase the overall experience when using the facility and bring in the rich history of the past.	AECOM	Hannah Hyde		Possible	Moderate	Stakeholders	Medium		Consider Opportunities to improve design with mana whenua representatives .	Graeme Doherty			Possible	Moderate	Medium	Live-Treat	
157	9/20/2021	There is a threat that the current channel level is not sufficient.	The cause of the threat is that the channel level has changed over the years and the current channel level is unknown.	The consequence of the threat is that the current channel level cannot accommodate the stormwater and cause flooding in the area.	AECOM	Kylie Hook		Unlikely	Moderate	Health & Safety	Medium		Survey the channel level and make improvements if needed.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
158	9/20/2021	There is a threat that the water can leaks from the flyover overhead.	The cause of the threat is that there appears to be leakage from the joints of the flyover.	The consequence of the threat is that it could cause flooding in the area.	AECOM	Adam Ashford		Unlikely	Moderate	Health & Safety	Medium		Investigate the flyover leaks overhead and maintain	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
159	9/20/2021	There is a threat of conflicting travel modes and movement in the area.	The cause of the threat is that a range of different modes (e.g. traffic, pedestrians, cyclists and etc) use that area to get to a range of different places (e.g. stations, bus stops and etc) and therefore, can conflict with each other.	The consequence of the threat is that the conflict moving and difference in speed could cause crashes with each other.	AECOM	Hannah Hyde		Likely	Moderate	Health & Safety	High		1) Road marking (slow down, double yellow lines, keep left). 2) Design with good geometrics 3) Waka Kotahi and Austroads design guidelines.	Graeme Doherty			Possible	Moderate	Medium	Live-Treat	
160	9/20/2021	There is a risk that the existing footpath kerb is being hit by vehicles and some places are damage.	The cause of the threat is that vehicles are hitting and damaging the existing footpath kerb.	The consequence of the threat is that it will damage vehicles and the footpath kerb will need more frequent maintenance. It is also not safe for cyclist cycling next to the kerb.	AECOM	Graeme Doherty		Unlikely	Severe	Health & Safety	Medium		1) Reduce speed. 2) Wider width. 3) Redirective kerbs.	Graeme Doherty			Unlikely	Severe	Medium	Live-Treat	
161	9/20/2021	There is an increased risk of crashes during the maintenance of the slip road.	The cause of the threat is that some road sections will be closed down due to maintenance of the road.	The consequence of the threat is that it could disrupt traffic and cause safety hazards.	AECOM	Graeme Doherty		Possible	Moderate	Health & Safety	Medium		1) maintenance at night time. 2) Sweeping.	Graeme Doherty			Unlikely	Moderate	Medium	Live-Treat	
163	9/20/2021	There is a risk that a large amount of construction will happen in the small area during the same time.	The cause of the threat is a range of project construction (TAT and the connection) that could be happening in the small area during the same time.	The consequence of the threat is that it could increase the safety risk for the road users and construction workers in the area.	AECOM	Graeme Doherty		Possible	Severe	Health & Safety	High		1) Need to check swept paths for HCVs. Option takes a couple of months. Option 1A a bit longer. Need to avoid cyclists mixing with trucks and buses. 2) Built in alliance. 3) Build into contract.	Graeme Doherty			Possible	Severe	High	Live-Treat	
164	9/20/2021	There is a threat that requiring path users to give way to vehicles coming out of the KR land may be illegal.	The cause of the threat is that it may be illegal to require path users to give way to vehicles coming out of the RK land. By law, a driver entering or existing a driveway must give way to road users on a footpath cycle path or shared path.	The consequence of the threat is that the intersection is not approved	AECOM	Graeme Doherty		Possible	Moderate	Stakeholders	Medium		Update drawings to show KR vehicles and effluent vehicles giving way.	Graeme Doherty			Rare	Moderate	Low	Live-Treat	

Appendix C

Option 1, 1A and 1D Drawings

ISO A1 594mm x 841mm

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AECOM

CONSULTANT

AECOM Australia Pty Ltd
A.B.N 20 093 846 925
www.aecom.com

PROJECT

WALKING & CYCLING CONNECTION BETWEEN HUTT ROAD & TE ARA TUPUA

CLIENT

Let's GET Wellington MOVING

PROJECT MANAGEMENT INITIALS

GD	TR	AA
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
D	26.01.2022	REVISIONS FOR ISSUE
C	15.09.2021	NOTES FOR RISK WORKSHOP
B	25.08.2021	KIWIRAIL AMENDMENTS
A	Aug-21	FOR DISCUSSION

PROJECT NUMBER

60623852

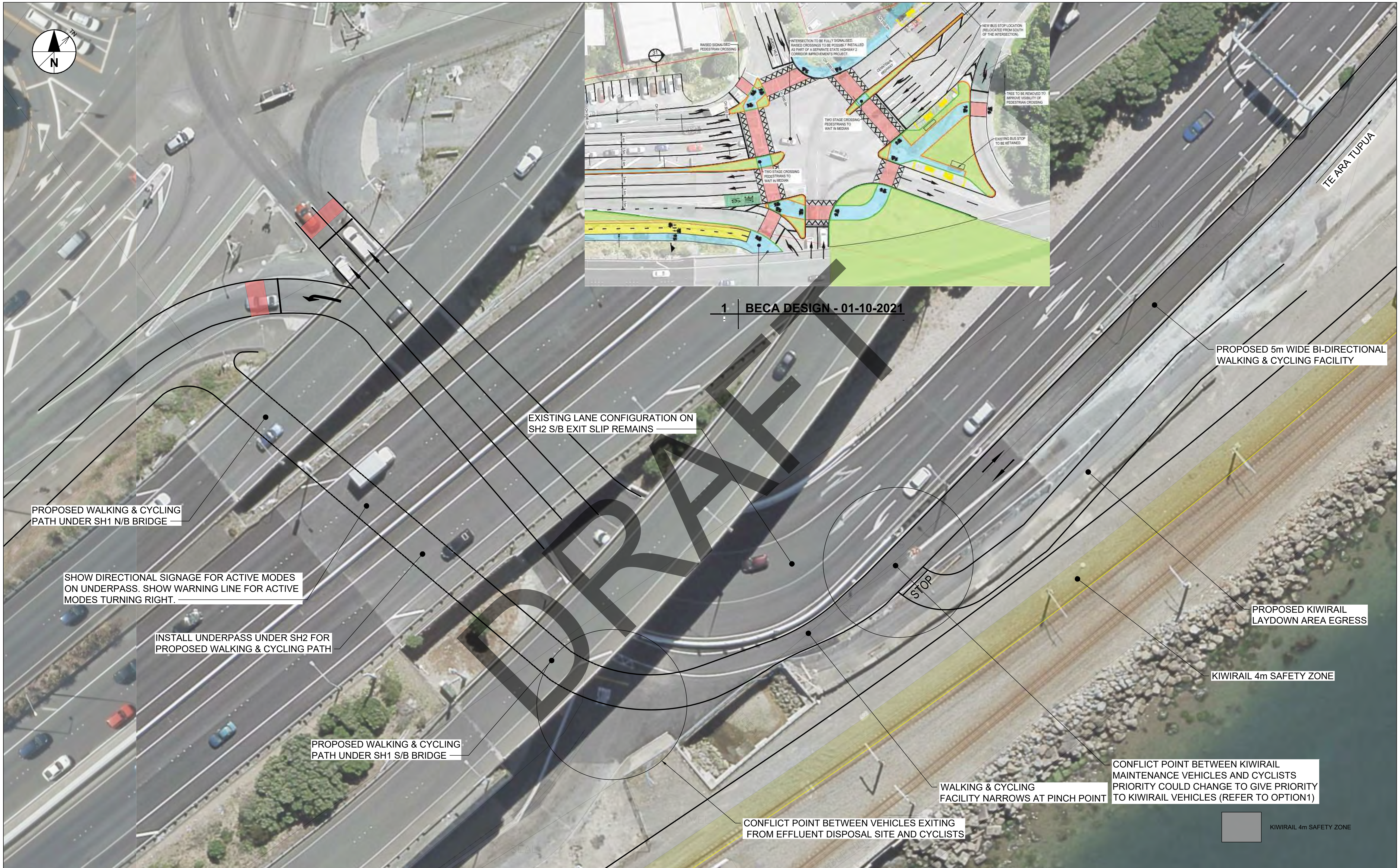
SHEET TITLE

CONCEPT PLAN OPTION 1

SHEET NUMBER

CI-0002

ISO A1 594mm x 841mm



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PROJECT MANAGEMENT INITIALS

GD	TR	AA
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
C	26.01.2022	REVISIONS FOR ISSUE
B	25.08.2021	KIWIRAIL AMENDMENTS
A	Aug-21	FOR DISCUSSION

PROJECT NUMBER

60623852

SHEET TITLE

CONCEPT PLAN OPTION 1A

SHEET NUMBER

CI-0003

ISO A1 594mm x 841mm

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PROJECT

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PROJECT MANAGEMENT INITIALS

GD	TR	AA
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

I/R	DATE	DESCRIPTION
B	26.01.2022	REVISIONS FOR ISSUE
A	Sept-21	FOR DISCUSSION

PROJECT NUMBER

60623852

SHEET TITLE

CONCEPT PLAN OPTION 1D

SHEET NUMBER

CI-0009

Appendix D

Cost Estimates and Parallel Cost Estimate

DRAFT

Project Estimate
Form C

Thordon Quay Hutt Road SSBC - The Connection Option 1

DBE

Detailed Business Case Estimate

Item	Description	Base estimate	Contingency	Funding risk
A	**Nett project property cost**	**110,000**	**16,500**	**11,000**
	Project Development Phase			
	- consultancy fees	nil	nil	nil
	- the NZTA-managed costs	nil	nil	nil
B	**Total Project Development**			
	Pre-implementation Phase			
	- consultancy fees	225,000	67,500	112,500
	- the NZTA-managed costs	180,000	54,000	90,000
C	**Total Pre-implementation**	**405,000**	**121,500**	**202,500**
	Implementation Phase			
	- Implementation fees	99,000	29,700	49,500
	- consultancy fees	100,000	30,000	50,000
	- the NZTA-managed costs	100,000	30,000	50,000
	- consent monitoring fees	5,000	1,500	2,500
	Sub-total base Implementation Fees	**304,000**	**91,200**	**152,000**
	Physical works			
1	Environmental compliance	15,000	7,500	4,500
2	Earthworks	209,040	104,520	62,712
3	Ground improvements	0	0	0
4	Drainage	106,625	53,313	31,988
5	Pavement and surfacing	328,910	164,455	98,673
6	Bridges	0	0	0
7	Retaining walls	210,000	105,000	63,000
8	Traffic services	461,700	230,850	138,510
9	Service relocations	110,000	55,000	33,000
10	Landscaping	7,500	3,750	2,250
11	Traffic management and temporary works	240,000	120,000	72,000
12	Preliminary and general	779,388	389,694	233,816
13	Extraordinary construction costs	0	0	0
14	**Sub Total Base Physical Works**	2,468,163	1,234,081	740,449
D	**Total for Implementation Phase**	**2,772,163**	**1,325,281**	**1,632,898**
E	**Project Base Estimate** (A+C+D)	**3,287,163**	**1,463,281**	**1,846,398**

Item	Description		Amount
F	**Contingency** (Assessed/Analysed)	**(A+C+D)**	**1,463,281**
G	**Project Expected Estimate**	**(E+F)**	**4,750,444**
	Nett Project Property Cost Expected Estimate		126,500
	Project Development Expected Estimate		Nil
	Pre-Implementation Expected Estimate		526,500
	Implementation Expected Estimate		4,097,444

Item	Description		Amount
H	**Funding risk** (Assessed/Analysed)	**(A+C+D)**	**1,846,398**
I	**95th percentile Project Estimate**	**(G+H)**	**6,596,841**
	Nett Project Property Cost 95th percentile Estimate		137,500
	Project Development 95th percentile Estimate		Nil
	Pre-Implementation 95th percentile Estimate		729,000
	Implementation 95th percentile Estimate		5,730,341

Date of estimate: Sept 2021	**Cost index (Qtr/Year)**
Estimate prepared by: Marc Cilliers	**Signed**
Estimate internal peer review by: Graeme Doherty	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by the NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate
Form C

DBE

Thordon Quay Hutt Road SSBC - The Connection Option 1D

Detailed Business Case Estimate

Item	Description	Base estimate	Contingency	Funding risk
A	**Nett project property cost**	**110,000**	**16,500**	**11,000**
	Project Development Phase			
	- consultancy fees	nil	nil	nil
	- the NZTA-managed costs	nil	nil	nil
B	**Total Project Development**			
	Pre-implementation Phase			
	- consultancy fees	225,000	67,500	112,500
	- the NZTA-managed costs	180,000	54,000	90,000
C	**Total Pre-implementation**	**405,000**	**121,500**	**202,500**
	Implementation Phase			
	- Implementation fees	99,000	29,700	49,500
	- consultancy fees	100,000	30,000	50,000
	- the NZTA-managed costs	100,000	30,000	50,000
	- consent monitoring fees	5,000	1,500	2,500
	Sub-total base Implementation Fees	**304,000**	**91,200**	**152,000**
	Physical works			
1	Environmental compliance	15,000	7,500	4,500
2	Earthworks	178,005	89,003	53,402
3	Ground improvements	0	0	0
4	Drainage	125,650	62,825	37,695
5	Pavement and surfacing	328,910	164,455	98,673
6	Bridges	0	0	0
7	Retaining walls	0	0	0
8	Traffic services	139,750	69,875	41,925
9	Service relocations	110,000	55,000	33,000
10	Landscaping	72,900	36,450	21,870
11	Traffic management and temporary works	240,000	120,000	72,000
12	Preliminary and general	403,065	201,532	120,919
13	Extraordinary construction costs	0	0	0
14	**Sub Total Base Physical Works**	1,613,280	806,640	483,984
D	**Total for Implementation Phase**	**1,917,280**	**897,840**	**1,119,968**
E	**Project Base Estimate** (A+C+D)	**2,432,280**	**1,035,840**	**1,333,468**

Item	Description		Contingency
F	**Contingency** (Assessed/Analysed)	**(A+C+D)**	**1,035,840**
G	**Project Expected Estimate**	**(E+F)**	**3,468,119**
	Nett Project Property Cost Expected Estimate		126,500
	Project Development Expected Estimate		Nil
	Pre-Implementation Expected Estimate		526,500
	Implementation Expected Estimate		2,815,119

Item	Description		Funding risk
H	**Funding risk** (Assessed/Analysed)	**(A+C+D)**	**1,333,468**
I	**95th percentile Project Estimate**	**(G+H)**	**4,801,587**
	Nett Project Property Cost 95th percentile Estimate		137,500
	Project Development 95th percentile Estimate		Nil
	Pre-Implementation 95th percentile Estimate		729,000
	Implementation 95th percentile Estimate		3,935,087

Date of estimate: Sept 2021	**Cost index (Qtr/Year)**
Estimate prepared by: Marc Cilliers	**Signed**
Estimate internal peer review by: Graeme Doherty	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by the NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

DRAFT

LET'S GET WELLINGTON MOVING: THORNDON QUAY AND HUTT ROAD – THE CONNECTION

PARALLEL ESTIMATE

17 January 2022

CONTENTS

APPENDICES

CONTACT

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Email	Luke.donnelly@wtpartnership.co.nz

DOCUMENT STATUS	NAME	DATE
PREPARED BY	Filip Lalovich	01.12.21
REVIEWED BY	Luke Donnelly	17.01.22
E-SIGNATURE APPROVED	Luke Donnelly	17.01.22

REVISION NO.	REVISION DATE	DRAFT.FINAL
00	01.12.21	FINAL
01	21.12.21	FINAL
02	17.01.22	FINAL

1 INTRODUCTION

WT Infrastructure (WT) have been commissioned by Let's Get Wellington Moving to provide a parallel estimate for The Connection between the Thorndon Quay to Upper Hutt Cycleway and the Ngā Ūranga to Pito-one Cycleway. The works entail the construction of an underpass below SH2 and cycleway works to link between the two projects.

We were provided with the following documents which helped form the basis of this updated budget estimate.

- *The Connection Draft Final SSBC addendum 37* by Aecom
- *The Connection Draft Final SSBC addendum 33* by Aecom
- *SH1N_10679_Original Construction Drawings 1982* drawing pack of the original structures
- *SH1N_10679_Original Construction Drawings 1982* drawing pack of the original structures
- *SH1N_10679_Original Construction Drawings 1982* drawing pack of the original structures

2 FINANCIAL SUMMARY

The following table provides a summary of the cost estimate included in Appendix A, along with a comparison to the Aecom Estimate. Please refer to our assumptions, clarifications and exclusions listed later in the document.

Item	Description	WT	Aecom	Variance
1	Project Base Estimate	8,465,114	5,753,321	2,711,793
2	Project Expected Estimate	11,973,346	8,449,681	3,523,665
3	95th percentile Project Estimate	14,270,679	11,775,773	2,494,906

2.1 VARIANCES

We have only been provided with the Aecom estimate summary, so we cannot comment on any detailed rates variances, but we have highlighted any discrepancies between the two estimates below:

- Pre-implementation fees = +$980k. We have allowed 14.5% for consultancy fees and 8.4% for NZTA managed Costs, which is in line with the agreed allowances for the wider Thorndon Quay and Upper Hutt project.

- Implementation Phase Fees = +$600k. We have allowed 8.4% for consultancy fees and 6.5% for NZTA managed Costs, which is in line with the agreed allowances for the wider Thorndon Quay and Upper Hutt project.

- Physical Works = +$800k. It is difficult to analyse the exact variances as we only have the Aecom cost summary and it is unclear which costs are captured under each element. Given the limited design information available to produce the estimates, differences are inevitable based upon the assumptions made.

- Project Contingency = +$800k. Please refer to the contingency section of the report for our allowances.

- P95 Contingency = -$1m. Please refer to the contingency section of the report for our allowances.

2.2 CONTINGENCY

We have used the General Approach to contingency and have applied the following percentages to each element:

Element	Project Contingency	P95 Contingency
Property Cost	30%	25%
Pre-implementation Phase	30%	25%
Implementation Fees	30%	25%
Environmental Compliance	40%	25%
Earthworks	40%	25%
Ground Improvements	50%	30%
Drainage	40%	25%
Pavement and Surfacing	40%	25%
Bridges & Tunnels	50%	30%
Retaining Walls	50%	30%
Traffic Services	40%	25%
Service Relocations	40%	25%
Landscaping	40%	25%
Traffic Management and Temporary Works	50%	30%
Preliminary and General	40%	25%
Extraordinary Construction Costs	50%	30%
Contractor's Offsite OH&P	40%	25%

2.3 METHODOLOGY

For the purposes of developing this estimate, we have assumed the following methodology for the installation of the underpass:

- The underpass will be installed open cut through the existing embankment.
- The works will be split into 2 stages to allow one-way traffic to be maintained on SH2. It is assumed the traffic travelling in the other direction will be diverted off SH2 earlier and re-directed on past this intersection.
- We have allowed to sheet pile down to 12m and excavate to subgrade.
- We have allowed for a 5m x 4m concrete culvert, with all construction details assumed.
- We have assumed a raft foundation and no allowance is included for piling.
- We have assumed that the full extent of crib wall on each side of the embankment will need to be replaced.

2.4 ALTERNATIVE METHODOLOGY & COST

The methodology described in 2.3 above will be very disruptive to traffic on SH2. The Aecom drawings referenced the works being completed under the Kiwirail line at Petone Station and indicated a similar methodology here. We believe that the works here are more complex than what we have seen of the Petone crossing due to the existing crib walls and abutments in close proximity to the works. As such we believe that these works would take longer than the 10 days indicated. It may therefore not be feasible to disrupt the SH2 traffic for this length of time.

However, without further engineering inputs, we are unable to develop a cost estimate for an option which effectively 'tunnels' below the SH without major disruption. We would suggest for budgeting purposes that a base estimate allowance of between **$10m** and **$15m** is carried to allow for this.

We therefore recommend that the value carried forward for budgeting reflects this higher cost. The table below uses the base estimate including contingency as the *Project Expected Estimate* and carries the alternative methodology costs as the *95th Percentile Estimate* (reflected as a 100% mark-up on the expected estimate).

Item	Description	$
1	Project Base Estimate	7,571,025
2	Project Expected Estimate	12,884,841
3	95th percentile Project Estimate	25,800,000

2.5 GENERAL ASSUMPTIONS, EXCLUSIONS AND CLARIFICATIONS

As part of our estimate we have assumed the following:

- We have used the same Land Purchase costs as Aecom but are unsure what these are based on.
- Project Development fees are excluded
- Development contributions are excluded
- Temporary works to the existing bridge and flyovers is excluded
- We have allowed for 30% of excavated material to be contaminated.
- We have allowed for a signalised cycleway / pedestrian crossing to the south of the underpass
- GST is excluded
- We have included an allowance of night works for 10 days
- We have included an allowance of $150k for urban design upgrades, to allow for etching or patterns to the new abutment retaining walls and the inside concrete face of the underpass
- Traffic management allowances are assumed based upon SH2 being shut in one direction for approximately 2 months in total.

APPENDIX A

IBE Estimate Summary

Project Estimate - Form B

Project Name: LGWM - Thorndon Quay - The Connection

IBE

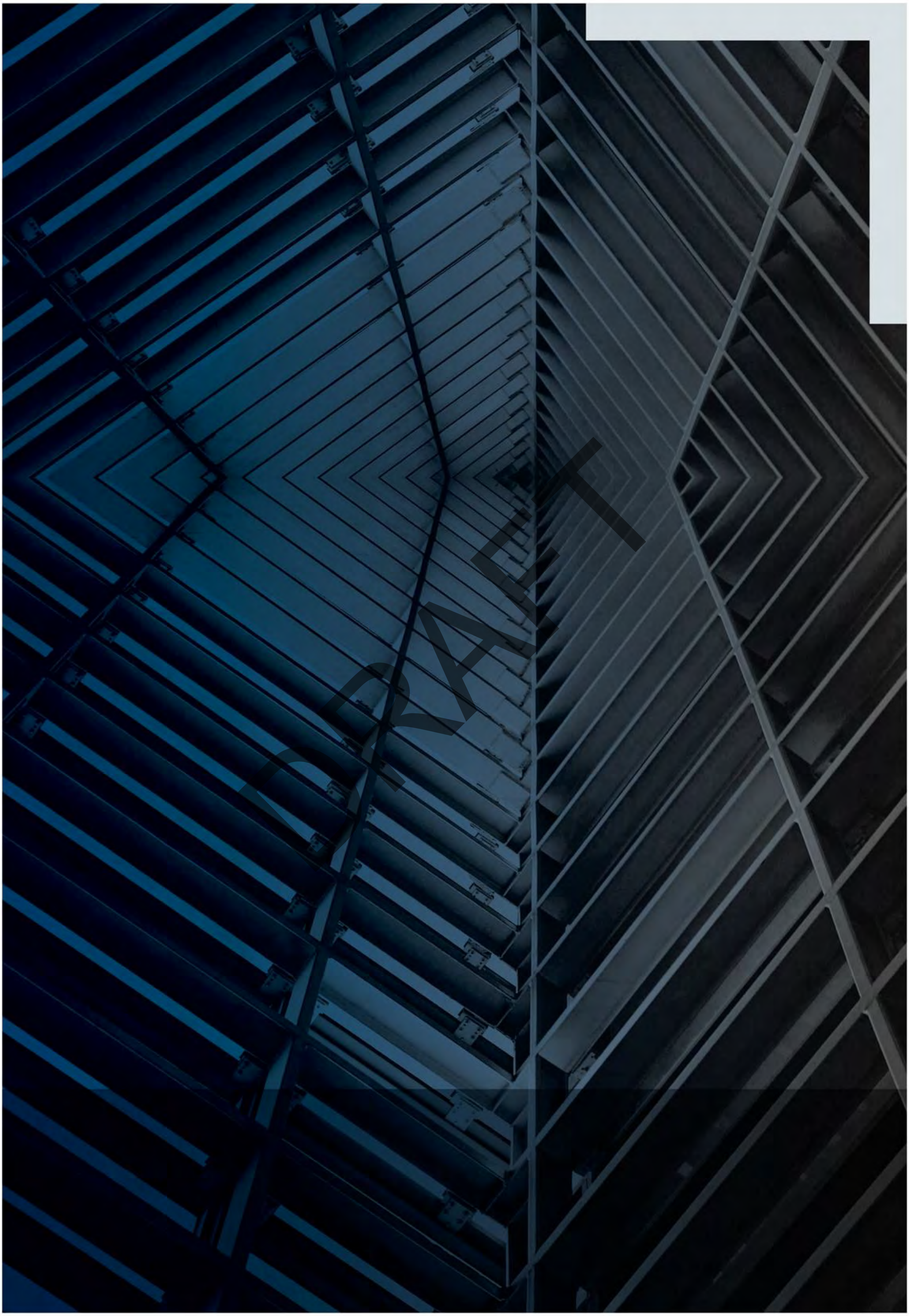
Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**110,000**	**33,000**	**27,500**
	Project Development Phase			
	- Consultancy Fees	Excluded	Excluded	Excluded
	- NZTA Managed Costs	Excluded	Excluded	Excluded
B	**Total Project Development**	**0**	**0**	**0**
	Pre-Implementation Phase			
	- Consultancy Fees	877,338	263,201	219,334
	- NZTA Managed Costs	510,080	153,024	127,520
C	**Total Pre-implementation**	**1,387,418**	**416,225**	**346,855**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	510,080	153,024	127,520
	- NZTA Managed Costs	391,742	117,522	97,935
	- Consent Monitoring Fees	0	0	0
	Sub Total Base Implementation Fees	**901,822**	**270,547**	**225,455**
	Physical Works			
1	Environmental Compliance	82,337	32,935	20,584
2	Earthworks	224,750	89,900	56,188
3	Ground Improvements	57,969	28,985	17,391
4	Drainage	68,882	27,553	17,221
5	Pavement and Surfacing	177,108	70,843	44,277
6	Bridges & Tunnels	1,929,132	964,566	578,740
7	Retaining Walls	624,000	312,000	187,200
8	Traffic Services	175,000	70,000	43,750
9	Service Relocations	50,000	20,000	12,500
10	Landscaping	150,000	60,000	37,500
11	Traffic Management and Temporary Works	660,000	330,000	198,000
12	Preliminary and General	818,852	327,541	204,713
13	Extraordinary Construction Costs	350,000	175,000	105,000
14	Contractor's Offsite OH&P	697,844	279,138	174,461
	Sub Total Base Physical Works	6,065,874	2,788,460	1,697,524
D	**Total for Implementation Phase**	**6,967,696**	**3,059,006**	**1,922,979**
E	**Project Base Estimate** (A+B+C+D)	**8,465,114**		

F	**Contingency** (Assessed/Analysed)	(A+B+C+D)	**3,508,232**
G	**Project Expected Estimate**	(E+F)	**11,973,346**
	Nett Project Property Cost Expected Estimate		Excluded
	Project Development Phase Expected Estimate		0
	Pre-implementation phase Expected Estimate		1,803,644
	Implementation Phase Expected Estimate		10,026,702

H	**Funding Risk Contingency** (Assessed/Analysed)	(A+B+C+D)	**2,297,334**
I	**95th percentile Project Estimate**	(G+H)	**14,270,679**
	Nett Project Property Cost 95th percentile Estimate		170,500
	Project Development Phase 95th percentile Estimate		0
	Pre-implementation Phase 95th percentile Estimate		2,150,498
	Implementation Phase 95th percentile Estimate		11,949,681

Date of Estimate	**4Q 2021**
Estimate prepared by	**Filip Lalovic**
Estimate internal peer review by	**Luke Donnelly**
Estimate external peer review by	**N/A**
Estimate accepted by NZTA	



Appendix E

Traffic Modelling Summary

Traffic volumes for the SIDRA analysis were derived from pre-Covid traffic volumes. Currently, due to Covid-19 the number of trips into and out of the city has changed. Traffic has gone back to 10% lower in December 2021 and may increase further to pre Covid levels in near future. The changes to travel patterns due to Covid-19, combined with changes through the opening of the Transmission Gully project, will become clearer through ongoing monitoring. As monitoring establishes a normalised travel pattern, further video review work will be undertaken to confirm the traffic baseline.

The modelling analysis assumed:

- A 10% growth rate to 2031 at 1% per annum
- Sensitivity tests based on a 15% growth rate to 2031

The results of the initial modelling analysis undertaken showed that:

- Volumes on SH2 are regulated by upstream constraints at the southbound Petone entry slip lane, which is beneficial for the performance of the options as this regulates traffic reaching the SH2 / Jarden Mile / Centennial Highway (Ngā Ūranga) intersection, so mitigating to some extent the impact of the reduced capacity of the two options.
- Historic data has shown that the future growth on the corridor is likely to be focused on the shoulders of existing peak travel times.
- The table shows the modelled average and 95% number of metres to the back of queue for both Option 1 and 1D. Cells highlighted in green indicates queue lengths are less than 400 metres (approximately the total length of the Hutt Road southbound off ramp slip lane) and cells highlighted in orange indicate queue lengths are greater than 400 metres.

Modelled SH2 southbound offramp queue lengths

	AM		PM	
	Average queue (m)	95% back of queue (m)	Average queue (m)	95% back of queue (m)
2021 Existing	73	118	222	362
2031 Existing	98	160	233	380
2031 Existing (Sensitivity Test)	114	185	257	419
2021 Option	118	193	227	370
2031 Option	154	251	300	490
2031 Option (Sensitivity Test)	170	277	346	565

- The predicted outcomes of the 95% back of queue for the 2031 scenario and both of the 2031 Sensitivity Test scenarios in the PM peak period are greater than 400 metres and therefore could affect the main movement along the SH2 southbound lanes.

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WAKA KOTAHI NZ TRANSPORT AGENCY

greater WELLINGTON REGIONAL COUNCIL Te Pane Matua Taiao

Absolutely Positively Wellington City Council Me Heke Ki Pōneke

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Appendix B

Existing Traffic Flows

Figure 1 Traffic Volumes: Thorndon Quay - Mulgrave to Moore Street (June 2019)

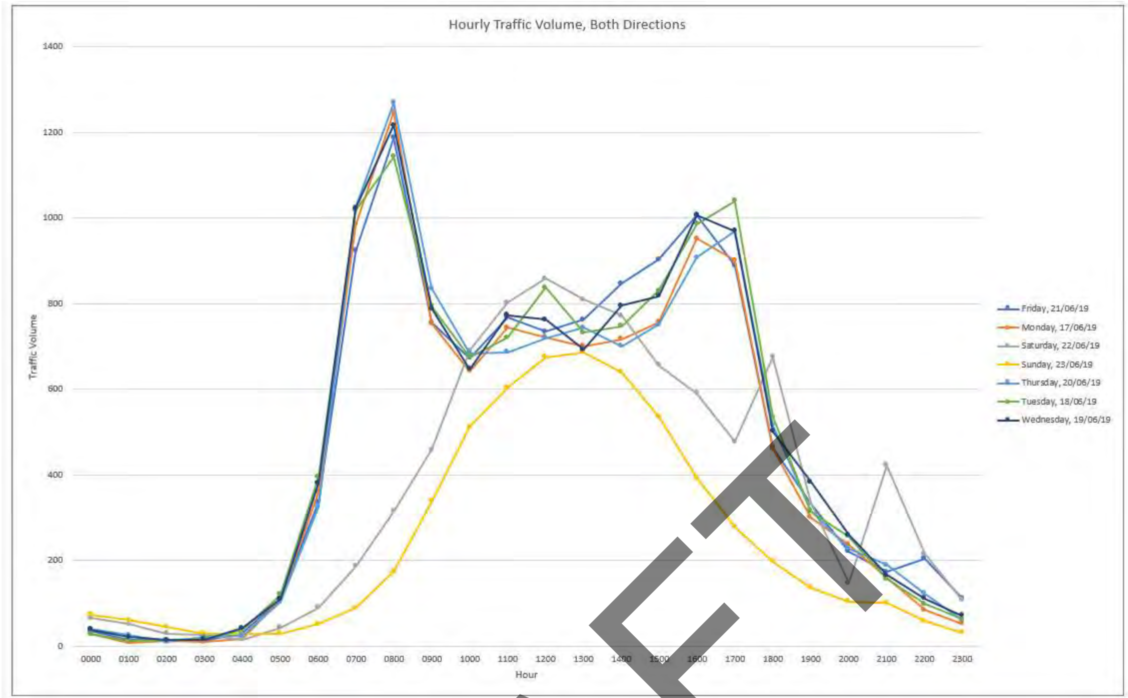


Figure 2 Traffic Volumes: Thorndon Quay – Davis Street to Tinakori Road (November 2019)

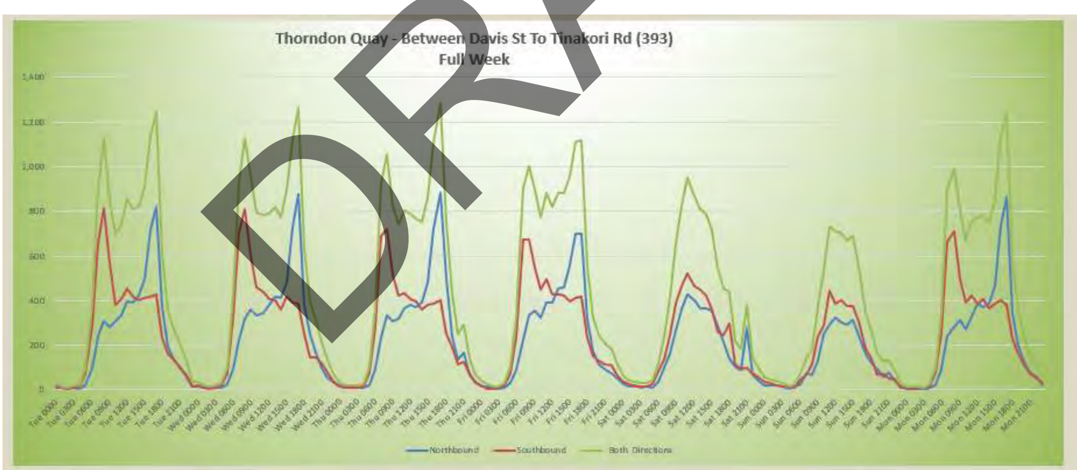


Figure 3 Traffic Volumes: Hutt Road – Tinakori Road to Sat Street (March 2019)

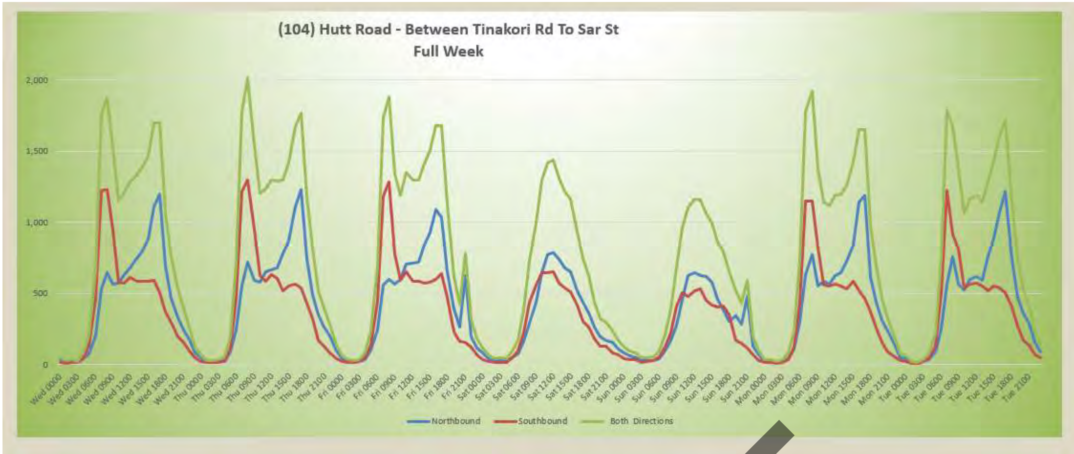


Figure 4 Traffic Volumes: Hutt Road – Aotea Quay to School Road (March 2019)

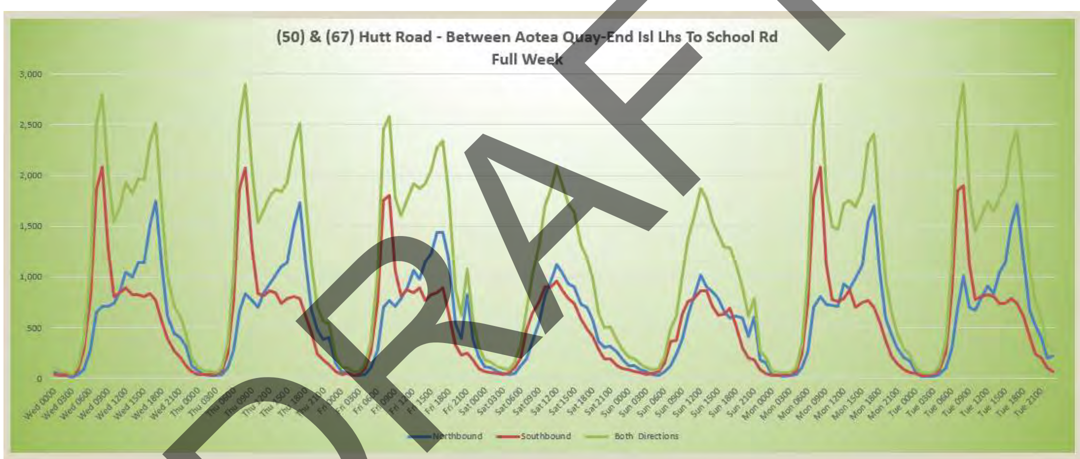


Figure 5 Traffic Volumes: Hutt Road – Westminster Street to Rangiora Avenue (February 2019)

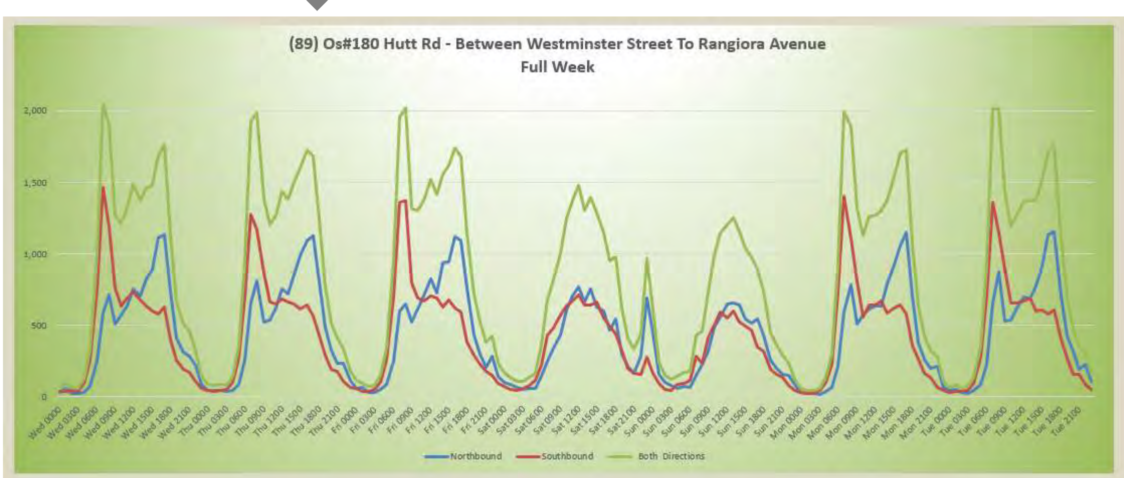
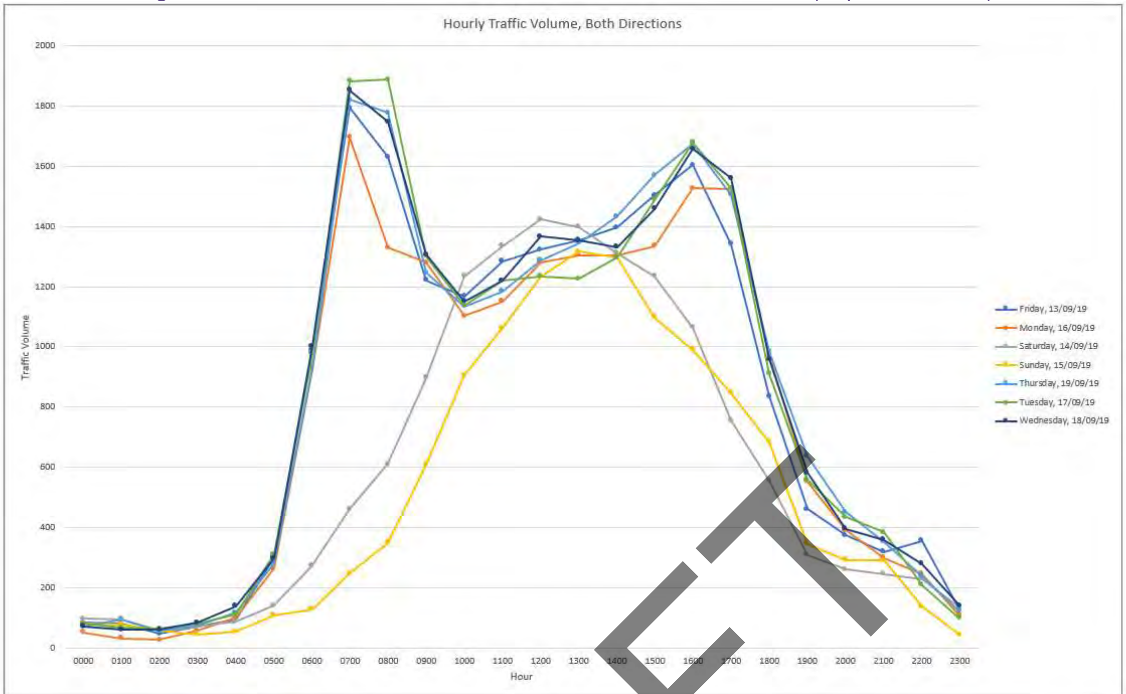


Figure 6 Traffic Volumes: Hutt Road – Jarden Mile to Onslow Road (September 2019)



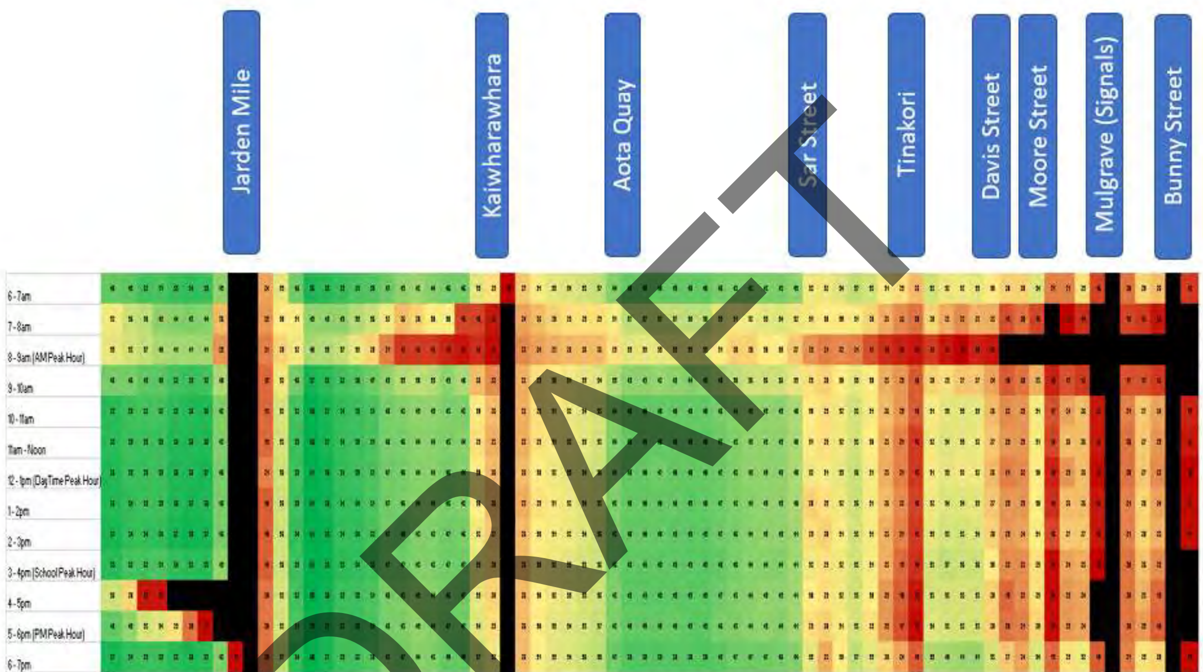
Appendix C

Analysis of Bus Operating Performance

In order to understand where delays to buses and other traffic occur along the TQHR corridor, TomTom data was sourced for 2019. The data obtained is for private vehicles, but gives a good indication of where buses experience delays, given that there are no bus priority measures currently on the TQHR corridor. Data was sorted into hour long time slots in order to help identify the locations where delays occur.

Southbound Delays

The diagram below illustrates the travel speeds in the southbound direction with the red and black colours indicating areas where traffic is slowed to less than 20km/h or stopped. Note that whilst this diagram covers the entire TQHR corridor that the SSBC concerns, it is not to scale.



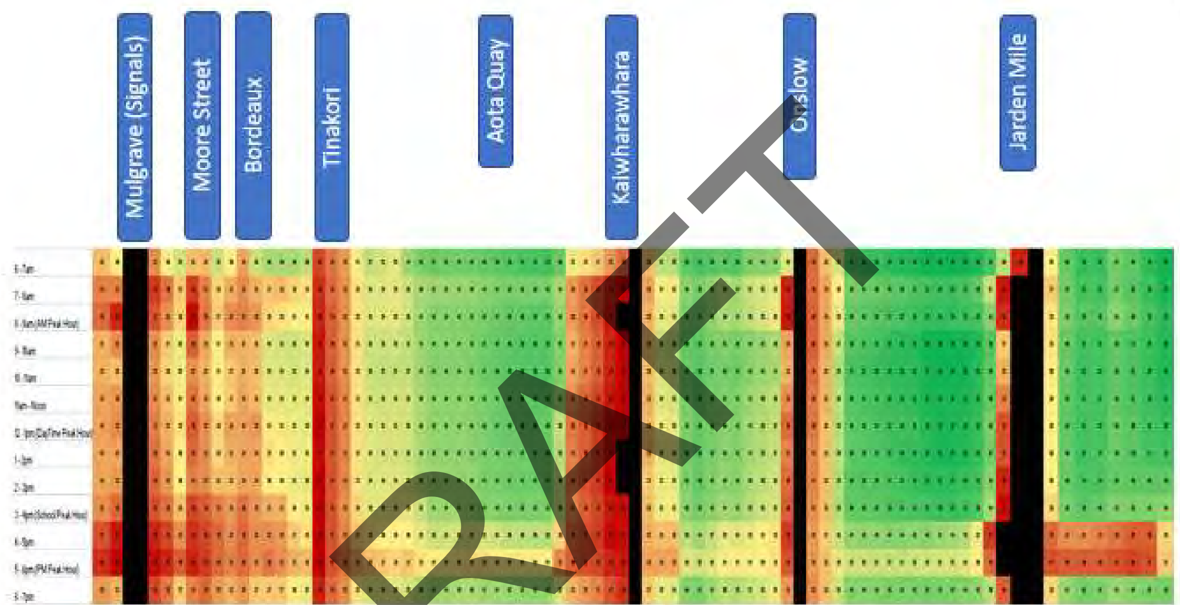
This analysis shows that there are several locations where traffic is slowed or queued at certain times of the day, notably:

- Jarden Mile/ Ngauranga Gorge Intersection: Delays at this intersection appear to occur in the evening peak period in the southbound direction. At other times of the day the delay is not significant.
- Kaiwharawhara Road/ Hutt Road Intersection: Delays occur at the intersection in the morning peak period (7am to 9am). This slower speed extends to the north indicating that a queue or slow moving traffic is present at the intersection on Hutt Road. Delays are minimal for the remainder of the day.
- Aotea Quay Ramps: Traffic is slowing in this location, which appears to be due to the diverging of traffic and weaving movements around the off ramp.
- Sar Street and Tinakori Road: Delays at Tinakori Road occur in morning peak period, which is possibly due to heavy right turn volumes at Tinakori Road with a queue which is believed to extend beyond the turn lane, causing blocking back into the southbound through lane.
- Davis Street: Delays at the intersection can be seen during the morning peak period, potentially caused by use of the zebra crossing.

- Moore Street: Delays at the intersection can be seen during the morning peak period, potentially as a result of the zebra crossing which is very busy during the morning peak period, as well as the close proximity of the bus stop to the crossing.
- Mulgrave Street: Delays at the intersection appear to be worse in the morning peak period than in the evening peak period.

Northbound Delays

The diagram below illustrates the travel speeds in the northbound direction with the red and black colours indicating areas where traffic is slowed to less than 20km/h or stopped on the TQHR corridor.



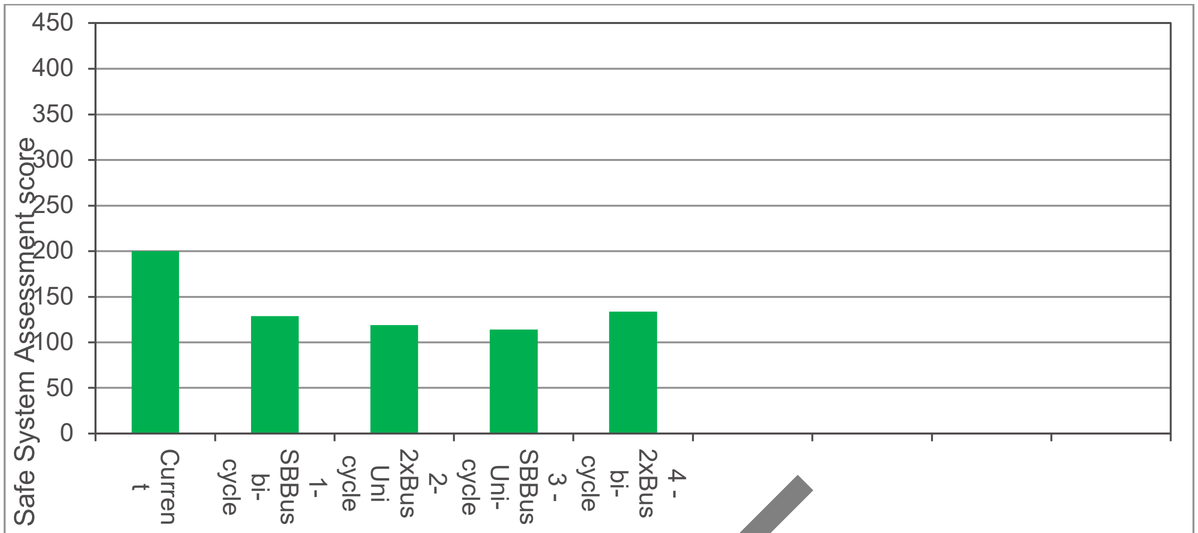
The main locations where delay occur are as follows:

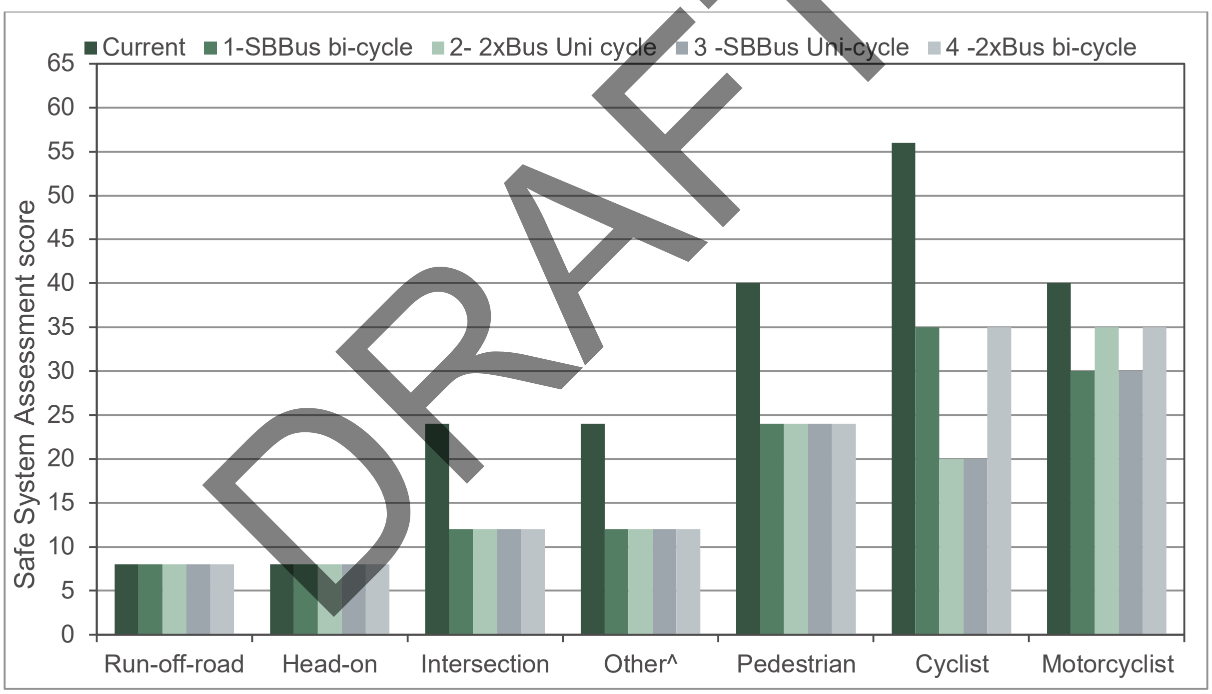
- Jarden Mile/ Ngauranga Gorge Intersection: Delays at this intersection appear to occur in the evening peak period, though at other times of the day the delay is not significant.
- Onslow Road: There appears to be some minor delays in both the morning and evening peak periods. This is due to all movements in the northbound direction being under signal control.
- Kaiwharawhara Road/ Hutt Road Intersection: Delays occur at the intersection throughout the day and appear to be slightly worse in the evening peak hour (5 to 6pm).
- Tinakori Road: Delay appears to occur in the northbound direction all day which should not, in theory, occur at a giveway controlled intersection. This may be an anomaly, though it is possible that traffic heading north is slowing or stopping to perform the tight left turn into the intersection or slowing or stopping to allow traffic to turn right.
- Bordeaux Bakery: Delays at the intersection occur throughout the day. This appears to be as a result of the zebra crossing and the side road friction at this section of the corridor.
- Moore Street: Delays at the intersection occur during both the morning and evening peak periods, potentially as a result of the zebra crossing.
- Mulgrave Street: Delays at the intersection occur in the evening peak period.

Appendix D

Safe System Framework Assessment

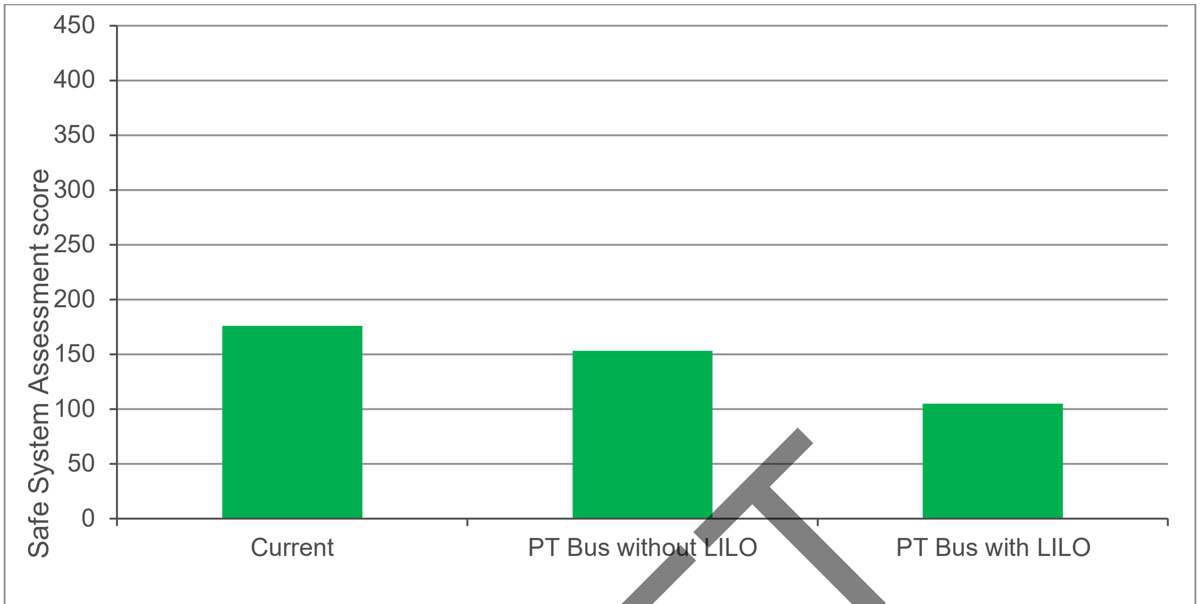
Thorndon Quay

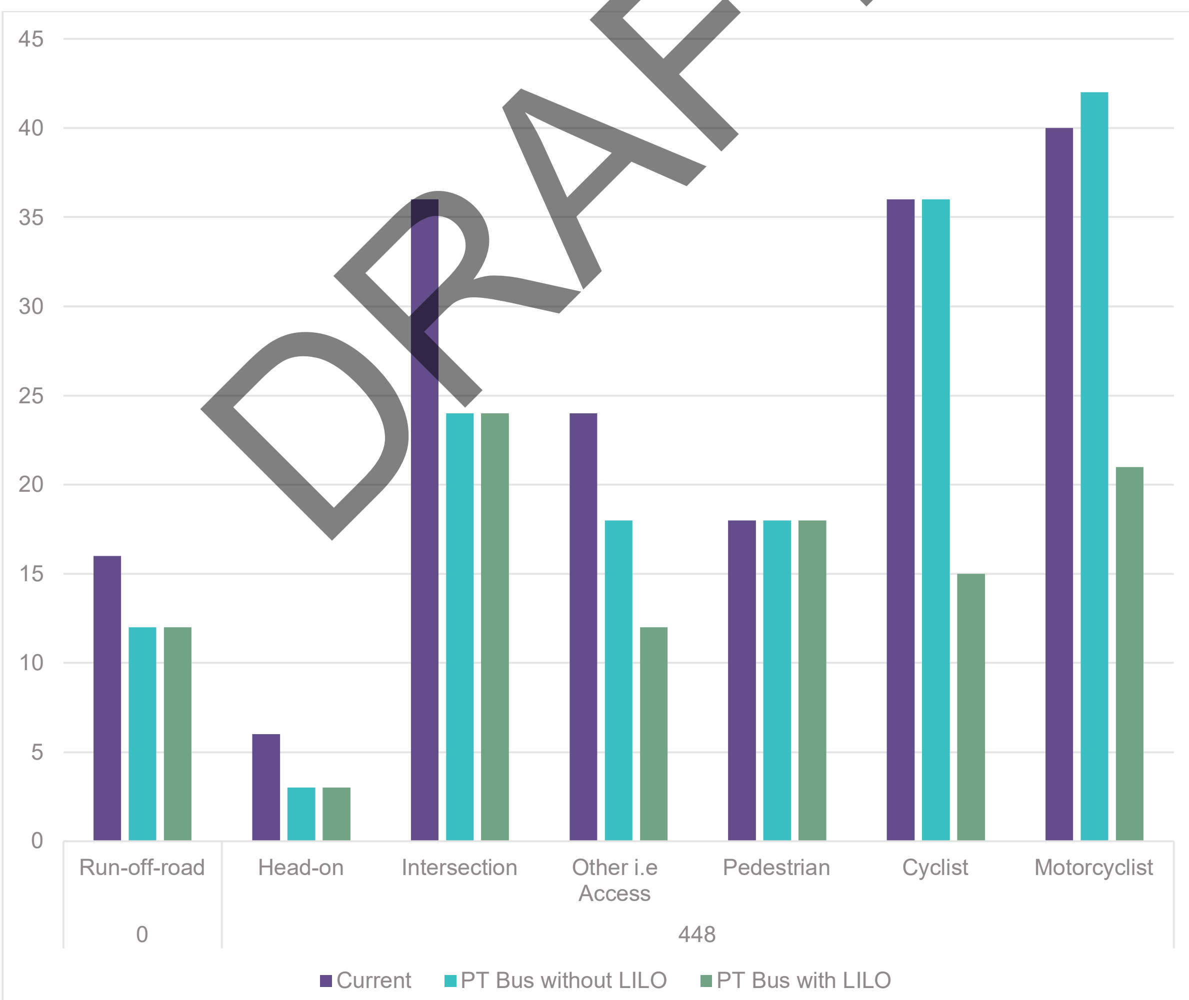




All options score better than the existing situation.

Hutt Road


Safe System Assessment score
450
400
350
300
250
200
150
100
50
0
Current
PT Bus without LILO
PT Bus with LILO


45
40
35
30
25
20
15
10
5
0
Run-off-road
Head-on
Intersection
Other i.e Access
Pedestrian
Cyclist
Motorcyclist
0
448
Current
PT Bus without LILO
PT Bus with LILO

Appendix E

Summary of Evaluation of Corridor Treatment Long List Options

Location	Option	Benefits	Disbenefits	Comment	Shortlist
Special Vehicle Lanes (SVLs) and Bus Lanes (including Busways)					
All	No priority (Existing)	Straightforward, less disruption, does not affect car parking.	Highly unlikely to address the Investment Objectives.	Poor performance against the investment objectives.	No
All	Southbound or northbound - Kerbside SVL - all day	Long term social benefits by improving public transport. Safety- easier to understand than part-time reducing complexity. High alignment with IO1 – Bus attractiveness.	Multiple traffic lanes can create safety issues for motorcyclists, cyclists and pedestrians. Full time lanes remove car parking. Also, likely to have a significant effect at Kaiwharawhara intersection on queuing in the morning peak hour. Limits opportunities to provide additional lane capacity for general traffic off peak.	Should be progressed as part of a corridor package, where it can be implemented without adverse impact on throughput and cyclists.	Yes
All	Southbound or Northbound - Kerbside SVL – peak hours	Long term social benefits by improving public transport. Good alignment with IO1 Bus attractiveness. Part time lanes allow parking to be available during off peak periods.	Safety – part time operation has safety implications due to variability of traffic. Multiple lanes create safety issues for vulnerable road users. Limits opportunities to allow for increased bus frequencies and priority off peak.	Should be progressed as part of corridor package, where it can be implemented without adverse impact on throughput and cyclists.	Yes
All	Northbound or Southbound - Central Running SVL - All day	Long term social benefits by improving public transport. Safety- easier to understand than part-time reducing complexity. Moderate to low alignment with IO1.	Difficult pedestrian access from footpaths and crossing over carriage way. Regular stops create flow disruptions.	Unlikely to significantly improve bus attractiveness and has adverse effects on amenity values for pedestrians.	No
All	Central Running Busway	Long term social benefits by improving public transport. Moderate to low alignment with IO1.	Difficult pedestrian access from footpaths and crossing over carriage way. Regular stops create flow disruptions.	Unlikely to significantly improve bus attractiveness and has adverse effects on amenity values for pedestrians.	No
All	Peak direction - Central Running Contraflow SVL	Long term social benefits by improving public transport. Moderate to low alignment with IO1	Difficult pedestrian access from footpaths and crossing over carriage way. Regular stops create flow disruptions.	Unlikely to significantly improve bus attractiveness and has adverse effects on amenity values for pedestrians.	No

Location	Option	Benefits	Disbenefits	Comment	Shortlist
All	Peak direction - SVL enabled by Tidal Flow	Long term social benefits by improving public transport. Using when needed approach provides a shared laneway design meaning more flexibility and serves north and southbound. Provides capacity for general traffic on the opposing direction. Moderate alignment to IO1.	Moderate negative score against the safety IO due to part time operation safety implications due to variability of traffic.	Should be progressed as part of corridor package, where it can be implemented as does not adversely impact on throughput, need to accommodate cyclists and address safety issues.	Yes
Cycling Facilities					
All	3.0 - 3.5m wide shared path	Safety benefits are separation from traffic and also a positive effect on improving Level of Service. Long term social benefits from improving cycling infrastructure with positive effects on public health, economic activity (retail spend) and sustainability.	Safety disbenefits, risk of conflict – cyclists/cyclists and peds, contra-flow cyclists at intersections/accesses. Connectivity not as good as uni-directional path on both sides of road leading to risks joining/leaving facility.	Scores lower than other options which provide a better LOS and safety outcomes	No
All	3.5 - 4.0m wide shared path	Safety and LOS as above. Long term social benefits from improving cycling infrastructure with positive effects on public health, economic activity (retail spend) and sustainability.	Safety and connectivity as above.	Scores lower than other options which provide a better LOS and safety outcomes.	No
All	3.0m bi-directional cycleway + 1.0m buffer (Width = 4.0m from edge of road to edge of footpath)	Separation from traffic removes high risk conflicts. Has a positive effect on improving Level of Service. Long term social benefits from improving cycling infrastructure with positive effects on public health, economic activity (retail spend) and sustainability.	Connectivity not as good as uni-directional path on both sides of road leading to risks joining/leaving facility. Contra-flow cyclists unexpected at intersections/accesses increasing conflict risk. Remove conflict with pedestrians.	Strong support for the cycling and safety IO's.	Yes
All	2.0m one-direction cycleway on both sides + 1m buffer (Total width = 3.0m) - available all day	Separation from traffic removes high risk conflicts. Facility on both sides of road gives better level of access than bi-directional paths avoiding need to cross to access facility. More intuitive	Due to restricted total width of street compromises will likely be needed on width for footpaths, landscaping, and bus lanes.	Strong support for the cycling and safety IO's.	Yes

Location	Option	Benefits	Disbenefits	Comment	Shortlist
		at intersections as cyclists moving with traffic. Has a high positive score against improving LOS and safety. Long term social benefits from improving cycling infrastructure with positive effects on public health, economic activity (retail spend) and sustainability.			
All	2.0m on-road cycle lane on both sides + 0.5 buffer (Total width = 2.5m) - available all day	Separation from traffic removes high risk conflicts. Facility on both sides of road gives better level of access than bi-directional paths avoiding need to cross to access facility. More intuitive at intersections as cyclists moving with traffic. Has a high positive score against improving LOS and safety. Long term social benefits from improving cycling infrastructure with positive effects on public health, economic activity (retail spend) and sustainability.	Cycleway safety will be focus with reduced buffer width.	Strong support for the cycling and safety IO's.	Yes
All	Kerbside SVL <4.2m wide (shared with buses and/or HOVs) - all day	Less exposure to general traffic than current. All day operation decreases safety risk over part-time as more readily understood.	Narrow lane increasing safety risk over a wider lane. Cycling LOS not improved and residual risk of conflict with passing traffic.	Scores lower than other options which provide a better LOS and safety outcomes.	No
All	Kerbside SVL >=4.2m wide (shared with buses and/or HOVs) - all day	Less exposure to general traffic than current. All day operation decreases safety risk over part-time as more readily understood.	Cycling LOS not improved and residual risk of conflict with passing traffic.	Scores lower than other options which provide a better LOS and safety outcomes.	No
All	Kerbside SVL <4.2m wide (shared with buses and/or HOVs) - peak time(s) only	Less exposure to general traffic than current. but narrow lane increasing safety risk over option with a wider lane. Part-time use can lead to confusion over current state of operation leading to confusion/risk.	Narrow lane increasing safety risk over option with a wider lane. Part-time use can lead to confusion over current state of operation leading to confusion/risk. Residual risk of conflict with passing traffic.	Scores lower than other options which provide a better LOS and safety outcomes.	No

Location	Option	Benefits	Disbenefits	Comment	Shortlist
All	Kerbside SVL >=4.2m wide (shared with buses and/or HOVs) - peak time(s) only.	Less exposure to general traffic than current. All day operation decreases safety risk over part-time as more readily understood.	Cycling LOS not improved and residual risk of conflict with passing traffic.	Scores lower than other options which provide a better LOS and safety outcomes.	No
Footpaths and Amenities					
All	No additional space available for wider footpaths and amenities	With general footpath width of 3m along both sides of Thorndon Quay is adequate for pedestrian movement.	Does not enable softening treatments such as street furniture, sheltered bus stops and landscape buffers appropriate to enhance nodal points and amenity. Does not improve Los for pedestrians.	Poor performance against the investment objectives. However, this is a benchmark for footpaths on Thorndon Quay and options will be assessed against reducing the footpath width below 3m.	No
All	0 - 1m (or up to 2m on one side) available for wider footpaths and amenities	Long term social benefits from improving footpaths. Slightly improved visual amenity with potential for landscaping to one side of the street.	Due to limited width of the street there will be compromises to cycling lanes and public transport so this needs to be considered.	Will support bus and cycling improvements by allowing space whilst improving or at least maintaining the pedestrian LOS on Thorndon Quay in terms of footpath width.	Yes
All	1 - 1.5m (or 2 - 3m on one side) available for wider footpaths and amenities	Long term social benefits from improving footpaths. Improves visual amenity with potential for landscaping to both sides of the street.	Due to limited width of the street there will be compromises to cycling lanes and public transport so this needs to be considered.	Will support bus and cycling improvements by allowing space whilst improving or at least maintaining the pedestrian LOS on Thorndon Quay in terms of footpath width.	Yes
All	1.5 - 2m (or 3 - 4m on one side) available for wider footpaths and amenities	Long term social benefits from improving footpaths. Improves visual amenity with potential for landscaping to both sides of the street.	Due to limited width of the street there will be compromises to cycling lanes and public transport so this needs to be considered.	Not to be progressed given the limited space available to be accommodated wider footpaths in Thorndon Quay, which would be at the expense of other key objectives such as cycling and bus improvements.	No
All	2 - 2.5m (or 4 - 5m on one side) available for	Long term social benefits from improving footpaths. Enables the	Due to limited width of the street there will be compromises to cycling lanes	Not to be progressed given the limited space available to be	No

Location	Option	Benefits	Disbenefits	Comment	Shortlist
	wider footpaths and amenities	footpath to include better interaction with the shop front e.g. enabling cafe tables to be on the footpath. Landscape treatment, shelter, and street furniture.	and public transport so this needs to be considered.	accommodated wider footpaths in Thorndon Quay, which would be at the expense of other key objectives such as cycling and bus improvements.	
All	>2.5m (or >5m on one side) available for wider footpaths and amenities	Long term social benefits from improving footpaths. Enables the footpath to include better interaction with the shop front e.g. enabling cafe tables to be on the footpath. Landscape treatment, shelter, and street furniture.	Due to limited width of the street there will be compromises to cycling lanes and public transport so this needs to be considered.	Not to be progressed given the limited space available to be accommodated wider footpaths in Thorndon Quay, which would be at the expense of other key objectives such as cycling and bus improvements.	No
Parking Provision					
All	Southbound - Retain existing (angled) parking layout with current morning Peak restrictions)	Enables parking to be retained in off-peak traffic. Does not remove any parking and thereby minimises the social impact.	Maintains the existing current poor safety situation off peak, offers little to no amenity benefits.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Southbound - Retain existing (angled) parking layout but with morning and evening Peak restrictions)	Slight improvement to safety due to addition of evening peak restrictions. Enables parking to be retained in off-peak traffic.	Offers little to no amenity benefits.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Southbound - Retain existing (angled) parking layout with parking available all-day (no peak time restrictions)	Does not remove any parking and thereby minimises the social impact.	Detrimental to current situation as removal of morning peak clearway increases cycle risk. Offers little to no amenity benefits.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Southbound - convert angled parking to parallel with current	Less parking reduces exposure to cyclists and general traffic. Driver sightlines improved exiting spaces	Removes some parking and thereby has a negative social impact.	Good alignment with safety investment objective and allows space for cycling improvements.	Yes

Location	Option	Benefits	Disbenefits	Comment	Shortlist
	morning peak restrictions)	reducing likelihood of a conflict. Enables more space to be dedicated to other modes of transport and reduces carpark dominance and improves visual sightlines safety. Peak morning movement so other modes of transport can use this space.			
All	Southbound - convert angled parking to parallel but with morning and evening Peak restrictions)	Less parking reduces exposure to cyclists and general traffic. Driver sightlines improved exiting spaces reducing likelihood of a conflict. Enables more space to be dedicated to other modes of transport and reduces carpark dominance and improves visual sightlines safety. Peak morning movement so other modes of transport can use this space. Limited benefit for pm restrictions.	Removes some parking and thereby has a negative social impact.	Good alignment with safety investment objective and allows space for cycling improvements.	Yes
All	Southbound - convert angled parking to parallel with parking available all-day (no peak time restrictions)	Less parking reduces exposure to cyclists and general traffic. Driver sightlines improved exiting spaces reducing likelihood of a conflict. Enables more space to be dedicated to other modes of transport. carpark dominance remains as not restricted times. No opportunity to use space for other transport at peak times.	No parking restrictions at morning/evening peak slightly scores lower in term of safety than other options. Car park dominance remains as not restricted times. No opportunity to use space for other transport at peak times.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Southbound - Remove on-street parking	Removes parking exposure to cyclists and general traffic. Overall safety will depend on how the road space is used. Generally improves amenity. however, some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached.	Some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached. Removes parking and thereby has a negative social impact.	Scores lower than other options which provide a better safety and amenity outcomes.	No

Location	Option	Benefits	Disbenefits	Comment	Shortlist
All	Northbound - Retain existing (angled) parking layout with evening Peak restrictions)	Slight improvement due to addition of evening peak restrictions. Risk of conflict between parking and general traffic/ cyclists reduced. Enables parking to be retained in off peak traffic.	Maintains the existing current poor safety situation off peak, offers little to no amenity benefits.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Northbound - Retain existing (angled) parking layout but with morning and evening Peak restrictions)	Slight improvement due to addition of morning/evening peak restrictions. Risk of conflict between parking and general traffic/ cyclists reduced. Enables parking to be retained in off peak traffic.	Maintains the existing current poor safety situation off peak, offers little to no amenity benefits.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Northbound - Retain existing (angled) parking layout with no peak time restrictions	Enables parking to be retained in off-peak traffic. Does not remove any parking and thereby minimises the social impact.	Maintains the existing current poor safety situation off peak, offers little to no amenity benefits.	Scores lower than other options which provide a better safety and amenity outcomes.	No
All	Northbound - convert angled parking to parallel with current evening Peak restrictions)	Driver sightlines improved for drivers exiting spaces reducing likelihood of a conflict. Enables more space to be dedicated to other modes of transport and reduces carpark dominance and improves visual sightlines safety. Peak pm movement so other modes of transport can use this space.	Removes some parking and thereby has a negative social impact.	Good alignment with safety investment objective and allows space for cycling improvements.	Yes
All	Northbound - convert angled parking to parallel but with morning and evening Peak restrictions)	Driver sightlines improved for drivers exiting spaces reducing likelihood of a conflict. Enables more space to be dedicated to other modes of transport and reduces carpark dominance and improves visual sightlines safety. Peak am and pm movement so other modes of transport can use this space.	Removes some parking and thereby has a negative social impact.	Good alignment with safety investment objective and allows space for cycling improvements.	Yes

Location	Option	Benefits	Disbenefits	Comment	Shortlist
All	Northbound - Remove on-street parking.	Removes parking exposure to cyclists and general traffic. Overall safety will depend on how the road space is used. Generally improves amenity. however, some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached.	Some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached. Removes parking and thereby has a negative social impact.	Scores lower than other options which provide a better safety and amenity outcomes.	No
Hutt Road - Aotea to Ngauranga	Northbound - Remove on-street parking.	Removes parking exposure to cyclists and general traffic. Overall safety will depend on how the road space is used. Generally improves amenity. however, some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached.	Some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached. Removes parking and thereby has a negative social impact.	Scores lower than other options which provide a better safety and amenity outcomes.	No
Hutt Road - Aotea to Ngauranga	Northbound - Remove on-street parking.	Removes parking exposure to cyclists and general traffic. Overall safety will depend on how the road space is used. Generally improves amenity. however, some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached.	Some on street parking important to serve nodal points and mechanism to slow traffic to acknowledge pedestrian orientated destination reached. Removes parking and thereby has a negative social impact.	Scories lower than other options which provide a better safety and amenity outcomes.	No
Property Access/Turning Facilities					
Hutt Road - Kaiwharawhara	Median/turning bays provided (or retained) along the corridor for direct property access	Reduces rear end risk although noted that this is generally low severity at urban speeds.	Does not improve overall amenity as vehicular driven.	Provides safe space for turning traffic without restricting property access.	Yes
Hutt Road - Kaiwharawhara	Median/turning bays provided at intersections only -	Reduces rear end risk although noted that this is generally low severity at urban speeds. However, with less	Restricting access to property will have negative social impacts.	Negative social impacts on property access restrictions.	No

Location	Option	Benefits	Disbenefits	Comment	Shortlist
	direct property access still available	turning bays means corridor can be dedicated to other uses.			
Hutt Road - Kaiwharawhara	Raised median/restrictions on direct property access - alternative access provided	Removes right angle crash risk that can be more severe. Removes risk of vehicles turning across (more vulnerable and less visible) motorcyclists and cycleway users.	Restricting access to property will have negative social impacts. May increase delay and travel distance for property access users.	Negative social impacts on property access restrictions.	No
Hutt Road - Kaiwharawhara	Raised median/restrictions on direct property access - no alternative access provided	Removes right angle crash risk that can be more severe. Removes risk of vehicles turning across (more vulnerable and less visible) motorcyclists and cycleway users. May result in unsafe/unexpected u-turning at intersections.	Restricting access to property will have negative social impacts. May increase delay and travel distance for property access users.	Negative social impacts on property access restrictions.	No
Other Physical Works					
All	No widening or build-outs	No change or improvements for cycling, pedestrians, or public transport unless carparking is altered.	Provides no improvement to pedestrian safety.	Poor performance against the investment objectives.	No
All	0 - 1m (or up to 2m on one side) widening beyond existing kerb	Widening beyond kerb will limit traffic management to lower levels.	Reduction in footpath width will have a negative impact on amenity and pedestrian LOS.	Poor performance against the investment objectives.	No
All	1 - 1.5m (or 2 - 3m on one side) widening beyond existing kerb	Widening beyond kerb will limit traffic management to lower levels.	Reduction in footpath width will have a negative impact on amenity and pedestrian LOS.	Poor performance against the investment objectives.	No
All	1.5 - 2m (or 3 - 4m on one side) widening beyond existing kerb	Widening beyond kerb will limit traffic management to lower levels.	Reduction in footpath width will have a negative impact on amenity and pedestrian LOS.	Poor performance against the investment objectives.	No
All	2 - 2.5m (or 4 - 5m on one side) widening beyond existing kerb	Widening beyond kerb will limit traffic management to lower levels.	Reduction in footpath width will have a negative impact on amenity and pedestrian LOS.	Poor performance against the investment objectives.	No

Location	Option	Benefits	Disbenefits	Comment	Shortlist
All	>2.5m (or >5m on one side) widening beyond existing kerb	Widening beyond kerb will limit traffic management to lower levels.	Reduction in footpath width will have a negative impact on amenity and pedestrian LOS.	Poor performance against the investment objectives.	No
All	0 - 1m (or up to 2m on one side) build out from existing kerb	Increase in footpath width will have a positive impact on amenity and pedestrian LOS.	Could impact one lane of traffic should be manageable at lower levels of traffic management.	Good alignment with Pedestrian LOS and amenity investment objective.	Yes
All	1 - 1.5m (or 2 - 3m on one side) build out from existing kerb	Increase in footpath width will have a positive impact on amenity and pedestrian LOS.	Potentially impacting up to two lanes of traffic. Stop go traffic management may therefore be required during construction.	Good alignment with Pedestrian LOS and amenity investment objective.	Yes
All	1.5 - 2m (or 3 - 4m on one side) build out from existing kerb	Increase in footpath width will have a positive impact on amenity and pedestrian LOS.	Potentially impacting up to two lanes of traffic. Stop go traffic management may therefore be required during construction.	Good alignment with Pedestrian LOS and amenity investment objective.	Yes
All	2 - 2.5m (or 4 - 5m on one side) build out from existing kerb	Increase in footpath width will have a positive impact on amenity and pedestrian LOS.	Will impact two lanes or more of traffic. Stop go traffic management may therefore be required during construction or night works.	Not to be progressed given the level of difficulty to physically implement this option and have sufficient space to accommodate bus and cycling in the corridor.	No
All	>2.5m (or >5m on one side) build out from existing kerb	Increase in footpath width will have a positive impact on amenity and pedestrian LOS.	Will impact two lanes or more of traffic. Stop go traffic management may therefore be required during construction or night works.	Not to be progressed given the level of difficulty to physically implement this option and have sufficient space to accommodate bus and cycling in the corridor.	No

Appendix F

Summary of Evaluation of Node and Intersection Treatment Long List Options

Location	Option	Comments	Progress to Short List?
Intersection Treatment Options			
Thorndon Quay - Mulgrave Street	Signalise right turn from Thorndon Quay into Lambton Bus Interchange and incorporate improved pedestrian/cyclist safety - phasing, advance stop boxes.	Good alignment with bus attractiveness and safety.	Yes
Thorndon Quay - Mulgrave Street	Close slip lane and direct all Mulgrave traffic to existing signals, allowing left turn there. Signalise bus entry/exit.	Scores lower than other options which provide a better bus reliability and cycling, pedestrian outcomes.	No
Thorndon Quay - Mulgrave Street	Swap over Mulgrave and Lambton Quay Bus Interchange entry/exit to remove Mulgrave/Bus Lane crossover.	Scores lower than other options which provide a better bus reliability and cycling, pedestrian outcomes.	No
Thorndon Quay - Davis Street	Signalise intersection.	Scores lower than other options which provide a better bus reliability and pedestrian outcomes.	No
Thorndon Quay - Davis Street	Raised platform intersection.	Good safety outcomes for pedestrians and cyclists.	Yes
Thorndon Quay - Moore Street	Raised platform intersection.	Good safety outcomes for pedestrians and cyclists.	Yes
Thorndon Quay - Moore Street	Signalise intersection.	Scores lower than other options which provide better bus reliability and pedestrian outcomes.	No
Thorndon Quay - Tinakori Road	Signalise Tinakori Road intersection and provide Toucan Crossing and bus priority.	Good alignment with bus attractiveness, safety and LOS outcomes for pedestrians and cyclists.	Yes
Hutt Road - Aotea Quay	Provide additional road signage at diverge to ramp to ferry terminal.	Scores lower than other options which provide better safety outcomes.	No
Aotea Quay	Turn-around facility at Aotea Quay/Mainfreight to allow trucks/people to use motorway to get to the Kaiwharahara Ferry Terminal.	Would help remove Kaiwharawhara ferry traffic from Hutt Road. Supports the freight objective.	Yes
Hutt Road - Kaiwharawhara	Improve pedestrian crossing facilities or provide new crossings at Kaiwharawhara intersection.	Good alignment with bus attractiveness, safety, and LOS outcomes for pedestrians.	Yes
Hutt Road - Kaiwharawhara	Provide bus lane and signal pre-emption southbound and northbound. Suggest extending bus lane beyond southbound bus stop to facilitate buses pulling out.	Does not maintain access by freight as is likely to cause large southbound queues in the morning peak period at Kaiwharawhara if just a bus only lane.	No

Location	Option	Comments	Progress to Short List?
Hutt Road - Kaiwharawhara	Bus queue jump at Kaiwharawhara Road/Hutt Road Intersection (northbound).	Good alignment with bus attractiveness outcomes.	Yes
Hutt Road - Kaiwharawhara	Connect School Road to Kaiwharawhara Road ban right turn in from Hutt Road.	Does not align well with environmental effects on the Kaiwharawhara Stream. Also scoring lower than other options which provide better bus attractiveness outcomes.	No
Hutt Road - Kaiwharawhara	Convert to seagull intersection.	Scores lower than other options which provide better bus attractiveness outcomes.	No
Hutt Road - Kaiwharawhara to Ngauranga	In combination with bus priority at Jarden Mile and Kaiwharawhara intersections, provide a bus lane south bound on Hutt Road - use one of existing traffic lanes.	May create issues at intersections as this is a bus only option. Could lead to reduced capacity for other general traffic.	No
Hutt Road - Jarden Mile/Centennial Highway	Centennial Highway intersection, considering signal pre-emption for buses and pedestrian crossings facilities.	Good alignment with bus attractiveness, pedestrian LOS, and safety outcomes.	Yes
Hutt Road - Jarden Mile/Centennial Highway	Centennial Highway southbound stop extend no stopping lines to facilitate bus pull-out and consider providing 5-minute parking for drop-off, so vehicles don't block bus stop.	Good alignment with bus attractiveness, and safety outcomes.	Yes
Pedestrian and Cycling Options			
Thorndon Quay - Bordeaux Crossing	Signalise existing zebra crossing (one stage or two stage crossing).	Scores lower than other options which provide better pedestrian safety outcomes.	No
Thorndon Quay - Bordeaux Crossing	Raised platform crossings (whether uncontrolled, zebra or signalised).	Good safety outcomes for pedestrians.	Yes
Thorndon Quay - Davis Street	Provide grade separated (bridge) to connect Davis Street to Stadium Concourse.	Good alignment with bus reliability and safety outcomes for pedestrians. However, has a poor travel time and accessibility outcomes for mobility impaired pedestrians.	Yes
Thorndon Quay - Davis Street	Provide grade separated (underpass) to connect Davis Street to Stadium Concourse.	Scores lower than other options which provide better pedestrian safety/LOS outcomes.	No
Thorndon Quay - Davis Street	Signalise existing zebra crossing (one or two stage crossing).	Scores lower than other options which provide better bus reliability and pedestrian outcomes.	No

Location	Option	Comments	Progress to Short List?
Thorndon Quay - Davis Street	Raised platform crossings (whether uncontrolled, zebra or signalised).	Good safety outcomes for pedestrians.	Yes
Thorndon Quay - Davis Street	Provide crossing over Davis Street to prioritise or raise awareness of pedestrians (raised platform or zebra).	Good safety outcomes for pedestrians.	Yes
Thorndon Quay - Davis Street	Reconfigure zebra and bus stop.	Scores lower than other options which provide better bus reliability and pedestrian outcomes.	No
Thorndon Quay - Moore Street	Provide crossing over Moore Street to prioritise or raise awareness of pedestrians (raised platform or zebra).	Good safety outcomes for pedestrians.	Yes
Thorndon Quay - Moore Street	Signalise existing zebra crossing (one stage or two stage crossing) - Toucan crossings.	Good safety and LOS outcomes for pedestrians and cyclists.	Yes
Thorndon Quay - Moore Street	Raised platform crossings (whether uncontrolled, zebra or signalised).	Good safety outcomes for pedestrians.	Yes
Thorndon Quay - Moore Street	Reconfigure zebra and bus stop.	Good alignment with bus reliability and safety outcomes for pedestrians.	Yes
Thorndon Quay - Motorway Overpass	Adding active mode crossing to connect to bus stops - at grade.	Good alignment with bus attractiveness and safety outcomes for pedestrians.	Yes
Thorndon Quay - Motorway Overpass	Adding active mode crossing to connect to bus stops - overpass or underpass.	Scores lower than other options which provide better pedestrian safety/LOS outcomes.	No
Thorndon Quay - Tinakori Road	New mid-block Signals to aid cyclists crossing Thorndon Quay. Will involve some parking removal and bus stop relocations (Toucan crossings).	Good safety and LOS outcomes for pedestrians and cyclists.	Yes
Hutt Road - Aotea Quay	Provide dropped crossing point north of bus stop and pedestrian refuge.	Scores lower than other options which provide better pedestrian safety/LOS outcomes.	No
Hutt Road - Aotea Quay	Provide "controlled" crossing (Zebra or signals, one stage or two stage).	Good safety outcomes for pedestrians.	Yes
Thorndon Quay - Mulgrave Street to Tinakori Road	Install additional wayfinding signage for cyclists and pedestrians.	Good alignment with alternative modes outcomes.	Yes
Hutt Road - Aotea Quay to Kaiwharawhara	Install additional wayfinding signage for cyclists.	Good alignment with amenity and cycling LOS outcomes.	Yes
Hutt Road - Rangiora Avenue	Place existing zebra crossing on platforms.	Good alignment with bus attractiveness, pedestrian LOS, and safety outcomes.	Yes

Location	Option	Comments	Progress to Short List?
Hutt Road - Rangiora Avenue	Signalise existing zebra crossing (one stage or two stage crossing) (Toucan or standard).	Good alignment with bus attractiveness, pedestrian LOS, and safety outcomes.	Yes
Hutt Road - Jarden Mile/Centennial Highway	Install additional wayfinding signage for cyclists and pedestrians	Good alignment with active modes outcomes.	Yes
Hutt Road - Jarden Mile/Centennial Highway	Provide pedestrian crossings at Jarden Mile/Hutt Road.	Good alignment with bus attractiveness, pedestrian LOS, and safety outcomes.	Yes
Amenity Options			
Thorndon Quay - Mulgrave Street to Tinakori Road	Addition of more bike facilities for parking throughout the route.	Good amenity and cycling LOS outcomes.	Yes
Thorndon Quay - Mulgrave Street	Provide amenity improvements (seating, landscaping etc).	Good amenity and active modes outcomes.	Yes
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	Shade and shelter.	Good alignment with amenity outcomes.	Yes
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	Streetscaping.	Good alignment with amenity outcomes.	Yes
Thorndon Quay - Motorway Overpass	Amenity improvements by adding lighting to the overpass to create a gateway effect, this improves the overall environment of the area, making it more appealing and safer. Also helps with road safety in alerting drivers to a change of environment.	Scores lower than other options which provide better pedestrian safety/LOS outcomes.	No
Thorndon Quay - Mulgrave Street to Moore Street	Provide shelter and shade structures between Subway exit from Railway Station on the east side of Thorndon Quay to Moore Street, provide shelter also on opposite side of Moore Street near pedestrian crossing.	Scores lower than other options which provide better pedestrian LOS and amenity outcomes.	No
Thorndon Quay - Motorway overpass to Tinakori Road	Provide amenity improvements (seating, landscaping etc) in space under pohutukawa trees between Motorway overbridge and Tinakori Road.	Scores lower than other options which provide better pedestrian and amenity outcomes.	No
Thorndon Quay - Motorway Overpass to Tinakori Road	Surface improvements, and adding cycle wheel ramps beside the stairs	Scores lower than other options which provide better pedestrian/cyclist safety/LOS outcomes.	No

Location	Option	Comments	Progress to Short List?
Hutt Road - Kaiwharawhara	Shade and shelter.	Good alignment with amenity outcomes.	Yes
Hutt Road - Kaiwharawhara	Streetscaping.	Limited value or opportunity to carry this out along the corridor. Other options score better for amenity outcomes.	No
Bus Operational Options			
Thorndon Quay - Pipitea Marae	Replace the car parking out front of the Marae with bus parking.	Overall negative score due to neutral scores against the IO's and negative scores against social and Tangata Whenua effects.	No
Thorndon Quay - Motorway Overpass	Use car park as bus layover area to reduce pressure on the Bus Interchange, Land is understood to be owned by NZTA.	Good alignment with bus attractiveness outcomes.	Yes
Thorndon Quay and Hutt Road - Aotea Quay to Mulgrave Street	Bus stop rationalisation.	Good alignment with bus attractiveness outcomes.	Yes
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	Remove all layby stops and replace with in lane bus stops to reduce bus delay.	Good alignment with bus attractiveness outcomes.	Yes
Hutt Road - Aotea Quay to Ngauranga	Remove all layby stops and replace with in lane bus stops to reduce bus delay.	Good alignment with bus attractiveness and safety outcomes.	Yes
Safety Improvements			
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	Determine safe and appropriate speed from speed review and implement the speed changes and appropriate engineering measures.	Good alignment with safety outcomes.	Yes
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	Reduce speed limit to 30km/h.	Good alignment with safety outcomes.	Yes
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	Reduce speed limit to 40km/h.	Good alignment with safety outcomes.	Yes
Thorndon Quay/Hutt Road - Aotea Quay to Mulgrave Street	School Zone (40kph).	Good alignment with safety outcomes.	Yes

Location	Option	Comments	Progress to Short List?
Hutt Road - Aotea Quay to Ngauranga	Determine safe and appropriate speed from speed review and implement the speed changes and appropriate engineering measures.	Good alignment with safety outcomes.	Yes
Hutt Road - Aotea Quay to Ngauranga	Engineer up - median and side barriers.	Good alignment with safety outcomes.	Yes
Hutt Road - Aotea Quay to Ngauranga	Install W section barriers on the roadside edge of the shared path in the 80km/h section of Hutt Road. May required some cycleway widening to maintain clear route.	Good alignment with safety outcomes.	Yes
Hutt Road - Aotea Quay to Ngauranga	Remove off road cycle path obstructions (power poles, streetlights, and other street furniture/utility cabinets etc).	Good alignment with safety outcomes.	Yes
Hutt Road - Kaiwharawhara to Ngauranga	Reduce speed limit to 60km/h (Onslow to Jarden Mile).	Good alignment with safety outcomes.	Yes
Rail Options			
Hutt Road - Kaiwharawhara	Re-open Kaiwharawhara Station with active mode connection to Hutt Road.	Although this option scored highly against active mode share, but is discounted due the station being outside of the scope of this project.	No
Hutt Road - Kaiwharawhara	Re-open Kaiwharawhara Station with integrated bus/rail interchange.	This option scored highly against bus attractiveness, but is discounted due to the station being outside of the scope of this project.	No

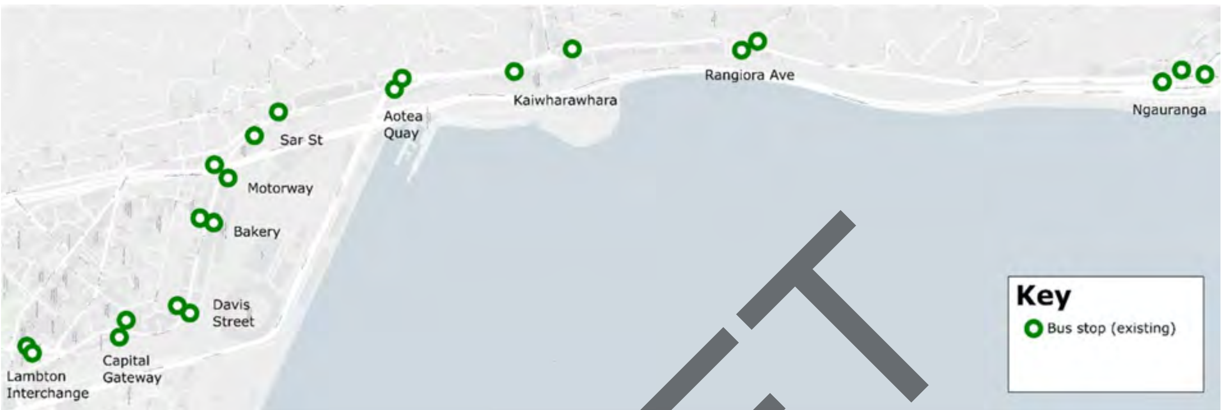
Appendix G

Bus Stop Rationalisation

The TQHR corridor has a large number of bus stops along its length. They are predominately standard kerbside arrangements. Their locations are shown in Figure 1.

Best practice suggests a 400m distance between stops. Given the above, options for optimising bus stop locations and spacing was explored further as the preliminary design was developed. Initial bus stop locations were workshopped and agreed with all (TWIG) partners.

Figure 1 Current Bus Stop Locations



To understand the effect of the bus stop locations catchment modelling was undertaken using a maximum 400 metre buffer. Figure 2 shows the existing bus stop catchments on Thorndon Quay. It shows that some of the existing bus stops are closely spaced and have a degree of overlap in the catchment areas they serve. This is likely to be creating unnecessary delays to bus services by stopping too frequently as bus stops are located too close to each other.

Figure 2 Current Bus Stop Catchments

Figure 3 shows the proposed new bus stop locations in order to help achieve improved bus journey times initially identified. The proposed relocation and rationalisation of bus stops was discussed with GWRC and the bus operators. By locating the bus stops after the pedestrian crossings, passengers who alight from the bus and who want to cross the main road will cross behind the bus and hence not delay the bus's onward journey. The locations shown were refined in the preliminary designs stage.

An area where the final location will need to be further considered is the stops near Moore Street intersection (Capital Gateway). From an urban design perspective, the driver is to have the stop near to the Marae area. Whereas from a purely spatial perspective (distances between stops) it is located the other side of Moore Street.

Figure 3 Proposed Bus Stop Locations

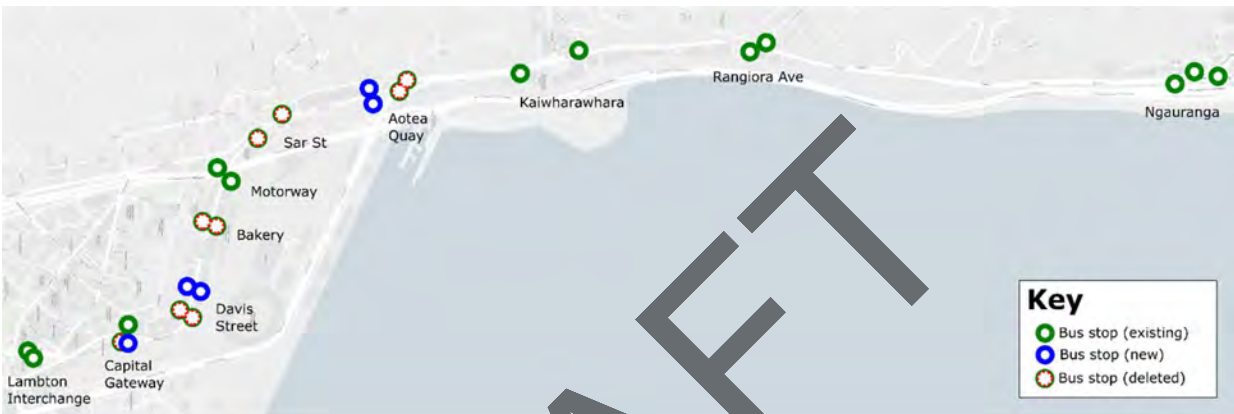


Figure 4 shows the revised catchment areas of the proposed bus stop locations. The revised stop locations will achieve an overall better balance between stop provision and catchment area served.

The main changes proposed are at the southern end of Hutt Road near Tinakori Road, where bus stops are proposed to be removed. This area has a very small catchment, and the removal is unlikely to have a significant effect on many existing bus users.

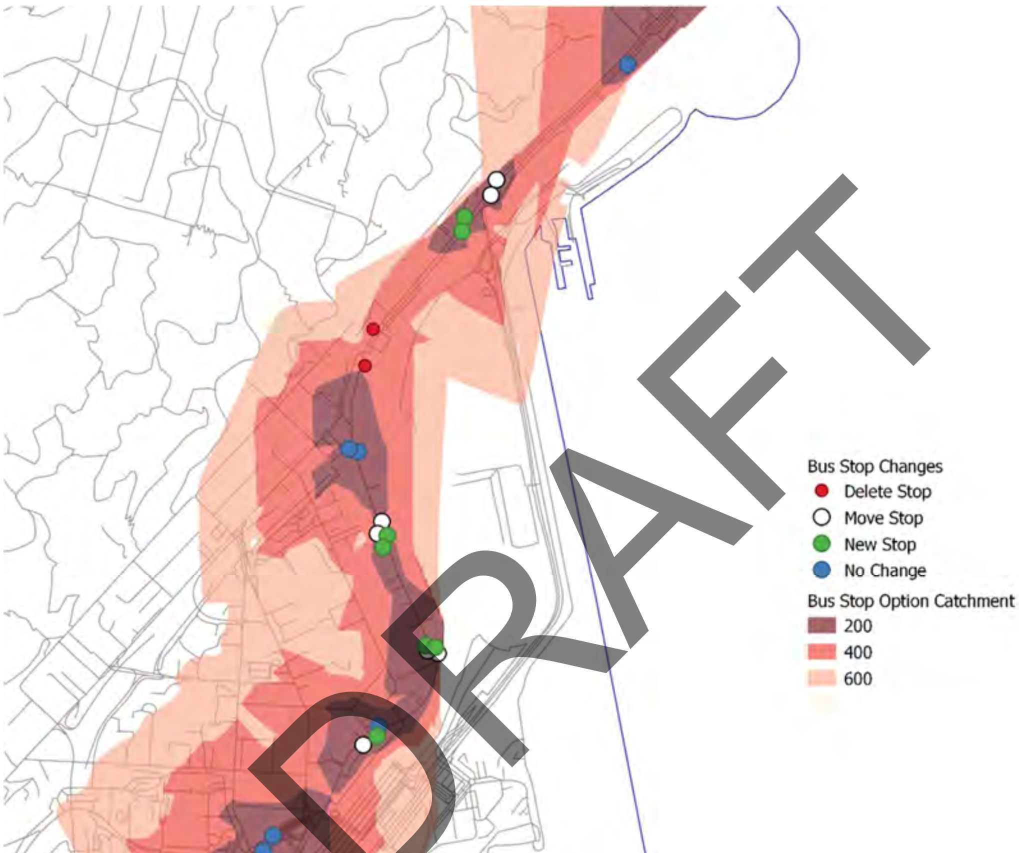
It should be noted that further refinements were made to bus stop locations in the preliminary design stage which are not shown in Figure 3 and Figure 4. The main changes made were as follows:

- Existing Southbound bus stop located outside the centre of Capital Gateway now located to be adjacent to Early Settler (Northern end of Capital Gateway)
- Existing Northbound bus stop located outside City Fitness now located at carpark between Resene Paints and Wellington Electric Bikes (85 Thorndon Quay)
- Existing Northbound bus stop located immediately North of Davis Street now located outside Abby Systems (137 Thorndon Quay)
- Existing Southbound bus stop located outside McKenzie Willis (230 Thorndon Quay) removed
- Existing Northbound bus stop located outside 191 Thorndon Quay removed
- Existing Southbound bus stop located outside Heritage Service Building (284 Thorndon Quay) removed
- Existing Northbound bus stop located outside Kennards Self Storage removed
- Existing Southbound bus stop located immediately North of Hutt Road Overbridge now located 40m South of Rail Overbridge
- Existing Northbound bus stop located immediately North of Hutt Road Overbridge now located outside Omega Car Rentals (77 Hutt Road)

- Existing Northbound bus stop located immediately South of Jarden Mile on Hutt Road now located immediately North of Jarden Mile on Centennial Highway
- Existing Southbound bus stop located immediately South of the SH1 under pass now located in the traffic island immediately North of the turn off to SH2 on Centennial Highway.

The detailed design process will confirm the exact placement and layout of bus stops. Further changes may therefore be made in detailed design.

Figure 4 Proposed Bus Stop Catchment Areas



Appendix H

Alternative and Options Report

27 October 2021

Thorndon Quay Hutt Road

Alternative and Options Report

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1 Executive Summary

1.1 Introduction

Thorndon Quay Hutt Road (TQHR) is part of the Let's Get Wellington Moving (LGWM) three-year programme and is being progressed through a Single Stage Business Case (SSBC) process. The priorities for the three-year programme are to make travel by bus to and through the central city faster and more reliable, and to create a better environment for people walking and on bikes. Thorndon Quay and Hutt Road is the busiest bus route outside of the city centre and the busiest route in the city for people cycling to and from work.

The changes to Thorndon Quay and Hutt Road are needed to improve safety, give buses greater priority and provide better walking and cycling facilities. With a growing number of people expected to live and work in the Wellington region, more people will want to walk, cycle or take the bus instead of going by car. Te Ara Tupua, the planned shared path between Ngauranga and Petone, will enable more people to walk and cycle between the Hutt Valley and Wellington.

This report summarises the multi-criteria assessment (MCA) of the shortlist options to arrive at the preferred option. It builds on the options development and shortlisting process documented in the earlier Long List to Short List Report[1].

The report starts with an introduction to LGWM and the TQHR project. It summarises the background to the short list MCA, including the problems, benefits and investment objectives as well as summarising the option development and shortlisting process. Transport modelling undertaken for the short list options is presented. The main body of the report discusses the MCA process for the shortlist options, summarises the public and stakeholder engagement process, followed by presenting indicative cost estimates and a preliminary economic assessment of the short list options. Finally, the report recommends a preferred option to advance in the SSBC.

1.2 Background

1.2.1 Problems

The following problem statements were defined from previous consultation and evidence.

PROBLEM ONE
Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus.
PROBLEM TWO
The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists.
PROBLEM THREE
Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area.
PROBLEM FOUR
High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road.

[1] Thorndon Quay Hutt Road Long to Short List Report, LGWM, November 2020

1.2.2 Benefits of Investment

By addressing the problems, the following potential benefits of investing in transport improvements for the TQHR corridor were identified:

1.3 Investment Objectives

The TQHR project has five Investment Objectives which build on the identified problems and benefits for the corridor:

i Improve level of service for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport

ii Improve level of service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road

iii Reduce the frequency and severity of crashes

iv Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area

v Maintain similar access for people and freight to the ferry terminal

The freight investment objective recognises the need to maintain the freight and people access to the ferry terminal and Centreport while making longer-term investments in other modes along Hutt Road and Thorndon Quay.

1.4 Options Short List

The long list to short list assessment process[2] arrived at four core options for short list assessment. The key elements which make up the short list options include whether to provide bus lanes in southbound direction only or both northbound and southbound, as well whether to provide a unidirectional or bidirectional cycleway along the corridor.

The four short list options (summarised in the table on the following page) also included special vehicle or bus lanes on Hutt Road to improve the level of service for bus users and to maintain similar access for freight to the port from the north. The special vehicle lane is a traffic lane which is expected to be used by buses and trucks for the purpose of this assessment.

The long list assessment found that the provision of a special vehicle or bus lane on Hutt Road added additional risks to right turning traffic and had the potential to mask motorcyclists that would share the lane with buses. Vehicles exiting properties may not see motorcyclists travelling behind or close to buses when they share the lane. To mitigate this risk, a left in / left out option and a service lane suboption were developed and included in the short list as two sub-options to each

[2] Thorndon Quay Hutt Road Long to Short List Report, November 2020

main option (suboptions A and B). Suboption A also included a new roundabout on Aotea Quay to provide a turnaround facility for trucks which may be impacted by the left in / left out arrangement on Hutt Road.

The short list options and suboptions are summarised below.

Table 1: Short List Options

Option	Elements			Common Elements
	Thorndon Quay Bus Lanes	Thorndon Quay Cycle Lanes	Hutt Road Special Vehicle Lanes	
Option 1: Southbound bus lanes with Thorndon Quay bidirectional cycleway	Southbound	Bi-directional	Southbound	▪ Removal of angle parking on Thorndon Quay to improve safety ▪ Speed limit review ▪ Intersection upgrades ▪ Pedestrian Crossing Improvements ▪ Bus stop rebalancing ▪ Thorndon Quay amenity improvements
Option 1A: Southbound bus lanes with Thorndon Quay bidirectional cycleway	Option 1 plus: • Left-in / Left-out on Hutt Road (central median) • Construct a roundabout on Aotea Quay			
Option 1B: Southbound bus lanes with Thorndon Quay bidirectional cycleway	Option 1 plus: • Creation of a service lane on east side of Hutt Road (between Onslow and Kaiwharawhara) • Signalise Kaiwharawhara and Onslow Road intersections			
Option 2: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	Both directions	Uni-directional	Both directions	
Option 2A: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	Option 2 plus the same variants as for Option 1A			
Option 2B: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	Option 2 plus the same variants as for Option 1B			
Option 3: Southbound bus lanes with Thorndon Quay unidirectional cycleway	Southbound	Uni-directional	Southbound	
Option 3A: Southbound bus lanes with Thorndon Quay unidirectional cycleway	Option 3 plus the same variants as for Option 1A			
Option 3B: Southbound bus lanes with Thorndon Quay unidirectional cycleway	Option 3 plus the same variants as for Option 1B			
Option 4: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	Both directions	Bi-directional	Both directions	
Option 4A: Southbound and Northbound bus lanes	Option 4 plus the same variants as for Option 1A			

Option	Elements			Common Elements
	Thorndon Quay Bus Lanes	Thorndon Quay Cycle Lanes	Hutt Road Special Vehicle Lanes	
with Thorndon Quay bidirectional cycleway				
Option 4B: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	Option 4 plus the same variants as for Option 1B			

1.5 Multi-Criteria Assessment of Short List Options

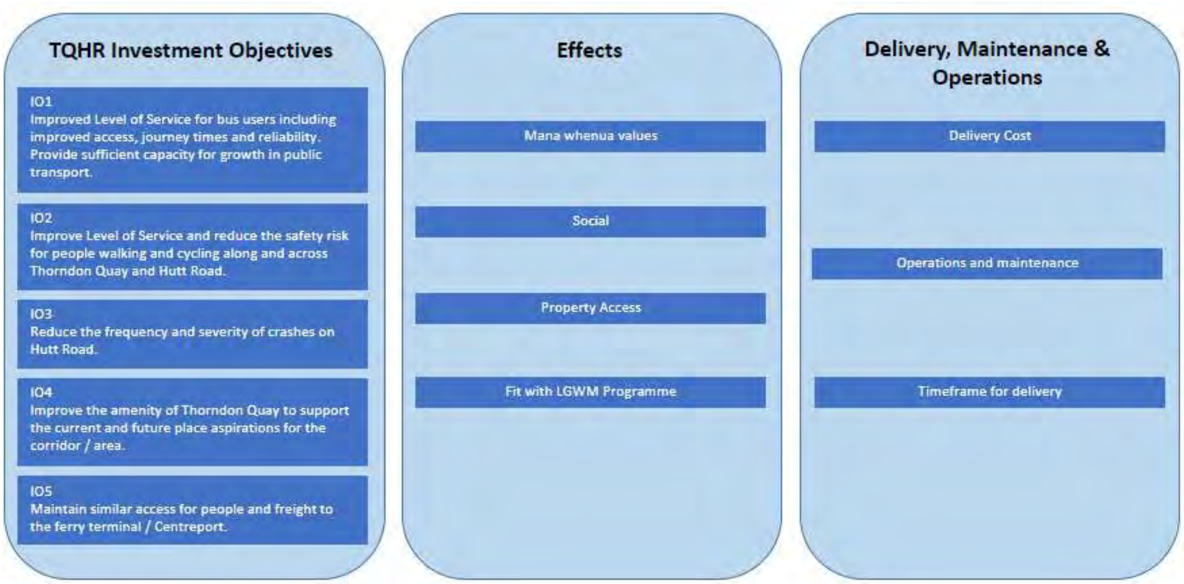
The short list options were taken through an MCA process in two stages. The first (or 'interim') MCA was undertaken in late 2020 to allow development of a technically preferred option to advance while the wider LGWM programme was being reviewed. The second MCA was undertaken in June 2021 to consider engagement feedback and an assessment against mana whenua values, which were still under development when the interim MCA was undertaken.

1.5.1 MCA Criteria

The short list MCA included an assessment of the options against their contribution to the investment objectives, effects and delivery, maintenance and operations criteria.

The main topics included in each of these areas are summarised below (note that mana whenua values were not included in the interim MCA):

Figure 1: MCA Criteria



1.5.2 Interim MCA Summary

The highest scoring options from the interim MCA were Options 4A and 4B.

While Options 4A and 4B scored similarly overall, the provision of a service road (suboption B) was discounted as being more disruptive, fit less with other regional projects and carried larger implementation risk.

The provision of bidirectional or unidirectional cycling facilities was also discussed. It was noted that the provision of a bidirectional cycleway (i.e. Options 1 or 4) should be aligned with the wider LGWM programme as there are bidirectional facilities planned to the north and south of the TQHR corridor. This would provide a consistent cycle path and ease of connection.

It was also noted that while both unidirectional and bidirectional cycle facilities would improve safety and level of service, unidirectional cycleways (Options 2 or 3) scored better for safety, due to less risk with cyclists travelling with the direction of general traffic.

Following the interim MCA workshop, the Technical Advisory Group (TAG) met to discuss a recommended option. The TAG supported the highest scoring option of 4A while noting the additional safety risks inherent with bidirectional cycleways which will require consideration in the design phase.

The TAG recommended that Option 4A was the best option to take forward as the interim preferred option. This decision was supported by the LGWM Programme Steering Group.

1.6 Stakeholder and Public Engagement

Engagement on the preferred option was undertaken from 10 May to 8 June 2021. The engagement strategy and activities were led by LGWM with support from the TQHR project team. Stakeholders and the public were consulted on the interim preferred option for the TQHR project as well as WCC's intention to change angle parking to parallel parking on Thorndon Quay ahead of other changes to improve safety for cycling.

LGWM received 1,613 submissions on the proposal. Of those who submitted, 72% of the respondents said it was important or very important to make improvements for people walking, riding bikes and using the bus on Thorndon Quay and Hutt Road. LGWM produced an engagement summary report[3] which is available on the LGWM website.

Pedestrians, bus users, cyclists, people who use e-scooters as well as people who travel through and visit the area generally felt that the proposal would have a positive impact. Submissions from people who drive cars, trucks, motorcyclists and those that lived in the area or had a disability had a mixed response about the impacts of the proposal. Business owners and people that worked in the area felt that changes would have a negative impact.

Around 70% of respondents said the changes on Hutt Road and the changes on Thorndon Quay would have positive or very positive impacts for people walking, people in buses, and people on bikes. People's feedback was mixed on what they thought the impacts would be for people driving, people who live, work or own a business on these streets, or people with a disability.

There were a number of common themes received from submissions regarding changes to be considered when further developing the proposal. Changes to be considered along Thorndon Quay include:

- The impacts on commercial delivery vehicles

[3] May-June 2021 Hutt Road / Thorndon Quay Engagement, Data Analysis Report, 29 June 2021

- Drop-off parking to be made available
- Safety for pedestrians crossing the street, especially small children
- Impact to businesses in a tough retail environment
- Bus stop locations to be outside or close to key destinations

Changes to be considered along Hutt Road include:

- Allowing safe vehicle access into and out of properties around pedestrians and cyclists
- Increase the width of the bike lane
- Address concerns from businesses about how their customers will access their business if they cannot make a right turn

1.7 Final MCA

Following the close of stakeholder and public engagement, a second MCA workshop was held on 30 June 2021. The purpose of this workshop was to consider the impact of engagement feedback on the interim MCA scores, update scores based on any further information, as well as to incorporate the mana whenua values assessment into the MCA.

-The delivery team noted that since the interim MCA, some preliminary design of Option 4A had progressed, including more detailed evaluation of the available width on Hutt Road and desired width for the various modes. Based on this further work, the delivery team considered that the service lane 'B' suboption does not physically fit within the corridor and property acquisition would be necessary. Discussion at the workshop confirmed that the delivery score for the service lane should be reduced to -5 (the lowest score possible).

As buildings would require alteration or demolition to implement the service lane suboptions, it was agreed that the service lane options, despite the scoring, should no longer be progressed due to the disproportionate cost and effect of land acquisition.

The introduction of the mana whenua values scores and the reduction of the delivery score for the service lane suboptions changed the relativity between options compared to the interim MCA. Options 4A and 4B still scored the highest, similar to the interim MCA. This scoring does not reflect the decision that the service lane suboptions should no longer be progressed. Option 4A is therefore recommended as the preferred option.

1.8 Indicative Costs and Economic Assessment

Indicative costs were assessed for the range of options. The P50 (50^{th} Percentile) costs range from \$23M to \$28M. The P95 (95^{th} Percentile) costs range from \$30M to \$41M. The indicative BCR's for the options range from 1.2 to 3.4.

1.9 Conclusion and Next Steps

The interim MCA found that Option 4A was the technically preferred option. Engagement with stakeholders and the public found that this option was supported by the majority of respondents. The final MCA, having considered the engagement feedback and included an assessment of the shortlist options against mana whenua values, also found that Option 4A was the preferred option.

This option includes northbound and southbound peak period bus lanes on Thorndon Quay and peak period special vehicle lanes on Hutt Road to be used by buses and freight (with these lanes reverting to parallel parking off peak), a bidirectional cycleway and a range of other safety improvements for the corridor, as well as a roundabout on Aotea Quay.

This option will be advanced to the SSBC, including preliminary design, more detailed cost estimation and economic assessment and development of the business case.

2 Introduction

This report summarises the alternatives and options assessment as well as the multi-criteria assessment (MCA) of the short list options to arrive at the preferred option. It builds on the options development and shortlisting process documented in the earlier Long List to Short List Report[4].

The report starts with an introduction to Let's Get Wellington Moving (LGWM) and the Thorndon Quay Hutt Road (TQHR) project. It summarises the background to the short list MCA, including the problems, benefits and investment objectives as well as summarising the option development and shortlisting process. Transport modelling undertaken for the short list options is presented. The main body of the report discusses the MCA process for the short list options, summarises the public and stakeholder engagement process, followed by presenting indicative cost estimates and a preliminary economic assessment of the short list options. Finally, the report recommends a preferred option to advance to the SSBC.

2.1 Let's Get Wellington Moving Programme

LGWM is a joint initiative between Wellington City Council, Greater Wellington Regional Council, and Waka Kotahi. LGWM seeks to deliver an integrated transport system that supports the community's aspirations for how Wellington City will look, feel and function. The LGWM focus area is from Ngauranga Gorge to the Airport, including the Wellington Urban Motorway and connections to the central city, hospital, and the eastern and southern suburbs. The LGWM programme objectives are:

2.2 Thorndon Quay Hutt Road Project

TQHR is part of the LGWM three-year programme and is being progressed through a Single Stage Business Case process.

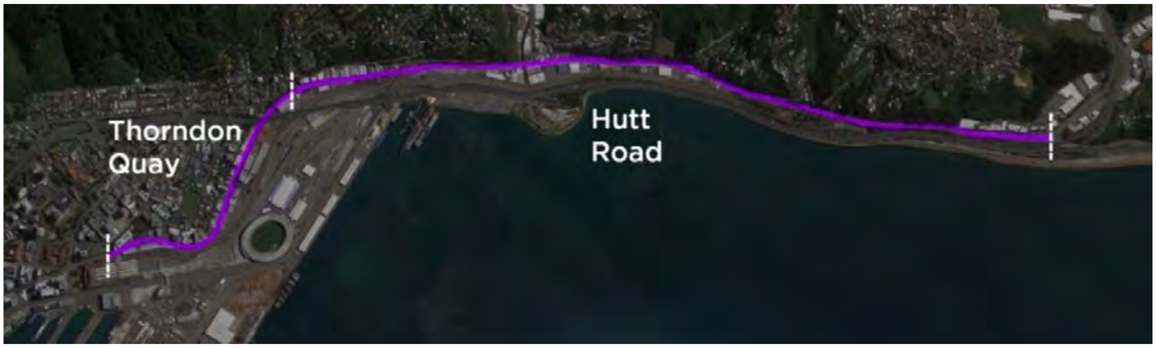
The priorities for the three-year programme are to make travel by bus to and through the central city faster and more reliable, and to create a better environment for people walking and on bikes. Thorndon Quay and Hutt Road is the busiest bus route outside of the city centre and the busiest route in the city for people cycling to and from work.

The changes to Thorndon Quay and Hutt Road are needed to improve safety, give buses greater priority and provide better walking and cycling facilities. With a growing number of people expected to live and work in the Wellington region, more people will want to walk, cycle or take the bus instead of going by car. Te Ara Tupua, the planned shared path between Ngauranga and Petone, will enable more people to walk and cycle between the Hutt Valley and Wellington.

The TQHR project area is shown in Figure 2 below.

[4] Thorndon Quay Hutt Road Long to Short List Report, LGWM, November 2020

Figure 2: TQHR Project Area



3 Background

3.1 Problems

The following problem statements were defined from previous consultation and evidence.

PROBLEM ONE
Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus.
PROBLEM TWO
The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists.
PROBLEM THREE
Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area.
PROBLEM FOUR
High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road.

3.2 Benefits of Investment

By addressing the problems, the following potential benefits of investing in transport improvements for the TQHR corridor were identified:

3.3 Investment Objectives

The TQHR project has five Investment Objectives which build on the identified problems and benefits for the corridor:

i. Improve level of service for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport

ii. Improve level of service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road

iii. Reduce the frequency and severity of crashes

iv. Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area

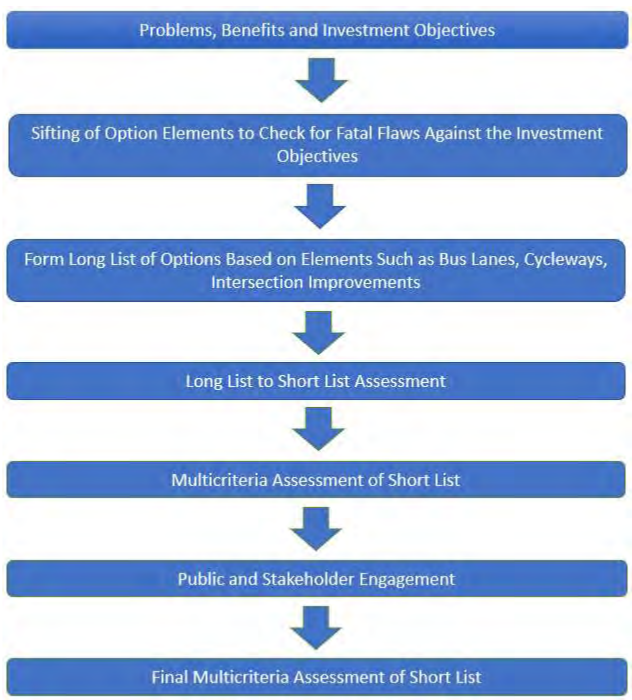
v. Maintain similar access for people and freight to the ferry terminal

The freight investment objective recognises the need to maintain the freight and people access to the ferry terminal and Centreport while making longer-term investments in other modes along Hutt Road and Thorndon Quay.

3.4 Options Development, Long List Assessment and Options Short List

The TQHR project used a multi-stage process to develop and assess options. This process is summarised in the diagram below.

Figure 3: Options Development and Assessment Process



The problems, benefits and investment objectives, as well as assessment of evidence and feedback from previous stakeholder engagement was used to develop a long list of elements (for example bus lanes, cycleway options, improvements to intersections and pedestrian crossings) which could be packaged to form options for the TQHR corridor. The long list of elements is documented in the Long List to Short List Report. These elements were checked for fatal flaws against the investment objectives. Some elements did not proceed, such as:

- Removing zebra crossings and replacing with refuge islands. These were excluded because zebra crossings have greater safety benefits.
- Installing traffic signals at the Davis Street intersection. This was excluded because it would increase bus travel times. Introducing further delay on the Thorndon Quay section of the route is not in alignment with the investment objectives which is to improve the level of service for bus users
- Building a roundabout at the Tinakori Road intersection. This was excluded because it would increase bus travel times by introducing delay to flows on Thorndon Quay.

The remaining elements were packaged into a long list of options and then assessed using the LGWM MCA process to arrive at four options for short list assessment. The key elements which make up the short list options include whether to provide bus lanes in southbound direction only or both northbound and southbound, as well whether to provide a unidirectional or bidirectional cycleway along the corridor.

The four short list options also included special vehicle or bus lanes on Hutt Road to improve the level of service for bus users and to maintain similar access for freight to the port from the north. A special vehicle lane is a traffic lane which can be used only by buses, or buses and trucks, or trucks and high occupancy vehicles (buses and cars with multiple occupancy).

The long list assessment found that the provision of a special vehicle or bus lane on Hutt Road added additional risks to right turning traffic and had the potential to mask motorcyclists that would share the lane with buses. Vehicles exiting properties may not see motorcyclists travelling behind or close to buses when they share the lane. To mitigate this risk, a left in / left out option and a service lane suboption were developed and included in the short list as two sub-options to each main option (suboptions A and B). Suboption A also included a new roundabout on Aotea Quay[5] to provide a turnaround facility for trucks which may be impacted by the left in / left out arrangement on Hutt Road.

The short list options and suboptions are summarised below. Diagrams of the short list options are contained in Appendix A.

Table 2: Shortlist Options

<table>
<tr><th rowspan="2">Option</th><th colspan="3">Elements</th><th rowspan="2">Common Elements</th></tr>
<tr><th>Thorndon Quay Bus Lanes</th><th>Thorndon Quay Cycle Lanes</th><th>Hutt Road Special Vehicle Lanes</th></tr>
<tr><td>Option 1: Southbound bus lanes with Thorndon Quay bidirectional cycleway</td><td>Southbound</td><td>Bi-directional</td><td>Southbound</td><td rowspan="3">▪ Removal of angle parking on Thorndon Quay to improve safety
▪ Speed limit review
▪ Intersection upgrades</td></tr>
<tr><td>Option 1A: Southbound bus lanes with Thorndon Quay bidirectional cycleway</td><td colspan="3">Option 1 plus:
• Left-in / Left-out on Hutt Road (central median)
• Construct a roundabout on Aotea Quay</td></tr>
<tr><td>Option 1B: Southbound bus lanes with Thorndon</td><td colspan="3">Option 1 plus:</td></tr>
</table>

[5] *It should be noted that, whilst this roundabout requires property acquisition, the disbenefits identified in the long list to short list report for property acquisition do not apply for this property as it does not affect buildings, amenity or vegetation. It was agreed that this option should therefore be short-listed, particularly given the safety and freight benefits of this option.*

Quay bidirectional cycleway	• Creatin of a service lane on east side of Hutt Road (between Onslow and Kaiwharawhara) • Signalise Kaiwharawhara and Onslow Road intersections			▪ Pedestrian Crossing Improvements ▪ Bus stop rebalancing ▪ Thorndon Quay amenity improvements
Option 2: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	Both directions	Uni-directional	Both directions	
Option 2A: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	Option 2 plus the same variants as for Option 1A			
Option 2B: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	Option 2 plus the same variants as for Option 1B			
Option 3: Southbound bus lanes with Thorndon Quay unidirectional cycleway	Southbound	Uni-directional	Southbound	
Option 3A: Southbound bus lanes with Thorndon Quay unidirectional cycleway	Option 3 plus the same variants as for Option 1A			
Option 3B: Southbound bus lanes with Thorndon Quay unidirectional cycleway	Option 3 plus the same variants as for Option 1B			
Option 4: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	Both directions	Bi-directional	Both directions	
Option 4A: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	Option 4 plus the same variants as for Option 1A			
Option 4B: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	Option 4 plus the same variants as for Option 1B			

4 Transport Modelling

A Transport Modelling Report was produced which documents the results of the transport modelling undertaken on the short list options. The Transport Modelling Report is contained in Appendix B.

The following conclusions have been drawn from the short list options modelling:

- The base case for bus travel time is just under 13 minutes. With the do-minimum, by 2036 the travel time for bus will be 21 minutes and 18 minutes for car and trucks[6].

[6] Table 1 of the Traffic Modelling Report (Appendix B)

- There appears to be a strong case for bus priority (southbound) in the morning peak (as per Option 1 and Option 3).
- There appears to be a case for bus priority (northbound) in the evening peak. However, the expected benefit is lower than expected benefits in the southbound morning peak. It is noted that there is potential for peak spreading[7] outside of the AM 7am – 9am peak as well.
- It is expected that with peak period bus priority, the bus journey times will be up to 10-11 minutes, which is lower than currently observed, and in the case of the morning peak period, significantly lower than the do-minimum.
- There doesn't appear to be a strong case for all-day bus priority along the corridor as the level of service (reliability) is expected to remain good in off-peak periods through to 2036. However, on Hutt Road (Ngauranga to Kaiwharawhara) it is worth considering the implementation of a Special Vehicle Lane all-day whilst there is very little congestion outside of peak periods because there is likely to be low impact to the existing traffic using this section of the corridor.
- The type of Special Vehicle Lane is a balancing act between improving reliability for buses, improving reliability for freight, managing the impact of converting a general traffic lane to a Special Vehicle Lane, and providing for a volume of traffic in the Special Vehicle Lane that does not negate its benefits.
- The roundabout at the Aotea Quay/Mainfreight entrance would be beneficial to include under all options to provide an additional access to the Interislander Ferry Terminal.
- Consider additional controlled crossing points along Thorndon Quay to reduce the spacing between the current (which will be upgraded) and proposed crossings at Tinakori Road and the motorway overpass (where bus stops are proposed). More crossings will improve the level of service by reducing the distance to walk to a formal crossing point. The provision of additional crossings is unlikely to have a significant impact on the reliability of public transport along the corridor.
- Uni-directional cycle paths on Thorndon Quay (between the motorway overpass and Thorndon Quay) may result in a poor level of service for cycling and walking due to the constrained width, hence extending the existing bi-directional cycle path is recommended through this section.
- The provision of a bi-directional path along Thorndon Quay provides a good level of service (B/C) and a higher level of service than the uni-directional cycle paths (D/E) using the Danish Cycling Level of Service method. This is primarily due to the path width and the buffer between the cycle path and the road. However, this assessment does not consider the safety implications of a bi-directional cycle path, which is being addressed through the Investment Objective related to safety. The advantage of the uni-directional cycling paths is that they provide access to all properties on both sides of the road, whilst catering for commuters as well. The bi-directional cycle path is expected to provide a higher level of service for commuters, but access to properties on the other side of the road is limited (cyclists cannot legally ride on a footpath).
- The elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models are to be further investigated in the SSBC to confirm the assessment of the reliability for trucks.
- It is noted that the model is validated to existing conditions and took into account higher order models as inputs. The modelling did not take into account any changes in behaviour/traffic patterns that have not been accounted for in other models.

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[7] Traffic Modelling Report (Appendix B), Page 20, the spreadsheet model considers average conditions over the two-hour peak period

Further modelling will be undertaken in the SSBC to assess the transport performance and impacts of the recommended option.

5 Short List Multi Criteria Assessment

5.1 Introduction

The short list options were taken through an MCA process in two stages. The first (or 'interim') MCA was undertaken in late 2020 to allow development of a technically preferred option to advance while the wider LGWM programme was being reviewed. The second MCA was undertaken in June 2021 to consider engagement feedback and an assessment against mana whenua values, which were still under development when the interim MCA was undertaken.

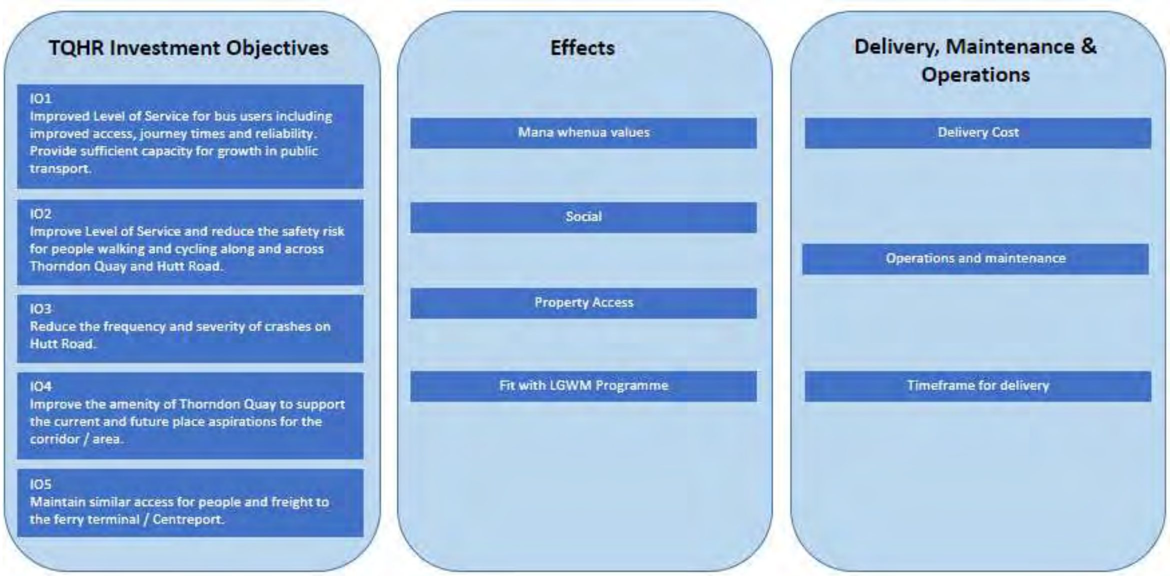
5.2 MCA Criteria

The short list MCA included an assessment of the options against their contribution to the following:

- investment objectives;
- effects; and
- delivery, maintenance and operations.

The main topics included in each of these areas are summarised below:

Figure 4: MCA Criteria



The considerations for each of the MCA criteria include:

- **Investment Objective 1:** Improving the level of service for bus users.
- **Investment Objective 2:** Improving the level of service and safety for those travelling by active transport modes.
- **Investment Objective 3:** Reducing the frequency and severity of crashes on Hutt Road.
- **Investment Objective 4:** Improving the amenity along Thorndon Quay.
- **Investment Objective 5:** Maintaining similar access for people and freight to the ferry terminal and freight hub.

- **Mana Whenua Values:** Alignment with mana whenua values developed for the LGWM programme
- **Social:** Effects on social and economic opportunities along and adjacent to the corridor.
- **Property Access:** Effect of access to properties along the corridor.
- **Fit with LGWM Programme:** Alignment with linked projects such as Golden Mile.
- **Delivery:** Construction impacts.
- **Operations and maintenance:** Impacts on services and maintenance costs.
- **Timeframe for delivery:** Speed of delivery to realise benefits**.**

5.3 MCA Criteria Review

Subject matter specialists met via a series of small individual workshops to go through the individual criteria with members of the Project Management Team and with TWG members. The individual workshops were centred around these key areas:

- Transportation
- Safety
- Social and Environmental
- Maintenance and Operations

The comments captured through these individual workshops is summarised in Table 3.

Table 3: Summary of the MCA Comments

Criteria	Commentary from Individual Workshops
Investment Objectives	
Investment Objective One	Options were reviewed against bus priority, with a specific focus on where bus priority is needed along the corridor and when it is needed. The morning peaks were considered to be the most beneficial. This was considered across all of the options.
Investment Objective Two	The key commentary captured was around the safety impact of bi-directional and uni-directional cycling. There was general consensus that unidirectional cycling paths are safer than bidirectional cycling paths.
Investment Objective Three	Risks around the interaction of turning vehicles with motorcyclists, cyclists and pedestrians were raised. Mitigation measures such as speed limit reductions and intersection improvements were all key considerations for options.
Investment Objective Four	From an amenity perspective there was in depth discussion around how amenity is managed and the impact of footpath widths, shared paths and planting to soften the corridor.

	The future function of the corridor was also a key consideration including improving the amenity value and balancing the through movement with the sense of place. Median strips with vegetation were considered a positive. Shared paths were considered a positive in that they provide more space for amenity. However, the mixing of potentially high speed cyclists and pedestrians was considered negative.
Investment Objective Five	Freight using the special vehicle lane was positive. There were also considerations around traffic volumes and the roundabout at Aotea Quay.
Effects	
Mana Whenua Values	These were developed by mana whenua and were considered in the final MCA. These are listed in Table 7.
Social	Equitable access was considered important from a social and economic opportunity perspective. Consideration was given to safer protected cycleways. It was noted that bidirectional cycleways – on one side of the road – reduce benefits and access. Other social aspects include building a sense of place and providing connections off the corridor.
Property Access	Property access is directly impacted by cycleways and bus lanes as well as special vehicle lanes. These are all considered within the evaluation of options. This criterion also considered safety and efficiency.
Fit with LGWM Programme	Overall programme objectives of LGWM were considered including improving safety and cycling as well as public transport. Innovating Streets was also an important consideration. It was noted that project delivery was not a differentiator.
Delivery, Maintenance, and Operations	
Delivery	Key considerations were maintaining cyclist and pedestrian flows, impacts to services, and impacts to traffic.
Operations and Maintenance	From an operations and maintenance perspective it was noted that it is much easier to maintain wider footpaths and cycle paths than the road. Maintaining the carriageway is difficult due to the narrow corridor. Further pavement assessments are required.
Timeframe for Delivery	A need for options to fit within a 24-month delivery timeframe for the whole corridor was considered.

5.4 Interim MCA Scoring

The MCA was scored on an 11-point system from -5 to 5, with 0 being no change from current state, positive being an improvement to the current state and negative being worse than the current state. The rationale behind the scores is summarised Table 4.

Table 4: Outcome Summary of MCA Reviews

Criteria	Details
Investment Objectives	
Investment Objective One: • Improve level of service for bus users including improved access, journey times and reliability • Provide sufficient capacity for growth in public transport	All options scored positive as they will improve the level of service for bus users along the corridor. This is because the options allow for journey time and reliability improvements while providing a suitable level of capacity for current and future growth. Bus travel times are estimated to improve by approximately 10 minutes in the southbound direction in the 2036 morning peak period and approximately 1-2 minutes in the northbound direction in the 2036 evening peak period. • **Options 2 and 4 scored highest (score of 4) as they include bus lanes / special vehicle lanes in both the northbound and southbound direction** • Options 1 and 3 scored 3 as they provide bus lanes / special vehicle lanes in the southbound direction only
Investment Objective Two • Improve level of service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road	All options improve the level of service, and reduce the safety risk, for people walking and cycling on Thorndon Quay and Hutt Road, as well as capacity for cycling growth. The assessment noted that the increasing lanes may create safety concerns for cyclists, pedestrians and other vehicles to cross. These elements will be further considered during design. While both unidirectional and bidirectional cycle facilities would be an improvement on the existing situation from a safety perspective, unidirectional cycleways (Options 2 or 3) scored better for safety, due to less risk with cyclists travelling with the direction of general traffic. The suboptions A and B scored better than their respective base option as they include measures to manage the risk of crashes between pedestrians and cyclists with vehicle right turn movements on Hutt Road. • **Options 2A, 2B, 3A and 3B ranked the highest with a score of 4** • Options 2 and 3 ranked the second highest with a score of 3 • Options 1A,1B, 4A and 4B had a score of 2 • Options 1 and 4 scored 1
Investment Objective Three	All options were considered to reduce the frequency and severity of crashes on Hutt Road. The assessment noted the provision of a special vehicle or bus lane on Hutt Road added additional risks to right turning traffic and had the potential to mask motorcyclists that would

Criteria	Details
• Reduce the frequency and severity of crashes on Hutt Road	share the lane with buses. Accordingly, the base Options (1, 2, 3 and 4) scored lowest. The suboptions A and B scored better than their respective base option as they included measures to manage the risk of crashes with vehicle right turn movements on Hutt Road. • **Options 1A, 1B, 2A, 2B, 3A, 3B, 4A and 4B ranked the highest with a score of 3** • Options 1, 2, 3 and 4 scored 1
Investment Objective Four • Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area	All options include amenity improvements for Thorndon Quay to support the current and future place aspirations for the corridor/area. These would vary depending on the option. For example, the scoring was sensitive to footpath widths and area available for amenity improvements (greater width received higher score) and unidirectional vs bidirectional cycleway (bidirectional resulted in less carriageway width which received a higher score). Option 4 and 4A had the most positive effects on character and place value by creating a vibrant street that includes footpath with trees. • **Option 4 and 4A ranked the highest with a score of 4** • Option 1, 1A, and 4B scored 3 • Option 3 and 3A scored 2 • Option 1B, 2, 2A, 2B, and 3B ranked the lowest with a score of 1
Investment Objective Five • Maintain similar access for people and freight to the ferry terminal / CentrePort	All options scored positive as the provision of special vehicle lanes on Hutt Road are expected to improve freight access to the ferry terminal / CentrePort. • **Options 2, 2A, 2B, 4, 4A and 4B ranked the highest with a score of 3, as they include special vehicle lanes in both the northbound and southbound directions** • Options 1, 1A, 1B, 3, 3A and 3B scored 2, as they include special vehicle lanes in the southbound direction only
Implementability	
Social	All options had positive effects on equity and access to social and economic opportunities, such as employment, retail, health, cultural and social connectedness, • **Option 2, 2A, and 2B ranked the highest with a score of 4** • Option 1, 1A, 1B, 3, 3A, 3B, 4, 4A, and 4B scored 3
Property access	Option 1B, 2B, 3B, and 4B provided positive long-term effects on access to and servicing of private buildings (i.e. deliveries, removals, building maintenance) since the service lanes reduce conflicts and provide safe access to properties. However, Option 1, 1A, 2, 2A, 3, 3A, 4, 4A had negative long-term effects on access • **Option 1B, 2B, 3B, and 4B ranked the highest with a score of 4** • Option 1A, 3A, and 4 A scored -2

Criteria	Details
	• Option 1, 2, 2A, 3, and 4 ranked the lowest with a score of -3
Fit with LGWM Programme	All options scored positively as they aligned with linked projects, such as the Golden Mile and City Streets. They provide the flexibility to integrate with linked projects (for example the bidirectional cycleways north and south of Thorndon Quay and Hutt Road), deliver the option incrementally, and scale the level of intervention. • **Option 4A ranked the highest with a score of 5** • Options 1A, 2A, and 4 ranked the second highest with a score of 4 • Option 1, 2, 3A, and 4B scored 3 • Option 1B,2B and 3 scored 2 • Option 3B scored the lowest with a score of 1. While still scoring positive, this option was seen to have the least integration with the wider programme, including providing unidirectional cycleways which will integrate least with bidirectional cycleways north and south of the project as well as the service road which could impact potential connectivity to the Multi-User Ferry Terminal.
Delivery, Maintenance & Operations	
Delivery	All options had negative scores. This was due to impacts on expected duration of delivery and effect on pedestrians, cyclists, bus operations and parking during delivery. It was also due to impacts on parking and access to and servicing of private buildings (i.e. deliveries, removals, building maintenance) during construction. • **Option 1 and 4** ranked **the highest (least negative impacts) with a score of -1** • Option 1A and 4A ranked the second highest with a score of -2 • Option 2 scored -3 • Option 1B, 2A, 2B, 3, 3A, 3B, and 4B ranked the lowest with a score of -4
Operations and maintenance	All options had negative scores due to impacts on public operational costs (maintenance, refuse collection, street cleansing, landscape maintenance), potential ability to accommodate utilities, services repairs and renewals, and flexibility (ie re-route bus services due to major planned and unplanned events and flexibility of future corridor use. • **Option 1, 3, and 4 ranked the highest (least negative impacts) with a score of -1** • Option 1A, 1B, 2, 3A, 3B, 4A, and 4B scored -2 • Option 2A and 2B ranked the lowest with a score of -3
Timeframe for delivery	Option 1 had positive impacts by demonstrating tangible improvements (outputs) within the 2018-21 / 2021-24 NLTP period and the ability to demonstrate tangible improvements (benefits) within the 2018-21 / 2021-24 period. The impacts of Option 1A, 2, 3, and 4

Criteria	Details
	were neutral. Option 1B, 2A, 2B, 3A, 3B, 4A, and 4B had negative impacts. • **Option 1 ranked the highest with a score of 2** • Option 1A, 2, 3, and 4 scored 0 • Option 1B scored -1 • Option 2A, 3A, and 4A scored -2 • Option 2B, 3B, and 4B ranked the lowest with a score of -3

5.5 Interim MCA Workshop Discussion

A workshop was conducted on the 18th of November 2020 to obtain inputs from the partners on the MCA assessment. Key points of discussion from the workshop include:

- Regarding the safety objectives (IO2 and IO3), all options would improve safety for all road users.
- The part-time bus lane may be less safe for pedestrians since they may not expect the buses to utilise the bus lane.
- Uni-directional cycle lanes may create safe crossing issues for cyclists and pedestrians on Hutt Road as well as cycle crossing over at Tinakori Road. The existing crossing point at Kaiwharawhara Road might pose safety challenges for cyclists. From a safety perspective, the unidirectional cycleway was preferred.
- It is noted that this project is focusing on the people who use the corridor and that the project area is the city gateway from the North to the South
- Buses would travel on the bus lanes on Thorndon Quay. Buses and trucks might travel through the special vehicle lane on Hutt Road.
- Multimodal transport and amenity design, such as maximising the footpath, may need to be in place to enable Kaiwharawhara Road to transform from industrial to mixed used since the design can encourage behaviour change that supports sustainability.

The partners generally agreed with the scoring and ranking of the options based on the previous individual workshops to reach a technically preferred option. However, was noted that public and stakeholder engagement were needed prior to confirming the recommended option.

5.6 Interim MCA Scoring Summary

The table below summarises the results of the MCA assessment of the options against investment objectives, effects and delivery, maintenance and operations using an 11-point (+5 - -5) system.

Table 5: MCA Scoring Summary

Option	Contribution to Investment Objectives					Contribution to Effects			Contribution to Delivery, Maintenance and Operations			Total	Option Rank
	IO1 – Bus Reliability / Attractive-ness	IO2 – Walking & Cycling	IO3 – Hutt Road Safety	IO4 – Thorndon Quay Amenity	IO5 – Similar Freight Access*	Social	Property Access	Fit with LGWM Programme	Delivery	Operations and Mainten-ance	Timeframe for Delivery		
Option 1: Southbound bus lanes with Thorndon Quay bidirectional cycleway	3	1	1	3	2	3	-3	3	-1	-1	2	**13**	6
Option 1A: Southbound bus lanes with Thorndon Quay bidirectional cycleway	3	2	3	3	2	3	-2	4	-2	-2	0	**14**	5
Option 1B: Southbound bus lanes with Thorndon Quay bidirectional cycleway	3	2	3	1	2	3	4	2	-4	-2	-1	**13**	6 Equal
Option 2: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	4	3	1	1	3	4	-3	3	-3	-2	0	**11**	9 Equal
Option 2A: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	4	4	3	1	3	4	-3	4	-4	-3	-2	**11**	9 Equal
Option 2B: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	4	4	3	1	3	4	4	2	-4	-3	-3	**15**	3 Equal

Option	Contribution to Investment Objectives					Contribution to Effects			Contribution to Delivery, Maintenance and Operations			Total	Option Rank
	IO1 – Bus Reliability / Attractive-ness	IO2 – Walking & Cycling	IO3 – Hutt Road Safety	IO4 – Thorndon Quay Amenity	IO5 – Similar Freight Access*	Social	Property Access	Fit with LGWM Programme	Delivery	Operations and Mainten-ance	Timeframe for Delivery		
Option 3: Southbound bus lanes with Thorndon Quay unidirectional cycleway	3	3	1	2	2	3	-3	2	-4	-1	0	**8**	12
Option 3A: Southbound bus lanes with Thorndon Quay unidirectional cycleway	3	4	3	2	2	3	-2	3	-4	-2	-2	**10**	11
Option 3B: Southbound bus lanes with Thorndon Quay unidirectional cycleway	3	4	3	1	2	3	4	1	-4	-2	-3	**12**	8
Option 4: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	4	1	1	4	3	3	-3	4	-1	-1	0	**15**	3 Equal
Option 4A: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	4	2	3	4	3	3	-2	5	-2	-2	-2	**16**	**1 Equal**
Option 4B: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	4	2	3	3	3	3	4	3	-4	-2	-3	**16**	**1 Equal**

*the assessment assumes that freight can use the special vehicle lanes on Hutt Road.

5.7 Interim MCA Summary

The highest scoring options from the interim MCA were Options 4A and 4B.

While Options 4A and 4B scored similarly overall, the provision of a service road (suboption B) was discounted as being more disruptive, fits less with other regional projects and carries larger implementation risk.

The provision of bidirectional or unidirectional cycling facilities was also discussed. It was noted that the provision of a bidirectional cycleway (i.e. Options 1 or 4) should be aligned with the wider LGWM programme as there are bidirectional facilities planned to the north and south of the TQHR corridor. This would provide a consistent cycle path and ease of connection.

It was also noted that while both unidirectional and bidirectional cycle facilities would improve safety and level of service, unidirectional cycleways (Options 2 or 3) scored better for safety, due to less risk with cyclists travelling with the direction of general traffic.

Following the MCA workshop, the Technical Advisory Group (TAG) met to discuss a recommended option. The TAG supported the highest scoring option of 4A while noting the additional safety risks inherent with bidirectional cycleways which will require consideration in the design phase.

The TAG recommended that Option 4A was the best option to take forward as the interim preferred option. This decision was supported by the LGWM Programme Steering Group.

6 Public and Stakeholder Engagement

The stakeholder section of this report outlines the consultation and engagement component of the TQHR project and summarises the feedback received.

6.1 Communications and Engagement Approach

Engagement on the preferred option was undertaken from 10 May to 8 June 2021. The engagement strategy and activities were led by LGWM with support from the TQHR project team. Stakeholders and the public were consulted on the technically preferred option for the TQHR project, as well as WCC's intention to change angle parking to parallel parking on Thorndon Quay ahead of other changes to improve safety for cycling.

Engagement material was made available on the LGWM website[8] including description of the proposal and background material. A consultation document was also produced which was available at meetings / open days and was made available in several languages. In addition to information on the TQHR project, WCC also produced a technical report[9] on the intended parking change as well as a draft traffic resolution which was made available on the LGWM website.

The consultation document and engagement material outlined the project objectives, the options evaluation process and the proposal for Thorndon Quay and Hutt Road. Stakeholders and the public were asked for their feedback on how the proposal met their priorities for how the streets were used and what they would like to see included as the proposal is further designed. A summary of the proposals included in the engagement material for Thorndon Quay and Hutt Road are below.

6.1.1 Thorndon Quay Proposal Summary

The proposal for Thorndon Quay will provide part-time bus lanes in both directions and extend the two-way cycle path from Hutt Road to the Lambton interchange at Mulgrave Street. Bus priority will

[8] https://lgwm.nz/our-plan/our-projects/thorndon-quay-and-hutt-road/have-your-say-thorndon-quay-and-hutt-road/

[9] Thorndon Quay parking and crashes analysis report

be provided at Mulgrave Street. The footpaths and street environment will be improved to make it a more pleasant place to visit.

Changes will allow for future growth in the numbers of people taking the bus and cycling, and will encourage more people to walk, shop and spend time on Thorndon Quay. Safety will be improved for everyone by removing the angle parking, providing a dedicated cycle path and improving pedestrian crossings.

Changes to parking will happen in two stages - the initial change in late 2021 is to convert the angle parking to parallel parking, to improve safety for everyone and make it easier for buses to pull into and out of bus stops. Further parking changes may be needed as part of the final street design to provide enough space for buses and bikes, this may include changes to the parking time limits.

The indicative cross section for Thorndon Quay is shown in Figure 5 below.

Figure 5: Thorndon Quay Indicative Cross Section

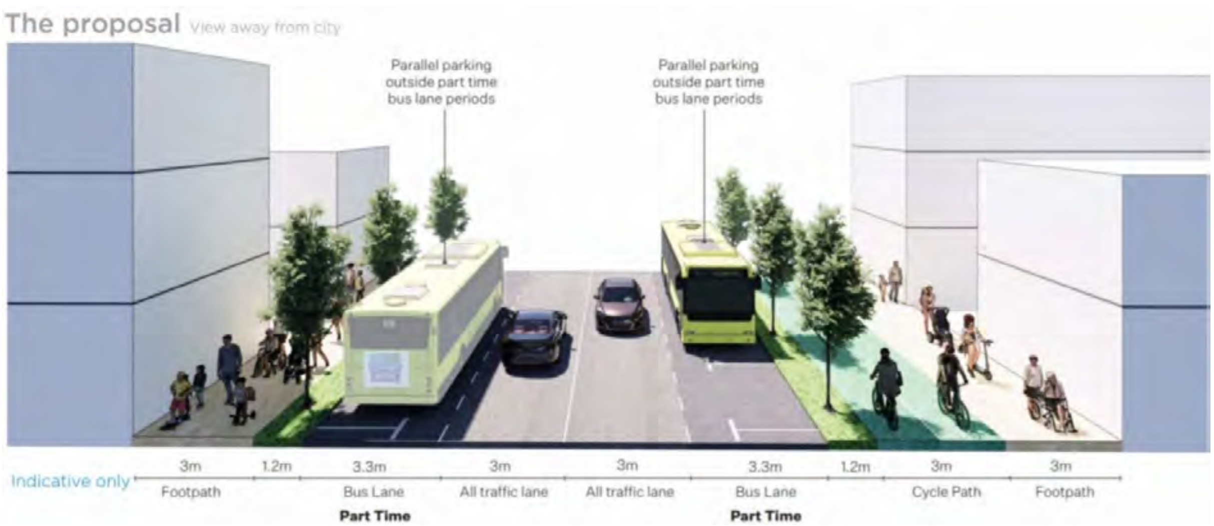
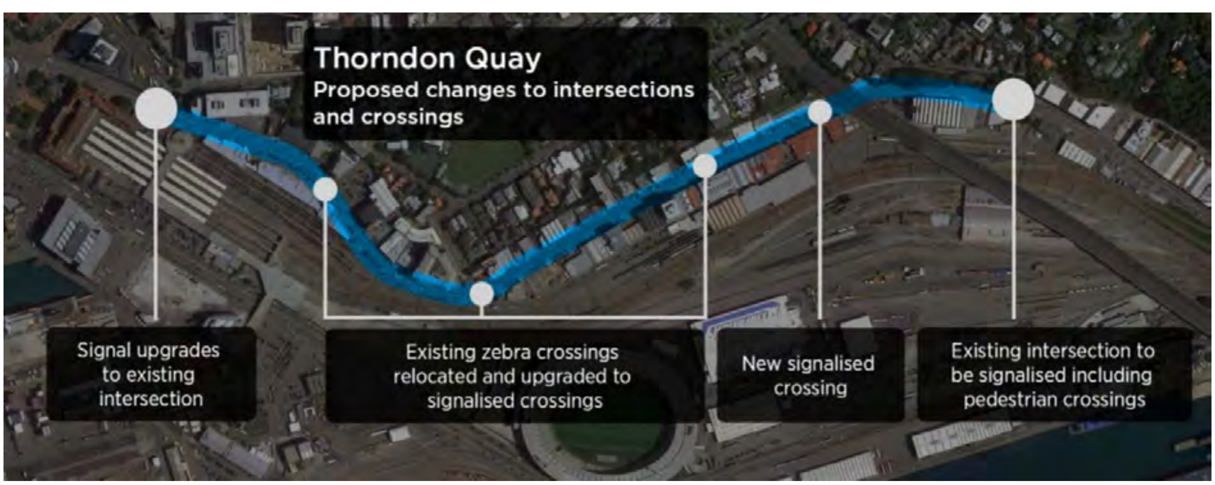


Figure 6 below illustrates proposed changes to intersections and crossings along Thorndon Quay.

Figure 6: Thorndon Quay – Proposed Changes to Intersections and Crossings



6.1.2 Hutt Road Proposal Summary

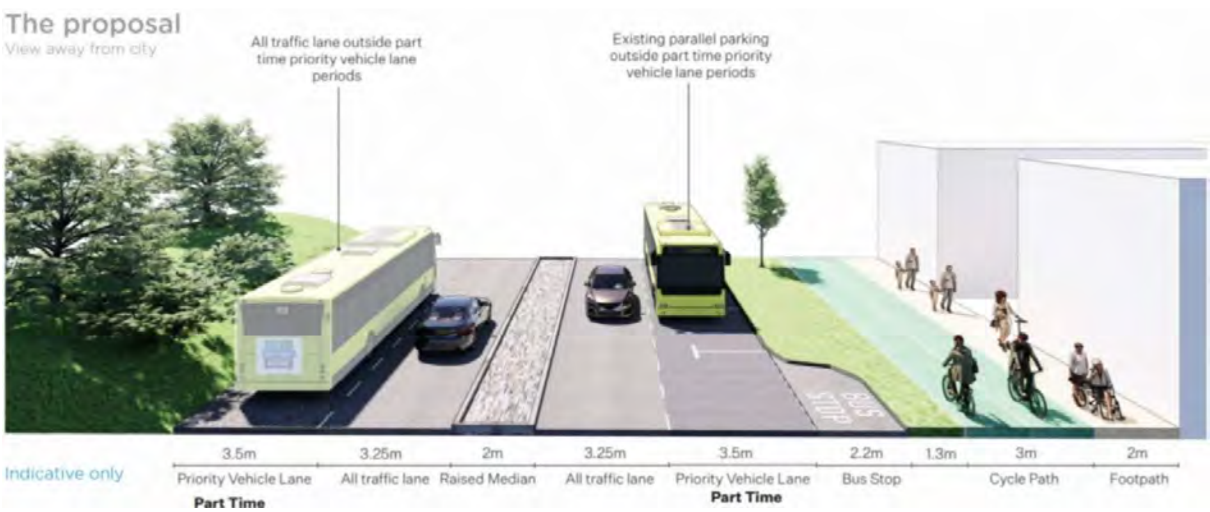
The proposal for Hutt Road includes providing part-time bus lanes in both directions and bus priority at the Ngauranga/Jarden Mile intersection. Bus lanes are proposed in both directions because this will improve bus travel times and reliability during peak hours, making buses a more attractive travel option.

The shared path between the Ngauranga/Jarden Mile intersection and Caltex will be upgraded to a two-way cycle path and dedicated footpath. The new paths will connect with the existing paths on Hutt Road and the bike path will connect with the proposed new cycle path on Thorndon Quay. There will also be a future connection to Te Ara Tupua.

A significant safety risk for everyone, particularly for people walking and cycling, is vehicles turning right across traffic on Hutt Road, between Aotea Quay and Ngauranga, to get into or out of the businesses. To address this, a raised central median is proposed to prevent right turns along this section of Hutt Road.

The indicative cross section for Hutt Road is shown in Figure 7 below.

Figure 7: Hutt Road Indicative Cross Section



Proposed changes to intersections and crossings along Hutt Road are shown in Figure 8 below.

Figure 8: MCA Hutt Road – Proposed Changes to Intersections and Crossings

A proposed new roundabout on Aotea Quay (to replace the traffic lights at the KiwiRail container terminal entrance) would give drivers of large vehicles intending to travel north from a business on Hutt Road a safe place to turn.

6.1.3 Engagement Events

A series of stakeholder engagement events were held over the May – June engagement period. These events are summarised in Table 6 below.

Table 6: Stakeholder Engagement Events

Event	Date	Event Information
Stakeholder Briefing	9 May 2021	Online stakeholder event to launch the engagement.
Open Days	21 May 2021	Open Day at Pipitea Marae
	22 May 2021	Open Day at Pipitea Marae
	23 May 2021	Information stand at Harbourside Market, Waitangi Park
	30 May 2021	Information stand at Johnsonville Market, Johnsonville School

6.2 Engagement Feedback

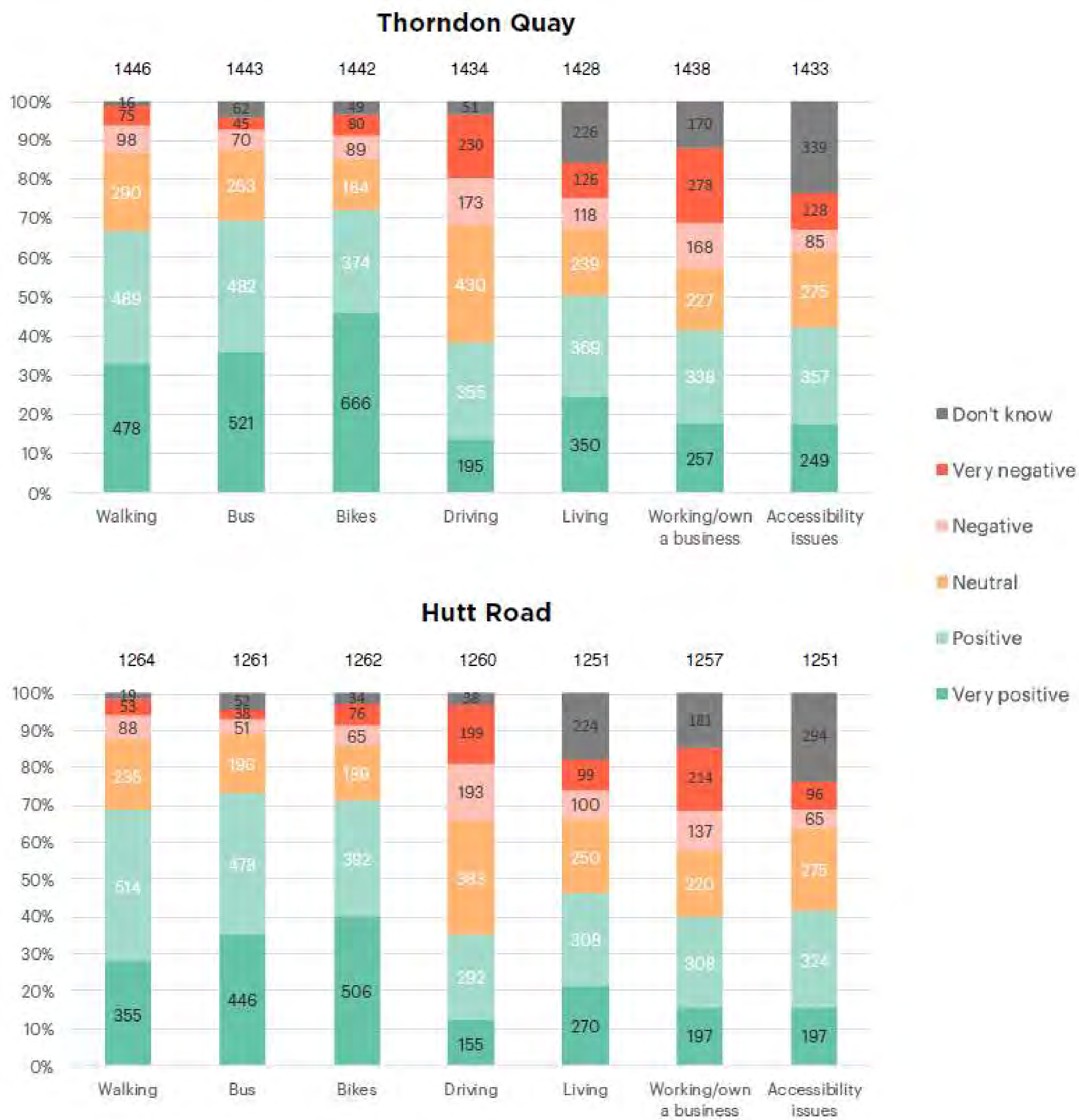
LGWM received 1,613 submissions on the proposal. Of those who submitted, 72% of the respondents said it was important or very important to make improvements for people walking, riding bikes and using the bus on Thorndon Quay and Hutt Road. LGWM produced an engagement summary report[10] which is available on the LGWM website.

Pedestrians, bus users, cyclists, people who use e-scooters as well as people who travel through and visit the area generally felt that the proposal would have a positive impact. Submissions from people who drive cars, trucks, motorcyclists and those that lived in the area or had a disability had a mixed response about the impacts of the proposal. Business owners and people that worked in the area felt that changes would have a negative impact.

Around 70% of respondents said the changes on Hutt Road and the changes on Thorndon Quay would have positive or very positive impacts for people walking, people in buses, and people on bikes. People's feedback was mixed on what they thought the impacts would be for people driving, people who live, work or own a business on these streets, or people with a disability.

[10] May-June 2021 Hutt Road / Thorndon Quay Engagement, Data Analysis Report, 29 June 2021

Figure 9: Engagement Summary – How People Felt About the Proposal



There were a number of common themes received from submissions regarding changes to be considered when further developing the proposal. Changes to be considered along Thorndon Quay include:

- The impacts on commercial delivery vehicles
- Drop-off parking to be made available
- Safety for pedestrians crossing the street, especially small children
- Impact to businesses in a tough retail environment
- Bus stop locations to be outside or close to key destinations.

Changes to be considered along Hutt Road include:

- Allowing safe vehicle access into and out of properties around pedestrians and cyclists
- Increase the width of the bike lane
- Address concerns from businesses about how their customers will access their business if they cannot make a right turn.

People were also asked what they would like to see designed into the streetscape. Responses included bike parking, more greenery and other parking options if on street parking is reduced.

A submission was also received from an organisation called the Thorndon Quay Collective which represents a number of businesses and other Thorndon Quay community members and was established in response to engagement. A key theme from the Thorndon Quay Collective submission is that the loss of and reconfiguration of parking will have an adverse impact on businesses on Thorndon Quay.

In addition to the key themes summarised above, there were many points of detail raised in the submissions that will need to be further considered in the future design phase. Ongoing engagement with stakeholders and properties along the Thorndon Quay and Hutt Road corridor will be important as the project transitions into the design phase.

7 Final MCA

7.1 Introduction

Following engagement, a second MCA workshop was held on 30 June 2021. The purpose of this workshop was to consider the impact of engagement feedback on the interim MCA scores as well as incorporate scoring of the options against mana whenua values into the MCA. The second MCA followed a similar process to the interim MCA, where project team subject matter specialists led assessment groups with LGWM partner organisation specialists to jointly assess and review the scoring for the options ahead of the full workshop. The full workshop was then held with attendance from the specialists, project team members as well as other representatives from the partner organisations to discuss and agree the scoring.

7.2 Mana Whenua Values and Scoring

The June MCA workshop was attended by a representative of mana whenua. The options were scored by mana whenua against their values as summarised in Table 7.

Table 7: Mana Whenua Values

Mana Whenua Values	
Whakapapa - A sense of Place	• Building works restore a healthy relationship with nature • Finished projects tell the story of the place • Native plantings • Urban agriculture
Wai-ora - Respect the Role of Water	• Acknowledge the importance of water • Resurrect the natural water courses • Manage water run off to ensure only purest water flows to the harbour

Pūngao-ora - Energy	• Minimise energy use during construction • Completed projects to aim to be energy neutral
Hau-ora – Optimising Health & Wellbeing	• Prior to construction minimise uncertainty by clear goals and timeline • During construction minimise disturbance to neighbours • Completed projects to use plantings and water flows to provide healthy environments
Whakamahitanga - Use of Materials	• Recycle the maximum of materials disposed of during construction • Build with materials and methods that use the lowest energy possible • Avoid toxic materials that may leach into air or ground water
Manaakitanga – Support a Just and Equitable Society	• Embody our values in these projects • Work with locals to the extent possible • Provide safe and inviting public spaces
Whakāhuatanga - Celebrate Beauty in Design	• Design in a way that lifts the human spirit • Incorporate public art and interpretation to tell the story of what has gone before
Whakamatautautanga	• Monitoring

Mana whenua scored all of the options positive against their values. Option 1B scored the highest with a score of 5. Options 1A, 3B and 4B scored 4. Options 1, 2B, 3A and 4A scored 3. Options 2A, 3 and 4 scored 2. Option 2 scored least with a score of 1.

The implementation of a bus lane on the southbound side was preferred over both directions as the southbound benefits were higher. Without the northbound bus lane, this would provide more ability to influence the design of the footpath on the northbound (or 'beach' side). Mana whenua noted that most of their land interests along the corridor were along this historical beach side.

The 'B' suboptions all scored higher than the 'A' and base options as they were considered to provide an opportunity to improve access and create a neighbourhood space for those properties along Hutt Road.

Mana whenua supported the bidirectional cycleway on the harbourside as it is consistent with other cycle projects north and south of Thorndon Quay and Hutt Road. Mana whenua noted that the change to angle parking to parallel was not considered in their scoring as WCC had already voted in favour of the change at the time of scoring the options.

7.3 Consideration of the Service Road (Suboptions B')

During the MCA workshop, the delivery specialists raised the challenges with implementing the Hutt Road service lane proposed in the 'B' suboptions. The service lane was previously highlighted at the interim MCA workshop as being more disruptive, fits less with other regional projects and carries larger implementation risk.

The delivery team noted that since the interim MCA, further preliminary design of Option 4A had progressed, including more detailed evaluation of the available width on Hutt Road and desired width for the various modes. Based on this further work, the delivery team considered that the service lane option does not physically fit within the corridor and property acquisition would be necessary. Discussion at the workshop confirmed that the delivery score for the service lane should be reduced to -5 (the lowest score possible).

In the long list assessment, it was established that if property acquisition was needed for an option, it should not be short-listed, particularly if buildings would require alteration or demolition which would be the case on Hutt Road[11]. It was therefore agreed that the service lane options, despite the scoring, should no longer be progressed due to the disproportionate cost and effect of land acquisition.

Other factors for discounting the service lane options included:

- Likely to be a noticeable impact for traffic not able to use the Special Vehicle Lane, and potential issues integrating with any MUFT proposal to connect to the intersection of Hutt Road/Kaiwharawhara Road
- Access and egress for the service lane would be via signal-controlled intersections at Onslow Road and Kaiwharawhara by altering the current intersections to signalised crossroads. There were concerns that this would increase the delay on Hutt Road and hence reduce the level of service for buses and freight as well as general traffic.

7.4 Other Criteria Assessments

The specialist teams for each of the MCA criteria reviewed their scoring from the interim MCA to assess how engagement feedback may affect the scoring. All of the specialist groups determined that the feedback did not alter their scoring or differentiation between options (i.e. changing from bidirectional to unidirectional cycleways or southbound only bus lanes).

The use of the Hutt Road SPV lane was discussed at the workshop. The assessment of the special vehicle lane assumed that freight would be able to use the lane in addition to buses. It was noted that the final use of the special vehicle lane would be determined by the project partners, which could include buses and freight but would not include T2 or T3 vehicles as modelling showed that inclusion of these vehicles in the lane would reduce the benefit for public transport.

The discussion at the workshop noted that the Thorndon Quay Collective submission raised concerns about loss of and reconfiguration of parking. It was noted that the submission strongly addressed the loss of parking issue but did not provide feedback that would differentiate between options. As all options involve the loss of and reconfiguration of on-street parking, the scoring did not change from the interim MCA.

While the scoring for the MCA criteria did not change from the interim MCA as a result of engagement, the workshop noted that there were many detailed points to further discuss with stakeholders and property owners during design. It is anticipated that dialogue between LGWM and stakeholders will continue into the design phase so that stakeholders, users and property owners can have input into the design as it develops.

[11] *The impact would require acquisition of approximately a 5-10m strip of properties along Hutt Road between Onslow Road and Kaiwharawhara Road. The majority of buildings on these properties are built to the street frontage, and therefore would require a highly significant alteration of the areas built environment.*

7.5 Final MCA Scoring

Table 8 below summarises the final MCA scores of the options against investment objectives, effects and delivery, maintenance and operations using an 11-point (+5 - -5) system. As indicated above, the 'B' suboptions were scored -5 for delivery, but this means they are effectively not practical options.

Table 8: Final MCA Scoring Summary

Option	Contribution to Investment Objectives					Contribution to Effects				Contribution to Delivery, Maintenance and Operations			Total	Option Rank
	IO1 – Bus Reliability / Attractive-ness	IO2 – Walking & Cycling	IO3 – Hutt Road Safety	IO4 – Thorndon Quay Amenity	IO5 – Similar Freight Access*	Mana whenua values	Social	Property Access	Fit with LGWM Programme	Delivery	Operations & Mainten-ance	Timeframe for Delivery		
Option 1: Southbound bus lanes with Thorndon Quay bidirectional cycleway	3	1	1	3	2	3	3	-3	3	-1	-1	2	**16**	7
Option 1A: Southbound bus lanes with Thorndon Quay bidirectional cycleway	3	2	3	3	2	4	3	-2	4	-2	-2	0	**18**	3
Option 1B: Southbound bus lanes with Thorndon Quay bidirectional cycleway	3	2	3	1	2	5	3	4	2	-5	-2	-1	**17**	4
Option 2: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	4	3	1	1	3	1	4	-3	3	-3	-2	0	**12**	11
Option 2A: Southbound and Northbound bus lanes with Thorndon Quay unidirectional cycleway	4	4	3	1	3	2	4	-3	4	-4	-3	-2	**13**	9
Option 2B: Southbound and Northbound bus lanes with	4	4	3	1	3	3	4	4	2	-5	-3	-3	**17**	4

Option	Contribution to Investment Objectives					Contribution to Effects				Contribution to Delivery, Maintenance and Operations			Total	Option Rank
	IO1 – Bus Reliability / Attractive-ness	IO2 – Walking & Cycling	IO3 – Hutt Road Safety	IO4 – Thorndon Quay Amenity	IO5 – Similar Freight Access*	Mana whenua values	Social	Property Access	Fit with LGWM Programme	Delivery	Operations & Mainten-ance	Timeframe for Delivery		
Thorndon Quay unidirectional cycleway														
Option 3: Southbound bus lanes with Thorndon Quay unidirectional cycleway	3	3	1	2	2	2	3	-3	2	-4	-1	0	**10**	12
Option 3A: Southbound bus lanes with Thorndon Quay unidirectional cycleway	3	4	3	2	2	3	3	-2	3	-4	-2	-2	**13**	9
Option 3B: Southbound bus lanes with Thorndon Quay unidirectional cycleway	3	4	3	1	2	4	3	4	1	-5	-2	-3	**15**	8
Option 4: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	4	1	1	4	3	2	3	-3	4	-1	-1	0	**17**	4
Option 4A: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	4	2	3	4	3	3	3	-2	5	-2	-2	-2	**19**	**1 Equal**
Option 4B: Southbound and Northbound bus lanes with Thorndon Quay bidirectional cycleway	4	2	3	3	3	4	3	4	3	-5	-2	-3	**19**	**1 Equal**

*the assessment assumes that freight can use the special vehicle lanes on Hutt Road.

The introduction of the mana whenua values scores and the reduction of the delivery score for the service lane options changed the relativity between options compared to the interim MCA. However, Options 4A and 4B still scored the highest, similar to the interim MCA.

During the workshop it was agreed that while Option 4B was tied for the highest score with Option 4A, it should be discounted due to the difficulty to implement a service land within the existing road space. Discounting Option 4B results in Option 4A having the highest score. Accordingly, Option 4A remains the recommended option to advance to preliminary design and the SSBC.

8 Cost Estimates

Indicative Business Case Estimates (IBE) were prepared for the base options (1 to 4), as well an -indicative left-in left-out and service lane option (options 4A and 4B were costed, though as indicated above it was subsequently agreed that Option 4B should be discounted), in accordance with the Waka Kotahi Cost Estimation Manual. These were prepared to give an indicative range of costs for the shortlisted options and suboptions. The indicative estimates do not include property costs. Due to the number of short list options, individual cost estimates were not prepared for all combinations of options and suboptions. The expected indicative cost estimates are provided in Table 9.

Table 9: Expected IBE Cost of the Short List Options

Option	Expected IBE Cost
Option 1	$25,444,000
Option 2	$27,694,000
Option 3	$23,793,000
Option 4	$28,127,000
Option 4A Includes Left-in / Left out on Hutt Road with Aotea Quay Roundabout	$33,089,000
Option 4B Includes Service Lane on Hutt Road with Aotea Quay Roundabout	$32,811,000

Further costing and economic analysis will be undertaken in the SSBC. The IBE summary sheets are contained in Appendix C.

9 Economic Analysis

Preliminary economic analysis was undertaken, primarily based on the corridor modelling that was undertaken (Appendix B).

Broadly, the corridor modelling estimated the average vehicle speeds based on the level of congestion (using volume/capacity speed flow curves) and intersection delays.

From the corridor modelling outputs, the following transport costs were assessed at this stage:

- Travel time and congestion costs
- Vehicle operating costs

- Active mode health benefits
- CO2 emission costs

This preliminary economic analysis was undertaken to provide an indicative understanding of the economic efficiency outcomes for the options assessed. As further discussed below, some benefits were not assessed at this stage and this preliminary analysis has focussed on the primary benefit streams.

The economic analysis was undertaken based on a 40-year evaluation period and a 4% discount rate. As the vehicle volumes differ slightly between options for similar sections, the variable trip method was applied to account for the change in road user surplus and resource cost correction.

9.1 Travel Time and Congestion Costs

The travel time and congestion costs were assessed for each of the sub-sections of the corridor for the morning and afternoon peak periods. These were individually assessed for each user group (i.e. bus passengers, trucks, single occupant, two occupant and three occupant vehicles).

9.2 Vehicle Operating Costs

Base vehicle operating costs were assessed based on the average speeds estimated for each sub-section and by vehicle type.

9.3 Emission Costs

CO_2 emission costs were assessed based on the vehicle type emission tonnage estimated from the base vehicle operating costs applied with the costs of CO_2 emissions prescribed in the Economic Evaluation Manual (EEM) / Monetised Benefits and Costs Manual.

9.4 Active Mode Benefits

The active mode benefits have been estimated based on bus passengers walking and assumed an average length of 280m.

Based on the preliminary run of the Thorndon Quay Cycle Model provided by the WCC, the model suggests an increase in cycle mode share from northern suburbs to the central area by 2%. As further analysis and review will need to be undertaken on the cycle model, a conservative 30% of the health benefits from the estimated demand in this preliminary assessment was applied.

9.5 Safety Benefits

A high-level safety benefits assessment was undertaken. This is largely based on first baselining the safety impacts that are common across all options (e.g. speed reduction), followed by accounting for differences between the options. For this preliminary assessment, the total social crash costs were estimated to be around $2.98 million per annum, or approximately $80 million over a 40-year period. Based on this preliminary assessment, the options were estimated to reduce the crashes by approximately between 20% and 30%.

9.6 Economic Analysis Results and Discussion

The results of the preliminary economic analysis are summarised in the following tables. It should be noted that this analysis only considered the four core options, as well as the Option 4A (recommended option) variant.

Table 10: Preliminary Economic Benefits for the Short List Options

Option	Travel Time ($m)		Safety ($m)	Active Modes ($m)	Others (VOC, CO2 etc) ($m)	Total Benefits ($m)
	Public Transport	Other Vehicles				
Option 1	$25.4	$0.4	$18.2	$23.6	$4.5	$72.1
Option 2	$42.1	-$25.4	$20.2	$23.6	$3.9	$64.5
Option 3	$25.4	$0.4	$23.4	$23.6	$4.5	$77.3
Option 4	$42.1	-$25.4	$13.0	$23.6	$3.9	$57.2
Option 4A	$42.1	-$61.8	$20.2	$23.6	$8.5	$32.6

Table 11: Preliminary Economic Assessment Results for the Short List Options

Option	Discounted Costs ($m)	Benefits ($m)	BCR
Option 1	$27.8	$72.1	2.6
Option 2	$23.5	$64.5	2.7
Option 3	$22.6	$77.3	3.4
Option 4	$23.9	$57.2	2.4
Option 4A	$27.9	$32.6	1.2

The results of the preliminary economic analysis include:

- The BCRs for the options range between 1.2 and 3.4.
- The travel time savings for public transport users outweighs the disbenefits for other vehicle users. Option 4A, which includes the raised median on Hutt Road, indicates that the public transport user benefits are not large enough to offset these disbenefits. The is mainly due to this option performing significantly worse in the afternoon peak period for the light vehicles in the inbound direction on these sub-sections:
    - Ngauranga interchange to Ngauranga stop (from approximately 100 seconds in the 2019 Do Minimum to 240 seconds in the option)
    - Rangiora to Kaiwharawhara (from approximately 80 seconds in the 2019 Do Minimum to 300 seconds in the option)
    - Tinakori Road to Moore Street (from approximately 100 seconds in the 2019 Do Minimum to 160 seconds in the option)

- Travel time benefits of all options start off negative in the modelled 2019 corridor spreadsheet model, turning to positive in the 2036 corridor spreadsheet model (with exception of Option 4A). When these are interpolated, the benefits for these options would turn positive from around year 2024. The disbenefits in 2019 are largely due to the benefits for public transport users being lower than the disbenefits to the light vehicle users, but this is estimated to exceed the disbenefits to the light vehicle users in the 2036 corridor model.

The preliminary economic analysis was undertaken for the main corridor traffic benefits to allow a comparison between options. Whilst the safety and active modes benefits have been included at this stage, these benefits will also need to be further assessed and detailed in the SSBC. The results of this preliminary analysis may also be impacted when wider network impacts have been considered.

As highlighted, the benefits are based on a high-level corridor spreadsheet model. As noted in the transport modelling summary, the elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models will need to be further investigated in the SSBC. These could have an impact on the corridor (as well as wider network impact) demand estimated at this stage. Given the impact of this, some benefits have not been included at this stage as they are:

- Relatively smaller in scale compared to some of the benefits from the corridor model;
- Unlikely to be significantly different between the options; and/or
- Highly dependent and sensitive towards the traffic demand on the network.

These benefits will be also be further updated in the SSBC following more detailed modelling on the recommended option. These benefits include:

- Active mode benefits for the corridor
- Safety benefits (or disbenefits). Once more detailed modelling has been undertaken in the next stage to incorporate the public transport elasticities response, routing and non-peak periods, the resulting estimated daily traffic volumes for the network will then be used to estimate the change in road safety benefits.
- Public transport infrastructure and vehicle benefits (if appropriate). These may include the vehicle and/or facilities features benefits.

10 Conclusion and Next Steps

This report documents the assessment of the short list options and summarises the engagement undertaken with stakeholders and public. The interim MCA found that Option 4A was the technically preferred option. This option includes northbound and southbound peak period bus lanes on Thorndon Quay and peak period special vehicle lanes on Hutt Road to be used by buses and freight (with these lanes reverting to parallel parking off peak), a bidirectional cycleway and a range of other safety improvements for the corridor, as well as a roundabout on Aotea Quay.

Whether freight will use the special vehicle lane will be further investigated during the design phase. The provision of a turnaround facility on Aotea Quay as required by Option 4A may remove the need to include freight in the special vehicle lane.

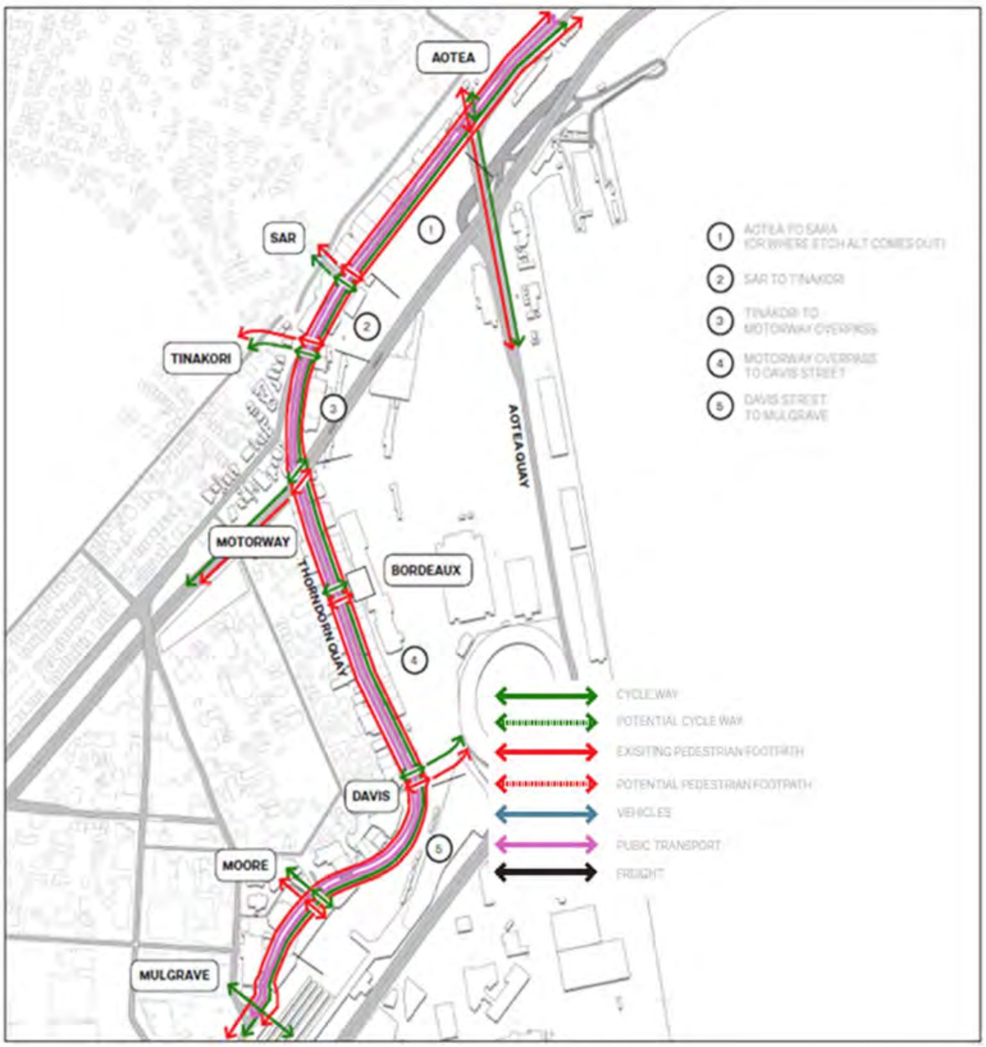
Engagement with stakeholders and the public found that this option was supported by the majority of respondents. The final MCA, having considered the engagement feedback and included an assessment of the short list options against mana whenua values, also found that Option 4A was the preferred option. This option will be advanced to the SSBC, including preliminary design, more detailed cost estimation and economic assessment and development of the business case.

Appendix A

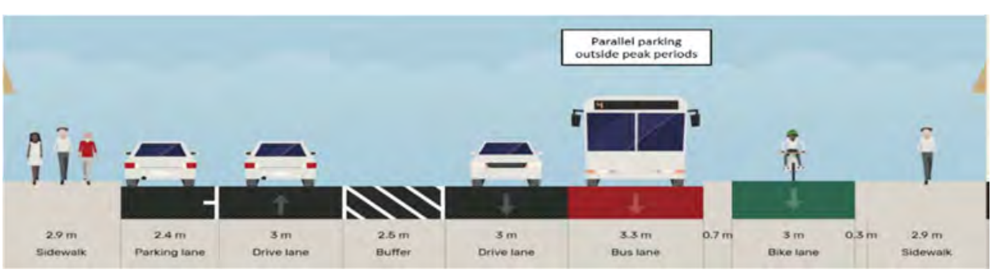
Short List Option Diagrams

Option 1

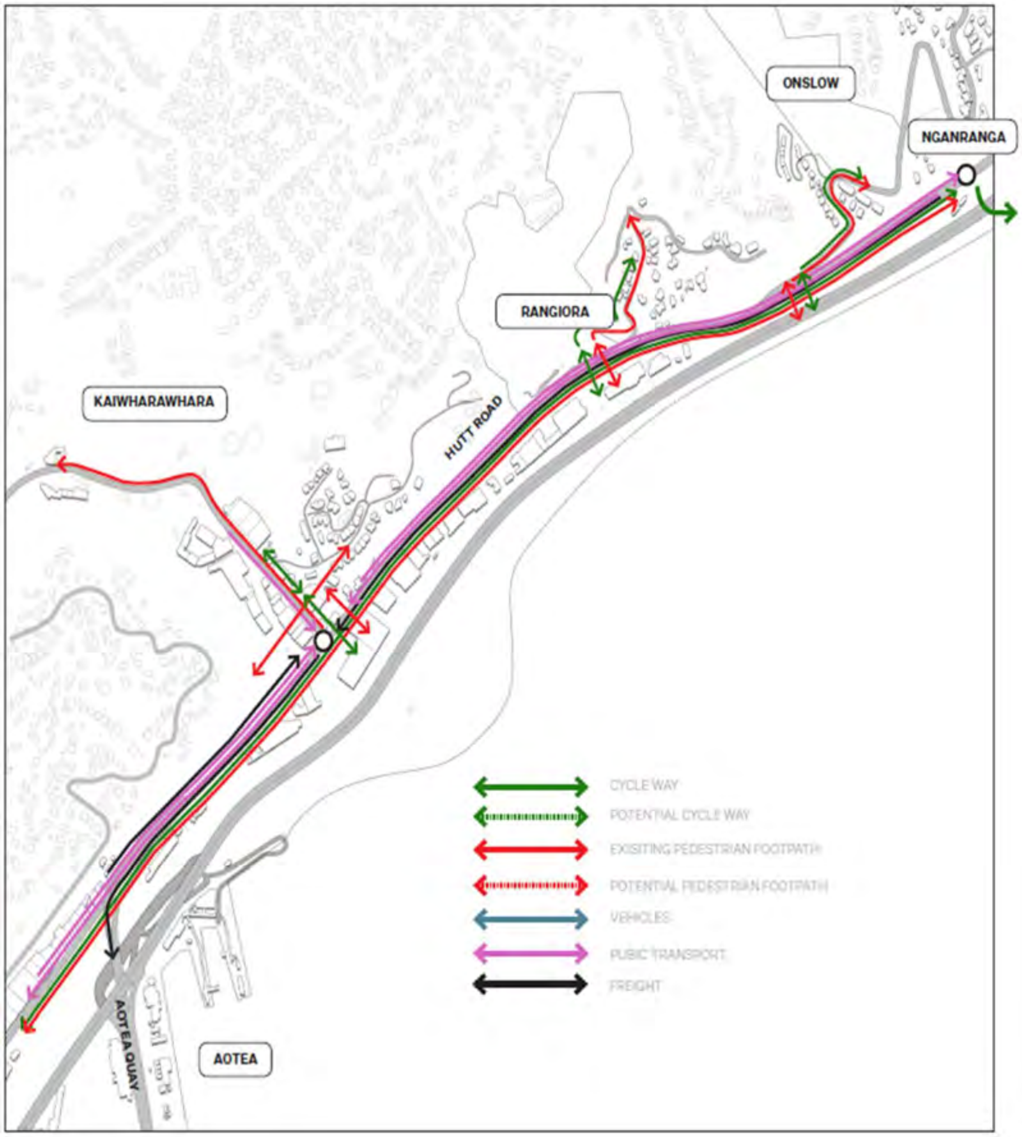
Option 1 provides a peak period southbound special vehicle lane on Hutt Road and southbound bus lane on Thorndon Quay. When not in use, the special vehicle lane / bus lane will be available for parallel parking. A bidirectional cycleway will be provided on the eastern (seaward) side of Hutt Road and Thorndon Quay. Option 1 is summarised in the diagrams below. Note that the dimensions on the cross sections are indicative only.



Option 1 - Thorndon Quay Indicative Plan



Option 1 - Thorndon Quay Indicative Cross Section

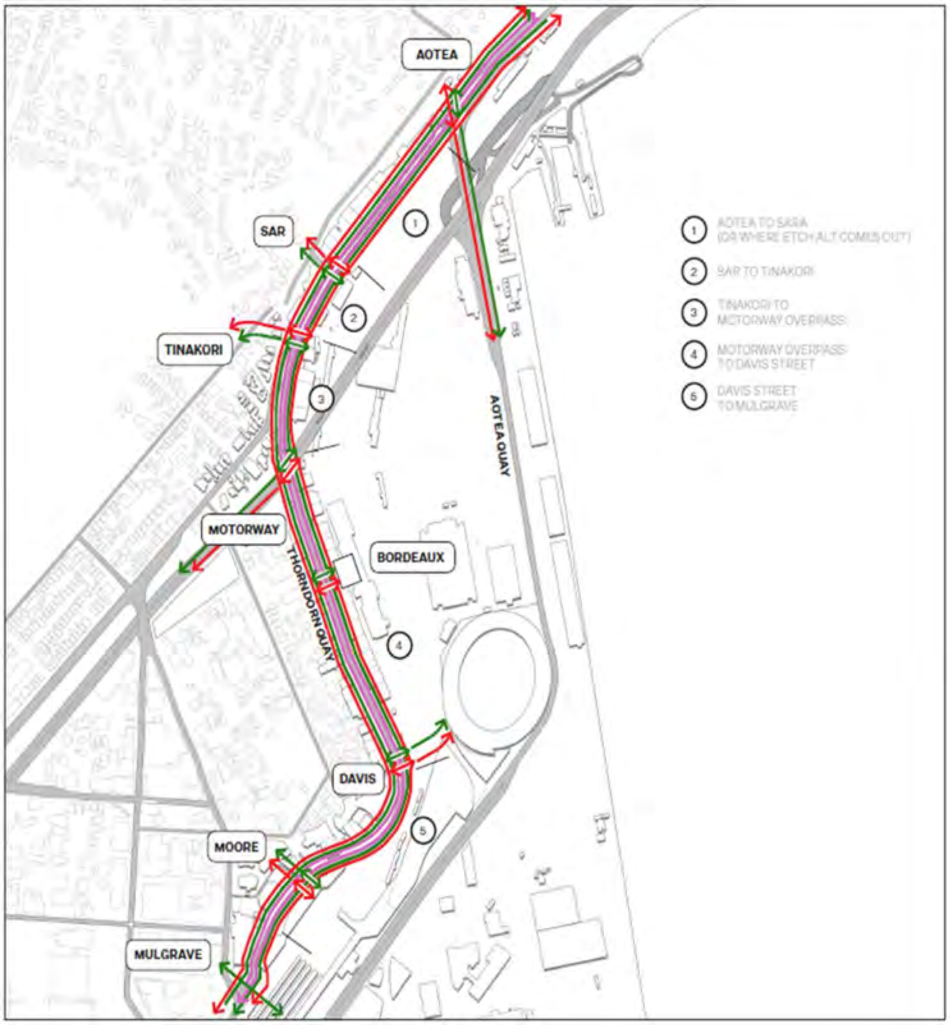


Option 1 - Hutt Road Indicative Plan

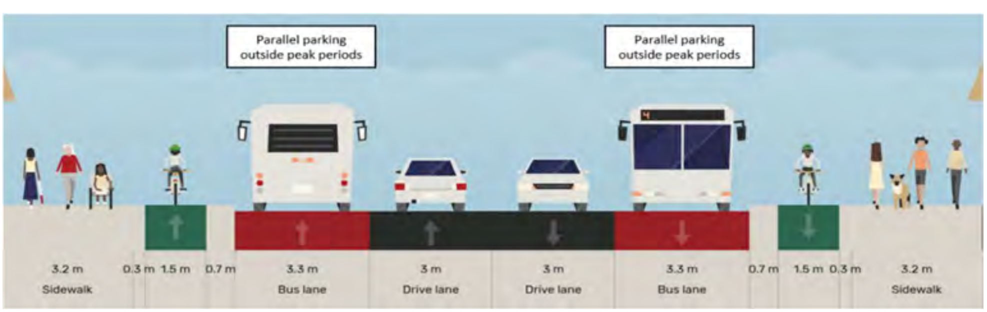
Option 1 - Hutt Road Indicative Cross Section

Option 2

Option 2 provides peak period northbound and southbound special vehicle lanes on Hutt Road and bus lanes on Thorndon Quay. When not in use, the special vehicle lane / bus lane will be available for parallel parking. A unidirectional cycleway (one direction of travel each side) will be provided on Thorndon Quay which will connect to the bidirectional cycleway on Hutt Road. Option 2 is summarised in the diagrams below. Note that the dimensions on the cross sections are indicative only.

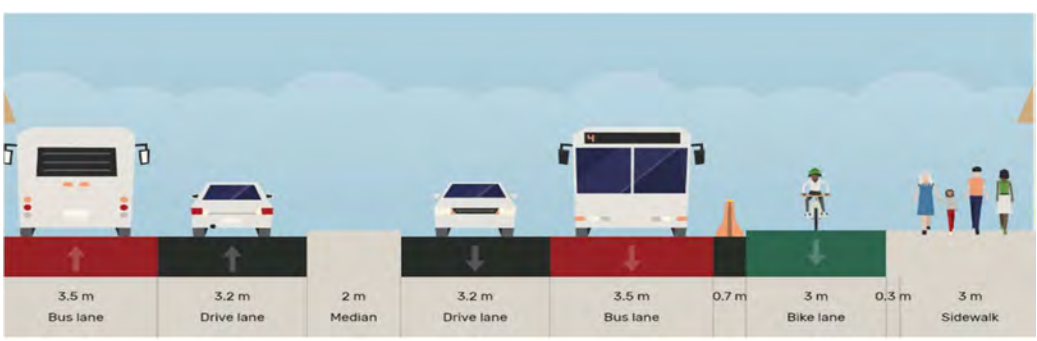


Option 2 - Thorndon Quay Indicative Plan



Option 2 - Thorndon Quay Indicative Cross Section

Option 2 - Hutt Road Indicative Plan

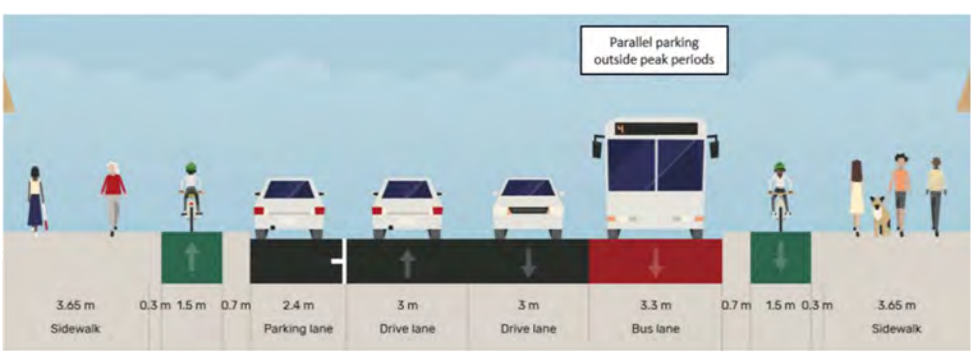


Option 2 - Hutt Road Indicative Cross Section

Option 3

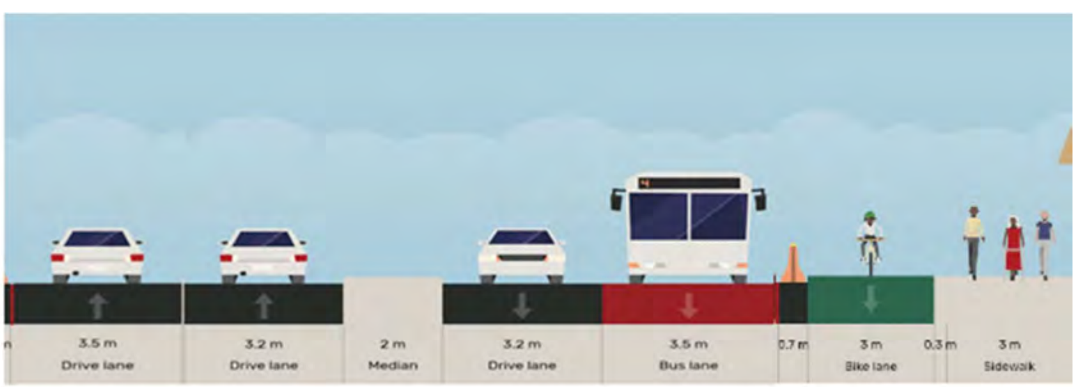
Option 3 provides a peak period southbound special vehicle lane on Hutt Road and southbound bus lane on Thorndon Quay. When not in use, the special vehicle lane / bus lane will be available for parallel parking. A unidirectional cycleway (one direction of travel each side) will be provided on Thorndon Quay which will connect to the bidirectional cycleway on Hutt Road. Option 3 is summarised in the diagrams below. Note that the dimensions on the cross sections are indicative only.

Option 3 - Thorndon Quay Indicative Plan



Option 3 - Thorndon Quay Indicative Cross Section

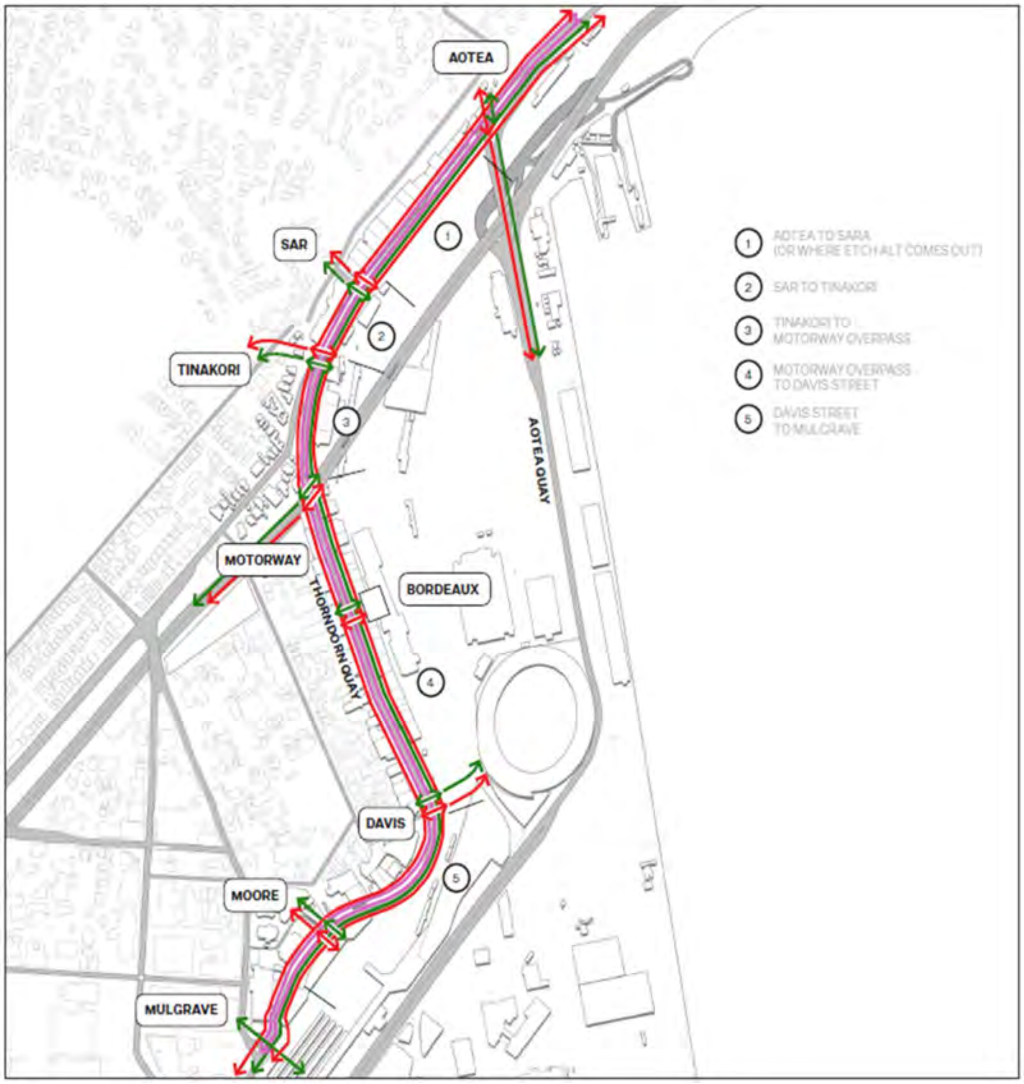
Option 3 - Hutt Road Indicative Plan



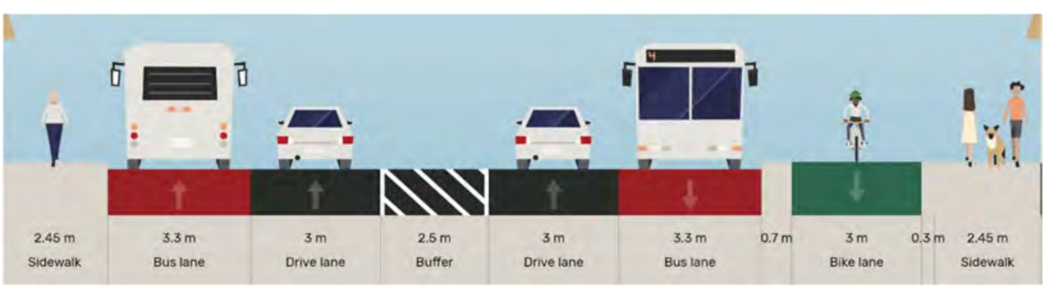
Option 3 - Hutt Road Indicative Cross Section

Option 4

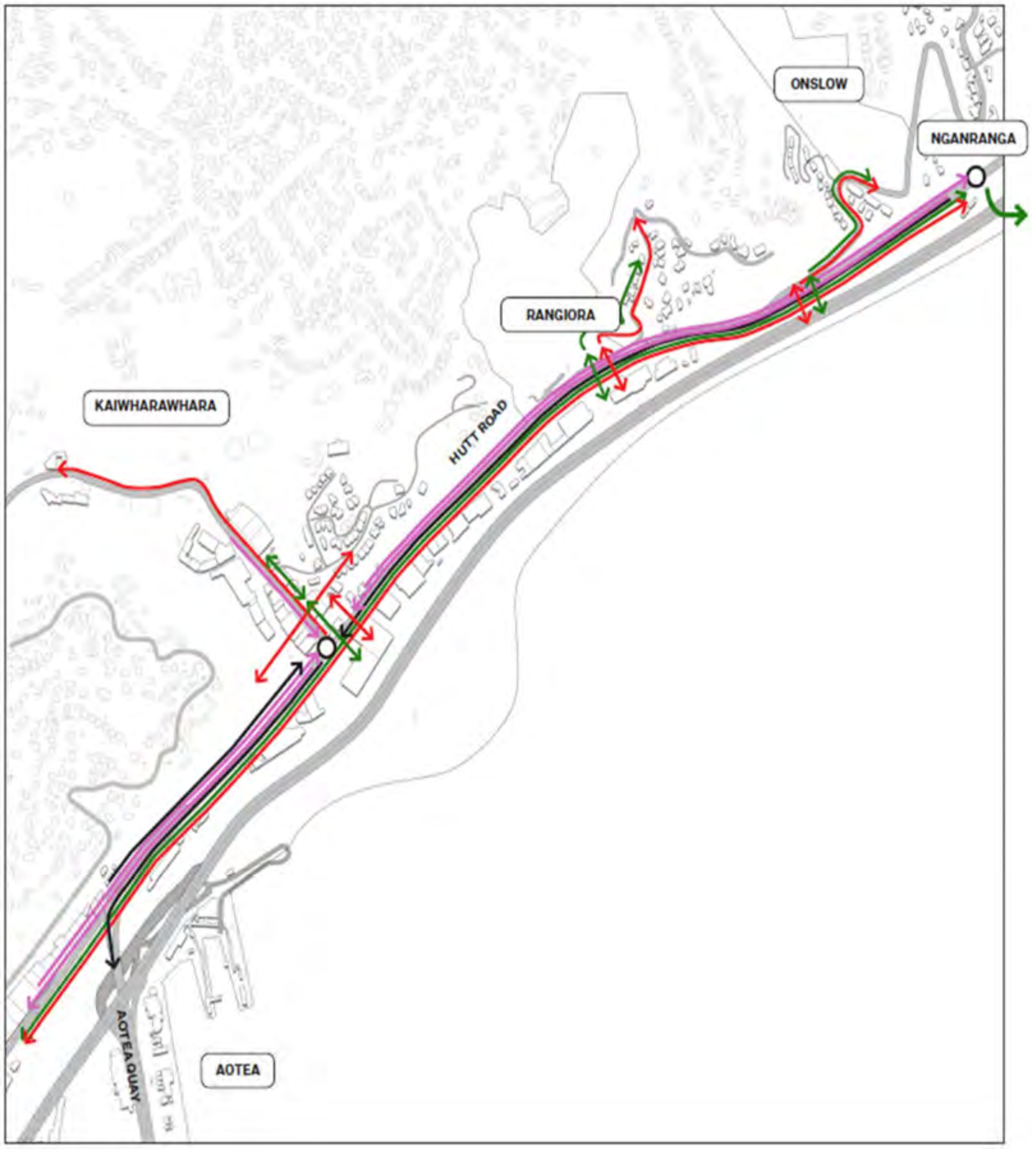
Option 4 provides peak period northbound and southbound special vehicle lanes on Hutt Road and bus lanes on Thorndon Quay. When not in use, the special vehicle lane / bus lane will be available for parallel parking. A bidirectional cycleway will be provided on the eastern (seaward) side of Hutt Road and Thorndon Quay. Option 4 is summarised in the diagrams below. Note that the dimensions on the cross sections are indicative only.



Option 4 - Thorndon Quay Indicative Plan



Option 4 - Thorndon Quay Indicative Cross Section



Option 4 - Hutt Road Indicative Plan

Option 4 - Hutt Road Indicative Cross Section

Suboptions

The long list assessment found that the provision of a special vehicle or bus lane on Hutt Road added additional risks to right turning traffic and had the potential to mask motorcyclists that would share the lane with buses. Vehicles exiting properties may not see motorcyclists travelling behind or close to buses when they share the lane. To mitigate this risk, a left in / left out option and a service lane suboption were developed and included in the short list as two sub-options to each main option (suboptions A and B).

Suboption A

Suboption A includes the provision of a raised median along Hutt Road to restrict turning movements to left-in / left-out. Provision for U-turns will be made at the north and south extents of Hutt Road. Potential locations for mid-block locations would also be investigated. An indicative cross section of Hutt Road with the raised median is shown below.

Suboption A: Hutt Road Indicative Cross Section

The diagram below shows the current U-turn area near Glover Street.

Existing U-turn Facility Near Glover Street

Suboption B

Suboption B includes the provision of a service lane along the eastern side of Hutt Road for property access. The service lane would extend from Onslow Road in the north to Kaiwharawhara Road in the south as shown in the figure below.

Suboption B: Extent of Service Lane

An indicative cross section for Hutt Road with the service lane is shown in the figure below.

Suboption B: Hutt Road Indicative Cross Section with Service Lane

Appendix B

Traffic Modelling Report

Thorndon Quay and Hutt Road – Single Stage Business Case

Transport Modelling and Analysis

9 November 2020

Contents

Executive Summary

Overview

This report outlines the transport modelling undertaken for Stage 1 of the Thorndon Quay and Hutt Road – Single Stage Business Case relevant for the options development and assessment. The broad approach is to use a combination of spreadsheet modelling and intersection modelling to provide an indicative level of benefits for options currently being considered. It should be noted, this document describes the indicative modelling only. Stage 2 of the project will assess the preferred option in more detail via a combination of AIMSUN and WTSM models operated by the Wellington Analytics Unit.

Thorndon Quay and Hutt Road are part of the critical northern route to and from Wellington city. Achievable benefits identified early include bus priority, reliability improvements and safety improvements for people cycling between the city and the planned Te Ara Tupua Ngauranga to Petone walking and cycling link.

The objectives of the Thorndon Quay and Hutt Road Single Stage Business Case are to:

1. Improve reliability of bus service equivalent to current daytime speed and variability by 2026 and maintain to 2036;
2. Improve Level of Service (LoS) for non-car modes by 2026 and maintain to 2036 - Walking LoS (C), Cycling LoS (A/B). Public Transport – Sufficient capacity for growth;
3. Reduce the safety risk along Thorndon Quay and Hutt Road for all vulnerable road users and Hutt Road for vehicles by 2030;
4. Amenity aligns with Place and Movement Framework criteria for Thorndon Quay by 2036; and
5. Freight - Maintain similar access (level of service) for people and freight to the ferry terminal / CentrePort.

Options Considered

The corridor options assessed are as follows:

Concept	Elements			Common Elements
	Thorndon Quay Bus Lanes	Thorndon Quay Cycle Lanes	Hutt Road Special Vehicle Lanes	
1	Southbound	Bi-directional	Southbound	▪ Speed limit changes ▪ Intersection upgrades ▪ Pedestrian Crossing Improvements ▪ Bus stop rebalancing ▪ Thorndon Quay amenity ▪ Hutt Road Safety Audit recommendations
2	Both directions	Uni-directional	Both directions	
3	Southbound	Uni-directional	Southbound	
4	Both directions	Bi-directional	Both directions	

Common elements to the proposals which have been incorporated into the modelling include:

- Reduced speeds;
- Signalising existing zebra crossings;
- A new signalised crossing under the motorway overpass;
- Signalising the intersection of Hutt Road, Thorndon Quay and Tinakori Road; and
- Rationalising the bus stops.

Converting a traffic lane to a special vehicle lane on Hutt Road between Kaiwharawhara Road and Aotea Quay has not been modelled, as it has potential for severe congestion between Hutt Road and Kaiwharawhara Road (morning peak) and, Aotea Quay and Hutt Road (evening peak), with wider network effects that may negate the public transport reliability improvements.

A high-level assessment has been undertaken to understand the potential benefits and effects of a service lane or raised median along Hutt Road (near Kaiwharawhara) and a roundabout at Aotea Quay.

Analysis Approach

The analysis conducted has been used to inform the anticipated benefits and effects for:

- Investment Objective 1 – Reliability of bus services;
- Investment Objective 2 – Active mode levels of service; and
- Investment Objective 5 – Freight reliability.

The assessment of motorised modes (buses, cars and trucks) has been undertaken for the morning and evening peak periods in each direction using a spreadsheet model that has been based on the Waka Kotahi Research Report 557, but disaggregated into sections to allow for the different options being considered. The model was validated to within 10% of the journey times for buses and for other traffic. This report presents the design year results (2036) and has been supplemented with SIDRA analysis for the Aotea Quay turnaround, and service lane on Hutt Road (near Kaiwharawhara).

Public transport patronage, route and mode choice, and traffic volume forecasts have been provided from the WTSM and AIMSUN models respectively. The AIMSUN models were developed for 2026, so a 10% uplift was applied to estimate a 2036 scenario. This will be verified following the WSTM tests to compare the do minimum and design option.

The assessment of active modes along the corridor has been undertaken using the Danish Level of Service method, and the crossing level of service has been based on both the crossing spacing and the crossing delay times as per Austroads[1].

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[1] Austroads Research Report – Level of Service Metrics (Network Operations Planning)

Results Summary

Bus and Freight Reliability

Table 1 and Table 2 present a summary of travel times between Ngauranga and Mulgrave Street for the options assessed. Different types of Special Vehicle Lanes on Hutt Road were considered due to the potential consequential impact of replacing one of the general traffic lanes with a Special Vehicle Lane. The potential attractiveness of the Special Vehicle Lane for people currently using SH1 has not been analysed at this stage, but it could be substantial. The main body of the report presents more detailed results.

Table 1: Summary results for southbound direction (2036 Morning Peak Period 7am – 9am)

<table>
<tr><th>Scenario</th><th>Bus Travel Time</th><th>Truck Travel Time</th><th>Car Travel Time</th></tr>
<tr><td>Base</td><td>12.9</td><td colspan="2">10.8</td></tr>
<tr><td>Do-Minimum (2036)</td><td>21.0</td><td colspan="2">18.1</td></tr>
<tr><td>Bus Lane on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.7</td><td colspan="2">24.5</td></tr>
<tr><td>HOV Lane (T2 or T3, no Trucks) on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.1 – 11.2</td><td colspan="2">23.3 – 25.1</td></tr>
<tr><td>HOV Lane (T2 or T3, with Trucks) on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>11.1 – 20.2</td><td>11.0 – 18.5</td><td>20.2 – 21.6</td></tr>
</table>

Table 2: Summary results for northbound direction (2036 Evening Peak Period 4pm – 6pm)

<table>
<tr><th>Scenario</th><th>Bus Travel Time</th><th>Truck Travel Time</th><th>Car Travel Time</th></tr>
<tr><td>Base (Modelled)</td><td>11.2</td><td colspan="2">9.6</td></tr>
<tr><td>Do-Minimum (2036)</td><td>11.4</td><td colspan="2">10.6</td></tr>
<tr><td><u>Bus Lane</u> on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>9.8</td><td colspan="2">13.2</td></tr>
<tr><td><u>HOV Lane (T2 or T3, no Trucks)</u> on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.0</td><td colspan="2">13.1 – 21.8</td></tr>
<tr><td><u>HOV Lane (T2 or T3, with Trucks)</u> on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.4 – 10.6</td><td>11.2 – 13.7</td><td>13.9 – 16.4</td></tr>
</table>

Bus Reliability

The provision of a Special Vehicle Lane on Hutt Road and a bus lane along Thorndon Quay is likely to result in consistent travel times in the order of 10 - 11 minutes through to 2036 in both directions. This is lower than the current observed peak period journey times and similar to the off-peak travel times, where there is very little congestion along the corridor.

In the morning peak period, when compared to the 2036 scenario without bus priority measures (the do-minimum), the potential benefit could be in the order of 10 minutes per bus. In the evening period, the benefits are expected to be in the order of 1 – 2 minutes; however, the caveat is that the model does not account for blocking back from the motorway ramps, and hence the benefits of bus priority are likely to be higher than estimated in this assessment. It is understood that the AIMSUN model includes for this, and therefore will be assessed within Phase 2.

During the day, the future conditions along the corridor are unlikely to significantly impact on the reliability of bus services (subject to parking turnover) that would warrant further consideration of full-time bus lanes or Special Vehicle Lanes along the corridor (particularly along Thorndon Quay).

The exception to the above conclusion is in the morning peak period where a T2 lane with trucks is proposed. The volumes of traffic eligible to use the Special Vehicle Lane on Hutt Road is too high to provide any benefit to any motorised mode travelling southbound through this section. This is also likely to apply for a T2 lane without trucks as cars with more than two occupants that use SH1 shift to Hutt Road to take advantage of the Special Vehicle Lane. Therefore, it is recommended that a T2 lane (with or without trucks) is not considered further.

This exercise confirms that a Special Vehicle Lane on Hutt Road and a proposed bus lane on Thorndon Quay are likely to provide benefits in the peak direction (southbound in the morning and northbound in the evening). This provides a strong contribution to Investment Objective 1 related to bus reliability, with the southbound direction in the morning peak period expected to provide the greatest benefits.

Freight Reliability

The reliability for trucks appears to be contingent on two aspects:

1. If trucks are eligible to use the Special Vehicle Lane on Hutt Road (Ngauranga to Kaiwharawhara); and
2. If trucks are not permitted to use the Special Vehicle Lane on Hutt Road (Ngauranga to Kaiwharawhara) and are confined to the general traffic lanes.

The use of the bus lanes on Thorndon Quay by trucks has not been considered as it is inconsistent with the street environment, there are likely to be challenges associated with the interaction at bus stops and the entrance to the bus terminal (crossing over the traffic lanes)

If trucks are eligible to use the Special Vehicle Lane on Hutt Road (between Kaiwharawhara and Ngauranga), then the reliability benefits for trucks (particularly in the peaks) are likely to be similar to the estimated public transport benefits in this section of the corridor.

If trucks are not eligible to use the Special Vehicle Lane, then they are likely to be susceptible to the impacts of replacing a general traffic lane with the Special Vehicle Lane (in the peak periods), which are expected to be a combination of:

1. Increased public transport patronage beyond what is forecast in Wellington Transport Strategy Model (WTSM) in the longer term;
2. Re-routing from Hutt Road to SH1 and other routes (such as Ngaio Gorge) beyond what is forecast in WTSM;
3. Re-routing from SH1 for vehicles eligible to use a Special Vehicle Lane on Hutt Road;
4. Peak spreading; and
5. Provision of an alternative route to the Interislander Ferry Terminal via the proposed Aotea Quay roundabout (discussed below).

The WTSM model forecasts reduce the traffic volume significantly, but still require an additional 300 vehicle per hour (~5% of the peak motorway flow) reduction in the demand for Hutt Road; however there isn’t the capacity on the motorway through the interchange to accommodate this in the 7am – 9am period and there is limited spare capacity in the 6am – 7am period. However, the combination of the above has the potential to provide a neutral outcome for freight travelling to Aotea Quay, but a range of impacts from neutral to moderate negative for trucks travelling via Thorndon Quay.

This uncertainty in the impacts warrants further investigation in both the elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models.

Benefit and Impact of Aotea Quay Roundabout

The potential benefit of the Aotea Quay roundabout is the potential to allow people and trucks travelling to the Interislander Ferry Terminal via SH1, instead of Hutt Road (which is the only route from the north accessible to the ferry terminal), and has the potential to be heavily congested in the morning peak period with the implementation of a Special Vehicle Lane. The work undertaken as part of the Multi-User Ferry Terminal project indicates that this may be in the order of 400 vehicles per hour in the respective morning and evening peaks. The conclusion at this stage is that there is merit in using the AIMSUM models to progress more detailed investigations of the benefits of this inclusion; however it is anticipated that there is a benefit for Interislander travel compared to the scenarios with a Special Vehicle Lane on Hutt Road but without the Aotea Quay roundabout.

Impact of Service Lane

The provision of a service lane along Hutt Road at Kaiwharawhara introduces another traffic signal phase and reduces the overall level of service to poor (F). However, except for a Special Vehicle Lane being a T2 lane (with or without trucks), the Special Vehicle Lane should operate reasonably efficiently, therefore continuing to provide benefits for public transport. If trucks are not able to use the Special Vehicle Lane, then they will be affected by the provision of the service lane to the same level as general traffic.

Furthermore, if the preferred proposal is to connect to a new Multi-User Ferry Terminal at the intersection of Hutt Road and Kaiwharawhara Road, the inclusion of the service lane would result in a 5-phase intersection, which may affect the performance of the Special Vehicle Lane as well. It is recommended that the Phase 2 work undertakes sensitivity testing to determine the impacts.

Active Modes

The assessment for active modes has been undertaken separately for facilities along the corridor and crossing opportunities along the section of the corridor between Aotea Quay and Thorndon Quay. Through the section between the motorway overpass and Tinakori Road, the cycling level of service with uni-directional cycle paths is expected to be poor, primarily due to the constrained width through the section, hence the bi-directional cycleway is preferred.

Walking level of service is expected to be good along the corridor for all options except the concept with bus lanes in both directions, and uni-directional cycle paths.

The levels of service estimated using the Danish Cycling Level of Service Method are provided in Table 3.

Table 3: Active Mode Level of Service along the corridor (Danish Level of Service)

Segment	Northbound		Southbound	
	Walk	Cycle	Walk	Cycle
Existing	D	F	D	F
Concept 1: Southbound bus lane with a bi-directional facility (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	F	C	C
Concept 2: Bus Lanes in both directions with uni-directional cycle paths (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	D	D	D
Concept 3: Southbound bus lane with uni-directional cycle paths (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	E	C	E
Concept 4: Bus lane in both directions with a bi-directional facility (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	F	C	B

The active mode level of service for people crossing the road has been evaluated using the level of service metrics provided by Austroads[2] which consider both the crossing delay and the crossing spacing.

The analysis indicates that if pedestrians and buses are prioritised over general traffic, then a 50 second cycle time would provide a good level of service for pedestrians crossing the road and public transport. At a 70 second cycle time (pedestrian delay of 30 seconds), it is anticipated that the reliability of public transport can be maintained for the concepts with no northbound bus lane on Thorndon Quay, but at the expense of increased pedestrian delay.

[2] AP-R575-15: Level of Service Metrics (Network Operations Planning, Figure A1.

The crossing level of service could be improved with additional crossings along the corridor, including under the motorway overpass (next to relocated bus stops), at Tinakori Road and potentially others along Thorndon Quay to provide a 100m spacing. In peak times, with a cycle time of 70 seconds, the level of service for all modes is expected to be good, and in off-peak periods a cycle time of 50 seconds would also result in a good level of service for all modes.

Conclusions and Next Steps

From the analysis undertaken, the following initial conclusions have been developed, and are subject to more detailed assessment in the next stage of the project:

1. There is a very strong case for bus priority (southbound) in the morning peak (as per Concept 1 and Concept 3) as it expected that there will be significant benefits;
2. There is a case for bus priority (northbound) in the evening peak, however the expected benefit is lower than benefits in the southbound morning peak;
3. It is expected that with peak period bus priority, the bus journey times will be in the order of 10-11 minutes which is lower than currently observed, and in the case of the morning peak period, significantly lower than the do-minimum;
4. There doesn't appear to be a strong case for all-day bus priority along the corridor as the level of service (reliability) is expected to remain good in off-peak periods through to 2036. However, along Hutt Road there would likely be a lesser impact to other road users if the Special Vehicle Lane was implemented before congestion develops throughout the day;
5. The type of Special Vehicle Lane is a balancing act between improving reliability for buses, improving reliability for freight, managing the impact of converting a general traffic lane to a Special Vehicle Lane, and ensuring that the volume of traffic in the Special Vehicle Lane does not negate its benefits. As a result, the recommendation at this stage (excluding safety considerations) is to exclude a T2 lane from further investigation;
6. The roundabout at Aotea Quay/Mainfreight entrance should be included under all options to provide an additional access to the Interislander Ferry Terminal, and/or to mitigate potential impacts of restricting right turn movements on Hutt Road if a raised median is implemented. The roundabout at Aotea Quay may negate the need to allow trucks in the Special Vehicle Lane to achieve the investment objective related to access to the Interislander Ferry Terminal;
7. Consider additional controlled crossing points along Thorndon Quay to reduce the spacing between the current (which will be upgraded) and proposed crossings at Tinakori Road and the motorway overpass (where bus stops are proposed). More crossings will improve the level of service by reducing the distance to walk to a formal crossing point. The provision of additional crossings is unlikely to have a significant impact on the reliability of public transport along the corridor;
8. Uni-directional cycle paths on Thorndon Quay (between the motorway overpass and Thorndon Quay) are expected to result in a poor level of service for cycling and walking due to the constrained width, hence extending the existing bi-directional cycle path is recommended;
9. The provision of a bi-directional path along Thorndon Quay provides good level of service (B/C) and a higher level of service than the uni-directional cycle paths (D/E) using the Danish Cycling Level of Service method. This is primarily due to the path width and the buffer between the cycle path and the road. However, this assessment

does not consider the safety implications of a bi-directional cycle path, which is being addressed through the Investment Objective related to safety;

10. The elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models are to be further investigated in Stage 2 of the project to confirm the assessment of the reliability for trucks.

Introduction

Overview

This report outlines the transport modelling undertaken for Stage 1 of the Thorndon Quay and Hutt Road – Single Stage Business Case relevant for the options development and assessment. The broad approach is to use a combination of spreadsheet modelling and intersection modelling to provide an indicative level of benefits for options currently being considered. In Stage 2 of the project, the preferred option will be assessed in more detail utilising a combination of AIMSUN and WTSM models operated by the Wellington Analytics Unit.

The Project

The Thorndon Quay and Hutt Road Single Stage Business Case (SSBC) project is one the of LGWM's Early Delivery interventions whose benefits could be delivered relatively quickly and are not constrained by the scope of the larger elements in the programme such as Mass Transit. The project is currently in its first stage of development which is seeking to identify a preferred option to deliver on the investment objectives agreed by the LGWM Steering Group.

Thorndon Quay and Hutt Road are part of the critical northern route to and from Wellington city. Achievable benefits identified early include bus priority, reliability improvements and safety improvements for people cycling between the city and the planned Te Ara Tupua Ngauranga to Petone walking and cycling link.

The objectives of the Thorndon Quay and Hutt Road SSBC are to:

1. Improve reliability of bus service equivalent to current daytime speed and variability by 2026 and maintain to 2036;
2. Improve Level of Service (LoS) for non-car modes by 2026 and maintain to 2036 - Walking LoS (C), Cycling LoS (A/B). Public Transport – Sufficient capacity for growth;
3. Reduce the safety risk along Thorndon Quay and Hutt Road for all vulnerable road users and Hutt Road for vehicles by 2030;
4. Amenity aligns with Place and Movement Framework criteria for Thorndon Quay by 2036; and
5. Freight - Maintain similar access for people and freight to the ferry terminal / CentrePort.

The analysis is intended to provide quantitative outputs to assess the benefits and impacts of the options against:

- Investment Objective 1 – Reliability of bus services;
- Investment Objective 2 – Active mode levels of service; and,
- Investment Objective 5 – Freight reliability.

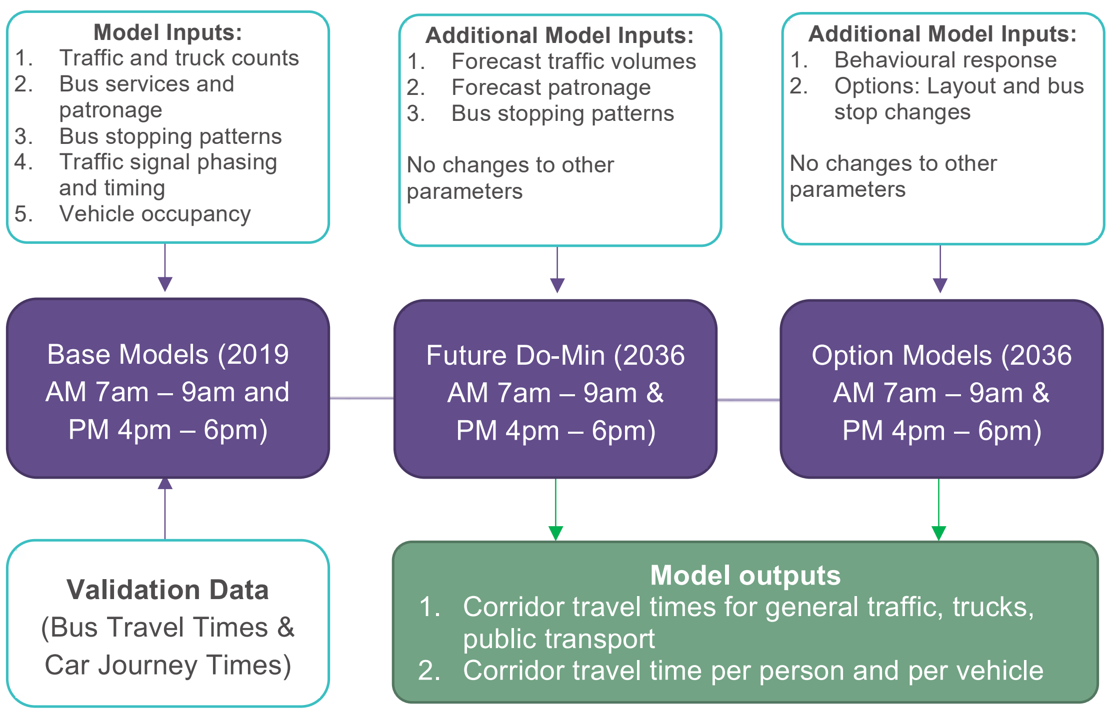
Methodology

Model Development

Overall Approach

The assessment of motorised modes (buses, cars and trucks) has been undertaken using a spreadsheet model based on the Waka Kotahi Research Report 557 but disaggregated into sections to allow for the different options being considered. These models have been developed for the morning and evening 2-hour peaks (7am – 9am and 4pm – 6pm respectively). The overall modelling approach is outlined in Figure 1.

Figure 1:Overall Modelling Approach for the corridor assessments



Base Model Inputs

The base model inputs and source are provided in Table 4.

Table 4: Base Model Inputs

Input	Source
Traffic Counts	SCATS and Tube Counts supplied by WCC and WAU that were reconciled to provide a count set for the morning (7am – 9am) and the evening peak (4pm – 6pm)
Peak Factor (% of traffic in the peak hour out of the 2 hour)	SCATS and Tube Counts supplied by WCC and WAU indicating just over 50% of traffic in the peak hour
Traffic Signal Phasing and Timing	SCATS information supplied by WCC
Bus Patronage	Case for Change and WTSM
Bus Acceleration and Deceleration at stops	Default parameters in the Transit Quality of Service Manual (TRB, 2010)
Dwell Time Per Stop	Case for Change
% of buses stopping at each stop	Case for Change
Gap acceptance for buses to re-enter traffic stream	Wellington Bus Priority Indicative Business Case
Zebra Crossing Delays	Input from TomTom data due to difficulties in modelling zebra crossings
Average Vehicle Occupancy	Cordon survey supplied by WAU. Vehicle occupancy on Hutt Road was estimated using Thorndon Quay (AVO – 1.51) and Aotea Quay (AVO = 1.26) to give a vehicle occupancy of 1.38
% of T2 versus T3	Assumed to be a ratio of 4 T2s: 1 T3 in-line with case studies used in Waka Kotahi Research Report 557. This equates to ~31% T2s and 8% T3s

Model Process

The spreadsheet model calculates the travel times in the kerbside lane (based on the eligibility of vehicles in the kerbside lane) and the other general traffic lanes for each direction and each time period, by adding the segment travel times along the corridor. For general traffic, the segment travel time is the sum of:

- The mid-block travel time; and
- The intersection delay (noting that zebra crossing delay is an input).

For buses the segment travel time is the sum of:

- The mid-block travel time;
- The intersection delay (noting that zebra crossing delay is an input);
- Bus acceleration and deceleration at bus stops;
- Dwell time at bus stops; and
- Re-entry delay where bus stops are indented.

The model processes are provided in Table 5

Table 5: Model Processes

Input	Source
Mid-block travel time	Akcelik speed-flow curves Link capacity set at 1,400 vph for Hutt Road (Ngauranga to Aotea Quay) and 1,000 vph along Thorndon Quay Friction factor (J-Parameter) = 1 The volumes used in the calculations of midblock travel times are the 2-hour volumes * the peak factor.
Intersection Delay	Uses HCM intersection delay formula with the observed traffic signal times – no adjustments except for downstream blocking The volumes used in the calculations of intersection delay are the 2-hour volumes * the peak factor.
Re-entry delay	Gap acceptance for buses to re-enter traffic stream (Source: Wellington Bus Priority Indicative Business Case) and the kerbside lane volume are used to estimate the re-entry delay for indented bus stops.
Weighted average dwell time	Dwell time per stop * % of buses stopping at the stop.
Bus stop acceleration and deceleration	Estimated using default parameters in the Transit Quality of Service Manual and the average speeds estimated from TomTom data provided by Waka Kotahi. This may overestimate the delay where there are slower speeds due to congestion.
Lane assignment	Where there are no Special Vehicle Lanes traffic has been assigned equally to the lanes. Where there is a Special Vehicle Lane, vehicles were assigned to it based on the eligibility, with the remainder assigned to the general traffic lanes. There is a limit in the model that does not allow for higher volumes in the Special Vehicle Lane than the adjacent general traffic lane.
Limits: Capacity	The model includes a function to constrain traffic volumes from passing through to the next section where: 1. The mid-block lane capacity is exceeded 2. The intersection lane capacity is exceeded
Limits: Speeds and Delays	The model includes a function to limit the mid-block travel to 10kph (severe congestion) and a maximum intersection delay of 10 minutes

Model Validation

The spreadsheet models were validated against the observed journey times:

- For buses (using the journey time information for the section between Centennial Highway and the Mulgrave Bus Terminal in the Case for Change (Figure 35 and 36); and
- For general traffic (using journey time information provided from TomTom supplied by Waka Kotahi for the period between March and November 2019).

The results are provided in Table 6 and Table 7. Time distance diagrams are provided in Figure 2 - Figure 5 to demonstrate the alignment between the modelled journey times and the observed journey times at points along the route. The results show that the model is well aligned with the observed journey times, providing confidence that they can be used for forecasting and option testing. Phase 2 of the assessment will build on this information with the use of AIMSUN.

Table 6: Journey Time Validation – Southbound

Route	Observed	Modelled	Difference
Buses – AM	13.3 mins	12.9 mins	-0.4 mins
Buses – PM	9.8 mins	9.8 mins	0 mins
General Traffic – AM	10.7 mins	10.8 mins	+0.1 mins
General Traffic - PM	8.7 mins	7.9 mins	-0.8 mins

Table 7: Journey Time Validation – Northbound

Route	Observed	Modelled	Difference
Buses – AM	9.7 mins	10.1 mins	+0.4 mins
Buses – PM	9.6 mins	11.2 mins	+1.6 mins
General Traffic – AM	8.1 mins	8 mins	-0.1 mins
General Traffic - PM	9.5 mins	9.3 mins	-0.2 mins

Figure 2: Bus journey time profile – modelled vs observed (2019 AM southbound)

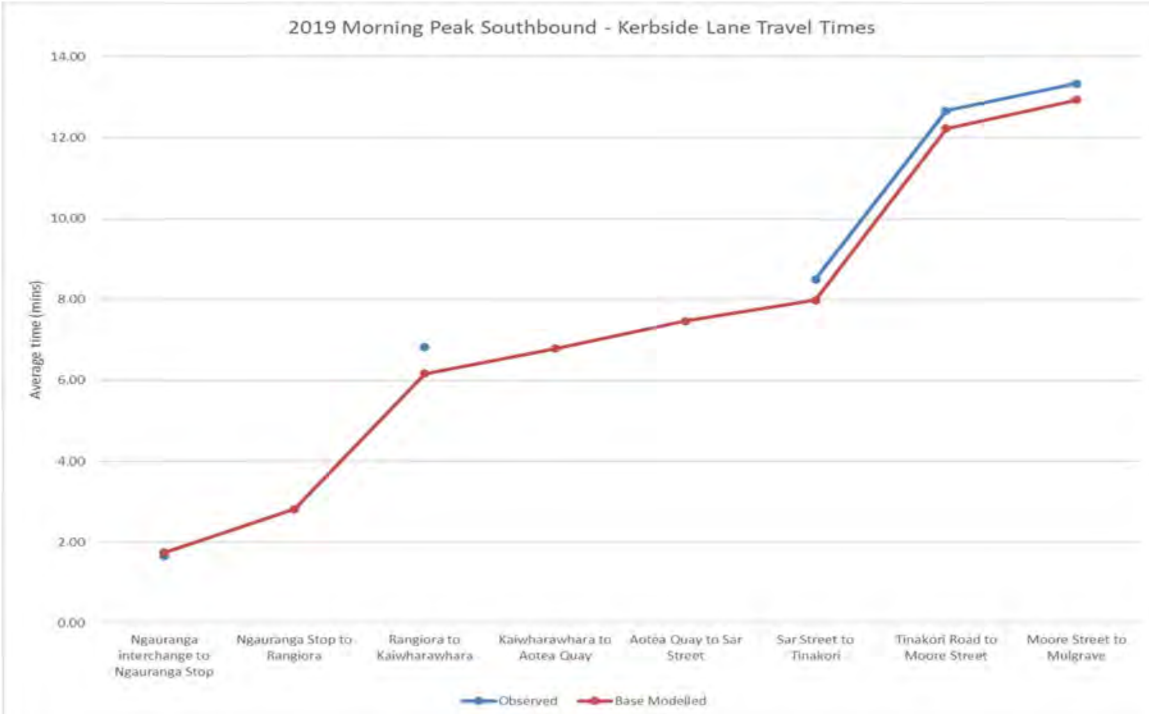


Figure 3: Bus journey time profile – modelled vs observed (2019 PM northbound)

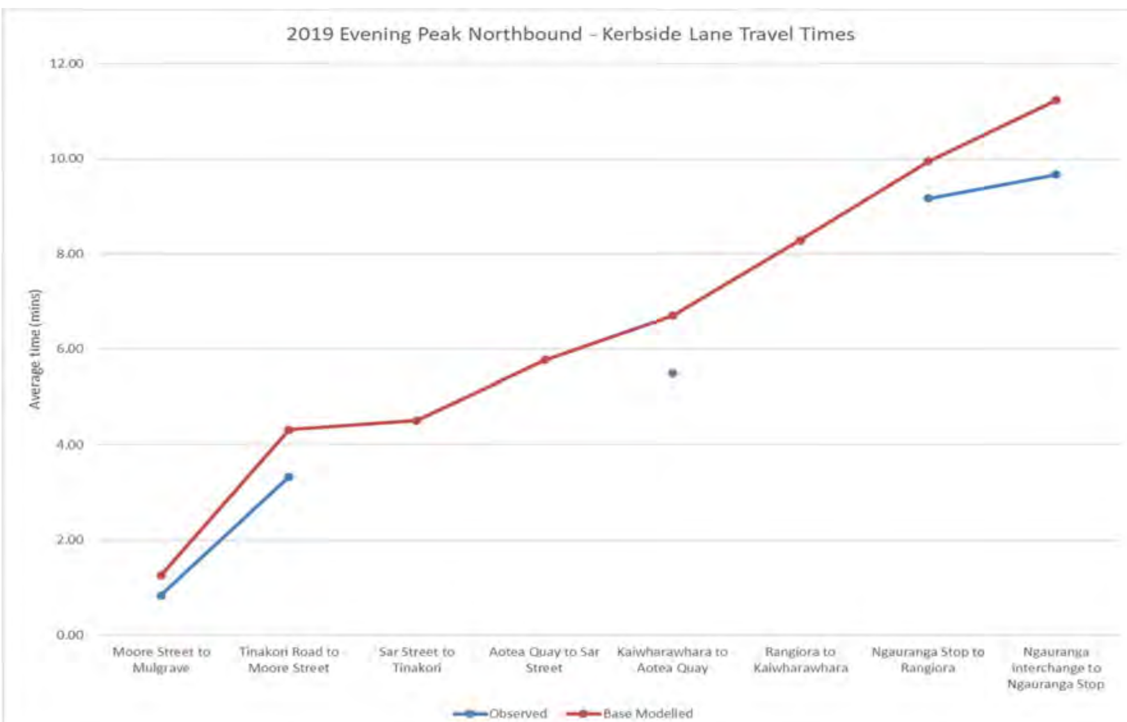


Figure 4: General traffic journey time profile – modelled vs observed (2019 AM southbound)

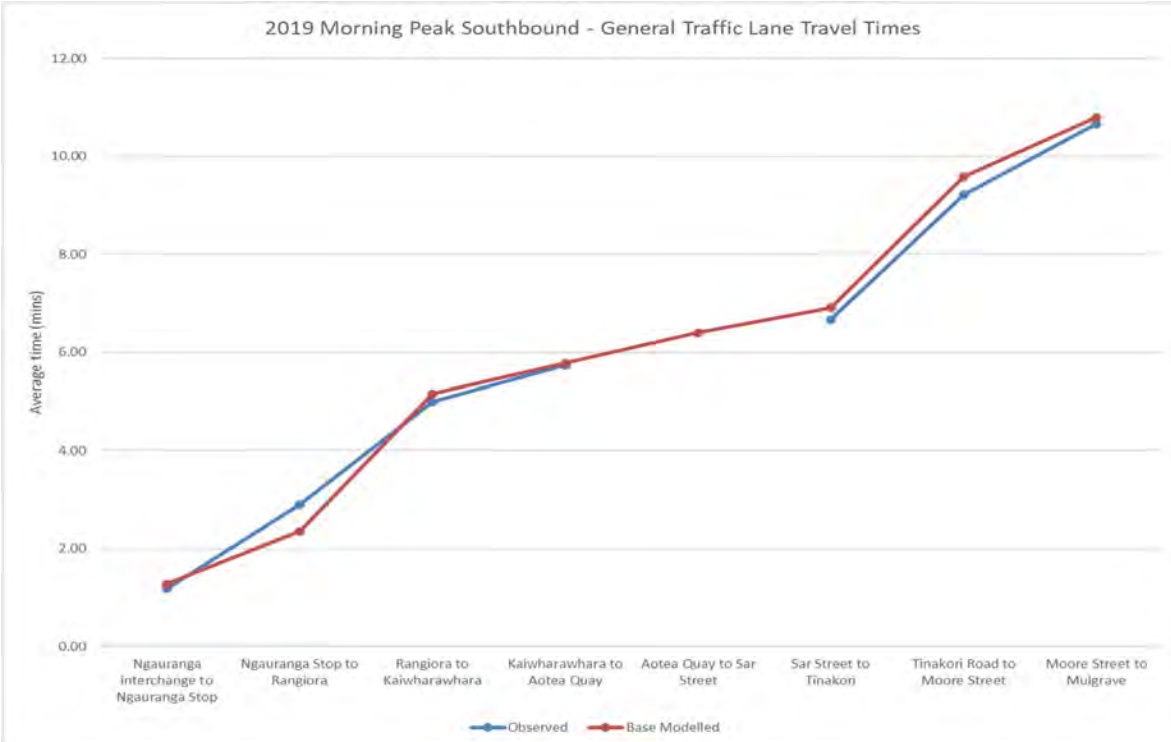
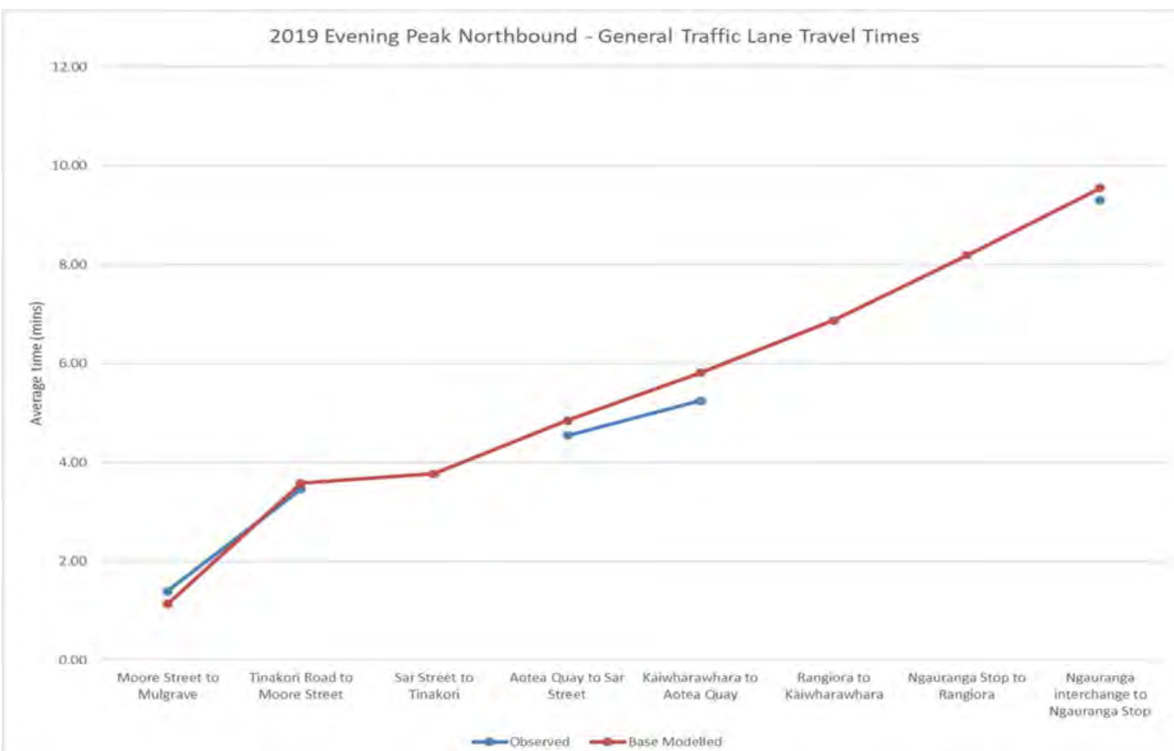


Figure 5: General traffic journey time profile – modelled vs observed (2019 PM northbound)



Limitations

Whilst the modelling approach draws on both the regional models (WTSM) and the AIMSUN models, there are limitations to the spreadsheet and SIDRA modelling that need to be recognised as they lead to the potential over-estimated of congestion for vehicles using the general traffic lane(s):

1. Route choice – the models have been developed to consider the performance of Hutt Road and Thorndon Quay using inputs from the WTSM and AIMSUN models to reflect the demands based on the scenario that includes a bus lane on Hutt Road (southbound between Jarden Mile and Kaiwharawhara). The effect of the congestion has been reflected in the corridor demands and diversion to other corridors (SH1, Onslow Road and Kaiwharawhara Road); however, there is potential for increased congestion to influence the choice of route between SH1 and Hutt Road, which is currently observed;
2. Peak spreading – the spreadsheet models reflect average conditions over the 2-hour period; however, there is the potential for the demand on Hutt Road to be spread over a longer period if the conditions in the peak 2 hour are severely congested;
3. Elasticities of demand – No additional work has been undertaken to test the demand elasticities for public transport patronage. This is explained further in the discussion on bus patronage forecasts.

The implication is in the selection of the Special Vehicle Lane and the knock-on impact to the economic evaluation where an option replaces a general traffic lane with a Special Vehicle Lane on Hutt Road between Jarden Mile and Aotea Quay. These limitations can be addressed in Stage 2 of the project where the final assessments will be completed.

Future Year (2036) Do-Minimum Models

The Do-Minimum model inputs and sources are provided in Table 8.

Table 8: 2036 Do-Minimum Modelled Inputs

Input	Source
Traffic Volume Forecasts	AIMSUN models (2026) plus an assumption that there would be 10% growth over the following 10 years
Peak Factor (% of traffic in the peak hour out of the 2 hour)	SCATS and Tube Counts supplied by WCC and WAU indicating just over 50% of traffic in the peak hour
Bus Patronage	WTSM, noting the discussion in the next section
Dwell Times	Increased proportionally to the bus patronage growth
All other parameters	No change from the base models

Future Year Option Models

Scenarios considered

The scenarios considered for the corridor assessment are as follows:

1. Hutt Road (between Ngauranga and Kaiwharawhara – both directions)
    a. No Special Vehicle Lane (do-minimum);
    b. Bus lane;
    c. T3 lane (no trucks);
    d. T3 Lane (with trucks);
    e. T2 lane (no trucks); and
    f. T2 lane (with trucks).
2. Hutt Road (Kaiwharawhara – Aotea Quay – both directions)
    a. No Special Vehicle Lanes due to the potential wider network impacts for trucks and general traffic, and potential weaving issues that could undermine the benefits of a Special Vehicle Lane.
3. Hutt Road (Aotea Quay to Tinakori Road – both directions) and Thorndon Quay
    a. Bus Lane
        i. On Hutt Road southbound, the existing clearway would be used as the bus lane; and
        ii. On Hutt Road northbound and Thorndon Quay, the existing parking lane and clearway would be used as the bus lane.

Trucks and high occupancy vehicles have not been considered for Thorndon Quay, as the buses travelling in the kerbside lane need to cross over into the bus station at Mulgrave Street, and the provision of a lane that increases capacity for general traffic and trucks is likely to exacerbate existing issues at the Mulgrave Street intersection (in the morning peak period) and on Hutt Road (near Tinakori Road) in the evening peak period.

Bus Patronage Forecasts

Modelled Forecasts

The patronage forecasts have been developed using the Wellington Strategic Transport Models (WTSM) for the scenarios listed in Table 9 for the 2036 AM Peak, Daytime Peak and PM Peak 2 hour periods in each direction (refer to LGWM Model Specification). For the Thorndon Quay and Hutt Road SSBC project, a morning peak period bus lane has been included between Jarden Mile (Ngauranga) to Kaiwharawhara intersection on Hutt Road. The next phase of assessment will require the latest LGWM scenarios in order to update the public transport patronage forecasts.

Table 9: 2036 WTSM Forecast Scenarios

Option	Golden Mile	City Streets	Thorndon Quay/Hutt Road*	MRT	Basin Reserve and Mt Victoria Tunnel	SH1 improvements (Terrace Tunnel to Ngauranga)
Do Minimum						
THQR Project	X	X	X			
Project plus LGWM Anchor Projects (RPI)	X	X	X	X	X	
RPI plus SH1 improvements	X	X	X	X	X	X

Table 10 provides the bus patronage forecasts for Thorndon Quay from the Wellington Strategic Transport Models. The percentages in brackets show the increase compared to the "do-minimum" scenario.

Table 10: Patronage uplift on Thorndon Quay with network improvements

Option	Morning Peak Inbound (2hr)	Daytime Peak Inbound (2hr)	Evening Peak Outbound (2hr)
Base Year (Modelled)	2,610 pax	480 pax	1,850 pax
Do Minimum	3,050 pax	590 pax	2,300 pax
2036 THQR Project	3,550 pax (+16%)	540 pax (-8%)	2,710 (+18%)
2036 THQR Project plus LGWM Anchor Projects (RPI)	3,400 pax (+11%)	760 pax (+30%)	2,680 (+16%)
2036 RPI plus SH1 improvements	3.270 pax (+7%)	740 pax (+26%)	2,550 (+11%)

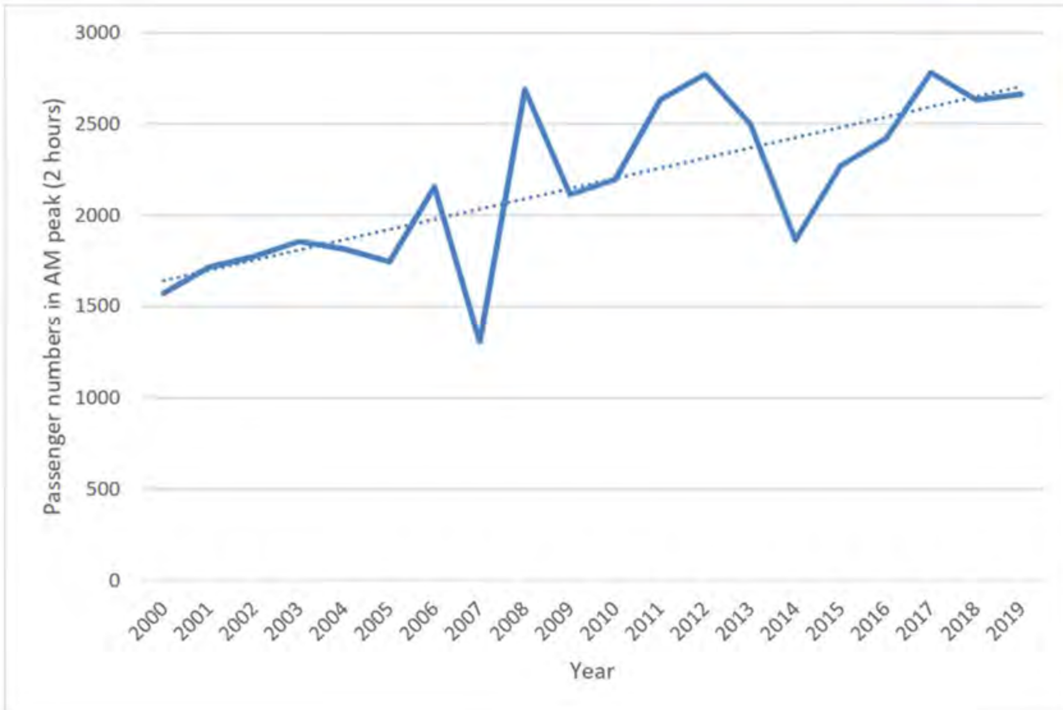
For the purposes of the assessment, the forecasts for the Thorndon Quay and Hutt Road SSBC project have been adopted for the assessment.

There is expected to be a significant increase in public transport across all the scenarios that can be attributed to the Thorndon Quay and Hutt Road SSBC project. It is also interesting to note that the forecast bus patronage on Thorndon Quay is lower with the additional of the anchor projects and additional SH1 improvements. However, the improvements on SH1 (between the Terrace Tunnel and Ngauranga) have an overall impact of less than 10% on bus patronage on Thorndon Quay, when a higher impact could have been expected with improved road access to the Wellington city centre afforded by the improvements to the motorway. This confirms that the Thorndon Quay and Hutt Road SSBC project contributes to the wider LGWM programme even with road improvements.

Sensitivity on Patronage Growth

Figure 6 below shows the historic passenger demands in the AM peak on Thorndon Quay as counted in the annual cordon surveys, which are undertaken in March of each year. The trendline indicates that bus passengers have been increasing by approximately 3% per annum (linear) since 2000.

Figure 6: Historic Public Transport Patronage (Source: Case for Change)



This comparison indicates that bus patronage growth in Wellington has been strong over the last 20 years. This could be attributed to the many bus priority measures implemented in the city centre and improvements to bus routes and services implemented across the wider region.

Table 11 presents a comparison between the modelled bus patronage forecasts and estimates based on historic growth. It indicates that the modelled forecast public transport patronage is approximately half of the estimated patronage estimated from the historic growth.

Table 11: Comparison of extrapolated growth with modelled forecasts on Thorndon Quay

Option	Modelled growth in the WTSM do-minimum scenario	Extrapolated from observed growth (2019 – 2036)
Do Nothing (Modelled: Base Year - 2036)	~3,050 pax (+17%)	~3,640 pax (+35%)

If the bus patronage follows the historic trends, and is double the modelled forecast growth, the potential increase in uplift as a result of the project could also apply. This comparison is provided in Table 12 using the uplifts outlined in Table 10

The implication to the Thorndon Quay and Hutt Road project is predominantly associated with the potential re-allocation of one of the general traffic lanes on Hutt Road as a Special Vehicle Lane (bus lane or high occupancy vehicle lane).

If the bus patronage growth follows the observed trend in the peaks there is the potential for the traffic volume forecasts to be over-estimated, and therefore the impacts to general traffic (and trucks if they are not permitted to use the Special Vehicle Lane) will also be over-estimated. This is discussed further later in the report.

Table 12: Sensitivity Patronage uplift on Thorndon Quay with network improvements

Option	2036 Morning Peak Inbound (2hr)		2036 Evening Peak Outbound (2hr)	
	Modelled	Based on historic growth	Modelled	Based on historic growth
Do Nothing	3,050 pax	3,640 pax	2,300 pax	2,740 pax
THQR Project	3,550 pax	4,220 pax	2,710 pax	3,180 pax

Traffic Volumes - Behavioural Response

In additional to patronage uplifts, the WTSM model results give an indication of the potential reduction in car trips along the corridor in the 2036 morning peak period with a southbound bus lane:

- 26% north of Kaiwharwhara compared with do minimum;
- 12% reduction between Kaiwharawhara – Tinakori; and
- 10% increase on Tinakori, and 21% on Thorndon Quay – all in the morning peak.

These reductions were applied in the southbound direction only approaching Kaiwharawhara intersection in the option where the Special Vehicle Lane on Hutt Road is a bus lane (noting that capacity constraints at Kaiwharawhara prevent traffic from reaching Tinakori Road and Thorndon Quay). For the scenarios where the Special Vehicle Lane is an HOV Lane, the process applied was as follows:

1. apply the reductions above to the forecast volume upstream of Kaiwharawhara Road;
2. estimate the HOV lane usage from the vehicle occupancy information and the forecast volumes;
3. add 1 and 2 to give the total traffic volume where the Special Vehicle Lane on Hutt Road.

The results of the forecast traffic volumes are shown in Figure 7 and Figure 8

Figure 7: Forecast Traffic Demand Southbound (2036 AM Peak Period – 2 hours)

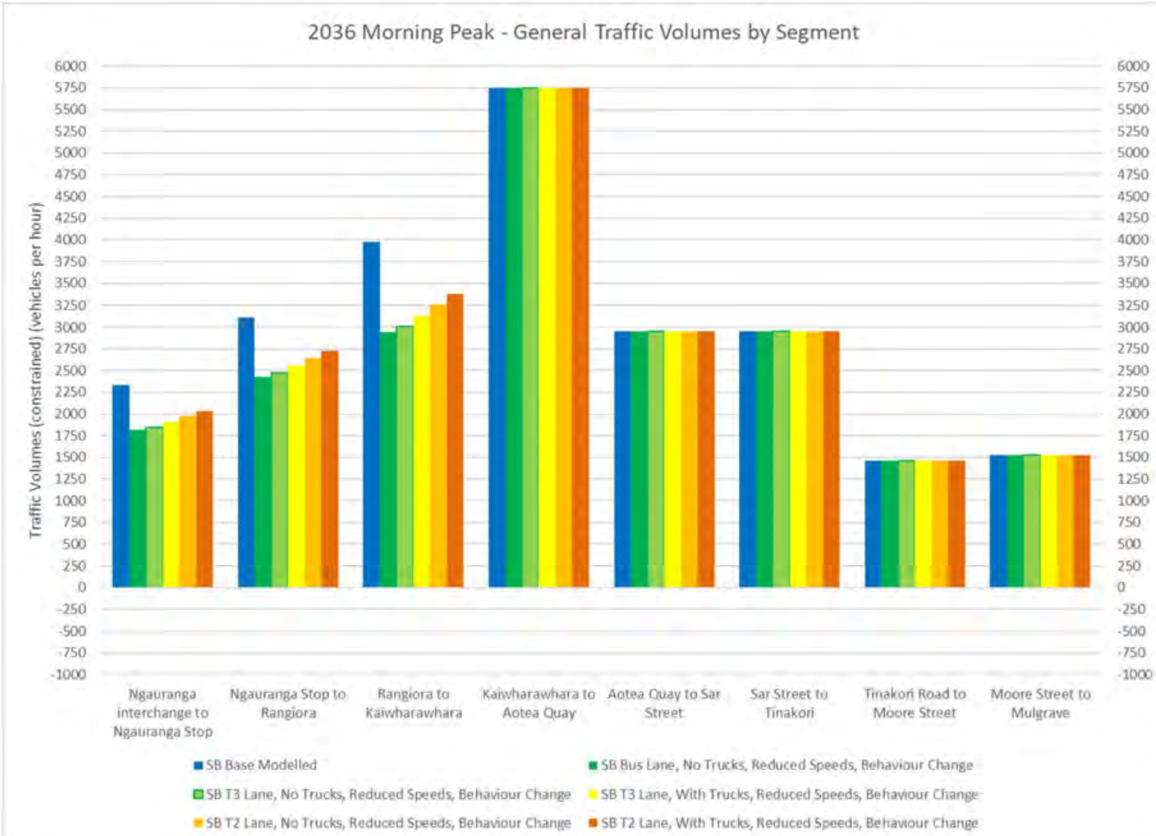
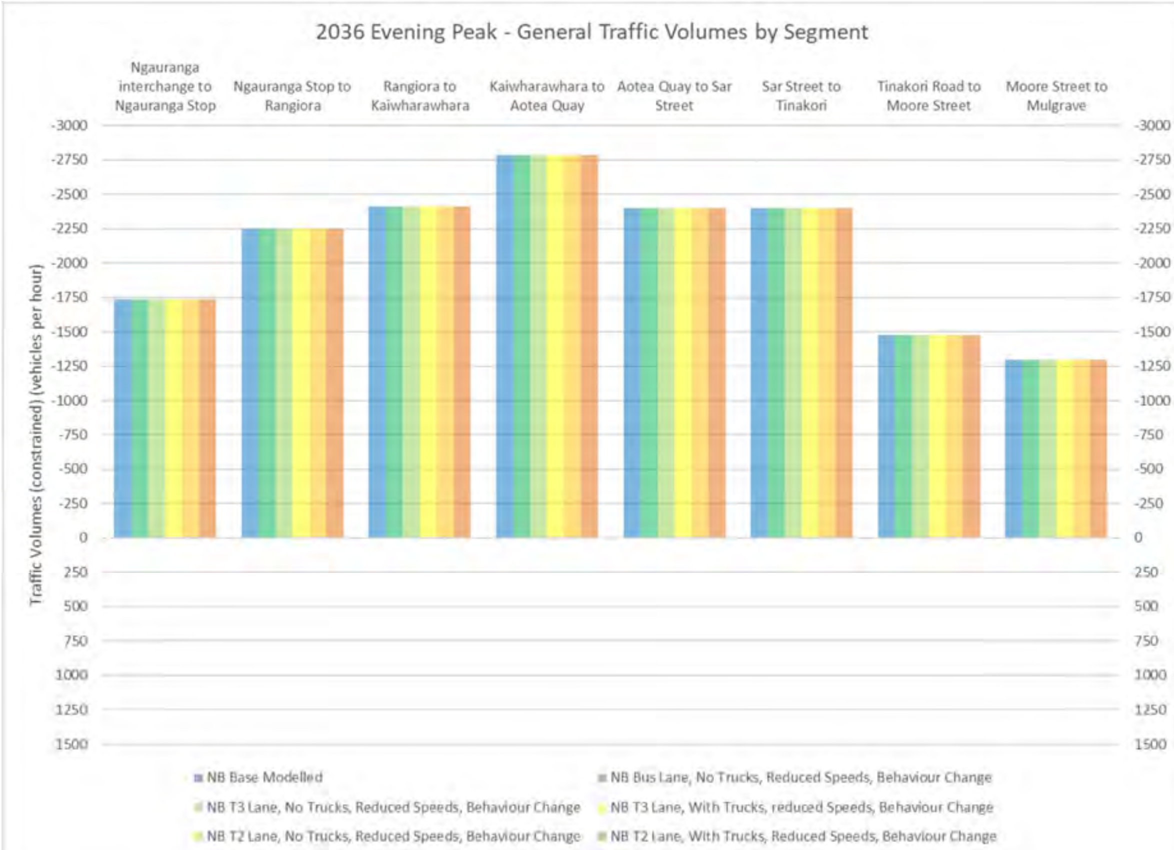


Figure 8: Forecast Traffic Demand Northbound (2036 PM Peak Period – 2 hours)



Corridor Assessments

Journey time summaries

Morning Peak Period

Table 13 summarises the journey times by mode along the corridor with the different scenarios. The ranges provided for the HOV lanes reflect the different use of the lane (T3 – 3 or more occupants or T2 – 2 or more occupants). Figure 9 and Figure 10 show the forecast journey times by segment in both directions.

From the modelling undertaken, the provision of bus priority with either a HOV lane or a Bus Lane along Hutt Road (between Ngauranga and Kaiwharawhara) is expected to provide significant benefits for bus passengers travelling southbound towards the city in the morning peak period.

The exception of the Special Vehicle Lane allowing for T2 plus trucks, is expected to result in the lane carrying similar levels of traffic to the general traffic lanes, therefore offering no benefit for bus passengers. Noting the limitations of the modelling with respect to route choice between SH1 and Hutt Road for high occupant vehicles, the situation where the Special Vehicle Lane is overloaded could also apply to a T2 lane without trucks.

In the northbound direction in the morning peak, it is expected that there is a negligible difference in journey times for all modes travelling along the corridor (less than 1 minute), irrespective of whether there is a Special Vehicle Lane along the corridor with the reduced speeds, crossing improvements and signalising intersections along Thorndon Quay.

Table 13: Southbound Journey Times (2036 Morning Peak Period)

<table>
<tr><th>Scenario</th><th>Bus Travel Time</th><th>Truck Travel Time</th><th>Car Travel Time</th></tr>
<tr><td>Base</td><td>12.9</td><td colspan="2">10.8</td></tr>
<tr><td>Do-Minimum (2036)</td><td>21.0</td><td colspan="2">18.1</td></tr>
<tr><td>Bus Lane on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.7</td><td colspan="2">24.5</td></tr>
<tr><td>HOV Lane (T2 or T3, no Trucks) on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.1 – 11.2</td><td colspan="2">23.3 – 25.1</td></tr>
<tr><td>HOV Lane (T2 or T3, with Trucks) on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>11.1 – 20.2</td><td>11.0 – 18.5</td><td>20.2 – 21.6</td></tr>
</table>

The segment by segment journey times for the different Special Vehicle Lane options (Figure 9 and Figure 10) indicate that the intersections of Centennial highway/Jarden Mile/SH2/Hutt Road (Jarden Mile intersection) and Hutt Road/Kaiwharawhara (Kaiwharawhara intersection) intersection are likely to be pinch points for people travelling south into the city, who are not eligible to use the Special Vehicle Lane. This is reflected in the segment travel times in Figure 10 where heavy congestion is reflected at the pinch points (where delays are capped to 10kph speeds in each section).

The modelling of the bus lane has assumed that the bus queue jump lane at the Jarden Mile intersection is in addition to the traffic lanes; whereas the modelling of the HOV lane has assumed that one of the lanes has been converted. At this intersection, there is the ability to “mix and match” (e.g. bus queue jump lane at the intersection, but then a lane converted to an HOV lane through to Kaiwharawhara)’ however that flexibility is not available at the Kaiwharawhara intersection which is constrained for space.

Figure 9: Kerbside Lane Travel Times by Segment (2036 Morning Peak 7am – 9am)

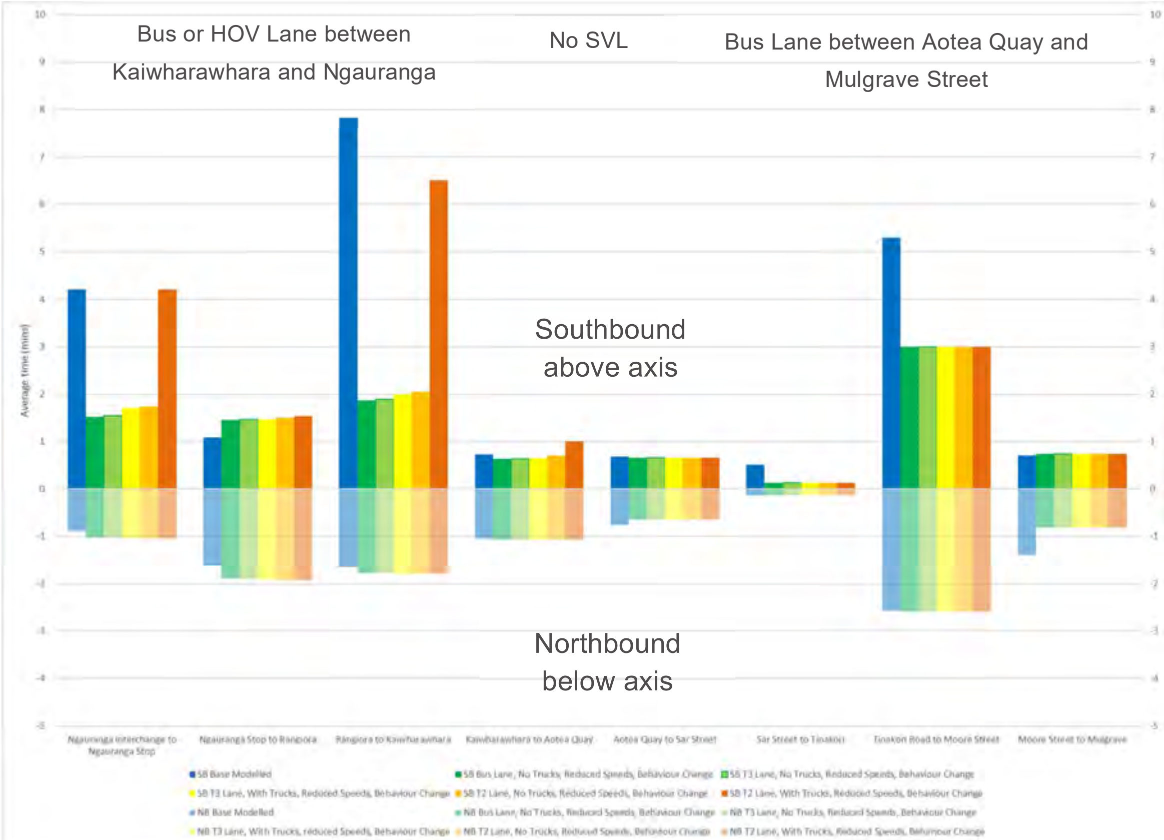
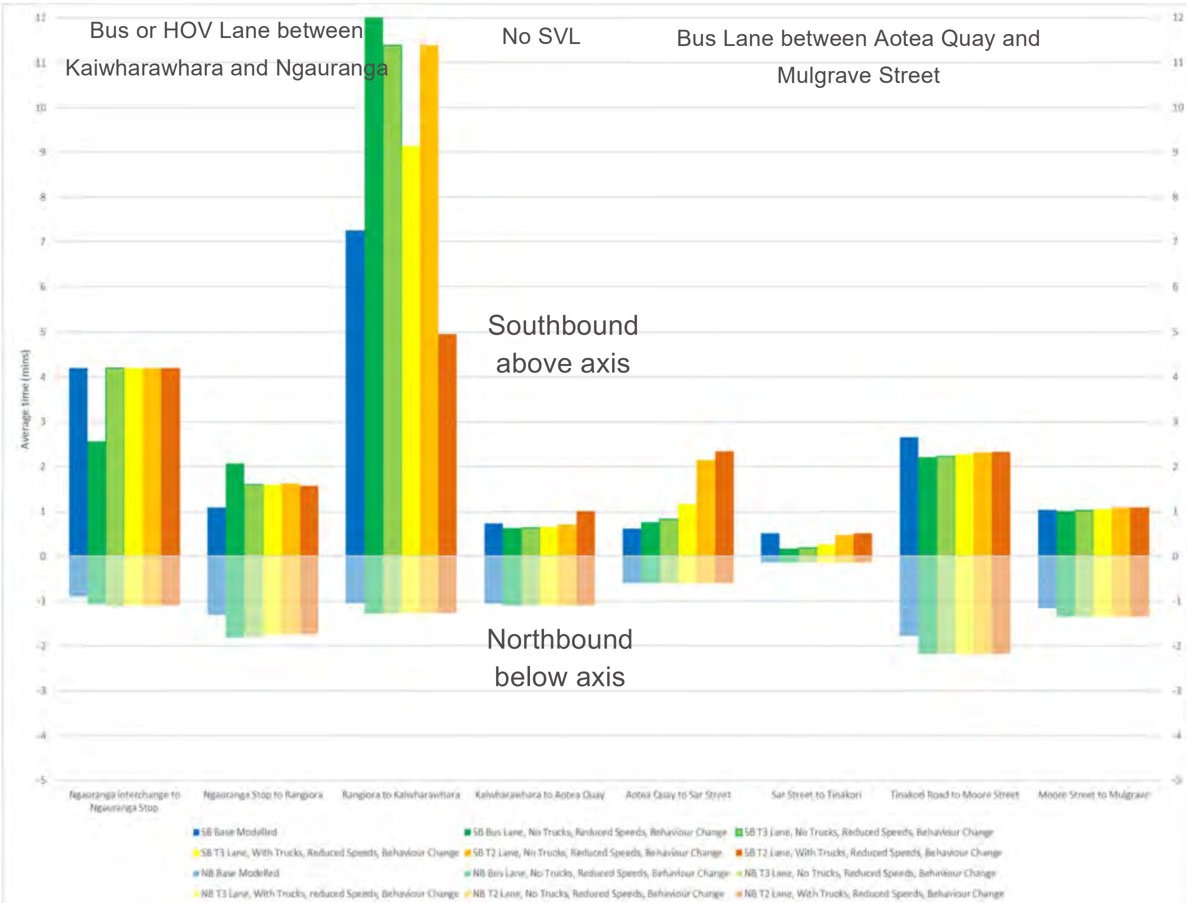


Figure 10: General Traffic Lane Travel Times by Segment (2036 Morning Peak 7am – 9am)



Evening Peak Period

Table 14 summarises the journey times by mode along the corridor with the different scenarios. The ranges provided for the HOV lanes reflect the different use of the lane (T3 – 3 or more occupants or T2 – 2 or more occupants). Figure 11 and Figure 12 show the forecast journey times by segment in both directions.

From the modelling undertaken, the provision of bus priority with either a HOV lane or a Bus Lane along Hutt Road (between Ngauranga and Kaiwharawhara) is expected to secure the reliability of buses travelling along the corridor in the evening peak period.

In the southbound direction in the evening peak, it is expected that there is a negligible difference in journey times for all modes travelling along the corridor, irrespective of whether there is a Special Vehicle Lane along the corridor (less than 1 minute) with the reduced speeds, crossing improvements and signalising intersections along Thorndon Quay.

Table 14: Northbound Journey Times (2036 Evening Peak Period)

<table>
<tr><th>Scenario</th><th>Bus Travel Time</th><th>Truck Travel Time</th><th>Car Travel Time</th></tr>
<tr><td>Base (Modelled)</td><td>11.2</td><td colspan="2">9.6</td></tr>
<tr><td>Do-Minimum (2036)</td><td>11.4</td><td colspan="2">10.6</td></tr>
<tr><td><u>Bus Lane</u> on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>9.8</td><td colspan="2">13.2</td></tr>
<tr><td><u>HOV Lane (T2 or T3, no Trucks)</u> on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.0</td><td colspan="2">13.1 – 21.8</td></tr>
<tr><td><u>HOV Lane (T2 or T3, with Trucks)</u> on Hutt Road (Ngauranga to Kaiwharawhara):
Bus Lane on Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay</td><td>10.4 – 10.6</td><td>11.2 – 13.7</td><td>13.9 – 16.4</td></tr>
</table>

The segment by segment journey times (Figure 11 and Figure 12) indicate that the intersections of Centennial highway/Jarden Mile/SH2/Hutt Road (Jarden Mile intersection) and Kaiwharawhara is likely to be pinch point for people travelling north away from the city if the lane was a T3 lane (with or without trucks) and carried through the intersection.

The modelling of the bus lane scenario has assumed that the bus queue jump lane at the Jarden Mile intersection and Kaiwharawhara is in addition to the traffic lanes; whereas the modelling of the HOV lane has assumed that one of the lanes has been converted. At these intersections (northbound), there is the ability to “mix and match” (e.g. mid-block HOV lane but two general traffic lanes plus bus queue jump lane at the intersections).

Figure 11: Kerbside Lane Travel Times by Segment (2036 Evening Peak 4pm – 6pm)

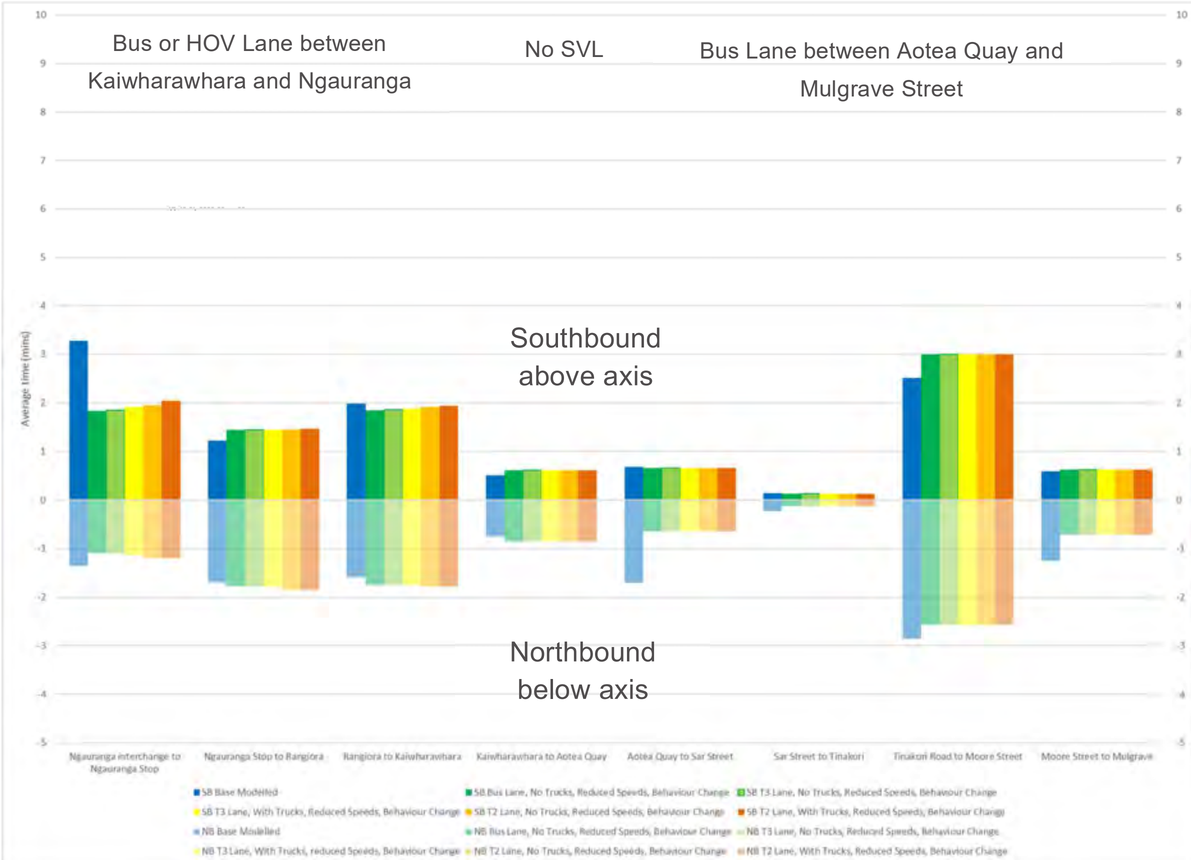
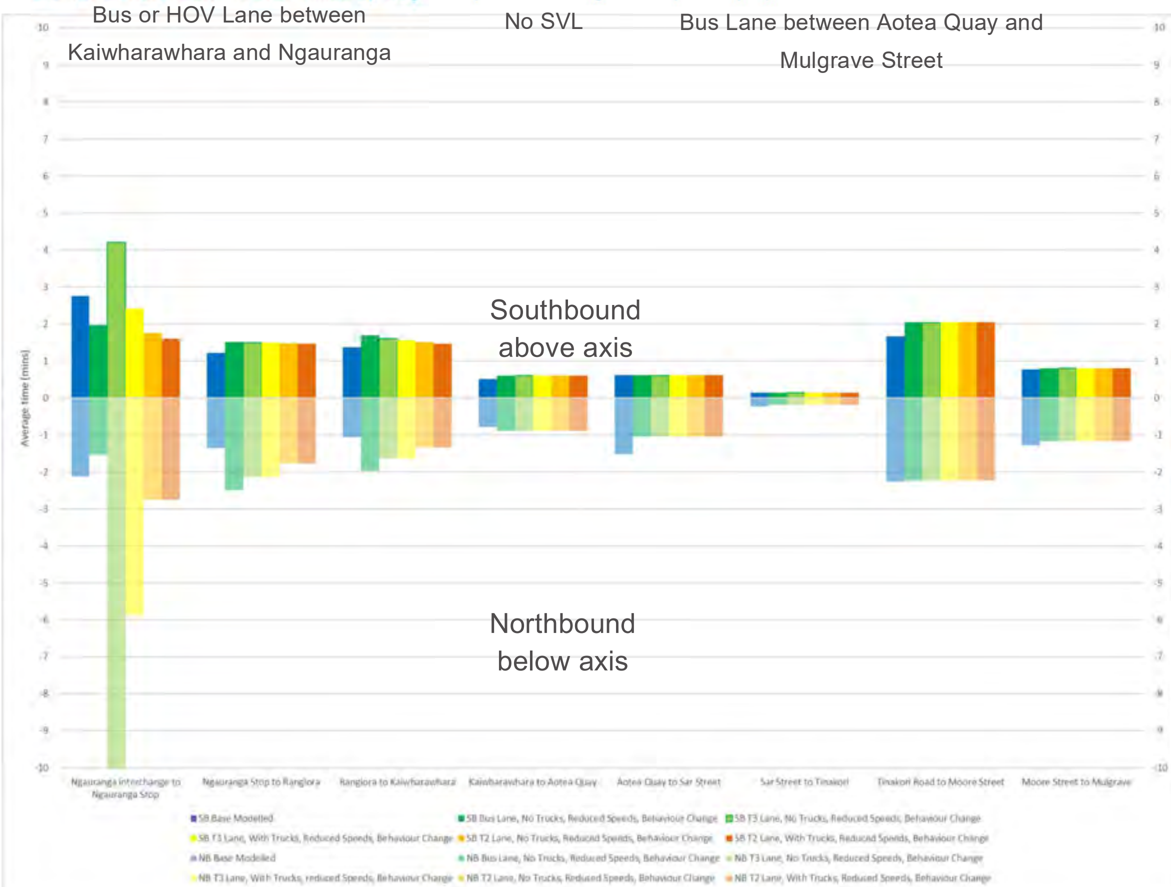


Figure 12: General Lane Travel Times by Segment (2036 Evening Peak 4pm – 6pm)

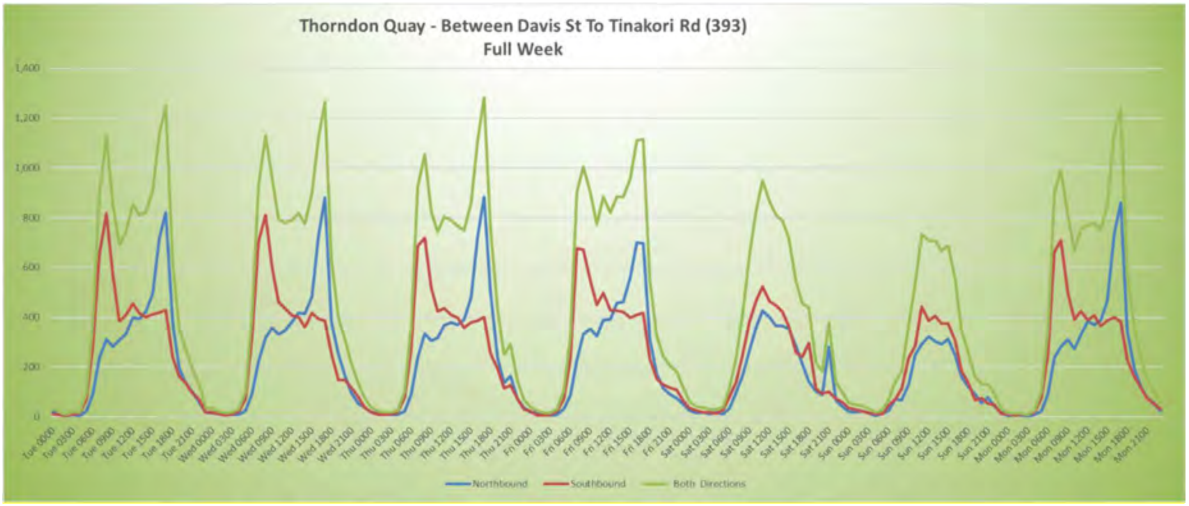


Daytime Peak Period

The daytime peak period has not been explicitly modelled; however, consideration has been given to whether a Special Vehicle Lane is warranted throughout the day. Along Thorndon Quay, the decision comes down to whether a bus lane should be provided at the expense of off-peak parking.

Traffic counts along Thorndon Quay (as shown in Figure 13) indicate that the peak hourly volume during the day is approximately 400 vehicles per hour in each direction.

Figure 13: Thorndon Quay Traffic Counts



The modelled forecasts in AIMSUN (based on the 2026 forecasts plus 10%) indicate that the peak daytime volumes remain fairly stable each direction. The forecasts from the Wellington Strategic Transport Models are similar at an absolute level; however, they indicate a growth of between 11% and 22% above the base year volumes. If there is growth outside of the peak period, it is not expected to have a significant impact on the reliability of buses, trucks and general traffic travelling along the corridor.

To put this in context, the northbound peak hour observed volumes is approximately 800 vehicles per hour with an observed journey time in the order of 3.5 minutes[3] - similar to the daytime peak running period, where the observed volumes are approximately 400 vehicles per hour northbound. This indicates that the reliability of the service does not appear to be a significant issue.

In the evening peak, the modelled forecasts indicate that there may be up to 1 minute saving for buses travelling along Thorndon Quay if a bus lane is implemented, noting that the forecast volumes travelling northbound are not expected to increase significantly, as the intersection with Mulgrave Street limits the amount of traffic that can continue on to Thorndon Quay. It is anticipated that if a bus lane was operating throughout the day northbound, the improvement to bus journey times and reliability would be lower.

In the southbound direction, the case is similar; however, the source of the congestion along the corridor is at the intersections with Mulgrave Street and Featherston Street in the morning peak period, with daytime peak and evening peak bus journey times being similar.

It is unlikely that a full-time bus lane would be justified based on either the bus patronage or the reliability of bus service during the day; however, it is recommended that this be monitored over time, given that there is flexibility in being able to adjust the times of bus lane operation.

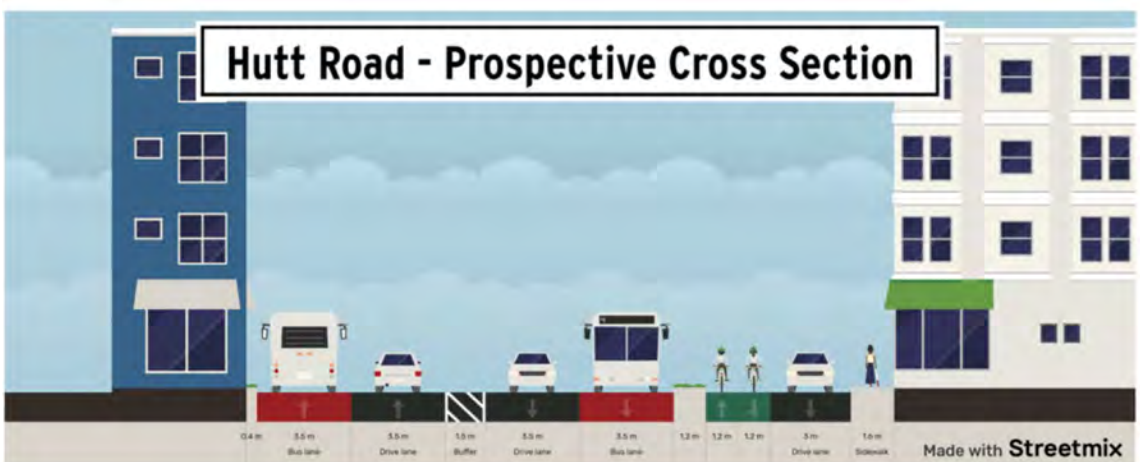
[3] Source: Case for Change: Figure 35

Effect of Southbound Service Lane on Hutt Road between Rangiora Avenue and Kaiwharawhara Road

To mitigate the potential risk of crashes associated with the implementation of a priority lane on Hutt Road, and to address the existing crash risk of turning vehicles colliding with cyclists, a service lane is being considered between Onslow Road and Rangiora Avenue. The potential cross section in shown in Figure 14 and Figure 15.

Figure 14: Potential Service Lane Layout on Hutt Road

Figure 15: Potential cross section for a service lane on Hutt Road



The proposal allows for entry back on to Hutt Road as the signalised intersection of Hutt Road and Kaiwharawhara Road, adding an additional traffic signal phase at the signalised crossing. This would allow for people leaving the businesses between Kaiwharawhara Road and Rangiora Avenue (including Westminster Street) to continue southbound along Hutt Road, to turn into Kaiwharawhara Road, or to turn back north along Hutt Road (subject to vehicle tracking for semi-trailers and B-Trains).

The effect of this has been modelled in SIDRA using the existing volumes and turning volumes out of Westminster Street from the AIMSUN base year models to understand the relative level of service, and the kerbside lane capacity (for a Special Vehicle Lane).

It has been assumed that a right turn lane will be provided for traffic turning right from Hutt Road and Kaiwharawhara Road, and that the traffic signal phasing will be the existing phasing plus one new traffic signal phase for the service lane.

Table 15 provides the expected levels of service with and without the service lane. The inclusion of the service lane is expected to have a significant impact on the overall efficiency of the intersection, which is aligned with expectations.

Table 15: Level of Service at the intersection of Hutt Road and Kaiwharawhara Road

Time Period	No Service Lane	With Service Lane
Morning Peak Hour	E	F
Daytime Peak Hour	B	C
Evening Peak Hour	D	F

The effects on a potential Special Vehicle Lane along Hutt Road have been considered by looking at the kerbside lane capacity (outlined in Table 16) with the service lane and comparing it to the estimated use of a Special Vehicle Lane in 2036 (shown in Table 17).

Table 16: Kerbside Lane Capacity with southbound service lane at the intersection of Hutt Road and Kaiwharawhara Road

Time Period	Southbound Kerbside Lane with service lane	Northbound Kerbside Lane with service lane
Morning Peak Hour	780 vph	220 vph
Evening Peak Hour	780 vph	350 vph (affected by left turn slip lane)

Table 17: Estimated Use of Special Vehicle Lane in 2036

Time Period	Special Vehicle Lane Type	Southbound Special Vehicle Lane	Northbound Special Vehicle Lane
Morning Peak Hour	Bus Lane	~35* vph	~20* vph
	T3 (No Trucks)	160 vph	50 vph
	T2 (No Trucks)	675 vph	210 vph
	T3 (with Trucks)	410 vph	115 vph
	T2 (with Trucks)	920 vph	280 vph
Evening Peak Hour	Bus Lane	~20* vph	~35*vph
	T3 (No Trucks)	75 vph	115 vph
	T2 (No Trucks)	300 vph	430 vph
	T3 (with Trucks)	150 vph	220 vph
	T2 (with Trucks)	370 vph	540 vph

Table 17 shows that the addition of a service lane and a signalised exit on to Hutt Road is likely to preclude the use of a T2 lane (with or without Trucks) as the Special Vehicle Lane would be operating over its capacity, which is a typical warrant for a Special Vehicle Lane. Furthermore, there is the potential for the intersection to become a major bottleneck for traffic exiting the city via Hutt Road as the capacity for a single northbound lane (if a lane was converted at the intersection to a Special Vehicle Lane) is likely to be fairly low at ~670 vehicles hour compared to a forecast of 1,500 vehicles per hour.

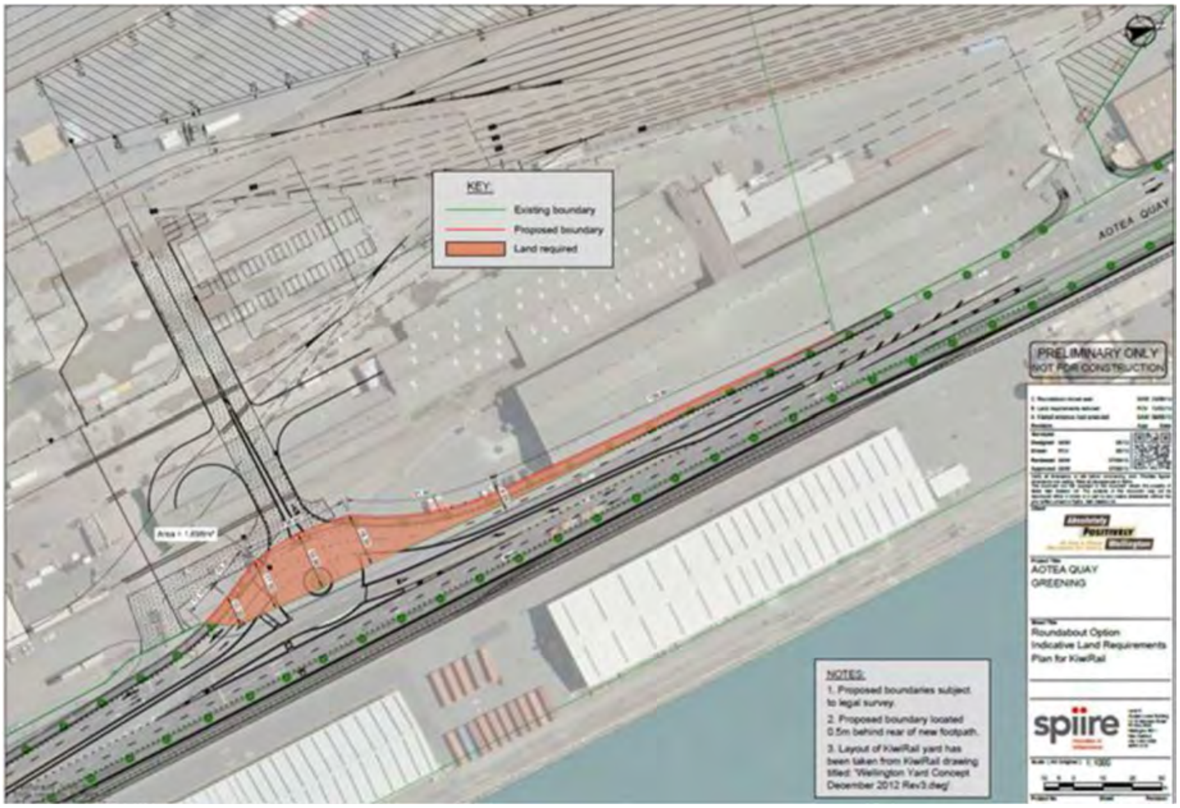
Effect of Roundabout on Aotea Quay

A turnaround facility along Aotea Quay (at the Mainfreight entrance) is being considered for the following purposes:

1. To provide an alternative route (via SH1) for people and trucks travelling to the Interislander ferry terminal whose current access is only available via Hutt Road; and
2. To mitigate the potential left-in-left out restrictions posed by either the service lane (discussed in the previous section) or the provision of a raised median on Hutt Road – both of which are being considered to reduce the safety risk along Hutt Road associated with turning crashes.

The proposed turnaround facility is a roundabout at Aotea Quay as outlined in Figure 16

Figure 16: Proposed Layout for Turnaround facility at Aotea Quay



The effect of this has been modelled in SIDRA using the AIMSUN 2026 volumes plus 10% to estimate what a 2036 scenario could look like. The volume undertaken to U-turn was the Interislander bound traffic in the morning peak period and the modelled counts turning right from Westminster Street forecast in the AIMSUN models.

The results indicate that the roundabout should operate efficiently in the morning peak period for this scenario (Level of Service B), and indicates that there would be sufficient capacity in the roundabout to cater for a significantly higher demand in line with estimated growth in ferry bound traffic.

In the evening peak period, the level of service based on the modelled scenario is expected to be good (Level of Service B); however, northbound travel on Aotea Quay may be adversely affected with increases in ferry terminal traffic as the volume-capacity ratio for this movement is >80%.

It is recommended that the roundabout be included as part of the project as it provides an alternative route for people and trucks accessing the Interislander ferry terminal and can be efficiently managed in the morning peak period. In the evening peak period, a metered roundabout may be more appropriate to manage the efficiency of the roundabout. As a short term measure (prior to further progression of the proposed Multi-User Ferry Terminal), the roundabout appears to be an appropriate treatment.

Commentary on the results

The modelled forecasts have been derived from the Wellington Strategic Transport Models, which are four-stage demand models. At the time of preparing this report, it was understood that the road capacity for Hutt Road was modelled at 1,400 vehicles per hour per lane; however, the capacity at the intersection is the key driver for congestion along the corridor having a capacity of up to 900 vehicles per hour for the through movements plus the right turning traffic into Kaiwharawhara Road (forecast to be ~250 vehicles per 2 hours).

The results indicate that for the peak direction on Hutt Road, the initial impact of displacing up to 900 vehicles per hour to facilitate the implementation of a Special Vehicle Lane is likely to result in increases in congestion along the corridor for general traffic and trucks, if trucks are not permitted to use the Special Vehicle Lane.

This effectively means that to maintain the reliability for freight along Hutt Road, freight must be allowed to use a Special Vehicle Lane, or a demand reduction of the general traffic lane down to just over 1,000 vehicles per hour between 7am and 9am is required.

To reduce the demands for Hutt Road to a “manageable level”, could mean a combination of:

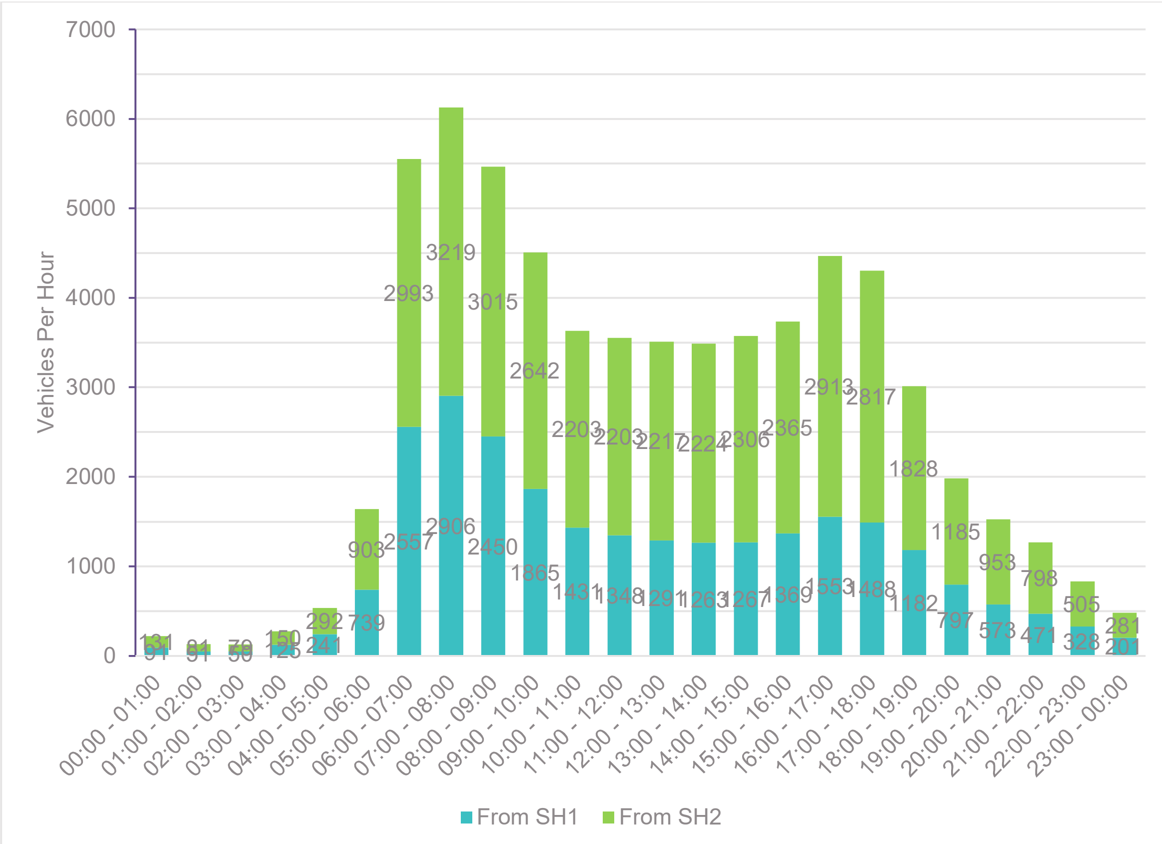
- Increased public transport patronage (noting the difference between modelled forecasts and extrapolated growth in the morning peak period);
- The inclusion of the turnaround at Aotea Quay/ Mainfreight could take up to 400 vehicles in the peak hour off Hutt Road, but noting that not all of this may be realised because of the congestion on SH1. However, journey times from TomTom (supplied by Waka Kotahi) confirm the anecdotal evidence that Hutt Road is being used as an alternative route to the congested SH1 corridor with journey times between Glover Street and Aotea Quay very similar at the height of the peak (approximately 7 mins 15 seconds). In the northbound direction, Hutt Road travel times are consistently slower than the motorway throughout the day (5 mins 15 seconds via the motorway versus 7 minutes via Hutt Road). There is the potential to see greater use of the motorway over Hutt Road in the evening peak period if it is reasonably accessible from ramps other than at Aotea Quay;
- Route choice shift from SH1 - it is estimated that around 6-8% of vehicles using Hutt Road in the morning peak period have 3 or more occupants (~150 vehicles per hour) and 5% on SH1 (~300 vehicles per hour). Hence, given that a T3 lane would be quicker than using the motorway, a shift away from the motorway back to using the Special Vehicle Lane on Hutt Road is conceivable. It is estimated that approximately 30% of vehicles using Hutt Road in the morning peak period have 3 or more occupants (~750 vehicles per hour) and 20% on SH1 (~1200 vehicles per hour). This potential demand for the T2 lane is likely to see it operate over its capacity and not provide any benefit to any motorised mode compared to the current road layouts;
- Route choice and mode shift away from Hutt Road – the effect of the congestion has been reflected in the corridor demands and diversion to other corridors outside of that forecast in the WTSM (SH1, Onslow Road and Kaiwharawhara Road), which indicates a shift of approximately 200 vehicles per hour to Kaiwharawhara Road and SH1, with a reduction at Onslow in the order of 200 vehicles per hour, and an increase of ~300 pax per hour using public transport. These forecasts were incorporated into the

corridor assessments but still leave a level of displaced traffic that could be difficult to effectively manage, particularly with the impacts to trucks;

- Impact of investment in rail - at the time of preparing this report, it is understood that the modelling forecasts provided for the Thorndon Quay and Hutt Road SSBC project include investment in rail (sub-programme named RS2) to provide better access for travel to Wellington from the north (e.g. Johnsonville, communities along the North Island Main Trunk Link, and communities in Upper and Lower Hutt and the Wairarapa). The potential implication is that if this investment is not delivered then both bus patronage and traffic volumes may be higher than forecast. For the Thorndon Quay and Hutt Road SSBC project, this may influence the type of Special Vehicle Lane that is preferred on Hutt Road (e.g. bus lane versus a high occupancy vehicle, and whether trucks should be permitted to use the Special Vehicle Lane), and the economic evaluation specifically related to benefits or disbenefits for general traffic and freight; and

- Peak spreading before and after the typical 7am – 9am peak, which seems like the most likely scenario in the short term. The Waka Kotahi TMS information indicates a peak flow of approximately 6,100 vehicles per hour. In the period between 8am and 9am, the motorway is heavily congested, therefore reducing the throughput down to ~5,400 vehicles per hour (as shown in Figure 17). If the motorway throughput could be sustained at the peak flow, there is the potential to substantially offset the impact of converting one of the general traffic lanes to a Special Vehicle Lane. If the trucks are not permitted to use the Special Vehicle Lane, there is likely to be some impact as it is anticipated that there would be sustained slow conditions on the motorway over a longer period, but not to the same level as estimated from the analysis so far.

Figure 17: Throughout traffic profiles on SH1 (southbound)



The combination of the above “behavioural responses” over and above what has been forecast in WTSM has the potential to provide a neutral outcome for freight travelling to Aotea Quay, but a range of impacts from neutral to moderate negative for trucks travelling via Thorndon Quay.

This uncertainty in the impacts warrants further investigation in both the elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models.

Active Modes Assessment

The assessment for active modes has been undertaken separately for facilities along the corridor and crossing opportunities along the section of the corridor between Aotea Quay and Thorndon Quay.

Corridor Facilities

The assessment of the facilities along the corridor has been undertaken based on the Danish Level of Service method (spreadsheet supplied by Waka Kotahi) for the options being considered (as outlined in Table 18). The corridor has been split into different segments in line with the changing road layouts, types of facilities and corridor widths.

Table 18: Segment for active mode levels of service

Segment	Special Vehicle Lane(s)	Cycling
Concept 1: (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street) (b) Thorndon Quay (Tinakori Road to Motorway overpass)	Southbound only	Bi-directional facility
Concept 2: (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street) (b) Thorndon Quay (Tinakori Road to Motorway overpass) (narrower)	Both directions	Uni-directional facilities
Concept 3: (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street) (b) Thorndon Quay (Tinakori Road to Motorway overpass) (narrower)	Southbound only	Uni-directional facilities
Concept 4: (a) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street) (b) Thorndon Quay (Tinakori Road to Motorway overpass) (narrower)	Both directions	Bi-directional facility

The levels of service estimated using the Danish Cycling Method are provided in Table 19.

Table 19: Active Mode Level of Service along the corridor (Danish Level of Service)

Segment	Northbound		Southbound	
	Walk	Cycle	Walk	Cycle
Existing	D	F	D	F
Concept 1: Southbound bus lane with a bi-directional facility (b) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	F	C	C
(c) Thorndon Quay (Tinakori Road to Motorway overpass)	D	F	C	C
Concept 2: Bus Lanes in both directions with uni-directional cycle paths (b) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	D	D	D
(c) Thorndon Quay (Tinakori Road to Motorway overpass)	D	E	D	E
Concept 3: Southbound bus lane with uni-directional cycle paths (b) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	E	C	E
(c) Thorndon Quay (Tinakori Road to Motorway overpass)	D	E	D	E
Concept 4: Bus lane in both directions with a bi-directional facility (b) Hutt Road (Aotea Quay to Tinakori Road) and Thorndon Quay (Motorway overpass to Mulgrave Street)	C	F	C	B
(d) Thorndon Quay (Tinakori Road to Motorway overpass)	D	F	C	C

Through the section between the motorway overpass and Tinakori Road, the cycling level of service with uni-directional cycle paths is expected to be poor, primarily due to the constrained width through the section, hence the bi-directional cycleway is preferred through this section.

Using the Danish Level of Service spreadsheet provided, it appears that the level of service for cycling is better with the bus lanes in both directions, which appears to be a little counterintuitive because there is a wider buffer between the cycleway and the road for the southbound only bus lane when compared to the concepts with bus lanes in both directions. Figure 18 provides an indication of what a uni-directional cycle path (next to a bus stop) could look like on Thorndon Quay.

Along Thorndon Quay, this assessment against the Danish Level of Service may not be a differentiating characteristic, as the assessment is based on the Dutch approach to provide cycle tracks on both sides of the road. In the Auckland Region, it is the width of facility and the buffer width that determines the level of service, with a 1.8m uni-directional cycle path meeting the threshold for a Quality of Service 2 facility (similar to Level of Service B), and a 3.0m bi-directional facility (1.5m in each direction) would be a Quality of Service 3 facility.

Walking level of service is expected to be good along the corridor for all except the concept with bus lanes in both directions, and uni-directional cycle paths.

Figure 18: Example from Karangahape Road in Auckland (currently under construction)

Crossing Opportunities

The active mode level of service for people crossing the road has been evaluated using the level of service metrics provided by Austroads[4] which give consideration to both the crossing delay and the crossing spacing (as shown in Figure 19).

Figure 19:Pedestrian crossing level of service

Wait time at crossing (seconds)	0-25	26-50	51-100	101-200	201-400	400+
180+	E+	E+	E	E-	F-	F-
151-180	D-	D-	E+	E	F	F-
121-150	D	D	E+	E	F+	F-
91-120	D+	D+	D-	E+	F+	F
61-90	C-	D+	D	E+	E-	F
46-60	C+	C	D+	D-	E-	F+
31-45	B-	C+	C-	D-	E-	F+
16-30	B	B-	C-	D-	E-	F+
0-15	A-	B	C-	D	E	F+

Spacing (m)*

* Spacing is distance between crossing points

** Total Delay = Wait Time + Walk Time (outside of desired walk path) (Sec)

Total delay**	LOS
0-18	A
19-36	A-
37-48	B+
49-60	B+
61-72	B-
73-90	C+
91-109	C+
110-128	C-
129-161	D+
162-194	D+
195-227	D-
228-292	E+
293-357	E+
358-423	E-
424-491	F+
492-559	F+
560+	F-

Source: VicRoads (2014).

However, research suggests that wait times exceeding 30 seconds lead to people becoming impatient and crossing the road. To understand what this means for Thorndon Quay, signalised crossings have been assessed to understand the vehicle capacity, and threshold to achieve a level of service A for buses (<= 10 seconds per bus) based on an average pedestrian delay of 20 seconds and 30 seconds respectively (shown in Figure 20).

The HCM equation for used to estimate the pedestrian crossing delay (shown below) where C is the cycle time and g_{walk} is the walk time (green man). The walk time has determined by calculating the number of rows of pedestrians waiting to cross the road at a given time, assuming 1sqm per pedestrian and a walk time of 2 seconds per row.

$$delay = (C - g_{walk})^2 / 2C$$

The forecast pedestrian volumes are in the order of 400 people per hour; however, in the morning peak, the intensity of the arrivals at crossing points is higher reflecting people (including school children) alighting buses and crossing the road.

[4] AP-R575-15: Level of Service Metrics (Network Operations Planning, Figure A1.

Figure 20: Level of Service and Capacity Thresholds to achieve desired pedestrian levels of service

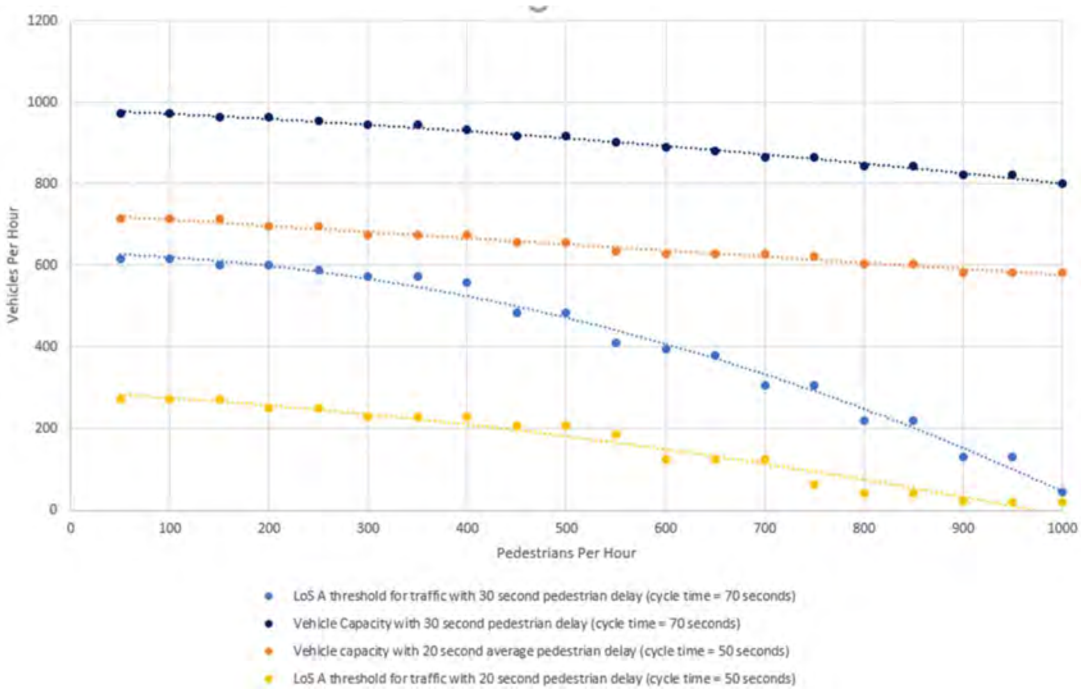


Figure 19 indicates that if pedestrians and buses are prioritised over general traffic, then a 50 second cycle time would provide a good level of service for pedestrians crossing the road and public transport; however during peak periods it is likely that the lower cycle times would result in a greater level of congestion along the corridor, which is particularly relevant for the southbound only scenarios. At a 70 second cycle time (pedestrian delay of 30 seconds), it is anticipated that the peak period traffic demands (and mixed running buses for the southbound bus lane only concepts) could be accommodated, but at the expense of increased pedestrian delay.

The analysis above does not consider signal co-ordination, nor reduced pedestrian delays if the signals are close to the bus stops. Using the Austroads method, the level of service is expected to be D- (compared with the existing LoS D) at the existing crossings primarily due to the crossing spacing. For signalised crossings adjacent to bus stops, it is anticipated that a level of service B is achievable as the stops are close to the crossing.

The crossing level of service could be improved with additional crossings along the corridor, including under the motorway overpass (next to relocated bus stops), at Tinakori Road and potentially others along Thorndon Quay to provide a 100m spacing. In peak times, with a cycle time of 70 seconds, the level of service for all modes is expected to be good, and in off-peak periods a cycle time of 50 seconds would also result in a good level of service for all modes.

Conclusions and Recommendations

Bus Reliability

The provision of a Special Vehicle Lane on Hutt Road and a bus lane along Thorndon Quay is likely to result in consistent travel times in the order of 10 - 11 minutes through to 2036 in both directions. This is lower than the current observed peak period journey times and similar to the off-peak travel times, where there is very little congestion along the corridor.

In the morning peak period, when compared to the 2036 scenario without bus priority measures (the do-minimum), the potential benefit could be in the order of 10 minutes per bus. In the evening period, the benefits are expected to be in the order of 1 – 2 minutes; however, the caveat is that the model does not account for blocking back from the motorway ramps, and hence the benefits of bus priority are likely to be higher than estimated in this assessment. In the counter peak direction, the expected benefits of the bus priority measures are likely to be less than a minute.

During the day, the future conditions along the corridor are unlikely to significantly impact on the reliability of bus services (subject to parking turnover) that would warrant further consideration of full-time bus lanes or Special Vehicle Lanes along the corridor (particularly along Thorndon Quay).

The exception to the above conclusion is in the morning peak period where a T2 lane with trucks is proposed. The volumes of traffic eligible to use the Special Vehicle Lane on Hutt Road is too high to provide any benefit to any motorised mode travelling southbound through this section. This is also likely to apply for a T2 lane without trucks as cars with more than two occupants that use SH1 shift to Hutt Road to take advantage of the Special Vehicle Lane. Therefore, it is recommended that a T2 lane (with or without trucks) is not considered further.

Freight Reliability

The reliability for trucks appears to be contingent on two aspects:

1. If trucks are eligible to use the Special Vehicle Lane on Hutt Road (Ngauranga to Kaiwharawhara); and
2. If trucks are not permitted to use the Special Vehicle Lane on Hutt Road (Ngauranga to Kaiwharawhara) and are confined to the general traffic lanes.

The use of the bus lanes on Thorndon Quay by trucks has not been considered as it is inconsistent with the street environment. There are likely to be challenges associated with the interaction at bus stops and the entrance to the bus terminal (crossing over the traffic lanes).

If trucks are eligible to use the Special Vehicle Lane on Hutt Road (between Kaiwharawhara and Ngauranga), then the reliability benefits for trucks (particularly in the peaks) are likely to be similar to the estimated public transport benefits in this section of the corridor .

If trucks are not eligible to use the Special Vehicle Lane, then they are likely to be susceptible to the impacts of replacing a general traffic lane with the Special Vehicle Lane (in the peak periods), which are expected to be a combination of:

1. Increased public transport patronage beyond what is forecast in Wellington Transport Strategy Model (WTSM) in the longer term;
2. Re-routing from Hutt Road to SH1 and other routes (such as Ngaio Gorge) beyond what is forecast in WTSM;
3. Re-routing from SH1 for vehicles eligible to use a Special Vehicle Lane on Hutt Road;
4. Peak spreading; and
5. Provision of an alternative route to the Interislander Ferry Terminal via the proposed Aotea Quay roundabout (discussed below).

The WTSM model forecasts reduce the traffic volume significantly, but still require an additional 300 vehicle per hour (~5% of the peak motorway flow) reduction in the demand for Hutt Road; however there isn't the capacity on the motorway through the interchange to accommodate this in the 7am – 9am period and there is limited spare capacity in the 6am – 7am period. However, the combination of the above has the potential to provide a neutral outcome for freight travelling to Aotea Quay, but a range of impacts from neutral to moderate negative for trucks travelling via Thorndon Quay

This uncertainty in the impacts warrants further investigation in both the elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models.

Benefit and Impact of Aotea Quay Roundabout

The potential benefit of the Aotea Quay roundabout is the potential to allow people and trucks travelling to the Interislander Ferry Terminal via SH1, instead of Hutt Road (which is the only route from the north accessible to the ferry terminal), and has the potential to be heavily congested in the morning peak period with the implementation of a Special Vehicle Lane. The work undertaken as part of the Multi-User Ferry Terminal project indicates that this may be in the order of 400 vehicles per hour in the respective morning and evening peaks. The conclusion at this stage is that there is merit in progressing to more detailed investigation of the benefits of this inclusion, using the AIMSUN models; however it is anticipated that there is a benefit for Interislander travel compared to the scenarios with a Special Vehicle Lane on Hutt Road but without the Aotea Quay roundabout.

Impact of Service Lane

The provision of a service lane along Hutt Road at Kaiwharawhara introduces another traffic signal phase and reduces the overall level of service to poor (F). However, except for a Special Vehicle Lane being a T2 lane (with or without trucks), the Special Vehicle Lane should operate reasonably efficiently, therefore continuing to provide benefits for public transport. If trucks are not able to use the Special Vehicle Lane, then they will be affected by the provision of the service lane to the same level as general traffic.

Furthermore, if the preferred proposal is to connect to a new Multi-User Ferry Terminal at the intersection of Hutt Road and Kaiwharawhara Road, the inclusion of the service lane would result in a 5-phase intersection, which may affect the performance of the Special Vehicle Lane as well. It is recommended that the Phase 2 work addresses this in more detail, including the integration of options being considered by the Multi-User Ferry Terminal project.

Active Modes

The assessment for active modes has been undertaken separately for facilities along the corridor and crossing opportunities along the section of the corridor between Aotea Quay and Thorndon Quay. Through the section between the motorway overpass and Tinakori Road, the cycling level of service with uni-directional cycle paths is expected to be poor, primarily due to the constrained width through the section, hence the bi-directional cycleway is preferred.

The assessment indicates that a lower level of service is delivered with the uni-directional cycle paths compared with the bi-directional cycle paths. Walking level of service is expected to be good along the corridor for all options except the concept with bus lanes in both directions, and uni-directional cycle paths.

Recommendations

From the analysis undertaken, the following initial conclusions have been developed and are subject to more detailed assessment in the next stage of the project:

1. There is a very strong case for bus priority (southbound) in the morning peak (as per Concept 1 and Concept 3) as it expected that there will be significant benefits;
2. There is a case for bus priority (northbound) in the evening peak, however the expected benefit is lower than benefits in the southbound morning peak;
3. It is expected that with peak period bus priority, the bus journey times will be in the order of 10-11 minutes which is lower than currently observed, and in the case of the morning peak period, significantly lower than the do-minimum;
4. There doesn't appear to be a strong case for all-day bus priority along the corridor as the level of service (reliability) is expected to remain good in off-peak periods through to 2036. However, along Hutt Road there would likely be a lesser impact to other road users if the Special Vehicle Lane was implemented before congestion develops throughout the day;
5. The type of Special Vehicle Lane is a balancing act between improving reliability for buses, improving reliability for freight, managing the impact of converting a general traffic lane to a Special Vehicle Lane, and ensuring that the volume of traffic in the Special Vehicle Lane does not negate its benefits. As a result, the recommendation at this stage (excluding safety considerations) is to exclude a T2 lane from further investigation;
6. The roundabout at Aotea Quay/Mainfreight entrance should be included under all options to provide an additional access to the Interislander Ferry Terminal, and/or to mitigate potential impacts of restricting right turn movements on Hutt Road if a raised median is implemented. The roundabout at Aotea Quay may negate the need to allow

trucks in the Special Vehicle Lane to achieve the investment objective related to access to the Interislander Ferry Terminal;

7. Consider additional controlled crossing points along Thorndon Quay to reduce the spacing between the current (which will be upgraded) and proposed crossings at Tinakori Road and the motorway overpass (where bus stops are proposed). More crossings will improve the level of service by reducing the distance to walk to a formal crossing point. The provision of additional crossings is unlikely to have a significant impact on the reliability of public transport along the corridor;
8. Uni-directional cycle paths on Thorndon Quay (between the motorway overpass and Thorndon Quay) are expected to result in a poor level of service for cycling and walking due to the constrained width, hence extending the existing bi-directional cycle path is recommended;
9. The provision of a bi-directional path along Thorndon Quay provides good level of service (B/C) and a higher level of service than the uni-directional cycle paths (D/E) using the Danish Cycling Level of Service method. This is primarily due to the path width and the buffer between the cycle path and the road. However, this assessment does not consider the safety implications of a bi-directional cycle path, which is being addressed through the Investment Objective related to safety;
10. The elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMSUN models and WTSM models are to be further investigated in Stage 2 of the project to confirm the assessment of the reliability for trucks, and;
11. Refine intersection layouts during Stage 2 of the project.

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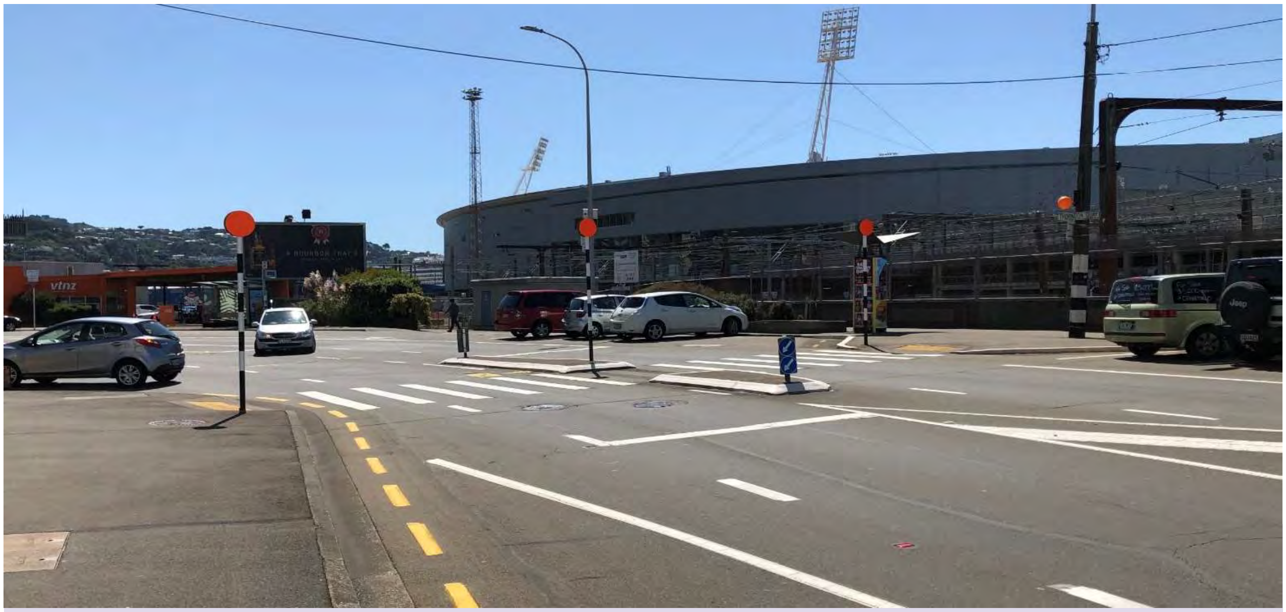


Appendix C

Indicative Cost Estimates

Project Estimate - Form B

Project Name: Thorndon Quay Hutt Road - Concept 1

IBE
Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**Excluded**	**Excluded**	**Excluded**
	Project Development Phase			
	- Consultancy Fees	Excluded		
	- NZTA Managed Costs	Excluded		
B	**Total Project Development**	**Excluded**	**Excluded**	**Excluded**
	Pre-Implementation Phase			
	- Consultancy Fees	987,680		
	- NZTA Managed Costs	764,578		
C	**Total Pre-implementation**	**1,752,258**	**525,677**	**341,690**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	692,429		
	- NZTA Managed Costs	1,278,776		
	- Consent Monitoring Fees	220,000		
	Sub Total Base Implementation Fees	**2,192,000**	**657,600**	**427,440**
	Physical Works			
1	Environmental Compliance	51,000		
2	Earthworks/Site Preparation /Earthworks	493,100		
3	Ground Improvements	Nil		
4	Drainage	485,400		
5	Pavement and Surfacing	2,736,080		
6	Bridges	Nil		
7	Retaining Walls	Nil		
8	Traffic Services	2,737,005		
9	Service Relocations	Exclud.		
10	Landscaping	5,628,000		
11	Traffic Management and Temporary Works	1,167,200		
12	Preliminary and General	2,330,000		
13	Extraordinary Construction Costs	Nil		
	Sub Total Base Physical Works	**15,628,000**	**4,688,400**	**3,047,460**
D	**Total for Implementation Phase**	**17,820,000**	**5,346,000**	**3,474,900**
E	**Project Base Estimate** (A+B+C+D)	**19,572,258**		

F	**Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**5,871,677**
G	**Project Expected Estimate**	**(E+F)**	**25,444,000**
	Nett Project Property Cost Expected Estimate		**Excluded**
	Project Development Phase Expected Estimate		**Excluded**
	Pre-implementation phase Expected Estimate		2,277,935
	Implementation Phase Expected Estimate		23,166,000

H	**Funding Risk Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**3,816,590**
I	**95th percentile Project Estimate**	**(G+H)**	**29,270,000**
	Nett Project Property Cost 95th percentile Estimate		**Excluded**
	Project Development Phase 95th percentile Estimate		**Excluded**
	Pre-implementation Phase 95th percentile Estimate		2,619,626
	Implementation Phase 95th percentile Estimate		26,640,900

Date of Estimate 04/11/2020	**Cost Index (Qtr/Year) 4 2020**
Estimate prepared Gaya Paranisamy	**Signed** PGa
Estimate verified Carl Viljoen	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate - Form B

Project Name: Thorndon Quay Hutt Road - Concept 2

IBE
Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**Excluded**	**Excluded**	**Excluded**
	Project Development Phase			
	- Consultancy Fees	Excluded		
	- NZTA Managed Costs	Excluded		
B	**Total Project Development**	**Excluded**	**Excluded**	**Excluded**
	Pre-Implementation Phase			
	- Consultancy Fees	942,980		
	- NZTA Managed Costs	764,578		
C	**Total Pre-implementation**	**1,707,558**	**512,267**	**332,974**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	741,118		
	- NZTA Managed Costs	3,749,976		
	- Consent Monitoring Fees	220,000		
	Sub Total Base Implementation Fees	**4,712,000**	**512,267**	**783,640**
	Physical Works			
1	Environmental Compliance	54,000		
2	Earthworks/Site Preparation /Earthworks	492,560		
3	Ground Improvements	Nil		
4	Drainage	485,400		
5	Pavement and Surfacing	2,179,020		
6	Bridges	Nil		
7	Retaining Walls	Nil		
8	Traffic Services	3,788,845		
9	Service Relocations	Exclud.		
10	Landscaping	4,212,000		
11	Traffic Management and Temporary Works	1,167,200		
12	Preliminary and General	2,503,000		
13	Extraordinary Construction Costs	Nil		
	Sub Total Base Physical Works	**14,883,000**	**4,464,900**	**2,902,185**
D	**Total for Implementation Phase**	**19,595,000**	**5,878,500**	**3,821,025**
E	**Project Base Estimate** (A+B+C+D)	**21,302,558**		
F	**Contingency** (Assessed/Analysed) (A+B+C+D)		**6,390,767**	
G	**Project Expected Estimate** (E+F)		**27,694,000**	
	Nett Project Property Cost Expected Estimate		**Excluded**	
	Project Development Phase Expected Estimate		**Excluded**	
	Pre-implementation phase Expected Estimate		2,219,825	
	Implementation Phase Expected Estimate		24,573,000	
H	**Funding Risk Contingency** (Assessed/Analysed) (A+B+C+D)			**4,153,999**
I	**95th percentile Project Estimate** (G+H)			**31,850,000**
	Nett Project Property Cost 95th percentile Estimate			**Excluded**
	Project Development Phase 95th percentile Estimate			**Excluded**
	Pre-implementation Phase 95th percentile Estimate			2,552,799
	Implementation Phase 95th percentile Estimate			28,257,993

Date of Estimate 04/11/2020	**Cost Index (Qtr/Year) 4 2020**
Estimate prepared Gaya Paranisamy	**Signed** PG
Estimate verified Carl Viljoen	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate - Form B

Project Name: Thorndon Quay Hutt Road - Concept 3

IBE

Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**Excluded**	**Excluded**	**Excluded**
	Project Development Phase			
	- Consultancy Fees	Excluded		
	- NZTA Managed Costs	Excluded		
B	**Total Project Development**	**Excluded**	**Excluded**	**Excluded**
	Pre-Implementation Phase			
	- Consultancy Fees	902,720		
	- NZTA Managed Costs	764,578		
C	**Total Pre-implementation**	**1,667,298**	**500,189**	**325,123**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	692,429		
	- NZTA Managed Costs	1,509,796		
	- Consent Monitoring Fees	220,000		
	Sub Total Base Implementation Fees	**2,423,000**	**500,189**	**438,478**
	Physical Works			
1	Environmental Compliance	51,000		
2	Earthworks/Site Preparation /Earthworks	493,100		
3	Ground Improvements	Nil		
4	Drainage	485,400		
5	Pavement and Surfacing	2,736,080		
6	Bridges	Nil		
7	Retaining Walls	Nil		
8	Traffic Services	2,737,005		
9	Service Relocations	Exclud.		
10	Landscaping	4,212,000		
11	Traffic Management and Temporary Works	1,167,200		
12	Preliminary and General	2,330,000		
13	Extraordinary Construction Costs	Nil		
	Sub Total Base Physical Works	**14,212,000**	**4,263,600**	**2,771,340**
D	**Total for Implementation Phase**	**16,635,000**	**4,990,500**	**3,243,825**
E	**Project Base Estimate** (A+B+C+D)	**18,302,298**		

Item	Description		Value
F	**Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**5,490,689**
G	**Project Expected Estimate**	**(E+F)**	**23,793,000**
	Nett Project Property Cost Expected Estimate		**Excluded**
	Project Development Phase Expected Estimate		**Excluded**
	Pre-implementation phase Expected Estimate		2,167,487
	Implementation Phase Expected Estimate		21,399,000

Item	Description		Value
H	**Funding Risk Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**3,568,948**
I	**95th percentile Project Estimate**	**(G+H)**	**27,370,000**
	Nett Project Property Cost 95th percentile Estimate		**Excluded**
	Project Development Phase 95th percentile Estimate		**Excluded**
	Pre-implementation Phase 95th percentile Estimate		2,492,611
	Implementation Phase 95th percentile Estimate		24,608,608

Date of Estimate 04/11/2020	**Cost Index (Qtr/Year) 4 2020**
Estimate prepared Gaya Paranisamy	**Signed**
Estimate verified Carl Viljoen	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate - Form B

Project Name: Thorndon Quay Hutt Road - Concept 4

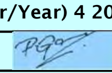
IBE

Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**Excluded**	**Excluded**	**Excluded**
	Project Development Phase			
	- Consultancy Fees	Excluded		
	- NZTA Managed Costs	Excluded		
B	**Total Project Development**	**Excluded**	**Excluded**	**Excluded**
	Pre-Implementation Phase			
	- Consultancy Fees	958,040		
	- NZTA Managed Costs	764,578		
C	**Total Pre-implementation**	**1,722,618**	**516,785**	**335,911**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	756,586		
	- NZTA Managed Costs	3,801,776		
	- Consent Monitoring Fees	220,000		
	Sub Total Base Implementation Fees	**4,779,000**	**516,785**	**794,368**
	Physical Works			
1	Environmental Compliance	54,000		
2	Earthworks/Site Preparation /Earthworks	492,560		
3	Ground Improvements	Nil		
4	Drainage	429,400		
5	Pavement and Surfacing	2,100,910		
6	Bridges	Nil		
7	Retaining Walls	Nil		
8	Traffic Services	4,116,305		
9	Service Relocations	Exclud.		
10	Landscaping	4,212,000		
11	Traffic Management and Temporary Works	1,167,200		
12	Preliminary and General	2,561,000		
13	Extraordinary Construction Costs	Nil		
	Sub Total Base Physical Works	**15,134,000**	**4,540,200**	**2,951,130**
D	**Total for Implementation Phase**	**19,913,000**	**5,973,900**	**3,883,035**
E	**Project Base Estimate** (A+B+C+D)	**21,635,618**		

F	**Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**6,490,685**
G	**Project Expected Estimate**	**(E+F)**	**28,127,000**
	Nett Project Property Cost Expected Estimate		**Excluded**
	Project Development Phase Expected Estimate		**Excluded**
	Pre-implementation phase Expected Estimate		2,239,403
	Implementation Phase Expected Estimate		24,970,000

H	**Funding Risk Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**4,218,946**
I	**95th percentile Project Estimate**	**(G+H)**	**32,350,000**
	Nett Project Property Cost 95th percentile Estimate		**Excluded**
	Project Development Phase 95th percentile Estimate		**Excluded**
	Pre-implementation Phase 95th percentile Estimate		2,575,314
	Implementation Phase 95th percentile Estimate		28,715,483

Date of Estimate 04/11/2020	**Cost Index (Qtr/Year) 4 2020**
Estimate prepared Gaya Paranisamy	**Signed** 
Estimate verified Carl Viljoen	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate - Form B

Project Name: Thorndon Quay Hutt Road - Concept 5

IBE

Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**700,000**	**210,000**	**136,500**
	Project Development Phase			
	- Consultancy Fees	Excluded		
	- NZTA Managed Costs	Excluded		
B	**Total Project Development**	**Excluded**	**Excluded**	**Excluded**
	Pre-Implementation Phase			
	- Consultancy Fees	1,125,200		
	- NZTA Managed Costs	764,578		
C	**Total Pre-implementation**	**1,889,778**	**566,933**	**368,507**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	938,973		
	- NZTA Managed Costs	4,413,776		
	- Consent Monitoring Fees	290,000		
	Sub Total Base Implementation Fees	**5,643,000**	**1,692,900**	**1,100,385**
	Physical Works			
1	Environmental Compliance	87,000		
2	Earthworks/Site Preparation /Earthworks	1,015,960		
3	Ground Improvements	Nil		
4	Drainage	722,400		
5	Pavement and Surfacing	3,478,110		
6	Bridges	Nil		
7	Retaining Walls	Nil		
8	Traffic Services	3,809,355		
9	Service Relocations	Exclud.		
10	Landscaping	4,212,000		
11	Traffic Management and Temporary Works	1,411,500		
12	Preliminary and General	3,183,000		
13	Extraordinary Construction Costs	Nil		
	Sub Total Base Physical Works	**17,920,000**	**5,376,000**	**3,494,400**
D	**Total for Implementation Phase**	**23,563,000**	**7,068,900**	**4,594,785**
E	**Project Base Estimate** (A+B+C+D)	**25,452,778**		

Item	Description		Value
F	**Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**7,635,833**
G	**Project Expected Estimate**	**(E+F)**	**33,089,000**
	Nett Project Property Cost Expected Estimate		910,000
	Project Development Phase Expected Estimate		**Excluded**
	Pre-implementation phase Expected Estimate		2,456,711
	Implementation Phase Expected Estimate		30,631,900
H	**Funding Risk Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**4,963,292**
I	**95th percentile Project Estimate**	**(G+H)**	**38,060,000**
	Nett Project Property Cost 95th percentile Estimate		1,046,500
	Project Development Phase 95th percentile Estimate		**Excluded**
	Pre-implementation Phase 95th percentile Estimate		2,826,000
	Implementation Phase 95th percentile Estimate		35,227,000

Date of Estimate 04/11/2020	**Cost Index (Qtr/Year) 4 2020**
Estimate prepared Gaya Paranisamy	**Signed**
Estimate verified Carl Viljoen	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

Project Estimate - Form B

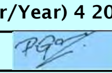
Project Name: Thorndon Quay Hutt Road - Concept 6

IBE
Indicative Business Case Estimate

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	**700,000**	**210,000**	**136,500**
	Project Development Phase			
	- Consultancy Fees	Excluded		
	- NZTA Managed Costs	Excluded		
B	**Total Project Development**	**Excluded**	**Excluded**	**Excluded**
	Pre-Implementation Phase			
	- Consultancy Fees	1,094,480		
	- NZTA Managed Costs	764,578		
C	**Total Pre-implementation**	**1,859,058**	**557,717**	**362,516**
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	904,266		
	- NZTA Managed Costs	4,289,776		
	- Consent Monitoring Fees	238,000		
	Sub Total Base Implementation Fees	**5,433,000**	**1,629,900**	**1,059,435**
	Physical Works			
1	Environmental Compliance	69,000		
2	Earthworks/Site Preparation /Earthworks	492,560		
3	Ground Improvements	Nil		
4	Drainage	429,400		
5	Pavement and Surfacing	2,602,910		
6	Bridges	Nil		
7	Retaining Walls	Nil		
8	Traffic Services	5,012,305		
9	Service Relocations	Exclud.		
10	Landscaping	4,212,000		
11	Traffic Management and Temporary Works	1,529,200		
12	Preliminary and General	3,060,000		
13	Extraordinary Construction Costs	Nil		
	Sub Total Base Physical Works	**17,408,000**	**5,222,400**	**3,394,560**
D	**Total for Implementation Phase**	**22,841,000**	**6,852,300**	**4,453,995**
E	**Project Base Estimate** (A+B+C+D)	**25,400,058**		

Item	Description		Amount
F	**Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**7,410,017**
G	**Project Expected Estimate**	**(E+F)**	**32,811,000**
	Nett Project Property Cost Expected Estimate		910,000
	Project Development Phase Expected Estimate		**Excluded**
	Pre-implementation phase Expected Estimate		2,416,775
	Implementation Phase Expected Estimate		29,694,000

Item	Description		Amount
H	**Funding Risk Contingency** (Assessed/Analysed)	**(A+B+C+D)**	**4,816,511**
I	**95th percentile Project Estimate**	**(G+H)**	**37,630,000**
	Nett Project Property Cost 95th percentile Estimate		1,046,500
	Project Development Phase 95th percentile Estimate		**Excluded**
	Pre-implementation Phase 95th percentile Estimate		2,779,292
	Implementation Phase 95th percentile Estimate		34,147,295

Date of Estimate 04/11/2020	**Cost Index (Qtr/Year) 4 2020**
Estimate prepared Gaya Paranisamy	**Signed** 
Estimate verified Carl Viljoen	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by NZTA	**Signed**

Note: (1) These estimates are exclusive of escalation and GST.

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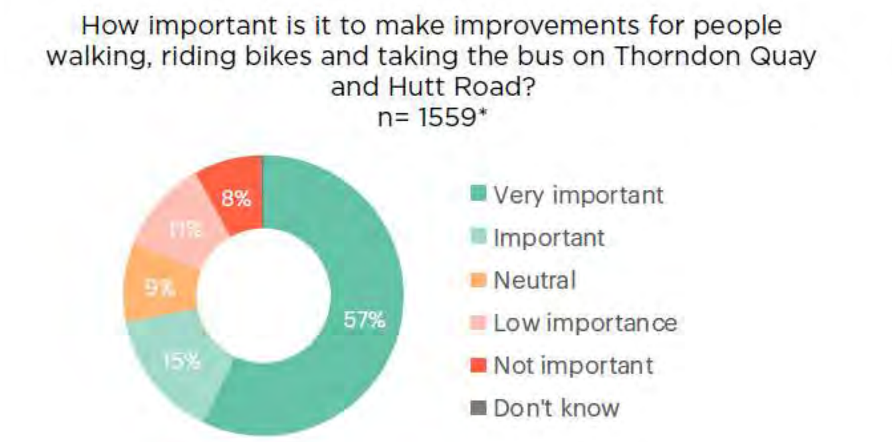
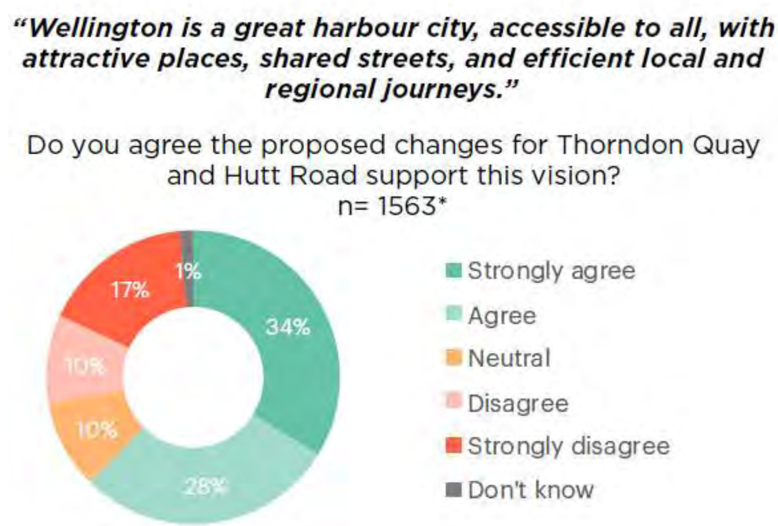
Appendix I

2021 Stakeholder and Public Engagement

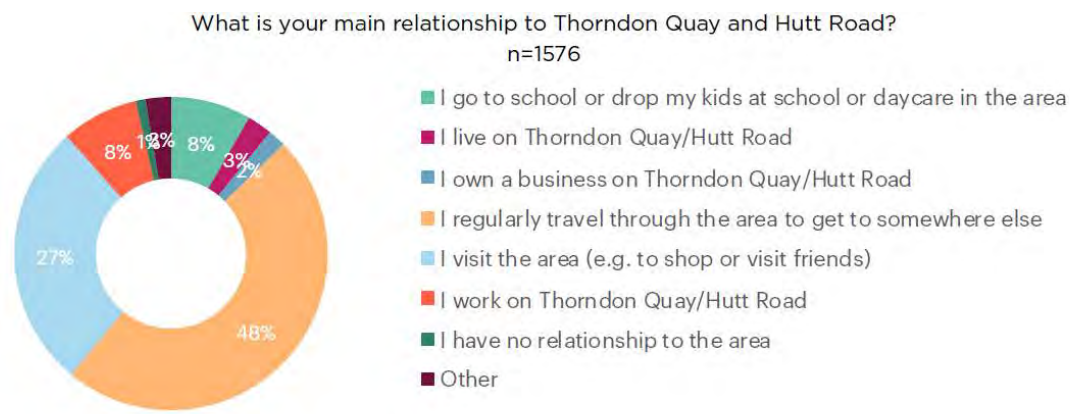
What People Thought

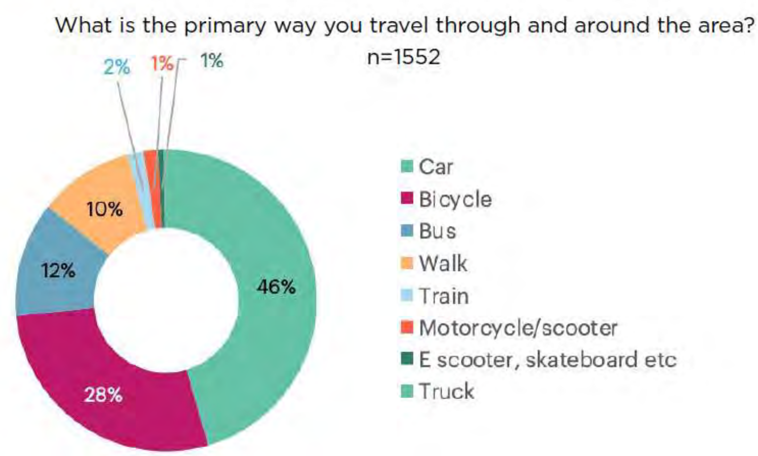
72% of respondents said that it was important or very important to make improvements for people walking, cycling and taking the bus on Thorndon Quay and Hutt Road. 62% of people agreed or strongly agreed that the proposed changes fit the vision that "Wellington is a great harbour city, accessible to all, with attractive places, shared streets, and efficient local and regional journeys".



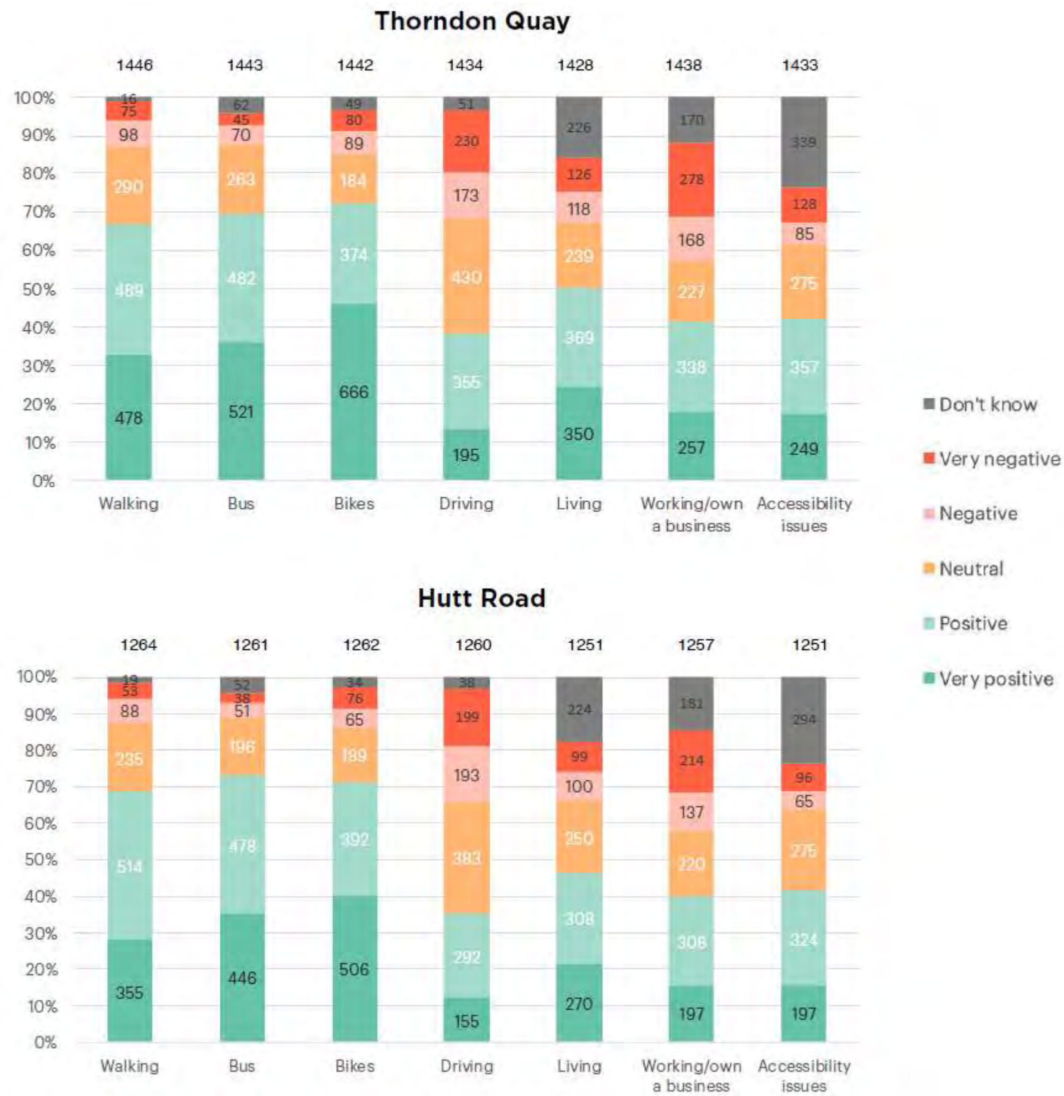


Most people's relationship to the area was either that they regularly travel through the area (48%) or visit the area (27%). 46% of respondents primarily travelled via car, and 28% primarily travelled via bicycle.





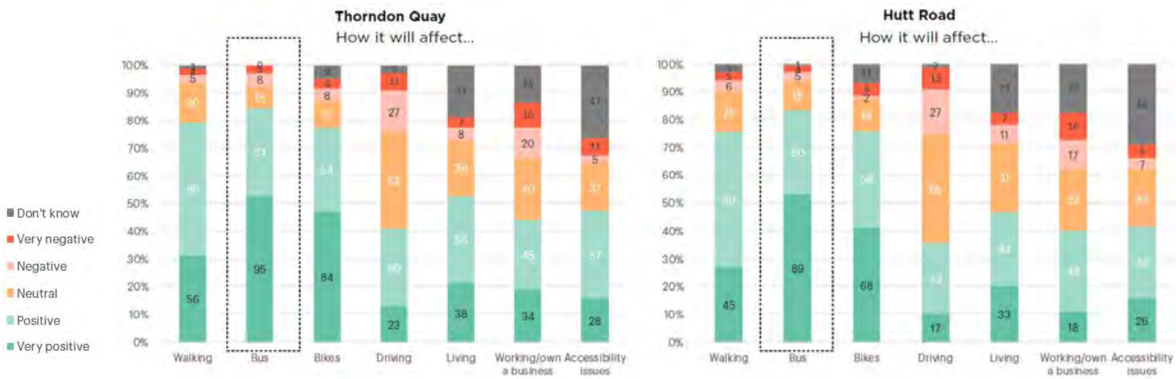
Around 70% of respondents said the changes on Hutt Road and the changes on Thorndon Quay would have positive or very positive impacts for pedestrians, people in buses, and cyclists. Feedback was mixed on what they thought the impacts would be for people driving, living, working/ owning a business, or for people with accessibility issues. At an aggregate level, there was not a significant difference between how people rated the impacts on different modes for Thorndon Quay, compared to how they rated them for Hutt Road.



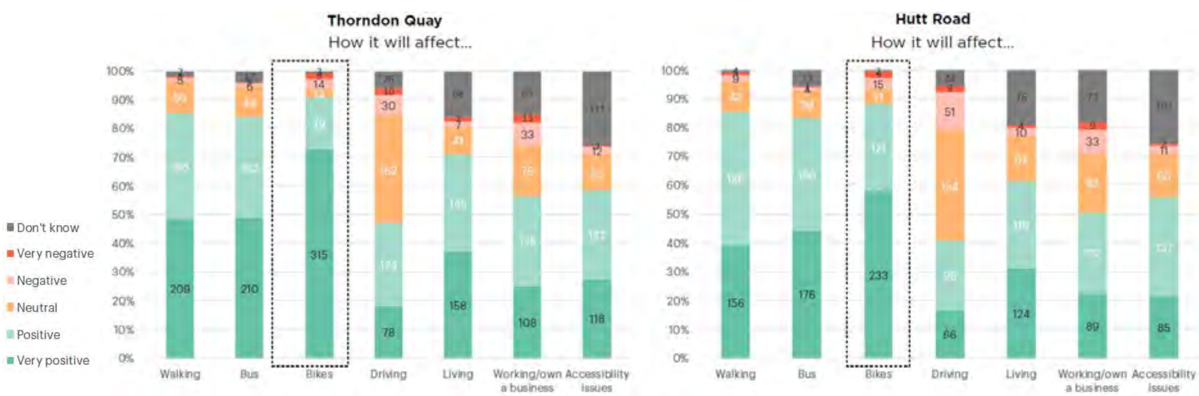
What People who use Different Modes of Travel Think about the Impacts of the Proposed Changes

People who reported that they walked, felt the proposed changes would have a positive or very positive impact. People who walk rated the Thorndon Quay changes as better (as measured by very positive), compared to the Hutt Road changes.

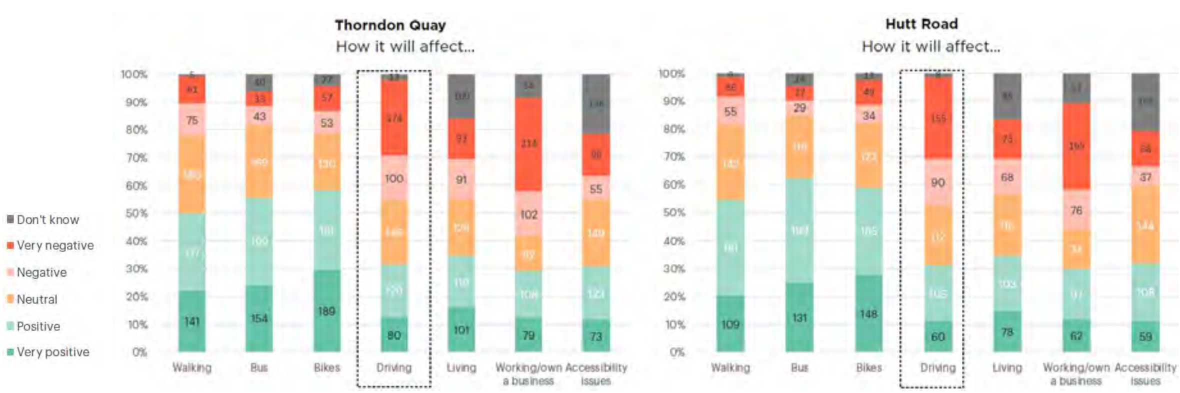
People using the bus felt the proposed changes would have a very positive impact.



People on bikes and e-scooters felt the proposed changes would have a positive or very positive impact. People who use bikes/ e-scooters rated the Thorndon Quay changes as better (as measured by very positive), compared to the Hutt Road changes.

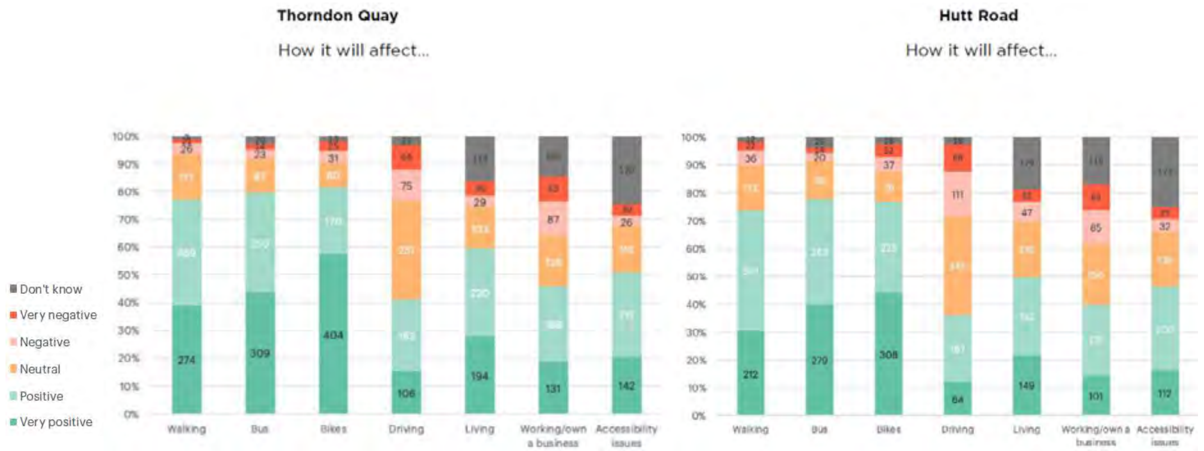


People who use cars/ trucks or motorbikes felt mixed about the expected impact of the proposed changes.

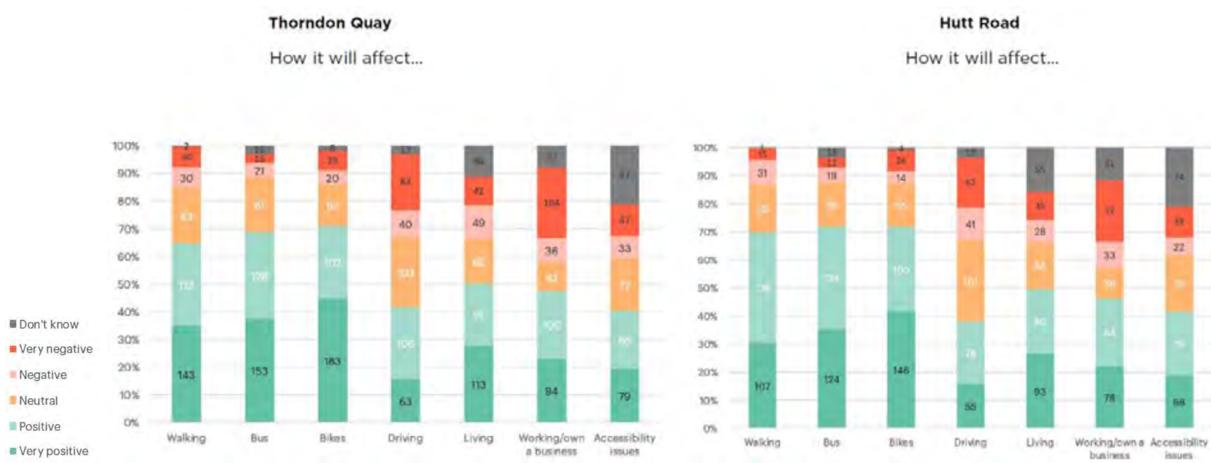


How People with Different Relationships to the Area Felt about the Impacts of the Proposed Changes

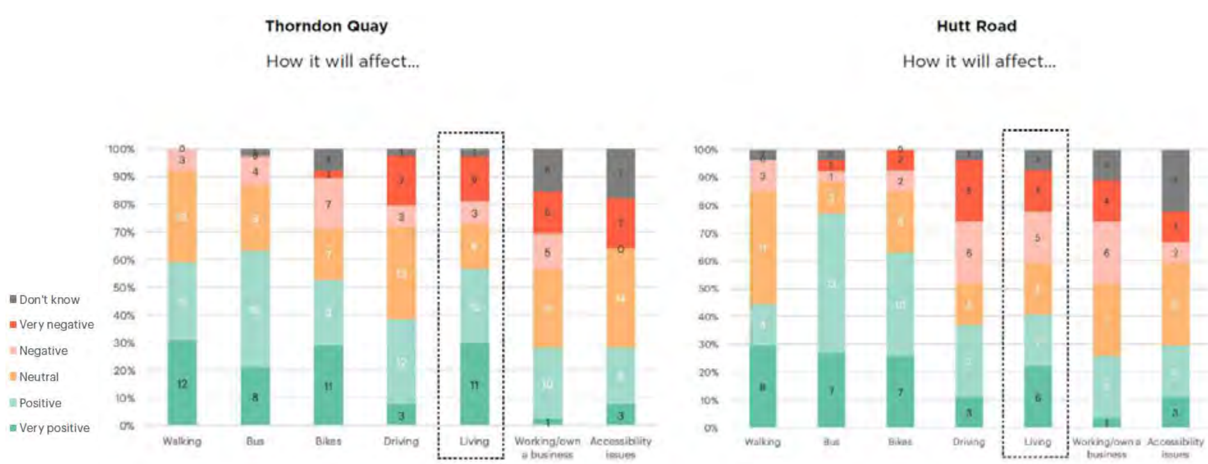
People who travel through the area generally thought the changes would have a positive impact.



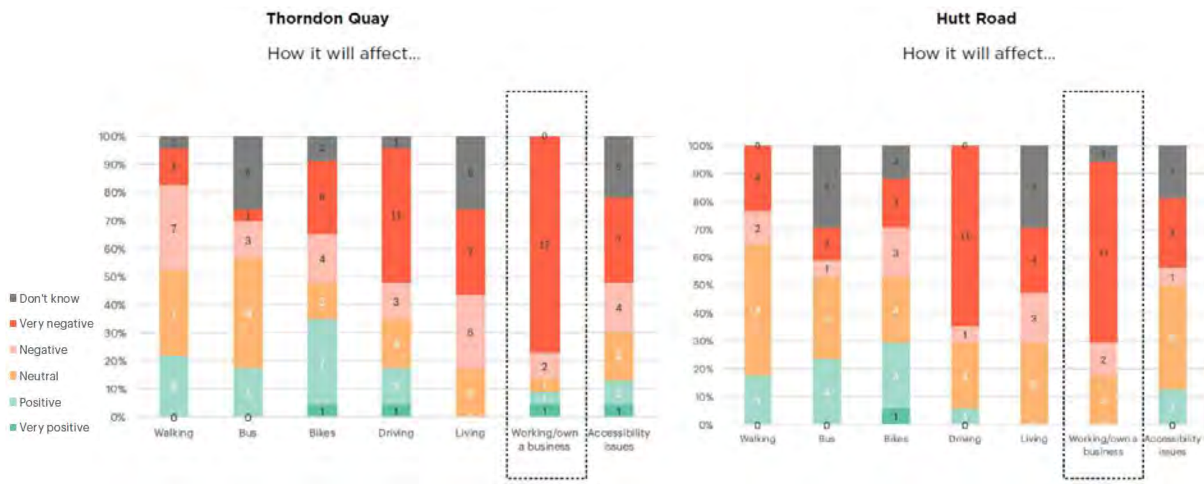
People who visit, reported that the changes would have a positive impact.



People who lived in the area were more positive about the Thorndon changes, but more mixed about the Hutt changes.

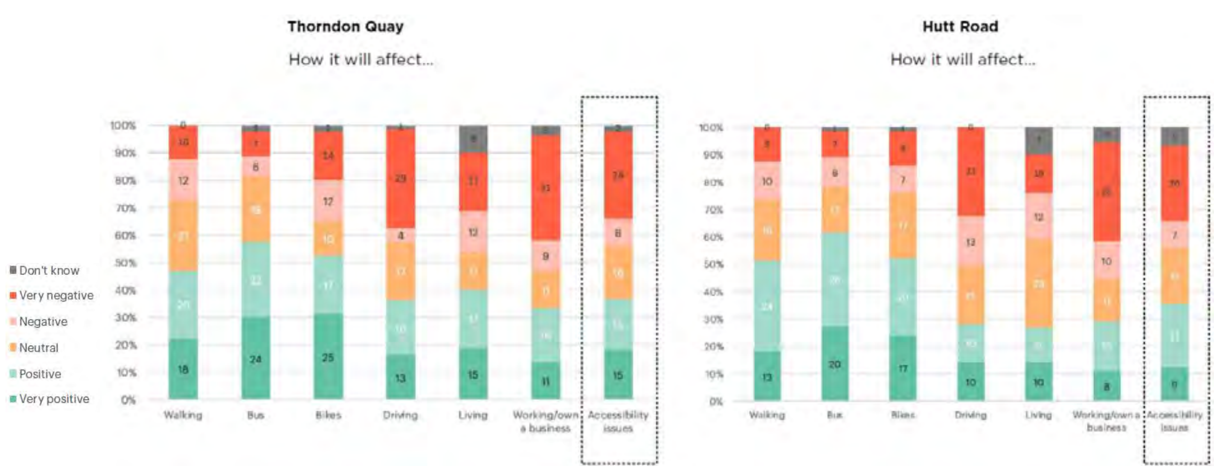


People who owned a business in the area were negative about the impacts the changes would have.

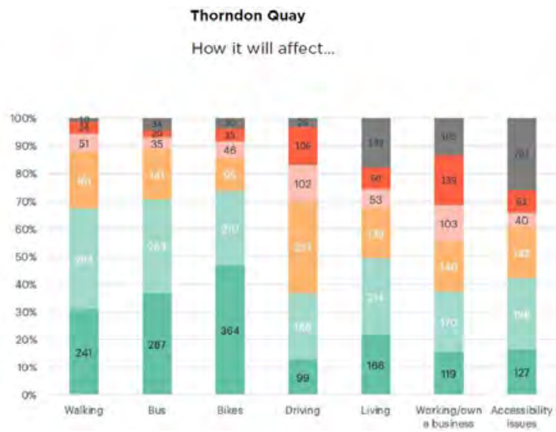


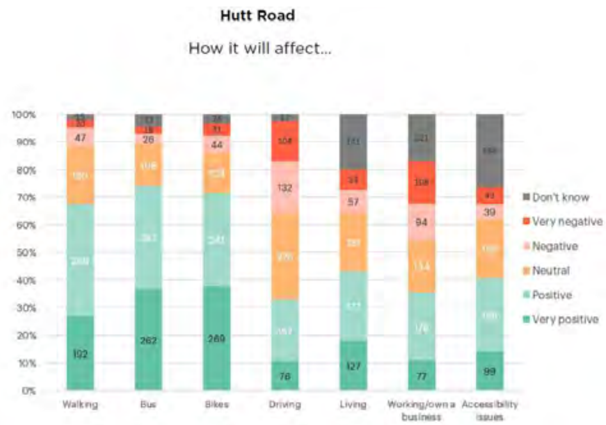
People who work in the area felt negatively about the Thorndon changes, but slightly mixed about the Hutt changes.

People living with a disability were mixed about the impacts the changes would have.

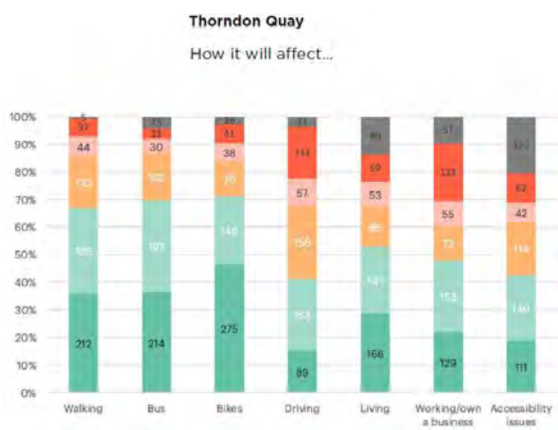


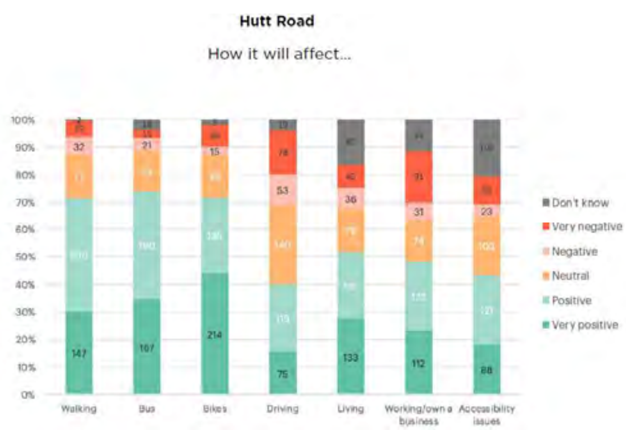
People from suburbs adjacent to the proposed changes felt positive about the impacts for walking, bus and bike, and mixed for other modes and relationships.





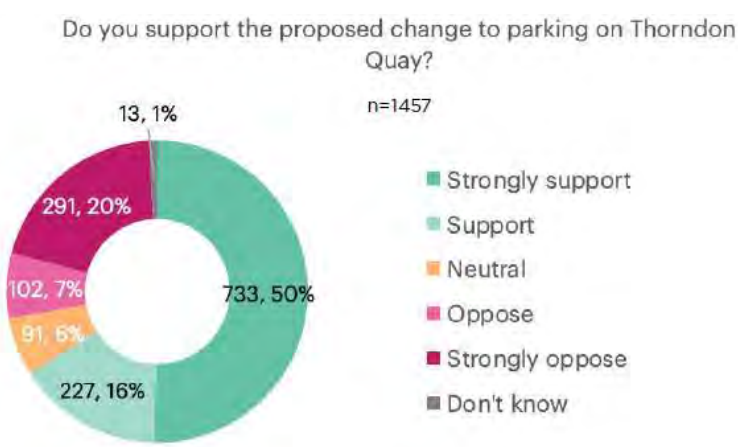
People from suburbs not adjacent to the proposed area felt more positively about the impacts for people living and working/ owning a business in the area, than those that are from the adjacent suburbs.



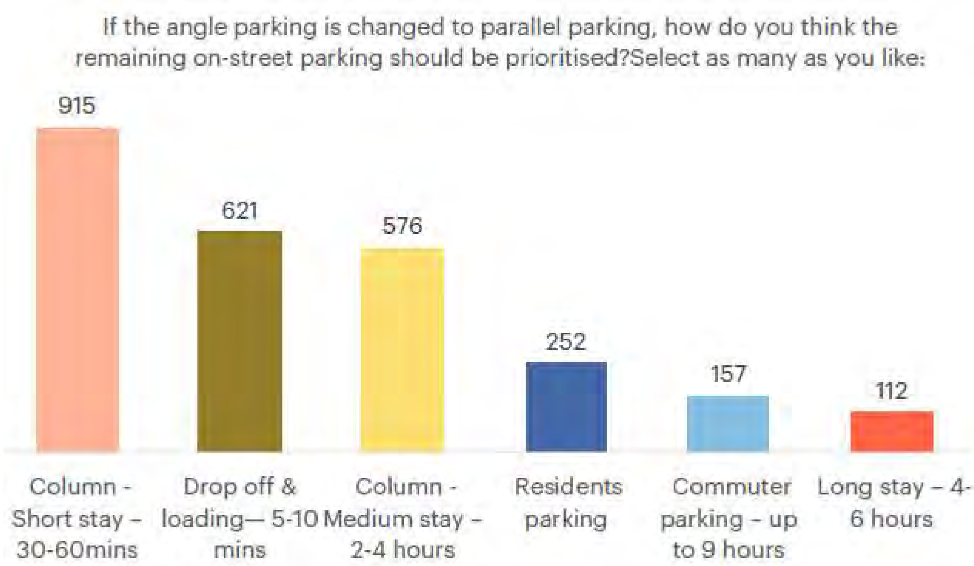


Feedback on the Thorndon Quay Angle Parking Change

66% of respondents strongly supported or supported the proposed change to parking on Thorndon Quay. 27% opposed or strongly opposed the change.



Of respondents that answered the question “If the angle parking is changed to parallel parking, how do you think the remaining on-street parking should be prioritised?”, 64% selected “Short stay - 30-60mins” parking, 11% selected “Commuter parking up to 9 hours”, and 8% selected “Long stay - 4-6 hours”.



7% said they would like to speak to Wellington City Councillors about the proposed parking change.

Next Steps

As explained in Section 4 of the SSBC, the feedback received has informed the preferred option to make safe and reliable travel choices, and a more attractive street environment.

Feedback about the initial parking changes to improve safety on Thorndon Quay was presented to Wellington City Councillors on 23rd June 2021. The Councillors agreed to convert angle parking to parallel parking on Thorndon Quay to address a key safety issue for people cycling in late 2021. They will monitor how the changes are working and discuss any future parking changes (if required) with the people that live, work and visit Thorndon Quay. This will lead to the completion of our final design.

It was also determined that, in 2022, the public will have an opportunity to have a say on proposed bus lane hours, speed limit review and further parking changes.

Appendix J

Preliminary Design Philosophy Statement

Let's GET Wellington MOVING

10 November 2021

Thorndon Quay Hutt Road

Preliminary Design Philosophy Statement

WAKA KOTAHI NZ TRANSPORT AGENCY

greater WELLINGTON REGIONAL COUNCIL Te Pane Matua Taiao

Absolutely Positively Wellington City Council Me Heke Ki Pōneke

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1 Introduction

1.1 Purpose

The purpose of this Preliminary Design Philosophy Statement (PDPS) is to set out the key design parameters and assumptions to be used in the development of the preliminary design for the single stage business case phase of the Thorndon Quay and Hutt Road Project (Project). This is a live document that will be updated throughout the project design phases.

1.2 Background

1.2.1 Let's Get Wellington Moving Programme

Thorndon Quay Hutt Road (TQHR) is part of the Let's Get Wellington Moving (LGWM) early delivery programme and is being progressed through a Single Stage Business Case (SSBC) process.

The priorities for the early delivery programme are to make travel by bus to and through the central city faster and more reliable, and to create a better environment for people walking and on bikes. Thorndon Quay and Hutt Road is the busiest bus route outside of the city centre and the busiest route in the city for people cycling to and from work.

The changes to Thorndon Quay and Hutt Road are needed to improve safety, give buses greater priority and provide better walking and cycling facilities. With a growing number of people expected to live and work in the Wellington region, more people will want to walk, cycle or take the bus instead of going by car. Te Ara Tupua, the planned shared path between Ngauranga and Petone, will enable more people to walk and cycle between the Hutt Valley and Wellington.

1.3 Project Objectives

1.3.1 Problems

From previous consultation and evidence gathered, the following problem statements were defined.

PROBLEM ONE
Unreliable bus travel times result in a poor customer experience for existing and potential bus users which reduces the attractiveness of and ability to grow travel by bus.
PROBLEM TWO
The current state of cycling facilities results in conflict between users, increases risk and limits cycling attractiveness for increasing volumes of cyclists.
PROBLEM THREE
Poor quality of the street environment creates an unpleasant experience for a growing volume of people reducing its attractiveness to walk and spend time in the area.
PROBLEM FOUR
High and growing traffic volumes combined with high speeds increases the likelihood and severity of crashes on Hutt Road.

1.3.2 Benefits of Investment

By addressing the problems, the following potential benefits of investing in transport improvements for the TQHR corridor were identified:

1.3.3 Investment Objectives

The TQHR project has five Investment Objectives which build on the identified problems and benefits for the corridor:

i Improve level of service for bus users including improved access, journey times and reliability. Provide sufficient capacity for growth in public transport

ii Improve level of service, and reduce the safety risk, for people walking and cycling along and across Thorndon Quay and Hutt Road

iii Reduce the frequency and severity of crashes

iv Improve the amenity of Thorndon Quay to support the current and future place aspirations for the corridor/area

v Maintain similar access for people and freight to the ferry terminal

The freight investment objective recognises the need to maintain the freight and people access to the ferry terminal and Centreport while making longer-term investments in other modes along Hutt Road and Thorndon Quay.

1.4 Project Area

1.4.1 General

The TQHR project area is shown in Figure 1 below. Thorndon Quay and Hutt Road are part of a critical route connecting Wellington City to the northern suburbs and the wider region. It is the busiest bus route outside the city centre, with more than 6,000 people travelling through on an average day. It is also the busiest route in the city for people biking to and from work, with up to 1,300 people biking on an average day.

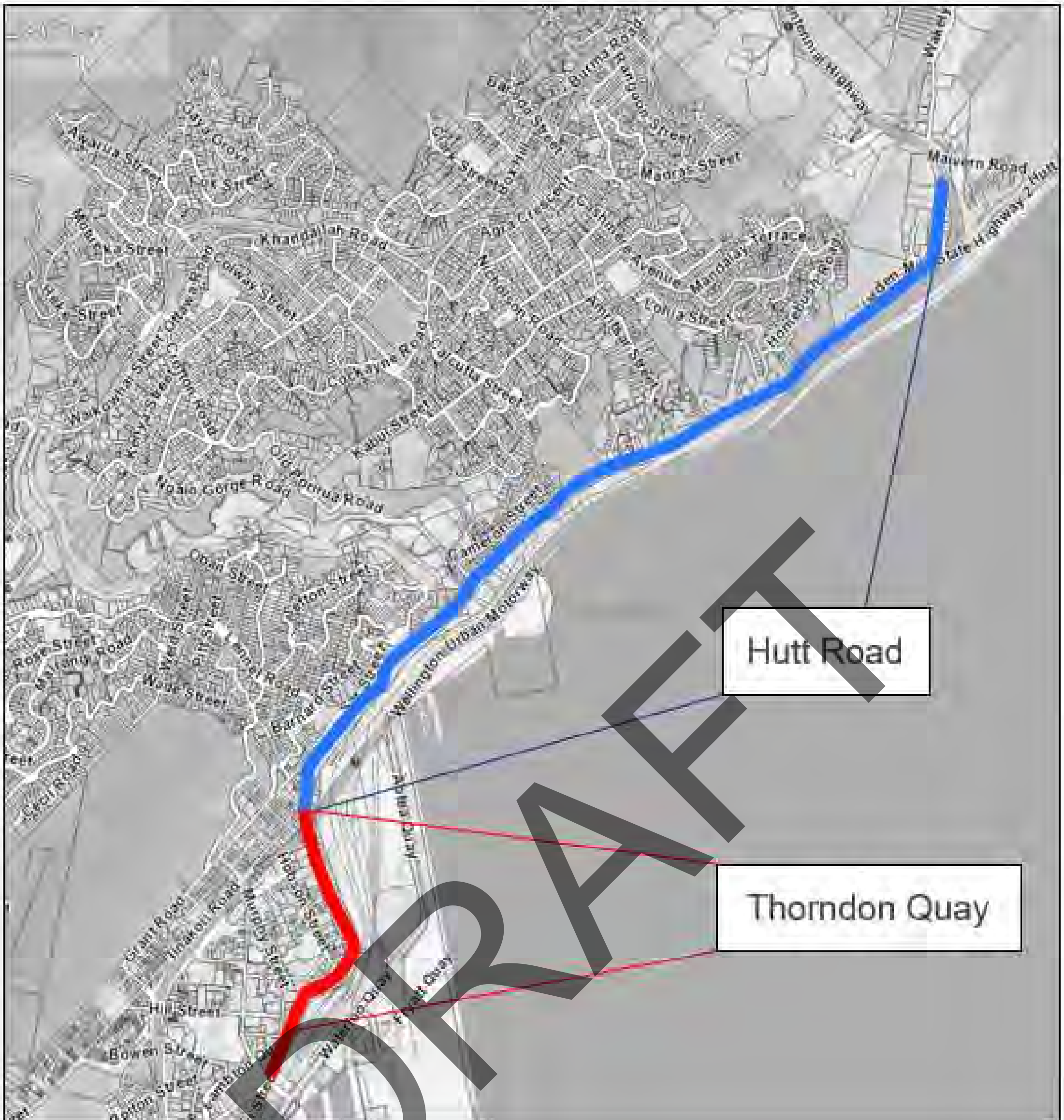


Figure 1 TQHR SSBC Project Area

1.4.2 Hutt Road / Jarden Mile Intersection

The signalised intersection between Centennial Highway, Jarden Mile, Hutt Road and the SH2 on and off ramps heading north from Wellington City has three traffic islands (between Jarden Mile and Hutt Road, the SH2 off-ramp and Hutt Road and Centennial Highway and SH2 on-ramp). There are also three median islands (on Hutt Road, Centennial Highway and SH 2 off-ramp). Facilities, in close proximity to the intersection and the Ngauranga Railway Station include an effluent disposal point (near the station) and commercial activity on Jarden Mile and Centennial Highway.

Figure 2: Existing Hutt Road / Jarden Mile Intersection

Existing speeds approaching the intersection vary between posted 50km/hr and 80km/hr limits.

There is a shared path running on the southbound side of Hutt Road and on the northbound side of Centennial Highway. Footpaths exist on both sides of Jarden Mile and the southbound side of Centennial Highway.

The intersection also includes bus stops on both sides of Hutt Road to the south of the Intersection and a further stop on the traffic island at the start of the SH2 on-ramp.

The intersection has high traffic volumes for all modes of transportation. Approximate average daily vehicle traffic volumes (ADT) are (circa 2016):

- Hutt Road (both directions): 16,400 (5% HCV)
- Jarden Mile (both directions): 1,400 (4% HCV)

- Centennial Highway (both directions): 25,500 (6% HCV)
- SH2 ramps (both directions): 12,100 (7% HCV)

1.4.3 Hutt Road

Hutt Road is some 3.5km in length starting from the north at the Jarden Mile Intersection and finishing where Hutt Road turns into Thorndon Quay at the Tinakori Road Junction. Hutt Road transitions from the urban environment of Thorndon Quay to a transportation corridor with larger retail units and local accesses. It is bounded immediately to the west by a steep scrub covered escarpment. To the east is State Highway 1, the North Island main railway lines and Wellington Harbour.

The key characteristics of Hutt Road include:

- Hutt Road is an over-dimension route and hazardous goods route.
- Hutt Road is a dual lane bi-directional road. Current lane widths are in the order of 3.4m. The central median is delineated by either chevron white lining or low-profile mountable kerbing. Lighting varies from single sided on the western side to sections on both sides after the rail bridge. There are numerous retaining walls, of various typologies, along the road.
- There are a number of stormwater structures along Hutt Road. Flows are predominantly from the North West draining 'across' the road/railway towards Wellington Harbour.
- A railway overbridge with central piers is located between Ngauranga Gorge and the Onslow Intersection.
- The intersection with Onslow Road is signalised. Onslow Road rises steeply from Hutt Road and runs parallel (northwards) with Hutt Road. This results in vehicles wanting to head north from Onslow Road needing to turn a full 180 degrees effectively cutting across the two lanes of Hutt Road.
- From the Intersection of Onslow Road into the city (Khaiwharawhara Intersection area) there are a number of large commercial units with direct access onto Hutt Road.
- The final Intersection on Hutt Road before it changes to Thorndon Quay is with Tinakori Road. This is another intersection where 180-degree manoeuvres are made onto a steeply rising side road. There are no pedestrian facilities for the first 100m of Tinakori Road.
- It is noted that the bulk of HCV's on Hutt Road are heading to and from the Port. Levels of movement beyond (entering Thorndon Quay) are significantly reduced.

1.4.4 Thorndon Quay

Thorndon Quay is an urban corridor approximately 1.3km in length between the intersections with Tinakori Road and Mulgrave Street. Thorndon Quay is primarily a single lane in each direction with a typical lane width of 3.5m. Angle parking is provided through the main commercial centre of Thorndon Quay. Cyclists are accommodated by space between the angled parking and the traffic lanes. The commercial units in Thorndon Quay are smaller in nature than the units on Hutt Road. There are three pedestrian zebra crossings on the Thorndon Quay.

There are two 'T' Intersections (Davis Street and Moore Street) on the western side of Thorndon Quay, which provide access to the Wellington Girls College and hence have significant traffic at school times. Davis Street provides access to the local Thorndon area. Moore Street is a Cul-de-sac with pedestrian access to Pipitea Street and Wellington Girls College.

Mulgrave Street is a one-way road at the intersection of Kate Sheppard Place, Lambton Quay (reserved for buses only) and Thorndon Quay. The Intersection has a number of crossing manoeuvres only some of which are currently signalised.

2 Preliminary Design Development Philosophy

2.1 Approach

This project is about people, enhancing communities and providing effective and efficient transport. This means prioritising modes of transport and allocation of space that supports moving people and accommodating freight.

Throughout the design development the LGWM project objectives have been principle guides to the design. Complementing the five objectives from the LGWM programme, it is proposed to apply fundamental urban design principles. Urban Design principles cover all aspects in the delivery of places. It provides guidance in achieving and assessing the quality of developed and restored urban areas.

Hutt Road and Thorndon Quay are both constrained corridors with limited available width to accommodate the various transport modes and other improvements. There are areas where compromises have been necessary to develop the design. For the different transport modes, the design has prioritised provision for walking and cycling, then public transport followed by general traffic. A strong safety focus has been used in the development of the preliminary design and has been a key criteria used in compromise discussions where necessary.

2.2 Mana Whenua Values

The following are the draft Mana Whenua values for the LGWM programme. These values are to be used to guide the development of the design.

Tahi – Whakapapa - A sense of Place

- Building works restore a healthy relationship with nature
- Finished projects tell the story of the place
- Native plantings
- Urban agriculture

Rua - Wai-ora - Respect the Role of Water

- Acknowledge the importance of water
- Resurrect the natural water courses
- Manage water run off to ensure only purest water flows to the harbour

Toru - Pūngao-ora – Energy

- Minimise energy use during construction
- Completed projects to aim to be energy neutral

Whā - Hau-ora – Optimising Health & Wellbeing

- Prior to construction minimise uncertainty by clear goals and timeline
- During construction minimise disturbance to neighbours
- Completed projects to use plantings and water flows to provide healthy environments

Rima - Whakamahitanga - Use of Materials

- Recycle the maximum of materials disposed of during construction

- Build with materials and methods that use the lowest energy possible
- Avoid toxic materials that may leach into air or ground water

Ono - Manaakitanga – Support a Just and Equitable Society

- Embody our values in these projects
- Work with locals to the extent possible
- Provide safe and inviting public spaces

Whitu - Whakāhuatanga - Celebrate Beauty in Design

- Design in a way that lifts the human spirit
- Incorporate public art and interpretation to tell the story of what has gone before

Whakamatautautanga

- Monitoring

3 Interim Option Scope

3.1 General

The technically preferred option is Option 4A. It includes Northbound and Southbound bus lanes on both Thorndon Quay and Hutt Road. The priority lane on Hutt Road (between Ngauranga and Kaiwharawhara) will be available for certain vehicles to use (e.g. buses, and freight), and will use the lane nearest the kerb, leaving one lane for general traffic. This will improve bus and freight reliability throughout the whole corridor in both directions by improving journey times to and from the city during the morning and afternoon peak traffic.

This option also introduces a separated cycle path on Thorndon Quay to improve cycle safety and level of service. It is complemented by the existing and proposed bidirectional cycle path on Hutt Road. This project is part of the Te Ara Tupua (Wellington CBD to Hutt Valley walking and cycling link) project and will connect to the Ngā Ūranga to Pito-one section of Te Ara Tupua.

The technically preferred option includes the following elements:

- Special Vehicle Lanes in both directions on Hutt Road
- Bus Lanes in both directions on Thorndon Quay
- A bidirectional cycleway on Thorndon Quay / Hutt Rd
- A roundabout on Aotea Quay
- Speed limit changes
- Intersection upgrades
- Pedestrian crossing improvements
- Bus stop rebalancing
- Amenity improvements to Thorndon Quay
- A median on Hutt Road to manage safety risks with turning movements /

The sections that follow summarise the design criteria for key design elements of the project, including where relevant, minimum and desirable widths for traffic lanes, bus lanes, cycleways and other infrastructure.

3.2 Hutt Road / Jarden Mile Intersection

A specimen design of the Hutt Road interchange was carried out by Beca in 2016. Figure 3 indicates the extents of that design. As part of the Stage 2 preliminary design the previous design has been reviewed for integration issues with the proposed preliminary design for the Hutt Road section.

The preferred design was prepared in accordance with the Austroads suite of design guides.

It is noted that there are some stormwater ponding issues that will need to be addressed in the detailed design on the northbound Hutt Road approach to the Intersection.

The proposed configuration (Figure 4) has been altered from the specimen design after consultation with the partner organisations. The main changes are the relocation of bus stops, the reassignment of lanes for the approaches northbound, including the removal of the central cycle lane converting to a bus lane. Consideration has also been given to weaving lengths for traffic approaching northbound. A 200m distance is provided where the SPV lane has been dropped to allow vehicles to correctly position themselves at the junction. Pedestrian and cyclist crossing provision has been made by designated crossings and increasing the sizes of the islands.

It is noted that an illegal movement carried out by some vehicles heading southbound on SH1 but turning left to jump queues needs to be addressed during the detailed design.

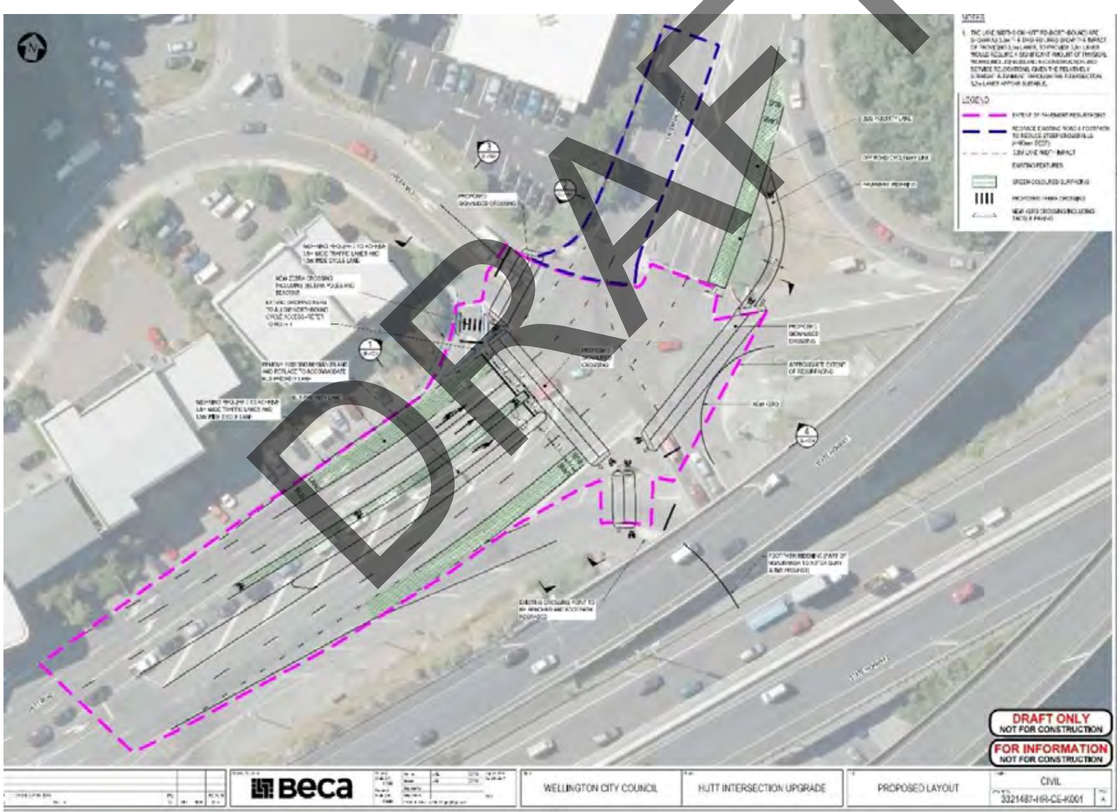


Figure 3: Specimen Design Diagram of the Hutt Road / Jarden Mile Intersection

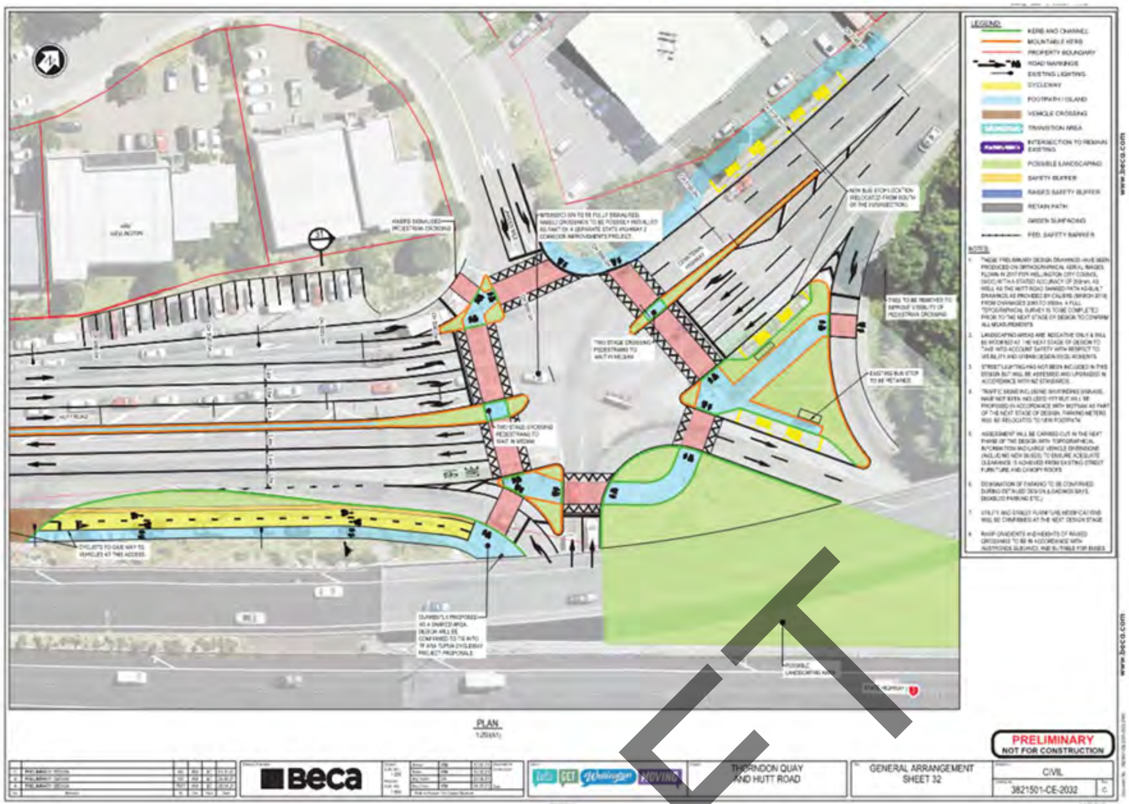


Figure 4: TQHR Project Prelim Design Diagram for the Hutt Road / Jarden Mile Intersection

3.3 Hutt Road

The proposal for Hutt Road is to reallocate road space by repurposing one lane in each direction to provide a peak period special vehicle lane (SPV) for buses and freight.

The key elements of the project along Hutt Road include:

- One general vehicle lane in each direction
- In the northern section, an SPV Lane for buses and freight.
- In the southern section the SPV lane becomes a peak period bus lane. During off peak the bus lane becomes on-street parallel parking.
- A raised central median to restrict right turns except at clearly defined and controlled locations.
- A 0.8m safety buffer to protect vulnerable users from traffic, from the wind blasts from large vehicles and from doors opening direct into the cycle path.
- Widened cycle and pedestrian lanes tying into the newly constructed lengths at the southern end of Hutt Road. These are proposed to be at the same level along Hutt Road to provide flexibility for multipurpose usage. The widths have been considered to allow for safe passing, considering people of varying competency levels. In a few locations the widths have had to be reduced from the desirable due to spatial constraints.

The proposed general cross sections for Hutt Road is shown in Figure 5 below.

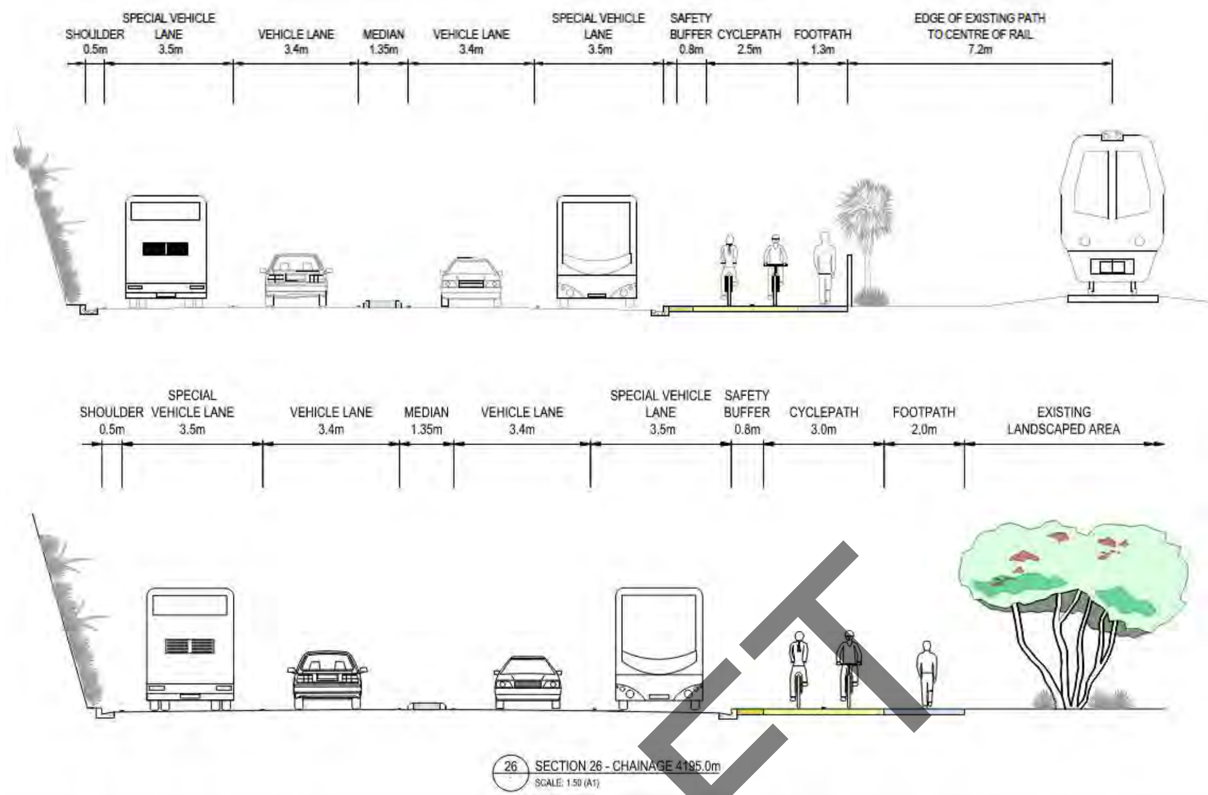


Figure 5: Proposed Hutt Road Cross Sections

The preliminary design does not alter the current configurations for Sar Street, Khaiwharawhara Road, and Rangiora Ave intersections. However, at the Onslow Road intersection the current Seagull configuration is proposed to be fully signalised. The purpose for signalisation is to provide a secure crossing for cyclists who are not currently catered for. Space at this intersection is constrained. However, sufficient space has been identified to widen the main cycle/pedestrian pathway as well. This will require combining the southbound through and right movements into one lane and 'split' phasing the intersection to restrict right turn filter movements. There is no provision for pedestrians going up Onslow Road and hence there is no proposed pedestrian crossing.

At Tinakori Street intersection raised crossings provide a safer crossing environment for both pedestrians and cyclists. Along Hutt Road, the recently constructed cycleway/footpath ties into the new configuration for the Thorndon Quay section. The bulk of the manoeuvres remain unchanged with exception of the addition of the bus lanes.

At the interface around the Tinakori Road Intersection, currently the existing uni-directional cycleway crosses to a bi-directional cycleway on the eastern side of Hutt Road. Cycle/Pedestrian crossing locations and functionality needs to be developed in conjunction with the review of the intersections as these are the logical crossing points. It is felt that currently the more vulnerable users are not well served.

The tables below summarise the existing vs proposed widths for key elements along Hutt Road.

Description	Existing	Proposed
Running lanes	2 lanes in each direction with approx. 3.4m lanes	1 lane in each direction for main traffic – proposed width varies 3.2 – 3.5m 1 SPV (nearside) lane varies 3.4 - 3.5m
Median	Flush - Varies approx. 3m	Raised - 3.0m
Safety Buffer	N/A	0.8m – same level - Buffer/Cycle/Ped
Cycle path	Combined Cycle ped 2.0m	3.0m - same level - Buffer/Cycle/Ped
Pedestrian path	As above	2.0m - same level - Buffer/Cycle/Ped
Parking	N/A	N/A

Table 1: Hutt Road – Existing vs Proposed Widths - North Section (Aotea Quay to Jarden Mile)

Description	Existing	Proposed
Running lanes	2 lanes in each direction approx. 3.4m lanes	1 lane in each direction for main traffic – proposed width varies 3.2 – 3.5m 1 SPV (nearside) Lane varies 3.4 - 3.5m Off peak SPV lane turns in to Parking lane
Median	Flush - Varies approx. 3m	Raised - 3.0m
Safety Buffer	0.8m – same level - Buffer/Cycle/Ped	0.8m – same level - Buffer/Cycle/Ped
Cycle path	3.0m - same level - Buffer/Cycle/Ped	3.5m same level - Buffer/Cycle/Ped
Pedestrian path	2.0m - same level - Buffer/Cycle/Ped	3.0m - same level - Buffer/Cycle/Ped
Parking	N/A	Off peak hours SPV lane becomes parking

Table 2: Hutt Road – Existing vs Proposed Widths - South Section (Tinakori Rd to Aotea Quay)

3.4 Thorndon Quay

The proposal for Thorndon Quay is to reallocate road space to provide:

- One general traffic lane in each direction
- One peak period bus lane in each direction which will be parallel parking off peak
- A dedicated, off road cycle path on the eastern side
- Raised buffers and amenity areas

The proposed general cross section for Thorndon Quay is shown in Figure 6 below.

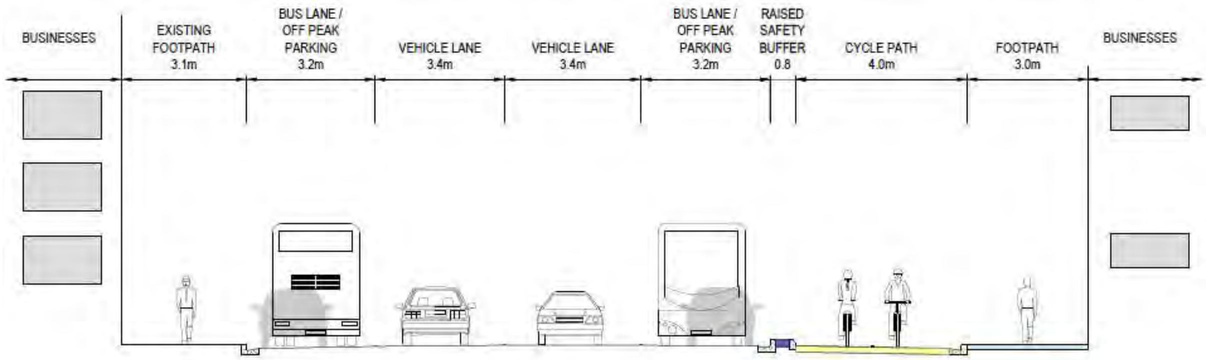


Figure 6: Proposed Thorndon Quay Cross Section

The proposed relocation of the cycle path to between the footpath and the parking / bus lane will significantly improve safety removing the potential conflict between cyclists and vehicles. Pedestrian and cycle crossings of Thorndon Quay will also be improved (raised signalised crossings), as well as the addition of landscaping and other amenity improvements.

Enhancements to the Mulgrave Street intersection, including full signalisation, have been developed which are intended to improve bus movements in and out of the adjacent bus station.

The table below summarises the existing vs proposed widths for key elements along Thorndon Quay.

Description	Existing	Proposed
Running lanes	1 lane in each direction approx. 3.5m lanes	1 lane in each direction for main traffic – proposed width 3.4m 1 Bus (nearside) Lane 3.2m Off peak Bus lane turns in to Parking
Safety Buffer	N/A	0.8m – raised level - Buffer/Cycle/Ped
Cycle path	In carriageway	4.0m - dropped level - Buffer/Cycle/Ped
Pedestrian path	Primarily in the order of 2m on both sides of road	West side unchanged - Eastern side 1.8 – 3.3m - raised level - Buffer/Cycle/Ped
Parking	Northbound mix parallel and diagonal parking Southbound mix some parallel but mostly diagonal parking	Off peak Bus lane turns in to Parking

Table 3: Thorndon Quay – Existing vs Proposed Widths

3.5 Aotea Quay Roundabout

A roundabout on Aotea Quay is proposed to provide a turnaround location for vehicles/freight as a result of restricting turning movements on Hutt Road. A design was carried out by (Spiire, circa 2014). This is shown in Figure 7 below. The design was reviewed by the project team for issues that may impact upon the integration into the preliminary design for TQHR. The following key issues were raised:

- There is no space to provide the footpath on the seaward side of the road / roundabout as the fenceline is hard up to the existing road with rail sidings on the other side
- The ‘Seagull’ configuration raises safety concerns due to the nature of the vehicles that will be pulling into the fast through lane. HCV’s will be exiting the roundabout at low speed and then merging into the fast lane of the through traffic on Aotea Quay. From a safety point of view this manoeuvre is considered problematic due to the differences in road speeds and limited visibility on the blind side of HCV’s as they pull out.

Figure 7: Aotea Quay Roundabout (Spiire Design for Wellington City Council)

Following the review and the safety audit comments it has been agreed that a full roundabout controlling all movements is the preferred option (Refer Figure 8). It is also the intention that the posted speed limit along Aotea Quay will be reduced from the current 70km/hr to 50km/hr and hence will be consistent with the posted speed on Hutt Road.

The proposed intersection needs to be signalised for traffic control purposes for the nearby sports stadium which has an emergency evacuation plan requiring closure of the road in an emergency. The signals are unlikely to be required 24/7 but may be required for other reasons during peak traffic times to facilitate vehicles exiting from the freight yards.

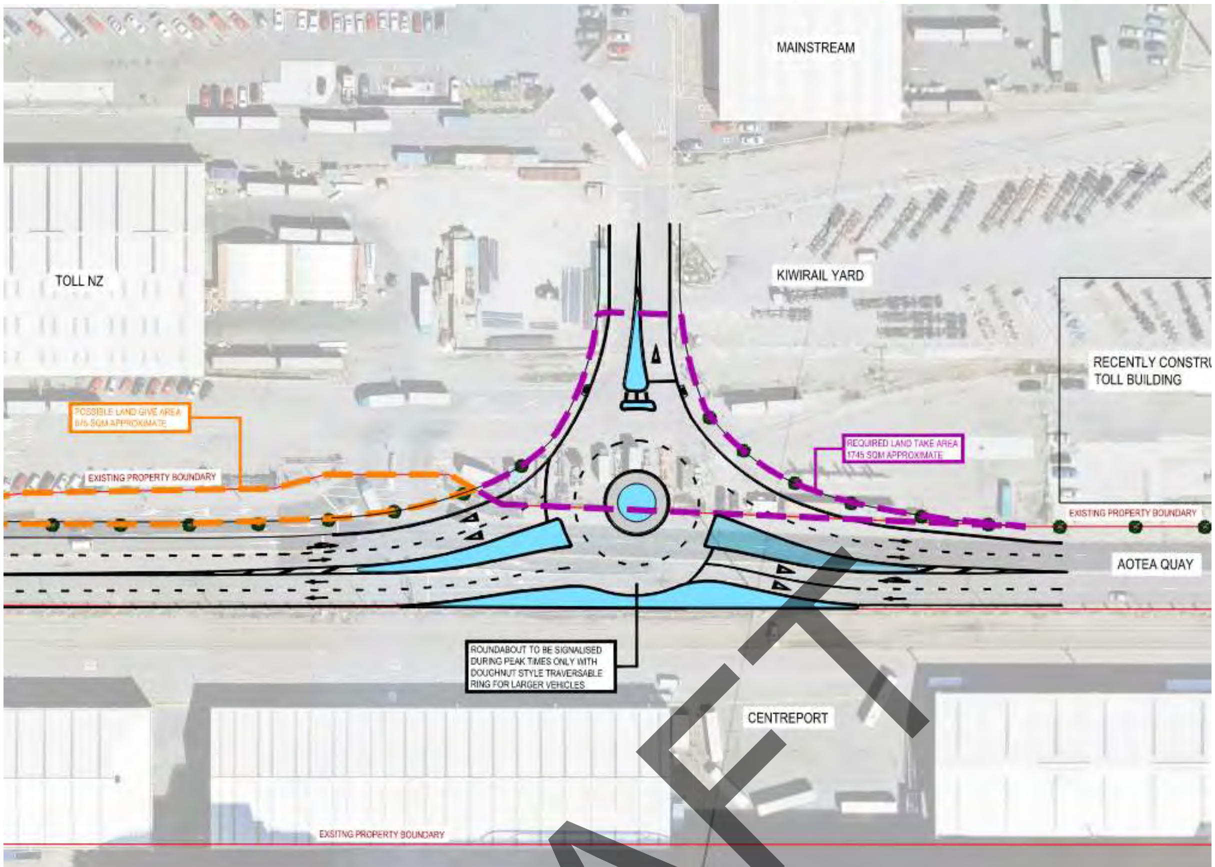


Figure 8: Proposed Aotea Quay Roundabout

At the time of writing this report further options were being developed to provide an option that mitigates the encroachment into KiwiRail land.

4 Design Criteria

4.1 Design Standards

The following design guides have been used as part of this design stage of the project:

- Austroads – Guide to Road Design including the following sections:
  - Part 2 Design considerations
  - Part 3 Geometric design
  - Part 4 Intersections and Crossings
  - Part 5 Drainage
  - Part 6 Roadside design Includes Part 6A Paths for walking and Cycling
- Cycling Aspects of Austroads Guides 2017
- Supplementary guidance from TM2501 – May 2012 - (Super-elevation calculations) and TM2502 – January 2014 – (on Surface water Run-off).
- The State Highway Geometric Design Manual (SHGDM)
- NZTA - Pedestrian planning and design guide – Nov 2009
- Wellington Water, Regional Standards for Water Services, May 2019 (Wellington Water, 2019)

- WCC Code of Practice for Land Development December 2012
- NZTA - P46 Stormwater Specification April 2016 (NZTA, 2016)
- NZTA – Traffic Control Devices Manual (Dec 2008)
- NZTA - Manual of Traffic Signs and Markings (MOTSAM)
- NZTA - Pedestrian Planning guide
- NZTA – Walking-cycling and public transport – Cycling standards and guidance
- NZTA – Technical Note 2 (TN002) - Separated cycleways at side roads and driveways

4.2 Design Traffic / Traffic Modelling

The following table summarises traffic data for Hutt Road and Thorndon Quay, taken from the Waka Kotahi One Network Classification database.

Road	Heavy Goods Vehicles %	Traffic ADT
Hutt Road	5 – 9 %	20,000 - 23,250
Thorndon Quay	5%	7,000 – 11,500

Table 4: Existing Traffic Volumes

Traffic modeling was initiated using Sidra modeling for each individual intersection. The output from these assessments was then submitted to Greater Wellington Regional Council for analysis using the regional models. The project team are awaiting the results of that modeling.

4.3 Road Classification

The road classification for both Hutt Road and Thorndon Quay is Arterial roads. The proposed classification will remain unchanged.

4.4 Design Speed

The current posted speed on Thorndon Road is 50km/hr. The operating speed is in the order of 60km/hr. It is proposed to drop this posted speed to 40km/hr.

The current posted speed on Hutt Road is 60km/hr rising to 80km/hr north of Onslow Road. The operating speed is between 70 and 90km/hr. It is proposed to drop these posted speeds to 50 and 60km/hr respectively.

The reduction in speeds is proposed on a safety basis.

Speeds less than 69km/hr are classified as low speed in *Austroads, Guide to Road Design Part 3*. This classification is then used to assist in the definition of suitable lane widths.

5 Geometric Design

5.1 Topographical Data

The preliminary design has been developed from the single stage business case phase using LIDAR data as the ground model and aerial photography from 2018. This information is considered suitable for the preliminary design stage. However, it is anticipated that a detailed topographical survey will need to be undertaken to enable refinement of the geometric design to inform the pre-implementation phase. Some specific areas such as the Mulgrave Intersection, Tinakori Road intersection and the section between Moore Street and Davis Street were approved for additional survey work to inform the preliminary design primarily due to the mature trees obscuring the LIDAR vision. The results of these surveys resulted in some realignment of the designed kerb lines at the Tinakori Road Junction.

5.2 Typical Cross Sections and Lane Widths

Indicative cross sections were developed for Stage 1. During Stage 2 these sections have been challenged and finalised in discussions with the partner organisations and inform the geometric design.

The project team have worked with the partner organisations to develop and agree parameters to inform the geometric design including lane widths, Special Purpose Vehicle (SPV) lane operations, bus stop locations and functionality as well as the amenity treatment. Meeting minutes from a joint design standards session with the partner organisations is included in Appendix A.

Table 5 summarises standard design widths for elements of the road corridor.

Table 5: Standard Design Widths for Individual Elements of the Road Corridor

Road Element	Standard Width	Design Source	Selected Widths
Footpath	Arterial Road 2.4m + Commercial Outside CBD 1.8m	NZTA Ped Planning Guide chapter 14 (Table 14.3)	2.0 - 2.4m Thorndon Quay 1.6m - 3.1m Hutt Rd
Cyclepath – Uni Directional	Min 2.4 / Tolerable 2.6 / preferred 3.0m	NZTA Cycling Network Guidance	Not used
Cyclepath – Bi Directional	Min 3.0 / Tolerable 3.5 / preferred 4.0m	NZTA Cycling Network Guidance	3.0-4.0m
Bus Lane	Min 3.7m / Preferred > 4.5m	AustRoads Part 3 section 4.9.2 (Table 4.22)	3.2m Thorndon Quay 3.5m Hutt Rd
Traffic Lane	Low Use/Low truck Vol 3.0 – 3.4m General Width All Roads 3.5m	AustRoads Part 3 (Table 4.3)	3.4m
High Occupancy Vehicle (HOV) Lane	3.5 – 4.5m	AustRoads Part 3 (Table 4.3)	SPV lane Hutt Rd 3.5m
Parking	2.1 – 3.2m (2.3m in normal conditions)	AustRoads Part 3 (Fig 4.46)	2.4m (within bus lane)

The existing shoulder and median spaces on Hutt Road have been redistributed to provide a raised median and improved cycle/ pedestrian widths. With the off-road cycle facility, the shoulders will not be required for cyclists, and broken-down vehicles will not completely block the road as there are two lanes in each direction.

5.3 Intersections

Other than the Aotea Quay Roundabout, no new intersections are proposed. Existing intersections have been assessed and developed against the new road configurations/proposed cross sections, performance assessments and safety. Traffic modelling of the intersections is currently being carried out.

5.4 Traffic Signals

5.4.1 Design Standards

The Traffic Signal design is to be based on the following standards:

- Austroads Guide to Road Design – Part 4a: Unsignalised and Signalised Intersections
- Austroads Guide to Traffic Management – Part 9: Traffic Operations
- RTS 14 Guidelines for Installing Pedestrian Facilities for People with Visual Impairment
- Signals New Zealand User Group (SNUG) National Traffic Signal Specification
- NZ Transport Agency Standard Signal Layout Draughting Guide Drawing 1/ 1061/ 140/ 8104/ Sheet 1/ Rev 0

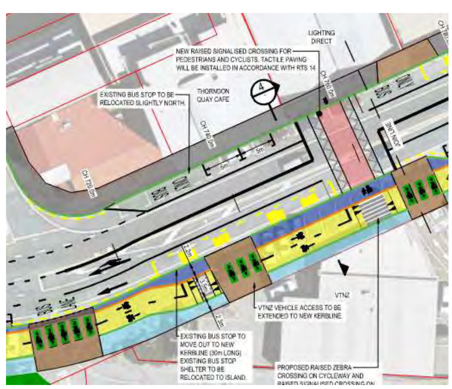
5.4.2 Overview

There are currently four signal-controlled intersections in the project area, being Jarden Mile, Kaiwharawhara Road, Onslow Road and Mulgrave Street. As the design developed, the functionality of the signalised intersections was assessed against the proposed cross section and functionality changes. Changes to signalised intersections include:

- The Mulgrave Street/Lambton Quay/Thorndon Quay intersection is proposed to be fully signalised. This is to reduce the safety risk for the currently unsignalised left turn movement from Mulgrave to Thorndon Quay which has reduced visibility due to the acute angle of the intersection as well as mature trees.
- The Tinakori Road and Onslow Road intersections are proposed to be fully signalised to improve pedestrian/cycle crossing facilities.
- Pedestrian crossings along Thorndon Quay will be signalised and the pedestrian crossing on Hutt Road near Rangiora Ave will also be signalised.

5.5 Pedestrian Crossings

It is proposed that all pedestrian crossings along Thorndon Quay will be raised and signalised. The locations of these crossings have been adjusted to tie in with the relocated bus stop locations. The crossings being located first before the bus stop in each direction which results in passengers crossing behind the buses and hence reducing potential delays to the onward journeys of the buses once those passengers have alighted. It also improves safety as it makes the crossing pedestrians more visible to other road users (not hidden by the departing buses).



The existing pedestrian crossing on Hutt Road near Rangiora Ave will also be signalised.

5.6 Accessways and Driveways

The potential conflict between people on bikes and scooters and pedestrians and vehicles entering/leaving properties is a key issue that has been considered during the preliminary design phase. Most access locations are in the Onslow Road to Tinakori Road section of Hutt Road and along Thorndon Quay on the eastern side.

A number of serious or significant issues as well as minor issues were identified in a safety audit of the Hutt Road cycleway. The more serious issues focussed on access/egress to businesses along the south-eastern side of the corridor. These predominantly identified issues with vulnerable users on the shared use facility and for cyclists. In relation to accesses generally, the safety audit notes *"A high level of cyclist / vehicle and pedestrian / vehicle conflicts were observed at major access points. In most situations, it was the exiting drivers not looking for cyclists, and pulling directly in front of the vulnerable user"*. The higher speed of cyclists was also observed to contribute to these conflicts. One of the key recommendations in the safety audit is to investigate improving cyclist safety at accesses through the installation of passive and active warning measures to raise awareness and mitigate the risk. Identifying and improving visibility lines and controlling speeds have also been key considerations.

It is proposed that all vehicles exiting units turn left only. U turns will only be at designated locations, where designated right turn lanes are provided within the central median. Vehicle tracking indicates that only a car with trailer can make use of the U turns. An 8m rigid truck fails due to its turning radii.

As part of the project investigation, traffic turning right across multiple lanes was raised as a significant road safety risk. This is due to turning drivers focussing on oncoming traffic which may be operating at differential speeds which may miss a filtering motorcyclist and cyclists/peds on the shared path as they turn. A Safe System Framework Assessment was undertaken on the existing arrangement and a number of options. Through this process the raised median island was identified as a significant improvement to this safety risk. Vulnerable users tend to be more susceptible to serious or fatal injury and the LILO was noted to result in a 58% and 48% reduction in risk score for cyclists and motorcyclists respectively. It is considered that the U-turning risk, which although may be present, is much less likely to result in serious injury. Further, any turning risk to vehicle occupants may be mitigated by a proposed speed limit reduction and by providing focal points for turning rather than at multiple crossing points.

It is proposed to retain the flush median from Sar Street to Aotea Quay as part of the preliminary design. A raised median is proposed from Aotea Quay through to Jarden Mile with strategically placed breaks to allow for business access and to control the locations of U-turns. Potentially, the U-turning risk could be mitigated further by the use of electronic warning signs triggered by the presence of vehicles in the U-turn bays.

5.7 Vehicle Tracking

Tracking path analysis has been undertaken on heavy vehicle turning movements at intersections using AutoTURN. A minimum of 600mm clearance has been allowed in addition to the tracking path to cater for driver error or misjudgement. The design vehicle is the 18m long quad rear axle semi-trailer and the 20m B-train tanker combinations. Note: No U-turns are possible for these large vehicles, however there is enough space for an 11m rigid truck and less to U-turn from Northbound to Southbound at the Jarden Mile intersection but not at any other intersections along Thorndon Quay and Hutt Road.

5.8 Structures

No additional structures are proposed. Existing structures include two rail bridges, the SH1 over bridge, retaining walls and signage structures. It is not intended to impact these structures.

The Aotea Quay overbridge is noted as constraining space for lane width. Based on this constraint it is proposed to have only a single lane under the overbridge section. The reduction in lane numbers happens straight after a bus stop and signalised pedestrian crossing.

5.9 Signage and Road Markings

All signage will be to NZTA Traffic Control Devices Manual and MOTSAM standards (where appropriate) during the detailed design stage.

5.10 Design Departures

The main areas identified for potential departures are lane widths, due to the constrained width of the corridor. The proposed departures and a comparison with the design guides is included in Table 5.

6 Other Design Features

6.1 Public Transport Facilities

6.1.1 Bus Stop Locations

Figures 9 and 10 show the current bus stop locations as well as the indicative new bus stop locations as part of rebalancing proposed in Stage 1. The relocation of bus stops have been explored further with GWRC and the operators and adopted in the preliminary design. One area where the final location may need to be further considered is the stops near Moore Street intersection (Capital Gateway). From an urban design perspective, the driver is to have the stop near to the Marae area. Whereas from a purely spatial perspective (distances between stops) it is located the other side of Moore Street. The final locations will be developed during the detailed design phase.

Figure 9: Current Bus Stop Locations

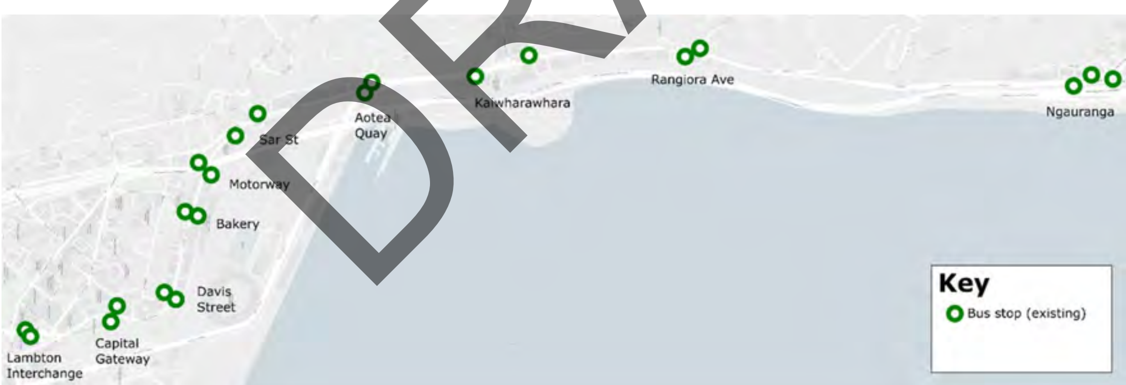


Figure 10: Potential Bus Stop Changes

6.1.2 Special Vehicle / Bus Lanes

The key considerations during preliminary design included:

- lane widths
- the inclusion of off-peak parallel parking within the lane
- whether bus stops will be within or (where space permitted) outside the lane. During the preliminary design process it was confirmed that there is insufficient space to provide bus stops outside the bus lane.

There were various factors discussed in selecting a 3.5m width for the SPV lane on Hutt Road. The road speed, types of vehicles proposed for the lane, the removal of the shoulder and a desire to reduce the temptation for cyclist to use the road in preference to the cycleway were all reviewed.

Conversely on Thorndon Quay where the road speeds will come down to 40km/hr, the bus lane width has been reduced to 3.2m thereby reducing the temptation for cyclists to try and share the lane with buses.

6.2 Parking Facilities

The project will involve loss of and changes to on street parking. These changes are predominantly the removal of the existing angle parking on Thorndon Quay and the replacement with parallel parking. At key locations (where for instance additional visibility is required) it has been necessary to remove some parallel parking.

A summary of the existing versus proposed parking numbers is set out below. As the detailing of the design develops these numbers are subject to change.

- Thorndon Quay – Existing 390 spaces – Proposed 258 spaces
- Hutt Road – Existing 133 – Proposed 125 spaces

6.3 Preliminary Urban and Landscape Design

6.3.1 Overview

The purpose of this PDPS section is to explain the overall approach, standards and requirements and urban design process for the TQHR project. This section sets up the process for the projects masterplan phase which will give effect to the LGWM urban design framework (UDF) through the detailed design phase.

LGWM is developing a programme wide UDF that will be developed in parallel to the TQHR masterplan work being undertaken through the detailed design phase. The urban and landscape masterplan for TQHR will be essential to guiding solutions to meet the project's intent and vision.

The UDF won't be completed in full prior to TQHR design phases starting. Therefore, the project will be required to work collaboratively with the Client and partners to ensure adequate urban design and landscape elements have been considered throughout the design process including the early phases.

TQHR project is located on what was the original foreshore prior to reclamation and seismic events occurring. This original foreshore continues north to Petone and south through the Golden Mile. There are various cultural, heritage, social, economic, and environmental places of interest along the TQHR corridor that will provide valuable opportunities to inform the projects design response.

The projects physical scope of works is located within the TQHR road corridor however, wider contextual data needs to be considered to deliver a sound urban and landscape design response.

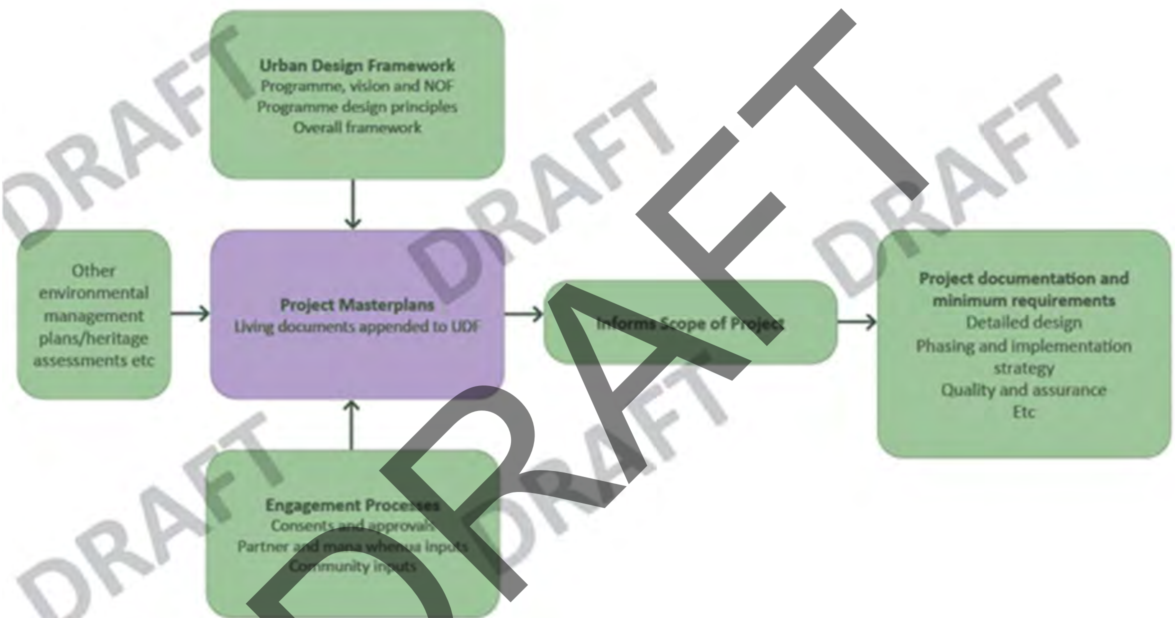


Image above: Draft LGWM Programme UDF process and how it relates to the LGWM projects like TQHR.

The TQHR project looks to:

- Consider and connect with the wider Wellington city vision and partnerships, its context, cultural heritage and landscape;
- Define streets and roads and reflect the Network Operating Framework (NOF);
- Shape streets to work with civic spaces and functions, neighbourhoods and street users;
- Define precincts that help characterise place and identity;
- Encourage safe and accessible mixed mode transport;
- Support and acknowledge urban development potential as well as infrastructure (services) needs;
- Measure and evaluate through:
  - Shift in physical and operational changes / improvements;
  - Changes in its use and function and its resulting impacts;

- Determining if investments delivered desired outcomes (safety, quality of life, sustainability, economic, environmental, improved mobility etc).

Both quantitative and qualitative metrics are important. There are different methodologies in how to measure the above; these include before and after photos, survey and consultation with local patronage and communities and traffic count recorders.

Urban design, landscape and aesthetic considerations will be developed through solutions that deliver value for money through the detailed design phases. CPTED, Safety in Design, Maintenance in Design, Whole of Life Costs (not just capital costs) also need to be considered within the urban design and landscape design process.

A preliminary urban design nodal point study report has been completed as part of the SSBC and Preliminary Design Philosophy Statement (PDPS) process (refer Appendix B) but further investigation and testing is required to consider the whole corridor.2

6.3.2 Urban Design Framework and TQHR Masterplanning work

Wellington City's six goals for the city and the community's urban design and transport principles have influenced the preliminary urban design aspects of the TQHR project and provides guidance to achieving and assessing the quality of developed and restored urban areas. This project is about people, enhancing communities and providing effective and efficient transport. This means prioritising modes of transport and allocation of space that supports moving people and accommodating freight.

Image above: Our City Tomorrow's six aspirational goals for the city

Natural Identity

The streets within the TQHR project offer social and economic benefits for Wellington. The rawness of the coastal hills along the Wellington harbour is an important context to consider - the TQHR project has an opportunity to celebrate this natural identity. The project should reflect Thorndon Quay & Hutt Road's unique local character and cultural landscape as the original harbour shoreline:

The TQHR section relates and connects to both the Te Ara Tupua project and the central city through nature & character. TQHR has been identified as a 'green boulevard' in WCC Green Network Plan. Green infrastructure including trees, active mode facilities (cycle storage, e-bike charging), green 'pocket' parks and water sensitive urban design are all opportunities to be explored in this design phase.

People, Place + Transport

Pedestrians and a mix of diverse modes of transport aid in developing a sense of place for communities and neighbourhoods. Success is achieved when delivering transport solutions that can also provide public space and 'pause' moments for people to share experiences, interact and socialise. Sound urban design principles are essential and will help guide to the right solutions to meet the project's intent and vision.

Included in Appendix B, the design team have established preliminary urban design principles that begin with focusing on a city-wide extent and describes three precincts within the TQHR area. A nodal point analysis was completed and is included in Appendix B. The project has focused on three nodes – Mulgrave Corner, Thorndon Quay Shops and Jarden Mile. These nodes are developed based on the existing concentration of activities and intensity. The focus is on people, place and transport as interconnected components. A completed site analysis around these nodes describes the preliminary constraints and opportunities for development that this design has been based upon.

In discussions with the local Iwi and when considering the wider picture from an urban design perspective. Connectivity to areas behind Thorndon Quay (to the west) has been considered. There is currently no connectivity between the SH1 overbridge and Davis Street. Creating pedestrian access through has been identified as a potential benefit for the community.

During consultation with the local Iwi one item that seems to have traction with the design team was the concept of pause and reflection spaces. These can be of various elements and outcomes but included ideas such as special plaques or tiling depicting the area's history, heritage and the local environment.

Other urban and landscape design items specific to TQHR for the masterplanning phase:

- Apply a place-based approach to street design and utilise Waka Kotahi's Final Draft of the Aotearoa Urban Street Planning & Design Guidelines;
- Areas along Thorndon Quay near the project site have been identified as growth areas within the WCC Spatial Plan, however, land immediately adjacent to the project has the same height limits as the operative District Plan to account for natural hazards. Consideration of the regeneration and development potential in and around the project area will need to be factored into the urban design and landscape design response;
- The project team will need to collaborate with other workstreams such as MRT and Strategic Highways, Golden Mile, City Streets, CCPI, WCC Streets for People and the Transition Project and coordinate with the Rail Precinct and Port project interfaces. Heritage, archaeology, mana whenua values and cultural considerations need to be taken into account as there are various histories associated with the project site (see also section 2.2 of this DPS for Mana Whenua Values);
- Design for good public transport customer experience in place-specific and accessible street- based stops and interchanges. Celebrate the views to the wider landscape through carefully planned spatial arrangement of lingering and movement spaces in relation to their context;
- Make culture visible. Integrate public arts in public spaces. Celebrate Wellington's weather and work creatively with lighting:
- Consider activation planning and facilitation (especially for the duration of city construction and for existing or future events i.e. Thorndon Fair)
- The context analysis prepared as part of the projects masterplanning and urban design response will help inform placemaking, sense of place and interpretation opportunities within the project;

- Enable universal access, safe and comfortable movement for all people by considering the interplay of public transport, active modes and pedestrian space

Figure **11: Nodal Point Analysis Location Plan**

6.3.3 Standards and References

The design has been developed in accordance with the NZTA requirements and include:

- NZTA Urban Design Professional Services Guide – PSG/12
- NZTA Bridging the gap: Urban Design Guidelines (2013)
- NZTA Urban Design Objectives and Methods (2013)
- NZTA Environmental and Social Responsibility Policy (2011)
- NZTA Landscape Guidelines – Final Draft September 2014
- NZTA Safe System
- NZTA Environmental Planning Manual

- NZTA P39 Standard Specification for Highway Landscape Treatments (2013)
- Waka Kotahi's Final Draft of the Aotearoa Urban Street Planning & Design Guidelines (2021)
- ESR Standard: Z19 State highway environmental and social responsibility standard

The following documents are key strategies and policies that influence the future shape of the city and will provide a foundation for the projects urban design response. Some of these have already been summarised in the draft LGWM UDF:

- Let's Get Wellington Moving Vison, Objectives, Priorities and Liveability criteria
- Transport Orientated development
- 'Planning for Growth' including the Central City Spatial Vision; Spatial Plan,
- The Operative District Plan (proposed being developed – out for engagement October 2021)' and the Proposed District Plan and Design Guides.
- National Policy Statement on Urban Development (NPS_UD) 2020
- Wellington Towards 2040: Smart Capital (2011)
- Central City Framework (2010)
- Draft Regional Growth Framework
- Draft Place & Movement Framework (2019)
- Te Atakura - First to zero (2019)
- Green Network Plan (due for completion Oct 2021);
- WCC Design Review Toolkit
- WCC Code of Practice for Land Development December 2012
- Our Capital Spaces;
- Our Natural Capital;
- Wellington Public Space Policy;
- Wellington Play Spaces Policy;
- Wellington Resilience Strategy;
- Accessible Wellington;
- Te Tauihu;
- The Public Art Policy (2012);
- The Trading in Public Places Policy (2006 but under review),
- Te Atakura.
- Wellington Design Manual (currently being scoped alongside the LGWM UDF).
- LGWM Development Concept Plans (Central City & Rail Precinct)
- LGWM Gehl Public Life Survey – 2004 and new version due for release in October 2021
- LGWM Heritage and Landscape Assessment
- LGWM Māori Cultural Heritage and Values Report
- Other standards referenced in this PDPS relevant to urban design such as 4.1 Design Standards; 5.4.1 Traffic Signals; 6.4.2.2 Stormwater; 6.4.3.1 Street Lighting and all other relevant guides and standards.

If there are structures the design team will need to refer to the Waka Kotahi bridge manual and if there is a need for a Bridge architect e.g. an iconic bridge then this should be noted in the PDPS also.

6.4 General Civil Components

6.4.1 Preliminary Pavement Treatments

6.4.1.1 Design Standards

The Pavement and Surfacing design is to be based on the following standards:

- Austroads Pavement Design – A guide to the Structural Design of Road Pavements 2004
- NZ Supplement to the Document, Pavement Design – A Guide to the Structural Design of Road Pavements (Austroads 2004), 2007
- NZ Transport Agency specifications (B, M, P and T series)
- NZTA - https://www.nzta.govt.nz/assets/resources/pavement-specification-guidelines-for-cycleways/Pavement-specification-guidelines-for-cycling-routes.pdf

6.4.1.2 Overview

Significant changes to pavements are not expected as the interim option is likely to be mainly a reallocation of road space. However, pavement considerations has been included in the preliminary design development. Preliminary pavement designs has been developed considering the expected:

- Traffic Loading
- Pavement design – Unbound, modified or bound
- Subgrade and subgrade improvement layer condition and strength parameters
- Pavement materials
- Surfacing
- Environmental factors affecting pavement design – Noise reduction, safety and skid resistance, drainage

Environmental factor considerations affecting the pavement design (for example noise reduction, safety, skid resistance, and drainage) will need to be undertaken which will inform the pavement allowances within the cost estimates.

Inputs will need to be provided to the geotechnical team to assist with drafting an investigation schedule to better understand costs and risks and inform the detailed design stage in locations where pavement may need to be widened.

6.4.1.3 Pavements Approach

There will be a need to have two different pavement systems for this element of work, an approach for infilling existing median islands/kerb buildouts that need to be removed and an approach for reinstatement adjacent to length of new kerbs.

Areas of pavement reinstatement that will be subjected to traffic will typically need to be a structural asphalt pavement, for both construction expediency and the expected traffic loadings. Pavement loading by GWRC buses that are operating under a HPMV permit, i.e. with higher axle loads than that are allowed with restriction will be considered in the detailed design phase.

This type of pavement is likely to be in the order of 175-200mm, made up of various Asphaltic Concrete (AC) layers depending on the underlying ground conditions. If the raised areas that are to be removed have been constructed over an existing pavement, it is recommended that a 150mm diameter pavement core is taken in order to ascertain the suitability of the existing pavement structure for the expected loading.

Reinstatement of the pavement adjacent to new kerbs can also be done with an asphalt pavement, with the width of reinstatement based on the future loading, i.e. reinstatement for a parking bay can be to a lower level of design compared to an area of reinstatement that will be part of a proposed traffic lane. Another factor that will influence the width of restatement will be the constructability of the pavement with respect to compactor sizes.

Due to the reconfiguration of the road space in the Thorndon Quay section, it is recommended that the carriageway and cycleways are resurfaced to eliminate all old road markings to avoid confusion with ghost markings. It appears that only limited areas of Hutt Road will require resurfacing due to layout changes.

New raised median islands/separators can be constructed on the existing pavement surface by cutting a key into the existing surface and the new kerb profile extruded into the key to avoid having to cut into the existing pavement beyond the extents of the raised feature.

Areas of new/widened footpath will need to be built to standard WCC footpath details (WCC Standards C.3.6). Likewise new cycleway pavements will be built to a standard equivalent to that of a WCC vehicle crossing (WCC C3.7a).

Whilst it is expected that all pavements, cycleways and footpaths will be surfaced with asphalt to provide a high amenity low maintenance cost effective surface, there is a preference to continue the concrete footpaths as per the new section between Tinakori Road and Kaiwharawhara Road intersections, especially for the Thorndon Quay section. This change in finish colour and texture clearly delineates the footpath from the cycleway and hence reduces the risks of users entering the wrong areas. It also will provide additional reinforcement for vehicles exiting onto the road to look out for pedestrians and cyclists. If this solution is to be followed structural crossings at all entrances and exits will need to be installed (WCC standard Drg 24/721).

6.4.2 Stormwater

The stormwater design approach is to retain the existing stormwater network, flow paths and inlets as much as is practicable.

Generally the project does not increase the impervious area, with existing sealed areas (parking lanes and bus lanes) being converted to sealed cycleways and footpaths, meaning that post-development runoff will not increase. The exception to this is between approximately CH4100 and CH4900 where the new footpath with extend into existing landscaped area.

6.4.2.1 Key Design Assumptions:

- Where possible, the existing catchments, flow paths, inlets and pipe system should be retained.
- The existing pipe system is assumed to have sufficient capacity. Capacity assessments of the existing system is not part of the preliminary design scope.
- Improvement to the stormwater system network is also not part of the design scope
- Condition assessment of stormwater network is also excluded
- As a consequence, no stormwater quality treatment has been included in the design.

6.4.2.2 Stormwater design criteria

The following design criteria are proposed, based on Austroads 6A, Wellington Water 2019 and NZTA 2016: Rainfall intensities will be as per Wellington Water 2019 for WCC with 20% allowance for climate change

Primary system (kerb and channel, sumps and pipes) are to be sized so the 10yr ARI (Average Recurrence Interval) event does not encroach on traffic lanes, but can encroach onto the shoulder, and can encroach into cycleways by up to 1 m width

Secondary system (overland flow) sized so that in the 100yr ARI flood event water depth does not exceed of 0.1 m and 2 m/s velocity on trafficable lanes with a minimum of one traffic lane free from flooding, with no limits on flooding over cycleways. (In a 100yr ARI event it is not anticipated that cyclists would be using the cycleways due to high rainfall and poor visibility.)

6.4.2.3 General Stormwater Philosophy

Stormwater system standards and specifications will be in accordance with the following organisations requirements, in order of precedence Wellington Water, WCC, and NZTA.

Raised pedestrian crossing on road and in cycleways would cut off overland flow paths, affecting both the primary and secondary systems. Raised crossings will be assessed and solutions developed on a case-by-case basis to allow overland flow through the following options:

- New sump connecting to existing pipe (primary flow only)
- Bubble up sump system discharging to the kerb and channel on downstream side
- Concrete “U” channel with grate discharging to the kerb and channel on downstream side

Existing sumps to be retained where possible, or replaced as close as possible to the existing location, and connected to the existing stormwater system.

Generally, in Thorndon Quay, the cyclepath and road are on grade with a raised safety buffer separating the two, and the stormwater system with consist of:

- Kerb and channel (e.g. standard WCC vertical kerb and channel) along the edge of traffic lane and cycle path, with regular kerb cut-downs through the kerb/raised safety buffer between the cycle path and traffic lane.
- Kerbs cuts through the raised safety barrier, to allow to stormwater flow across draining to existing/relocated sumps and the existing pipe system. (This assumes that the cycle path will have cross-fall in the same direction as the road as per the below typical section.)

Cycle path flood width to be checked for primary level of service, and where flood widths exceed 1 m consideration will be given to adding more sumps if practicable.

Walkways should continue to drain in the same manner as existing.

All stormwater sump grates, manhole covers, rodding eye/lamphole to be raised to new pavement levels where applicable

6.4.2.4 Section specific stormwater design philosophy

<u>Hutt Road</u> (CH1520 to CH5080)

Raised crossings at approx. CH1520, CH1930, CH3380 and CH5040 will be assessed and solutions developed on a case-by-case basis to allow overland flow.

On the west side of the road between approx. CH1640- CH1940 the kerb will move back towards the boundary, so sumps will need to be relocated to new kerb edge and reconnected to the existing stormwater system.

Within the project area between approx. CH1640 and CH5040 there is a centre island, however the road is in cross-fall and the island is located in the road crown (over the high point) and therefore would not affect the existing stormwater system.

Between approx. CH3565 and CH4835 on south side of the road the shoulder of the traffic lane is being replaced with an elevated cycle path and footpath.

- With no shoulder, this will reduce the flow that can be conveyed along the kerb and channel without encroaching on the traffic lane, effectively reducing the capacity.
- This would require additional sumps and laterals connecting into the existing stormwater pipe system (which is on the far side of the road in this location).
- The elevated cyclepath and walkway would also need to drain to the roadside kerb and channel.

Between approx. CH4100m and CH4900 on the south side of the road, the new footpath extends into existing landscaped area. This increase in impervious area will increase runoff, and therefore the stormwater system capacity will need to be assessed.

Thorndon Quay Road (CH140 to CH1520)

Raised crossings at approx. CH180, CH500, CH760, CH1060, CH1240 and CH1500 have been assessed and solutions will be developed on a case-by-case basis to allow overland flow.

Between approx. CH440m and CH740m the road is super-elevated (single cross-fall falling toward the west). Proposed cyclepath and walkway need to drain in the same manner as existing. This means that the cut downs in raised safely barrier will allow stormwater to runoff from the cyclepath across road to the existing stormwater sump and pipe network (rather than from the road into the cyclepath as in other locations).

Between approx. CH1260m and CH1340m the road super-elevated (single cross-fall falling toward the east) falling towards the cyclepath. This means that the kerb cut downs in the raised safety barrier will need to provide for runoff from the full road cross section, and hence more closely space kerb cut downs may be required than in the other areas.

6.4.2.5 Maintenance

- Maintenance of any existing/proposed assets needs to be considered for ease of access and safety of maintenance crew.
- Both bubble up sump system and concrete “U” channel and grate would need maintenance and inspections for blockages.

6.4.3 Street Lighting

6.4.3.1 Overview

With the road width remaining the same but changing in configuration the existing lighting will need to be assessed against the revised layouts. Currently lighting is predominantly on the western (landward) side of the route throughout, with lighting at the intersections being on both sides. As the kerb line on this side isn’t being revised significantly there should be limited need to relocate columns purely for clash purposes.

The project intersection(s) will need to be lit with appropriate highway lighting designed to the NZTA standards. The requirement for and proposed arrangement of any street lighting shall be confirmed with the LGWM partners at the detailed design stage.

6.4.3.2 Design Standards

The Street Lighting design is to be based on the following standards:

- NZ Transport Agency M/30 Specification and Guidelines for Road Lighting Design
- AS/NZS 1158 Lighting for Roads and Public Spaces
- "RightLight" Roading Lighting Guideline

6.5 Utility and Public Services

Significant impacts on utilities or services are to be identified as part of the project development. The LGWM utilities database was to be used to determine the location of utilities for preliminary design. Unfortunately, the data available was only up to Moore Street. Data for the rest of the project area is being collected by LGWM. A high-level desktop assessment of the most critical utility items and any potential impacts from the design will hence be undertaken as and when the data becomes available.

The location of the existing utilities will be cross referenced against the proposed road design to ascertain whether there is likely to be an impact on any existing utilities and if so if there is a need for any relocation or protection works to that utility or if modification can be made to the road design to avoid impacts.

The identified utility works will help to better understand costs and risks in locations where utilities are affected by the design.

6.6 Proposed Construction Methodology

The nature of the works is primarily relocation of kerb lines, some patch structural changes to suit the new alignments and then resurfacing and new lining. As such it should be relatively easy to split the works into linear sections for phasing. Associated works such as drainage, signage, streetlighting, landscaping and placemaking is yet to be developed.

6.6.1 Potential Phasing

The key constructability issues will be to accommodate and manage the high traffic volumes during construction. The project shall be broken up into construction areas such as the upgrade of existing roads/intersections (Thorndon Quay), and the upgrade of existing roads/intersections (Hutt Rd) with associated tie-ins to existing roads.

Performance criteria will be set for all traffic management plans including for sealing surfaces, minimum paved width, maximum delays for all traffic, particularly the traffic on SH1 and minimum standards for pedestrian and cyclist facilities in conjunction with the LGWM partners.

The detailed design shall develop a workable construction sequence including temporary intersection and road arrangements to demonstrate the feasibility and set baseline performance criteria for the traffic management.

6.7 Maintenance Requirements

This section will be developed through the design stages and will be dependent on the features installed but likely to include:

- Street Cleaning

- Landscape maintenance
- Signals Maintenance
- Stormwater systems maintenance
- Structures – Inspections and maintenance
- Regular Inspection

7 Preliminary Geotechnical Appraisal

The preliminary geotechnical appraisal report (PGAR) is appended to this report in Appendix D. The soil conditions along TQHR are summarised using historic data from the NZGD and Beca databases. The PGAR also provides an overview of key geotechnical issues.

There are three active faults in proximity to the TQHR route. Based on seismic hazards maps provided from Wellington City Council and previous studies, it is believed the existing route may be subject to fault rupture, tsunami, liquefaction, lateral spreading and earthquake induced slope stability. These geotechnical hazards are unaffected by the proposed improvements along the TQHR.

There are a number of historic geotechnical investigations along the entirety of the TQHR route, including boreholes, test pits, CPTs and hand augers. The boreholes indicate the site generally consists of reclaimed fill underlain by alluvium and marine deposits, with greywacke bedrock at depths greater than 15 metres below ground level. The thickness of these layers vary along the route.

Based on the current scope of works for the TQHR Project, proposed geotechnical investigations in advance of detailed designed are likely to consist of shallow test pits and pavement pits. Materials most importance to design will be "near surface". A geotechnical site investigation programme can be developed once the preferred solution is developed and approved.

8 Property

It is currently proposed to keep within the existing legal boundary of Thorndon Quay and Hutt Road. The proposed Aotea Quay roundabout will extend outside the existing road boundary. Hence no land acquisition is considered necessary other than at this location.

The property impact for the Aotea Quay roundabout will be determined as the overall design progresses. The current defined impact is indicated within the sketch in Section 2.4.

9 Environmental and Social Responsibility Issues

Minimum standard Z/19 – Social and environmental Management will guide the environmental and social responsibility assessments, which for the detailed business case phase includes the following:

- Update the Environmental and Social Responsibility Screen
- Prepare preliminary technical assessments
- Prepare the consenting strategy
- Update and Implement Public Engagement Plan

10 Risk Assessment / Safety in Design

A risk workshop has been held in February 2021 during the preliminary design stage. The purpose was to identify and agree key risks to guide the development of the preliminary design. Project risks were populated as far as possible in real time during the workshop and then finalised following the workshop. A key output of this workshop was identifying and agreeing risks that stakeholders see as being of main concern. The risk register is included in the appendices.

Risk pricing will be undertaken in the @Risk software, using Monte Carlo analysis technique. This will contribute to measuring and monetising risks and benefits for the Economic Case and the allocation and management of risk budgets in the Financial Case.

The preliminary design will follow the NZTA Safety in Design (SiD) guidelines. On the 29 April 2021 a SiD workshop for the preliminary design phase was undertaken. A SiD register has been updated and included in Appendix E.

Appendix A

Minutes of Preliminary Design Standards Meeting

Minutes of Meeting

LGWM - TQHR - 8 March 2021 Prelim Design Standards Meeting

Held 8 March 2021 at 2pm

at Microsoft Teams

Present:	Hannah Hyde
	Simon Kennett
	Mike Pilgrim
	Charles Kingsford
	Kylie Hook
	Hillary Fowler
	Eric Whitfield
	Blaise Cummins
	Aoife Campbell
	Will Maguire
	Marcus Brown
Apologies:	Soon Teck Kong
	Gerry Dance
Distribution:	All

Item	Action
1 Introduction / Purpose	
■ This meeting is a follow up to the meetings held in December 2020 with the partner org subject matter experts to discuss preliminary design standards for the Thorndon Quay and Hutt Road (TQHR) project. ■ Following the December 2020 meetings, the project team advanced preliminary geometric design and produced cross sections for the corridor. There are pinch points where there is competing demand for road space to accommodate all modes. ■ This meeting is to discuss key aspects of the cross section, trade-offs associated with available corridor width and to agree minimum desirable widths for the different modes. ■ Key areas for discussion included: – Cyclists using Hutt Road due to the (narrow) shared path width – Width of traffic lanes on Hutt Road – Cyclists travelling fast, 40kmh+ on path along Thorndon Quay and the risk of t-boning a car and pedestrian conflict risk – Width of bus lane. A width of 3.7m is in the middle of the dilemma zone where there is not enough room for cycle/bus to co-exist in the lane.	
2 Hutt Road	
■ The design speed was discussed. Preliminary design should provide supporting measures to help with speed definition. The potential for a different northbound vs southbound speed was suggested, if they were separated by a median, however this was felt to cause confusion for the users. Current proposal is to go with 50kph up to the Onslow Rd Intersection (the more built-up section) and beyond Onslow Rd (where there are limited turn offs) it will rise to 60kph. Speeds to be discussed further and confirmed. ■ Road shoulders can be reduced to 0.3m wide from those shown on cross sections, or preferably removed.	

- Possible relocation of gantry on Western side of North end of Hutt Road was discussed to avoid pinch point but may not be required now with revised design parameters – depending on extents of "Gateway Concept".
- Kerblines on Hutt Road can be moved where necessary
- There are a couple of sections where the corridor is restricted at the northern end of Hutt Road. In these locations the median could be reduced to 0.5m wide (back-to-back kerbs), enough to restrict turns and separate northbound and southbound flows and hence not take excessive corridor width
- The minimum shared path width is recommended to be 4.0m
- The minimum cycle lane width where separated to be 3.0m
- Existing separation between cycleway and footpath by line marking on Hutt Road is to be adopted for proposed Hutt Road cycle/footpath facility (i.e. no level difference)
- Minimum traffic lane width (for standard lanes) to be 3.4m
- Special Vehicle lanes to be 3.5m wide but could be reduced to 3.2m at pinch points
- The 0.8m wide protective buffer should be provided on path (not in shoulder)
- Refuse, signs and other similar items proposed to be left on 0.8m wide cycle segregation
- A drop off facility is to be allowed for at day care centre near Kaiwharawhara intersection
- Fully signalising the Onslow Road junction may remove the southbound merge lane and hence free up space
- The possibility of widening the path to the East into KiwiRail land around the pinch point area of Onslow Road was discussed. Design team are looking into this option
- Where possible at driveways, consider increasing width of cycleway/footpath from 3m/2m to 3.5m/2.5m to allow for cyclist to move around car exiting businesses, potentially stopped on path awaiting a gap in traffic (Thorndon Quay and Hutt Road Business Section)

3 Thorndon Quay

- Along Thorndon Quay the bus lane can be reduced to 3.2m wide to discourage cyclists from riding parallel to buses in this lane (they should be either on the cycle path or in the main carriageway)
- Minimum traffic lane width (for standard lanes) to be 3.4m
- Shoulders were shown on the cross sections. It was noted that shoulders feel like a rural treatment and were not needed in a 40kph urban area. No shoulder required along Thorndon Quay
- A 0.5m raised safety buffer is to be provided between the cycleway and the bus lane/off-peak parking
- Agreed that the cycleway should be lower speed and that it was acceptable for cyclists to go on road if they wanted to travel faster due to 40km/h speed limit. A 20km/h cycleway design speed is suggested to mitigate risk from vehicle accesses and conflict with pedestrians
- The use of raised pedestrian crossings, changes in road texture/colour was considered useful elements to reduce cycle speeds on both carriageway and cycleway
- Visibility lines were highlighted as being critical for safety
- LED studs were discussed as a potential design option however should be considered with caution. It was noted there was a trial at the Caltex station on Hutt Road which gave false positives and false negatives. Project team to look into combining entries/exits where two exist on one property to reduce conflict points.
- Simon Kennett has cyclist speed data for Hutt Road and will provide to the project team

Minuted by: Eric Whitfield

Appendix B

Urban Design Principles

Preliminary Design // 20.04.21

LGWM Thorndon Quay Hutt Road

DRAFT

WARREN AND MAHONEY®

Prepared For

LGWM

Document Control

Prepared by:
Emily Dalley

Approved by:
Shannon Joe

On behalf of Warren and Mahoney Architects Limited

Document Revision Status

Revision A: 20.04.21
Preliminary Design Phase Report

Contact

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Disclaimer

While Warren and Mahoney has endeavoured to summarise the Preliminary Design process in this document and appendices, the report format cannot represent the broad range and depth of information captured on the Preliminary Design Drawings, Specifications and Schedules. Approval of the specific issues contained in this report does not discharge the obligation of the client team to review the drawings and specifications in their entirety.

Contents

Site Plan

Urban Design Principles
Complementing the LGWM five priorities for the region's success and the community's urban design and transport principles - these have influenced the urban design aspects of the Thorndon Quay Hutt Road (TQHR) project and provides guidance in achieving and assessing the quality of developed and restored urban areas. This project is about people, enhancing communities and providing effective and efficient transport. This means prioritising modes of transport and allocation of space that supports moving people and accommodating freight.

Natural Identity
The streets within the TQHR project offer social and economic benefits for Wellington. The rawness of the coastal hills along the Wellington harbour is an important context to consider - the TQHR project has an opportunity to celebrate this natural identity.

People, Place + Transport
Pedestrians and a mix of diverse modes of transport aid in developing a sense of place for communities and neighbourhoods. Success is achieved when delivering transport and can also provide public space and 'pause' moments for people to share experiences, interact and socialise.
The project is framed within maximum widths of the existing road corridors. Sound urban design principles are essential and will help guide to the right solutions to meet the project's intent and vision.

The project will also look to:
- Consider and connect with the wider Wellington, its context and landscape
- Define streets and roads
- Shape streets to work with neighbourhoods and street users
- Define nodes that help characterise place and identity
- Encourage safe and accessible mixed mode transport
- Measure and evaluate through:
  - o Shift in physical and operational changes / improvements
  - o Changes in its use and function and its resulting impacts
  - o Determining if investments delivered desired outcomes (safety, quality of life, sustainability, economic, improved mobility etc)

Both quantitative and qualitative metrics are important. There are different methodologies in how to measure the above; these include before and after photos, survey and consultation with local patronage and communities and traffic count recorders.

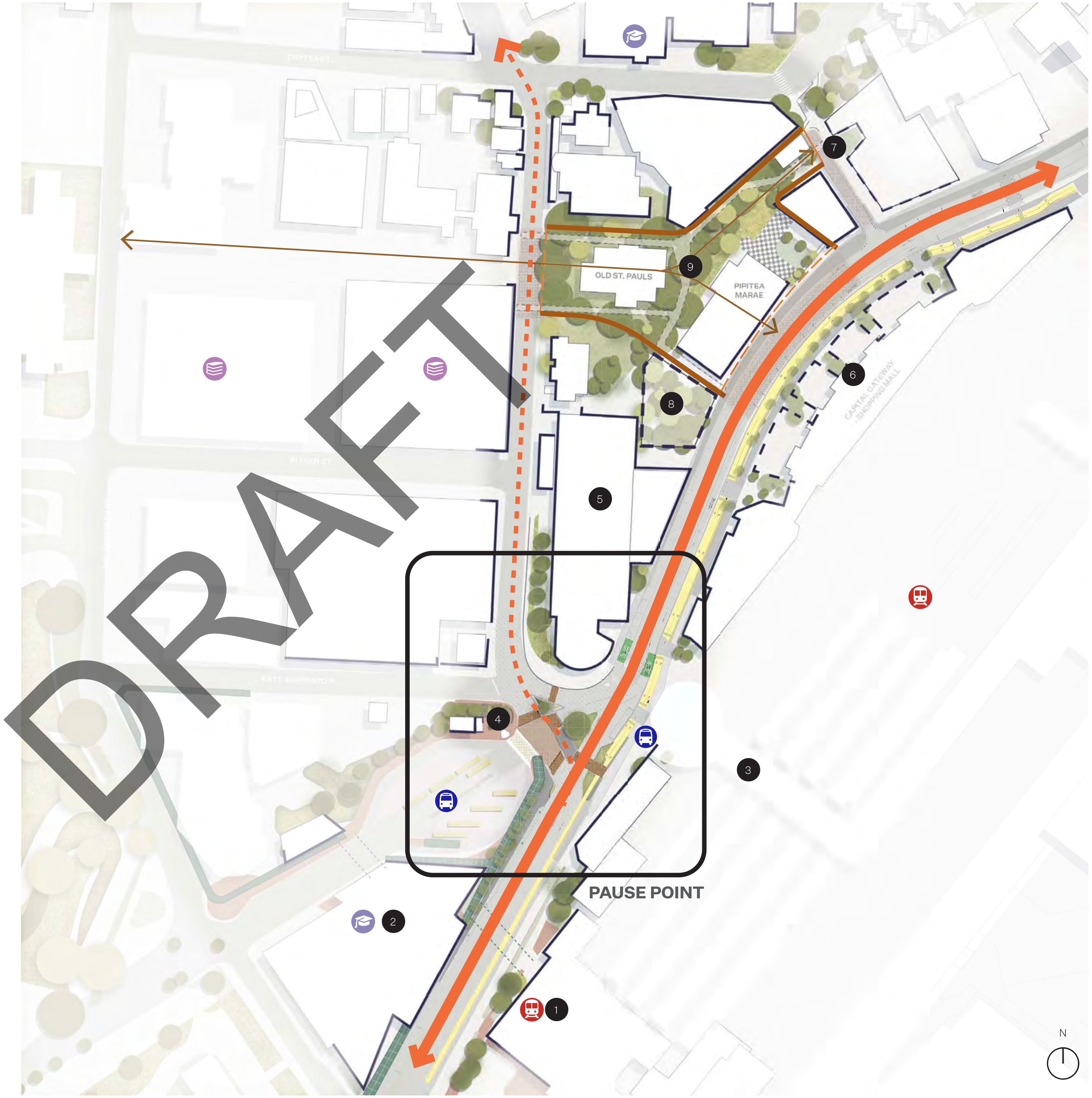
Nodes
The project has focussed on 3No. Nodes – Mulgrave Corner, Thorndon Quay Shops and Jarden Mile. These nodes are developed based on the existing concentration of activities and intensity. The focus is on people, place and transport as interconnected components. A completed site analysis around these nodes describes the current constraints and opportunities for development that this design has been based upon.

Node 01

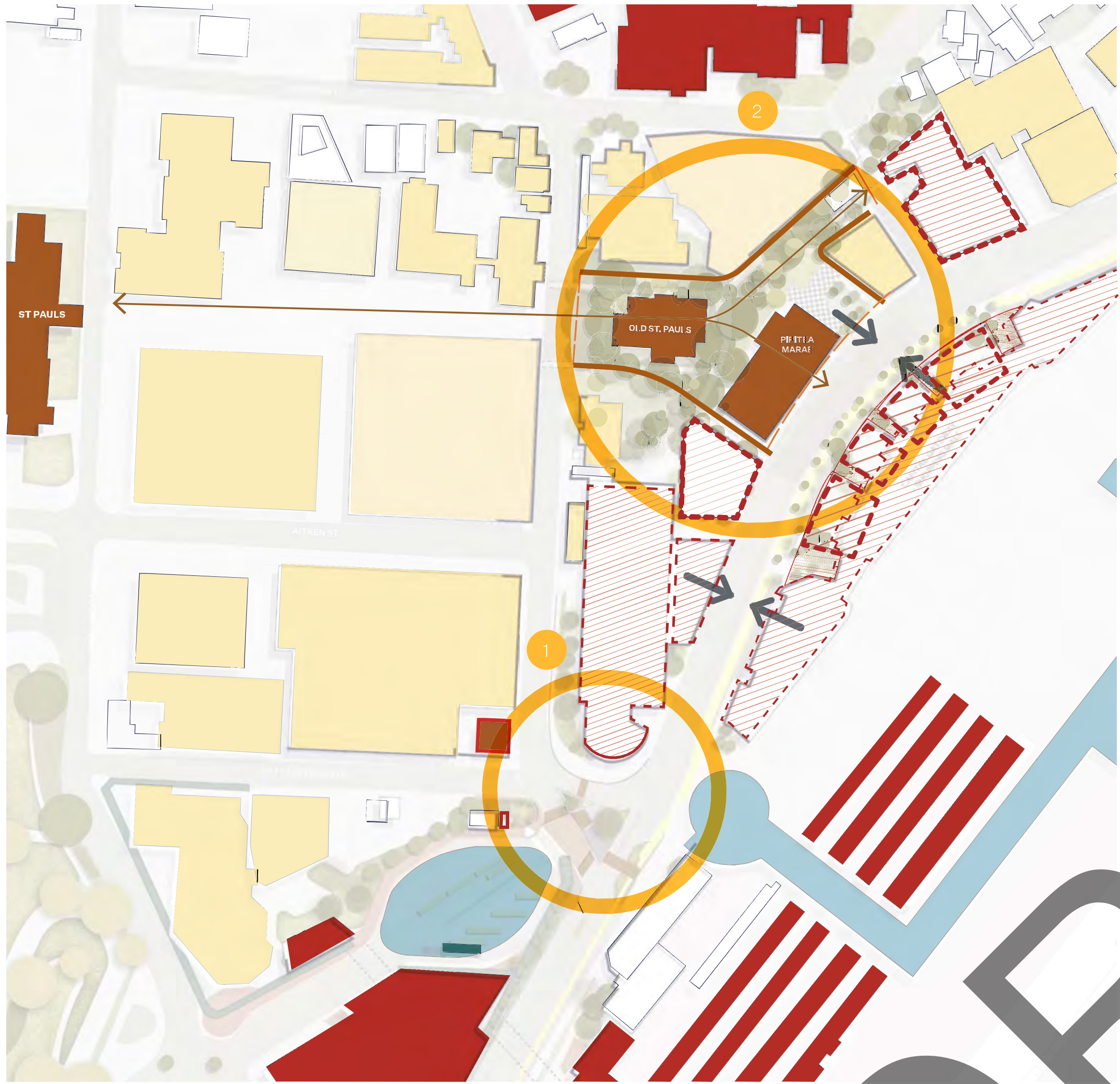
Mulgrave Corner

Located on the edge of the city centre, this node has high pedestrian activity from the Victoria University hub and the Wellington Railway Station. The intersection of Mulgrave and Thorndon Quay is often seen as the gateway into the city centre. The bus interchange poses significant challenges with people and bus conflicts. The design creates safe zones for pedestrains and their crossing points via visual surface treatments. Not-withstanding this the underlining problem remains the need to change the bus access location or relocate the bus interchange all together.

The extent of the node expands to include an opportunity to tie together Old St Paul's Church, the Pipitea Marae and their open spaces. The opportunity to create a 'cultural precinct' within this node by strengthening permeability via landscape pathways and open spaces to connect to Mulgrave St, Thorndon Quay and Moore St. The node is looking to the whole extent of the block where we would foresee the redevelopment of the existing Archives building and other properties in the near future turn into mixed use residential. The injection of people and activity will support the adjacent Wellington Girl's College. The node also not only strengthen Thorndon Quay but it enables Mulgrave Street to activate more and be a feeder into Thorndon and later connect back into the second node Thorndon Quay Shops.



1. Railway Station: Peak time 8am & 5pm
2. VUW Campus/Bus Exchange: Peak time 8am & 5pm
3. Stadium Platform: Event on
4. Potential pause spot
5. Potential Commercial/Mixed use development
6. Potential Commercial/ Retail Extension
7. Urban landscaping. Pedestrian oriented street: Peak time Students 8am & 5pm
8. Potential low green space or Commercial development
9. Cultural Precinct Walkway



Uses

At peak times (8am and 5pm), there is high pedestrian movement between the Wellington Girls' College, Victoria University Campus, Bus interchange and the Railway Station (circle 1). Old St Paul's Church and Pipitea Marae currently sits in the center of the node enveloped by greenery (circle 2). There is an opportunity to enhance the cultural dialogue with these key sites to celebrate Wellington's rich history by creating boundless edges that connect back to local streets.

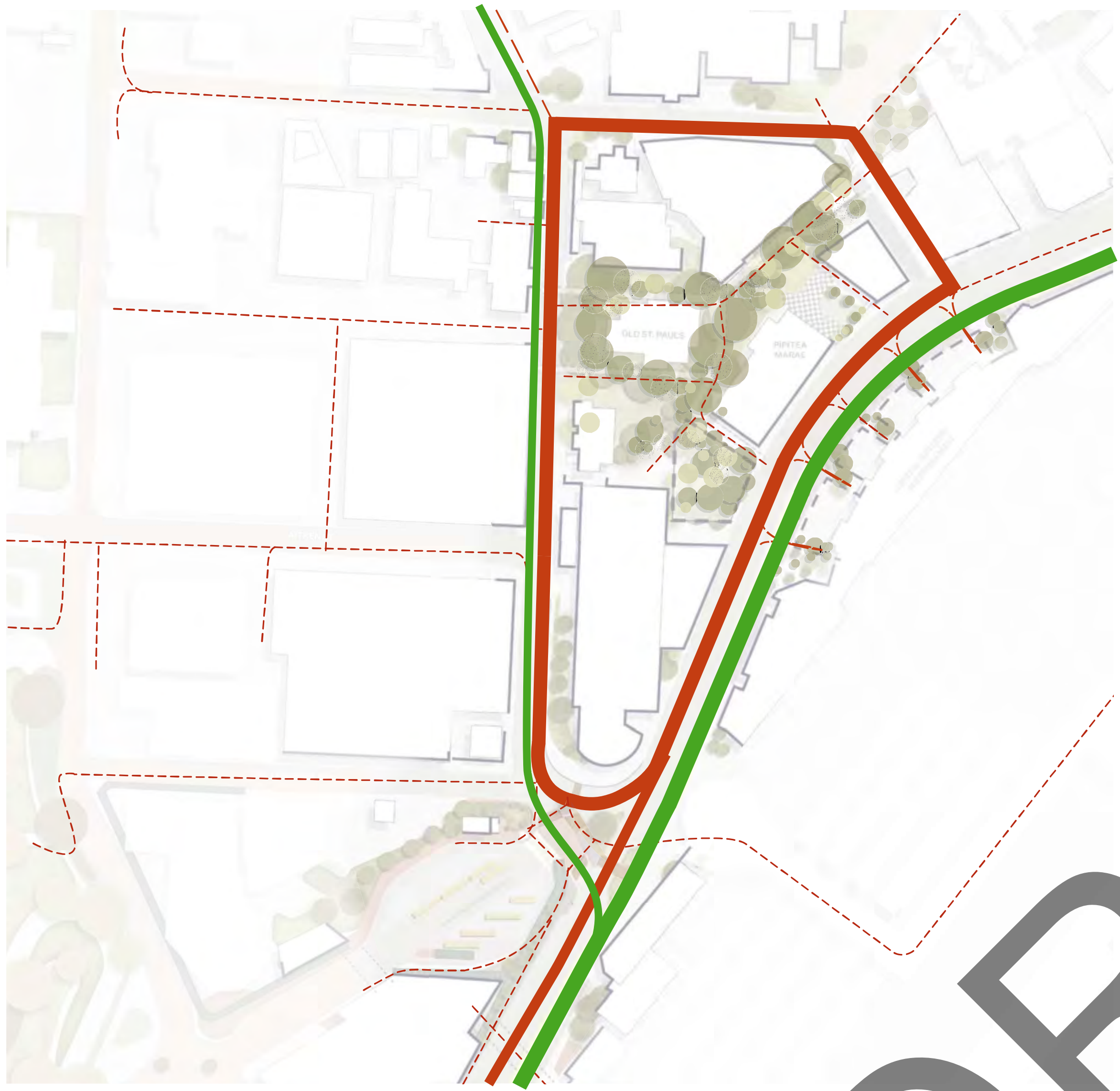
The bus interchange poses conflicts with pedestrians and buses.

- Public/ High Activity
- Commercial/ Retail
- Cultural Precinct
- High Activity in peak times
- Potential new Commercial/ Retail

Streetscape

The streetscape is instrumental to bind the railway, university, cultural, and business precincts together. Strengthening the Thorndon Quay arterial circulation route and secondary routes such as Mulgrave, Aitken and Pipitea Street connects the node with a strong weave of streets.

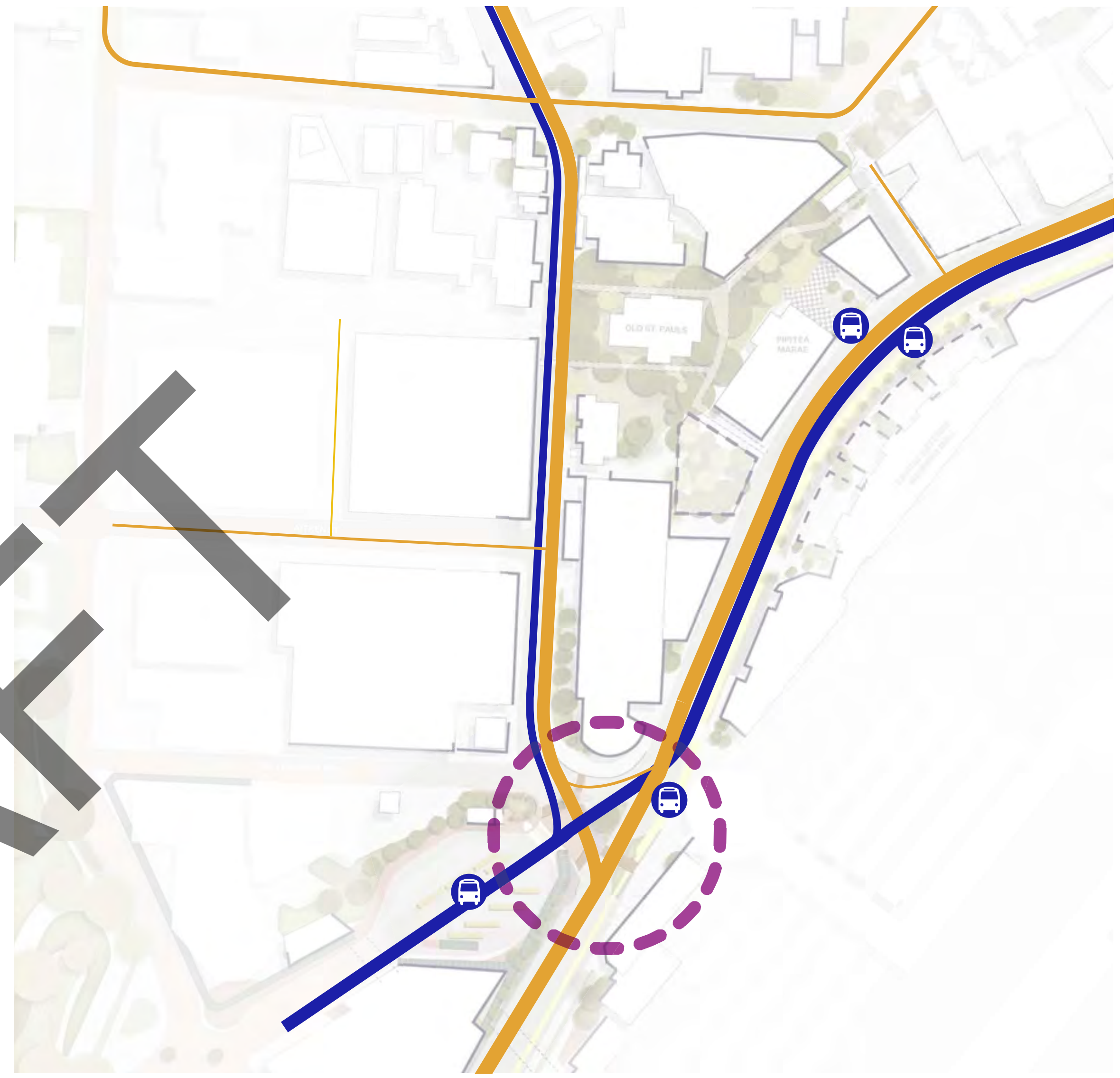
- Primary Road
- Secondary Road
- Developed Potential Link



Pedestrian & Cycle Movement

A high volume of pedestrians commute between Wellington Girls', Victoria University and the bus and rail stations creating pressure and vehicle conflict at the Mulgrave St intersection. Shifting the node to a pedestrian focused area will improve safety and improve connection to existing amenities such as Old St Paul's and Pipitea Marae.

- High Pedestrian movement
- Low Pedestrian movement/ Off
- Multi-Modal



Vehicle Movement

Shifting the Mulgrave corner node away from being a vehicle dominated area is instrumental for creating a safer, more connected, and vibrant node.

The proposal recommends the option to explore relocating the bus interchange or alternative access point, to remove existing conflicts with pedestrian crossings and vehicles.

- Bus Movement
- Vehicle Movement
- Pedestrian - Vehicle Conflict

Node 01

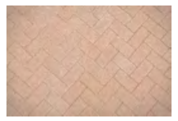
Pause Point

The node looks to bring green open space and paved ground treatment as the main system to calm and slow vehicles. As a highly active node with mixed modes of transport - legibility and a people first approach is the priority. The horizontal road treatment is a warmer / softer tone of colour and texture to contrast to the standard road asphalt. Highly legible wider pedestrian crossing points will be critical for safety and visibility to reduce conflicts with vehicles. Extensive zones of soft coloured pavers will diminish the overall car dominated environment while careful not to entice free off the pathway pedestrian movement.

Access into the bus interchange remains problematic and conflicts with natural pedestrian crossing. The design strong recommends a review of the bus interchange entrance and its manoeuvring routes or full relocation of its facilities.

1. Paved pedestrian crossings to highlight pedestrian focused zone:
   Stone with soft tone

2. Alternative treatment to asphalt:
   Soft tone similar but more subtle than the surrounding pedestrian crossings



3. Landscaping used to celebrate the gateway of Mulgrave St and Thorndon Quay.
   Landscaping used to reduce the width of the corridor, to give visual queues to slow down for pedestrians.

4. Congregation point with seating and potential a coffee kiosk to mark the gateway to Mulgrave Street: Greenery and paver with soft tone to connect with the character & heritage precinct

5. Raised shoulder with North bound cycle lane connecting:
   Low planting on edge

Node 02

Thorndon Quay Shops

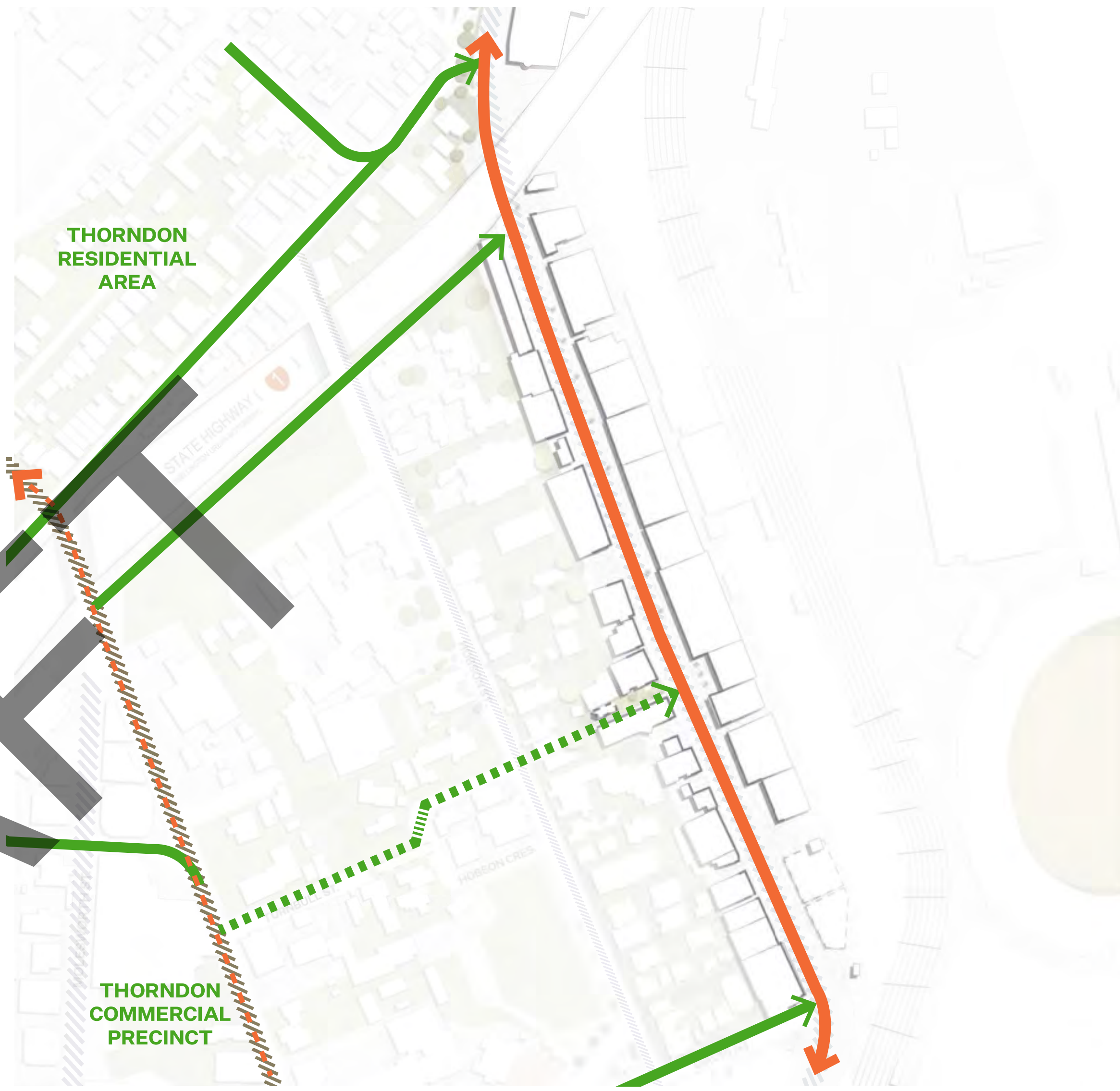
Thorndon Quay shops is prodominantly made up of light industry / retail outlets with little focus on community amenity. Some mixed use residential has been developed but the commercial strip remains lacking in pedestrian activity and lifestyle. Bordeaux Bakery has been a success story for the area and remains a popular attraction for Wellington. This project looks to create opportunities to create further success stories by building better streetscape, character and amenity to this area.

By defining this area rather than passing through, the design looks at gateways. The northern gateway in particular is challenging with the motorway overpass and its space beneath. We look at existing infrastructure as a canvas for more pronounced urban design moves such as art installation.

The introduction of 'pause points' along the strip will provide moments for congregation and open space. Its compact nature is from the constrained width of the strip and combining the various modes of transport into a comfortable people orientated environment.

Thorndon Quay Shops is disconnected to the residential areas in Thorndon. It is advantegous to bring more connection here and the design proposes a through site link from Hobson St to Thorndon Quay. Located mid way along the strip it provides pedestrain linkage to bring both areas including the schools together.

1. Queen Margaret College: Peak time 8am & 5pm
2. Wellington Girls' College: Peak time 8am & 5pm
3. Sky Stadium: Event on
4. Three new pedestrian crossings/ pause points (+option)
5. Potential Southern Gateway commercial/ mixed use development
6. Potential Northern Gateway Art Installation
7. Potential through-site pedestrian link



Uses

The Thorndon Quay Node is lined with commercial, retail and a few residential buildings. Thorndon residential and commercial precinct sits adjacent to the long stretch of Thorndon Quay shops.

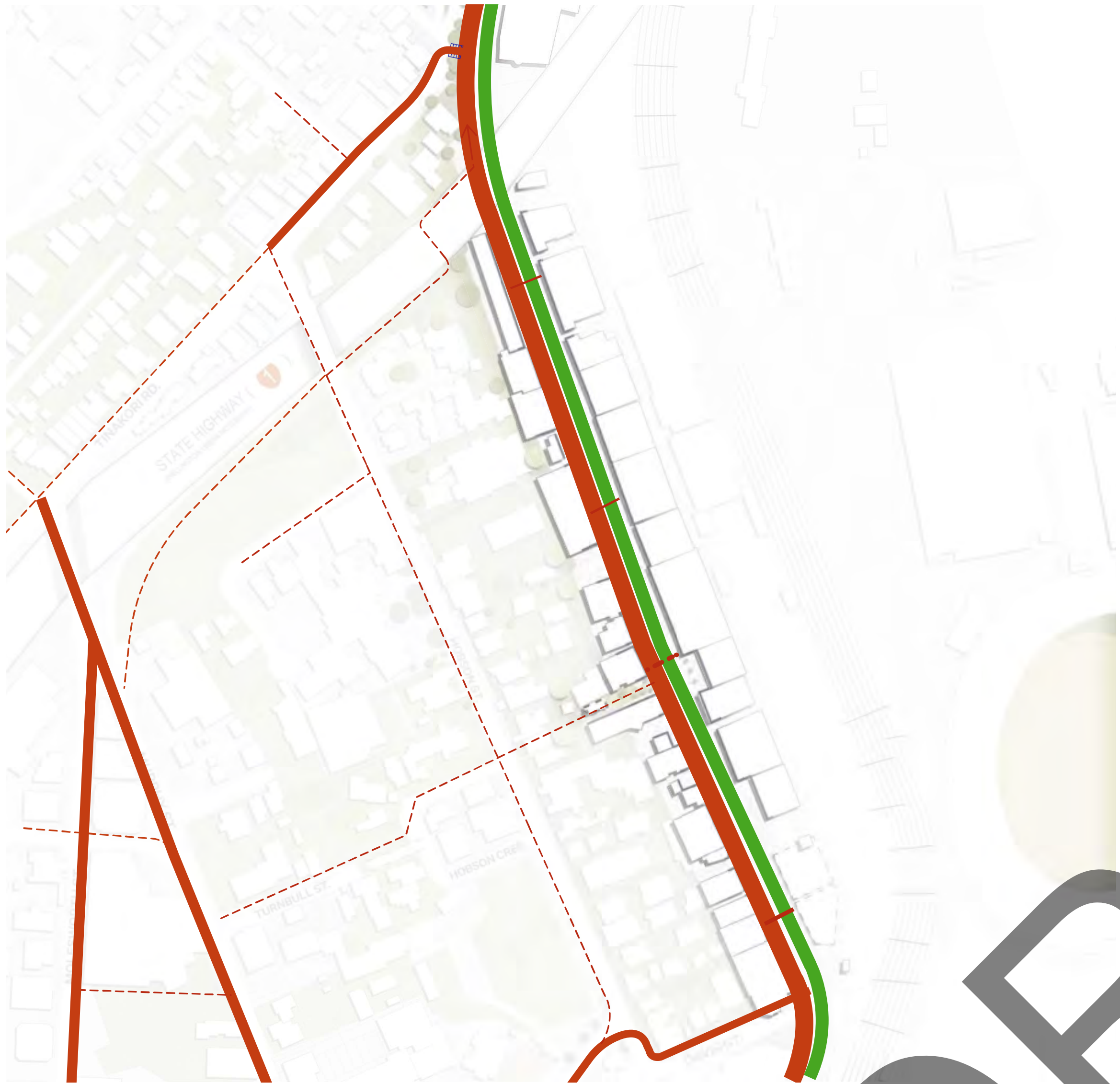
There is a strong disconnect between the two areas which a connection would be highly desirable.

- Public/ High Activity
- Commercial/ Retail
- Residential
- High Activity in peak times
- Potential new Commercial/ Retail

Streetscape

Thorndon Quay node stretches about 580m along the edge of the Thorndon suburb with access points at Tinakori Road, Davis Street, and a pedestrian walkway at the northern end by the State Highway bridge. Strengthening the streetscape to enable the residential and commercial areas of Thorndon to connect and engage with Thorndon Quay and its businesses will be instrumental in binding the node with its suburb.

- Primary Road
- Secondary Road
- Developed Potential Link



Pedestrian & Cyclist Movement

Giving more presence to pedestrians using finer grain elements such as street furniture, landscape buffers and pause points around crossings will improve connection with existing businesses and amenities such as Wellington Girls' College and Queen Margaret College. A potential through-site link is proposed half-way along the street length to give another access point to the node, complementing the access points at each end. Pause points also help encourage cyclists that within this node speeds must reduce and pedestrian awareness increase so to provide a safer enviornment for all to use.

High Pedestrian movement
Low Pedestrian movement/ Off
Multi-Modal

Vehicle Movement

High volumes of private vehicles and public bus routes dominate the Thorndon Quay Shops node. To create a safer more pedestrian oriented space with more public engagement, the vehicles are required to reduce speed or stop at proposed pause points. Giving some more presence to pedestrians and cyclists will enable the node to shift away from a vehicle dominant street.

Bus
Vehicle

Node 02

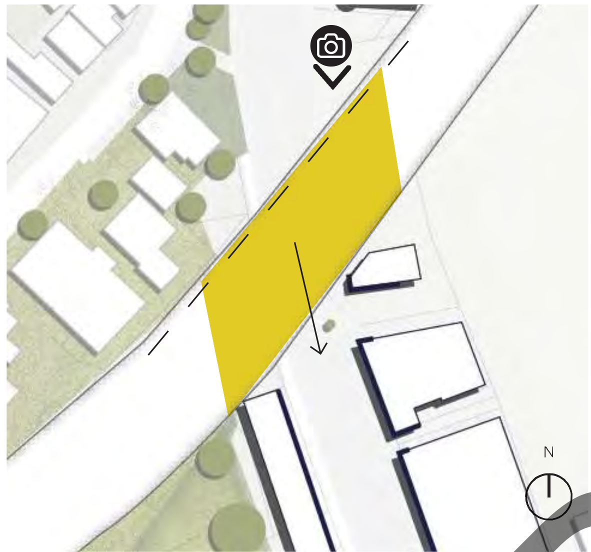
Gateway

Conceptual Ideas

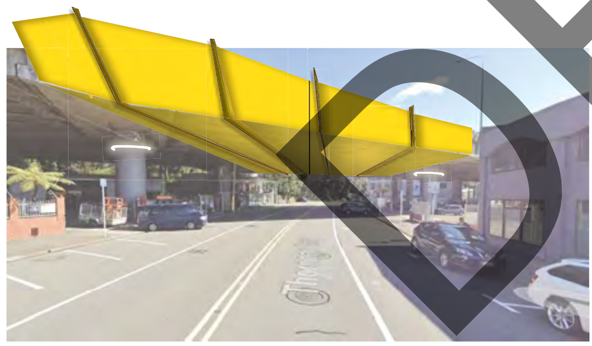
The Gateway interventions are proposed to celebrate and mark each end of Thorndon Quay shops by creating a visual division that influences vehicles and pedestrians to reduce speed and engage with the finer grained urban environment. We see this as a catalyst to define Thorndon Quay Shops' identity and character while reasoning with the wider Wellington look and feel.

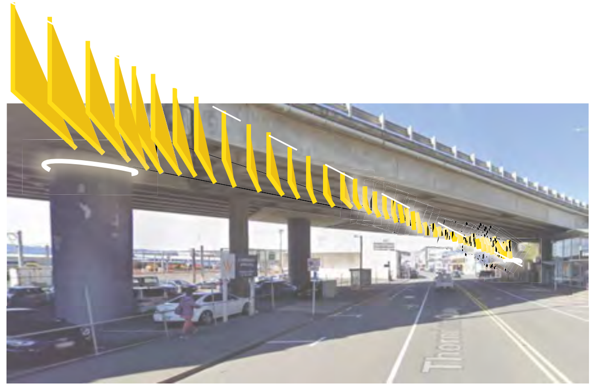
Suggested is the introduction of landscape and art. The art installations intend to establish dialogue between the brutal motorway infrastructure and the fluid connection from Wellington's green hills and Wellington's harbour on the East.

This technique has been successful in many global cities. A suggestion could be by using the underside of the State Highway 1 bridge that passes over the northern end of Thorndon Quay there is an opportunity to host urban artwork will act as both a gateway to the shops and revitalise the forgotten area under the bridge.



Northern Gateway





Precedents

Nelson Street Cycleway 'Light Path' - Auckland, New Zealand

Memorial Bridge - Christchurch, New Zealand

Waterview Connection - Auckland, New Zealand

Melbourne Gateway - Melbourne, Australia

Swan Street Bridge - Melbourne, Australia

Bridge Area - Neuied, Germany

Node 02

Pause Point

A high level proposal to introduce a pause point to the centre of the Thorndon Quay strip with a proposed through site link to establish a pedestrian connection to the neighbouring Thorndon residential area. Currently no access is possible so acquisition of private land will be required to achieve the through site link. There is potential for small retail to be introduced to support the open space.

This proposal looks at relocating the mid crossing to this area (refer to item 3)

1. Potential through-site pedestrian link from Hobson St to Thorndon Quay
2. Landscaping proposed at pause point
3. Proposed pedestrian crossing outside Bordeaux Bakery to shift to alternative location complementing the potential pause point at the through-site link: Soft toned with landscaping
4. Potential public/ commercial development on the through-site lane

Node 03

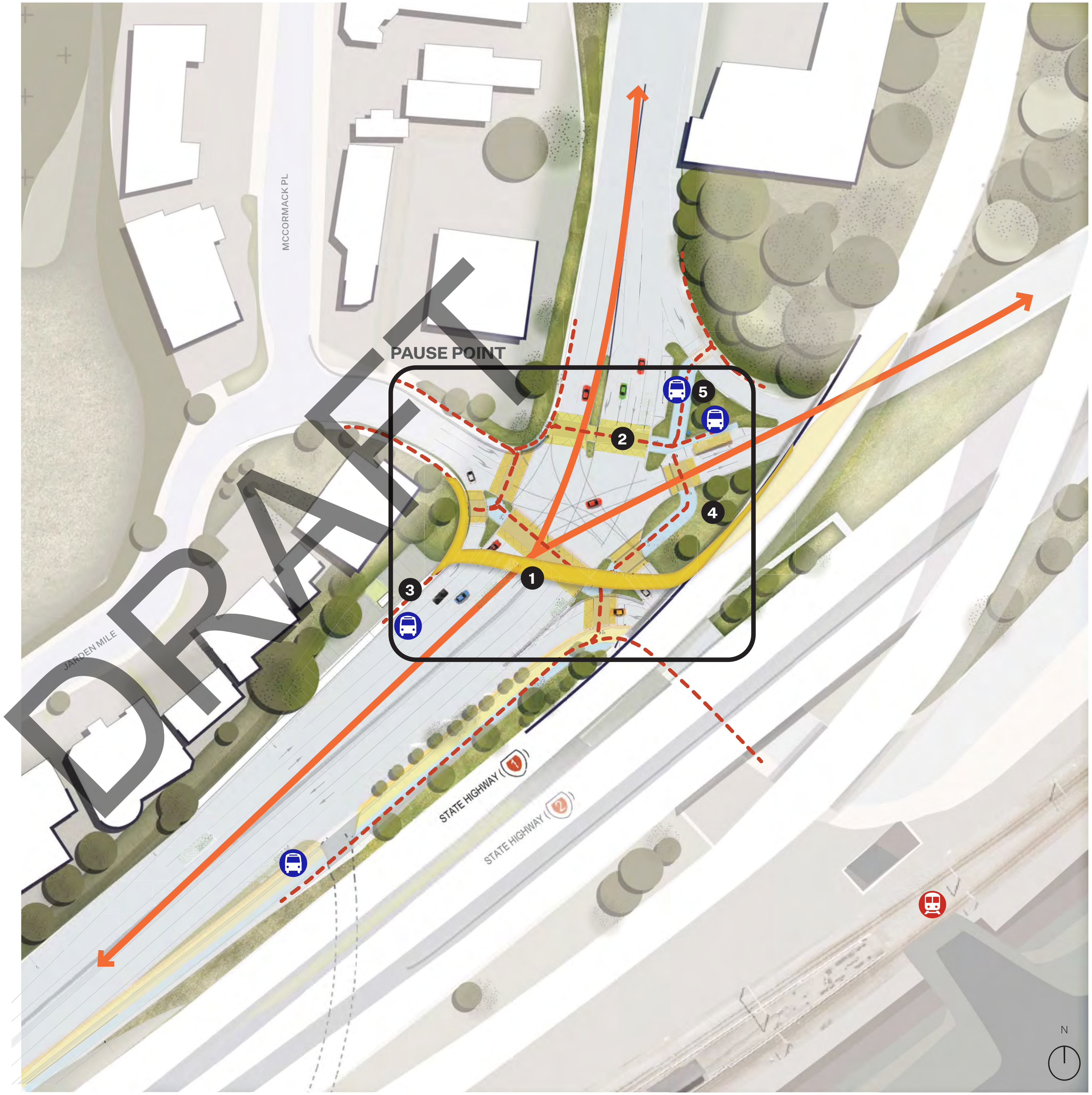
Jarden Mile

This node known to be extremely busy with vehicles and dominated by asphalt. The environment is felt to be unsafe to pedestrians and cyclists with freight also moving in this area.

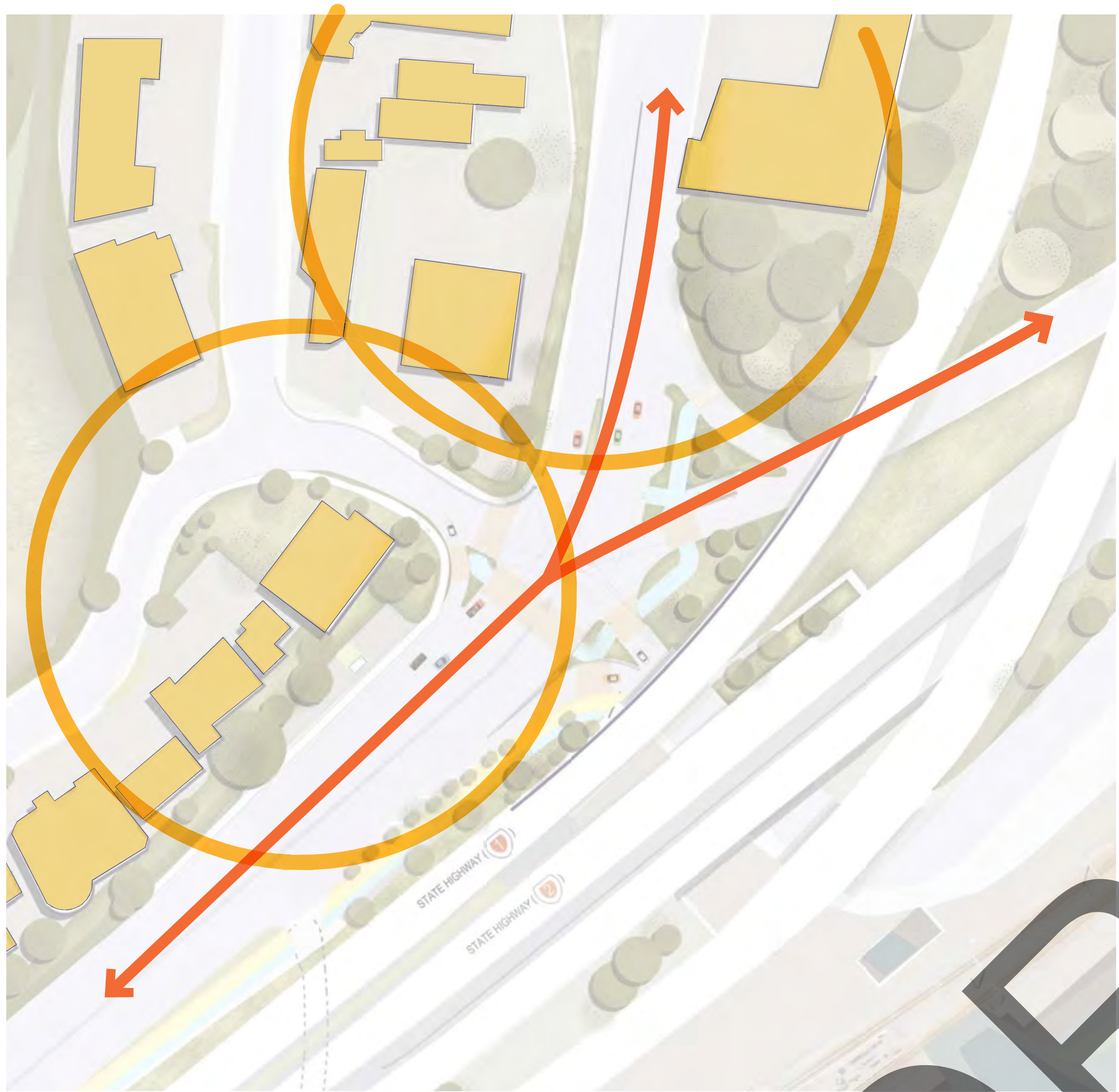
Commercial and industrial is located here and many bus passengers and cyclists are required to cross the busy road.

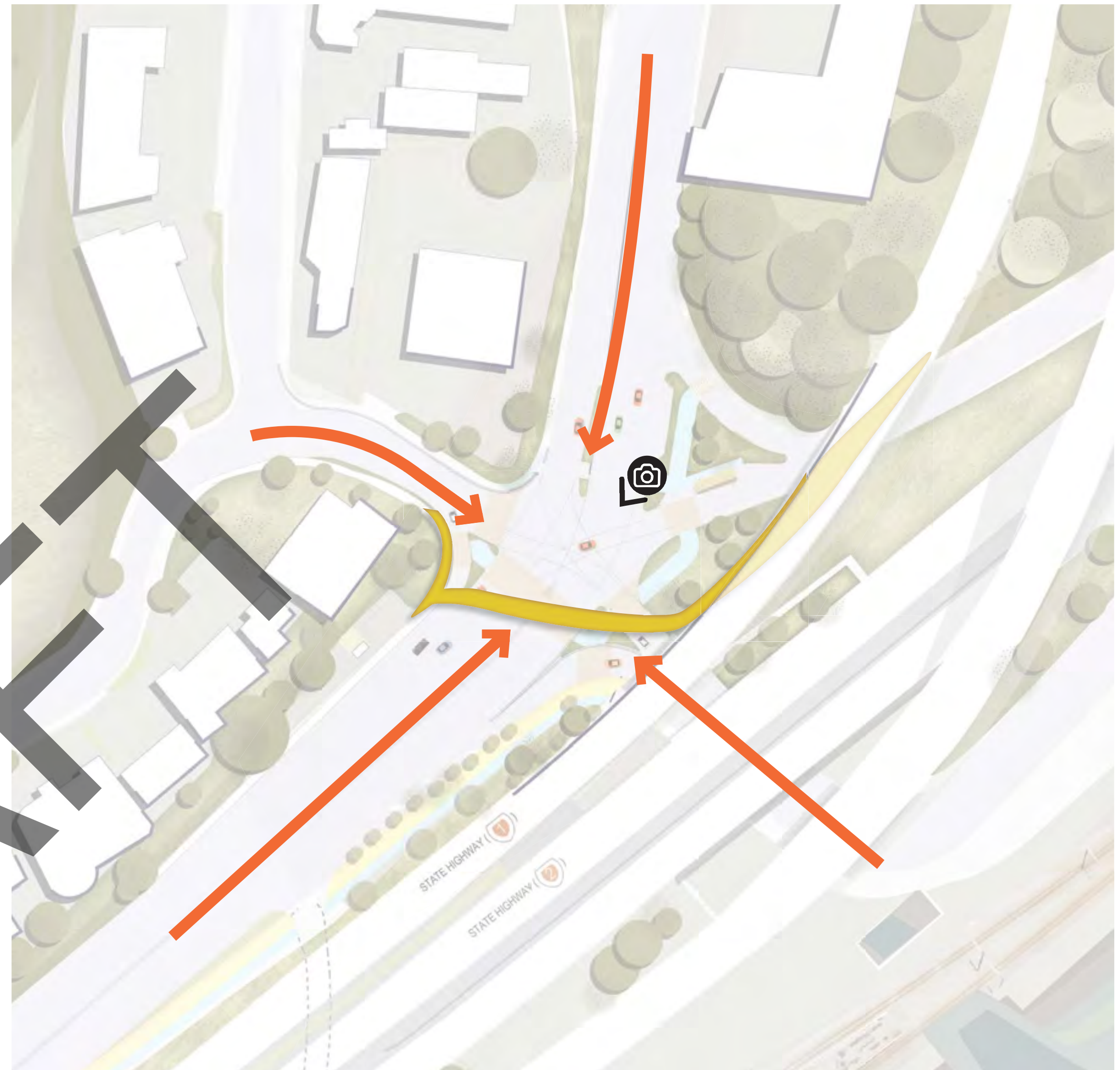
Landscape and art is proposed to define this area. A bold and powerful gateway will signal the entry to Wellington City and also create a sense of place for Jarden Mile. Texture and tone to the pavement crossings and significant landscaping to the edges will help to close in the space and create an environment and awareness of pedestrains that co-exist in this space.

We strongly believe horizontal treatment only will not suffice and propose significant art work be highly legible and mark this gateway. Similarly to the northern Thorndon Shops gateway proposal, working and connecting to existing motorway structure and potentially providing pedestrian shelter.



1. Gateway Art Installation clinging to the underside of State Highway 1 overpass. Shelter integrated into design: Yellow finish
2. Coloured pedestrian crossings: pastel yellow tone
3. Extended pedestrian footpath
4. Increased Greenery to connect with the surrounding landscape
5. Landscaped island with developed path in line of desire to pedestrian crossing





Uses

Commercial and retail businesses are located along Jarden Mile and further North in Ngaranga. Other than commercial businesses, this node is dominated by transport infrastructure as it is the junction where State Highway 1 and 2 converge to start Hutt Road.

Commercial/ Retail

Gateway

The gateway to be visible from all access routes. A unified design that is bold and defining for Jarden Mile node and for the greater Wellington region.

Pedestrian & Cyclist Movement

Highly legible pedestrians and cycling routes and crossing will be required in this node. It is envisioned that with the gateway proposal it will visually make vehicles aware of the other modes of transport in this area and slow down.

- High Pedestrian movement
- Low Pedestrian movement/ Off peak
- Developed Potential Pedestrian Movement
- Multi-Modal
- Pedestrian - Vehicle Conflict

Vehicle Movement

Through the realignment of vehicle lanes and increase in pedestrian points the area is more enclosed forcing greater awareness for vehicles thus improving safety.

- Bus
- Vehicle

Node 03

Pause Point

Combined with the bold gateway art installation and texture/ tone pavement treatments, views from afar and experienced close up the domination of road is greatly reduced. The additon of landscaping around crossings and in between road corridors suggests a more calm and human environment.

Solid medians are introduced as stepping stones across a wide corridor to help reduce the perceived distance of travel.

Potential for new shelters to connect bus stops to the business area would be part of the gateway installation.

1. Gateway art installation
2. Coloured pedestrian crossings
3. Pedestrian footpath added
4. Planting along footpath
5. Developed islands with low planting

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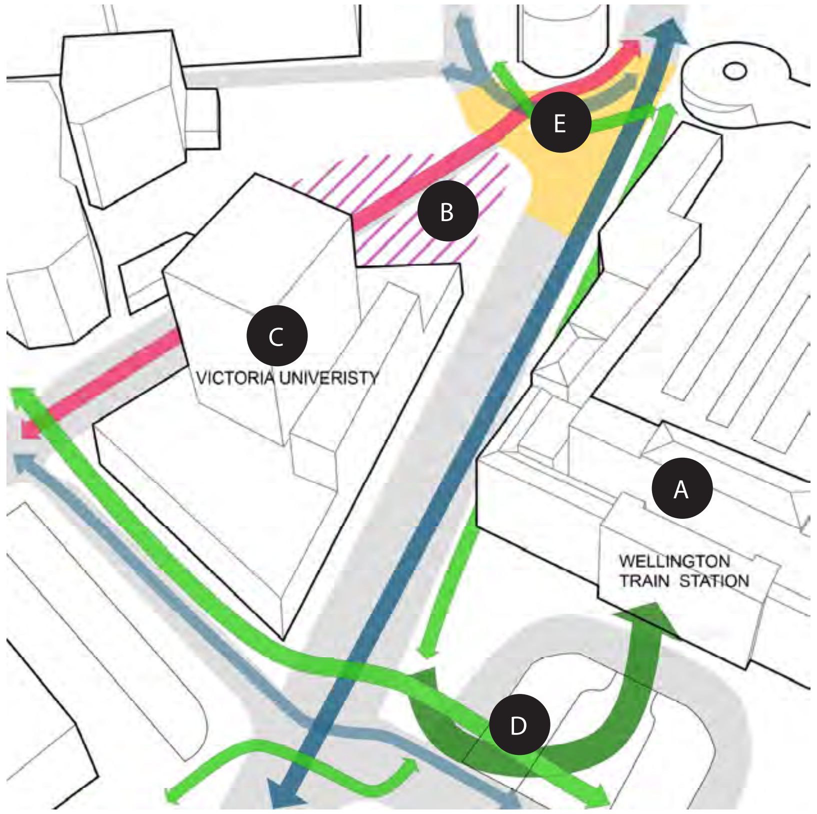
Nodal Points



Mulgrave Precinct

A Wellington Train Station sits at the north end of the CBD. It is the gateway into the city for many commuters and students.

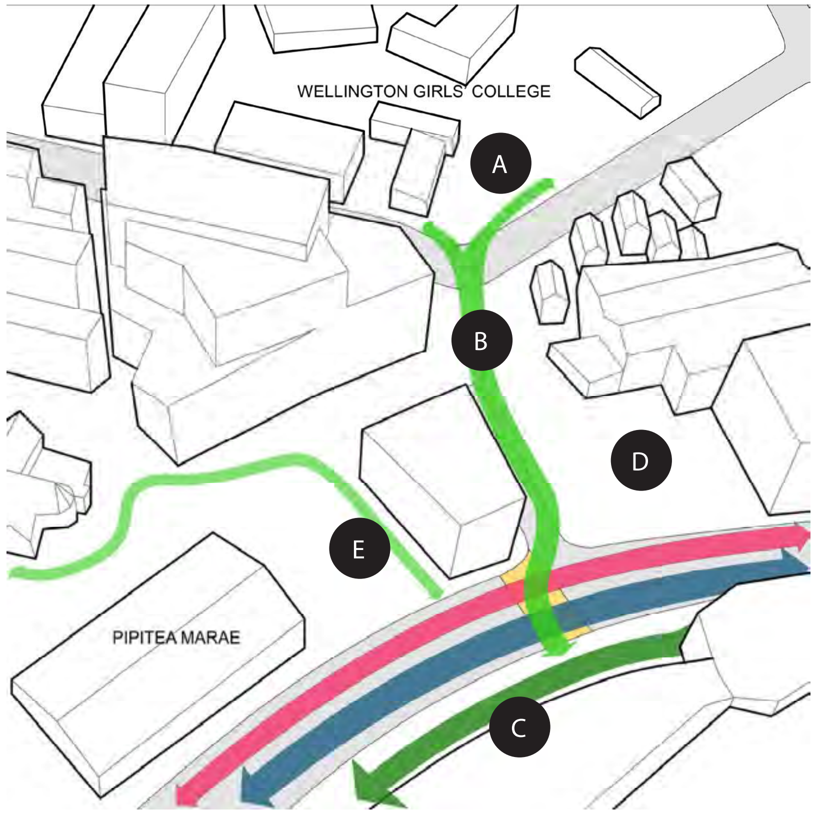
B Mulgrave Street Bus interchange lies at the north end of Lambton Quay - the end of the 'Golden Mile', which facilitates most public transit routes through the CBD.

C Victoria University's Pipitea Campus. It houses the schools of law and commerce and is tactically positioned in the government precinCt and adjacent to the train station.

D The space in front of the train station is one of the most heavily trafficked pedestrian spaces in the city.

E The transition from Featherston Street to Thorndon Quay forms a major intersection. Buses joing the main route north via Thorndon Quay here, sharing the road with cars and cyclists.

BUS INTERCHANGE
HEAVY INTERSECTION
PEDESTRIANS & CYCLISTS
VEHICLES
BUSES



Moore Street

A Wellington Girls' College is one of several schools in the Throndon area. Students make up many of the rush hour commuters.

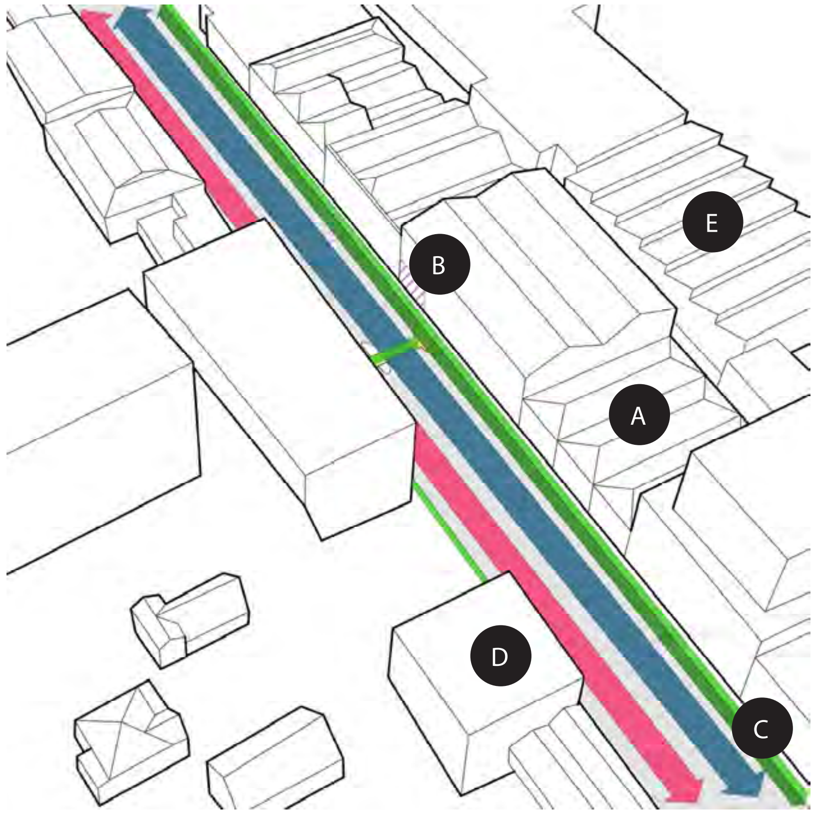
B Steps link the top of Moore Street to Pipitea Street. During the mornings and afternoons, students from nearby schools use this thoroughfare as a shortcut to the station.

C The eastern footpath of lower Thorndon Quay provides direct access to the Train Station.

D A carpark at the junction of Thorndon Quay and Moore Street is reminiscent of almost every open space found on the Quay - dedicated solely to the parking of vehicles.

E A pathway links Thordon Quay to Mulgrave Street via Pipitea Marae and Old St Pauls Cathedral. Small pockets of greenery scatter the edge. These are the only green spaces until the end of Thorndon Quay.

CROSSING
PEDESTRIANS & CYCLISTS
VEHICLES
BUSES



Thorndon Quay Shops

A — The dense and high built fabric of the Thorndon Quay Shops is distinguished by a mostly industrial typology.

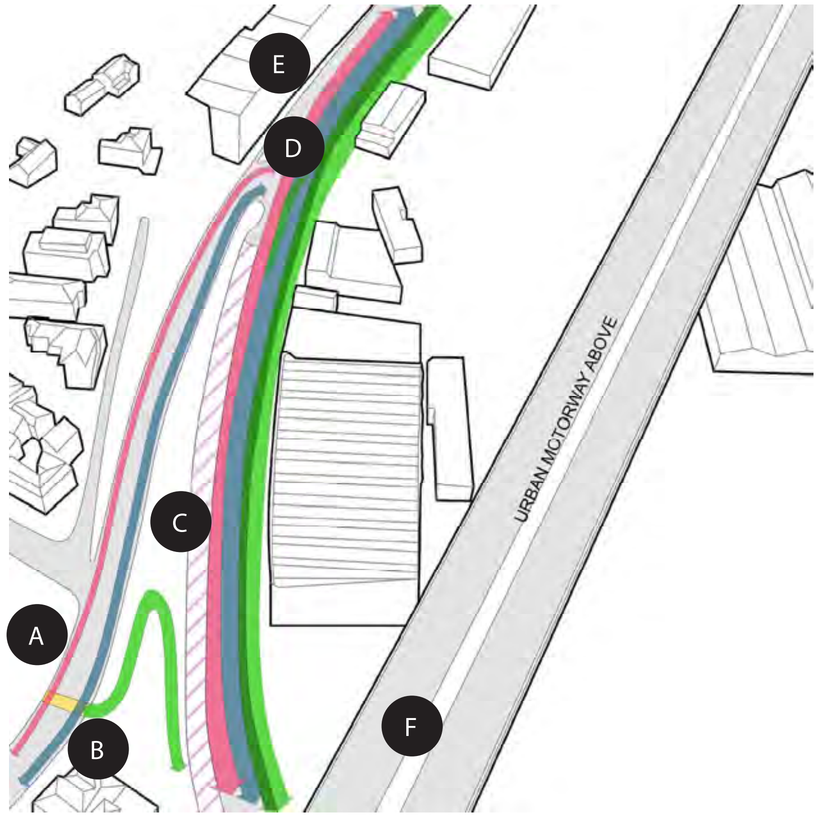
B — The well-known Bordeaux Bakery is a rare draw-card along Thorndon Quay. It is one of few destinations accessed by foot. A well placed pedestrian crossing sits adjacent - the only safe crossing along this stretch of Thorndon Quay.

C — The eastern side of Thorndon Quay includes an on-road cycleway. North bound cyclists share the path with vehicles with less dedicated space. However, a significant amount of parallel and angles parking is present on both sides of the road, all along the Quay.

D — Retail along this section of Thorndon Quay consists mostly of homeware, appliance and vehicle service based businesses. They therefore attract private vehicles, and the vehicular realm is dominant over that of the pedestrian.

E — Industrial yards and buildings behind Thorndon Quay back onto the railway yards and train tracks. They are not accessible.

NODE = BAKERY
CROSSING
PEDESTRIANS & CYCLISTS
VEHICLES
BUSES



Tinakori Road Intersection

A — Tinakori Road links to suburban Thorndon. It is characterised by and known for its Edwardian and Victorian era residential villas.

B — A pedestrian crossing across Tinakori Road links to a winding pathway down to Thorndon Quay under mature Pohutukawa trees.

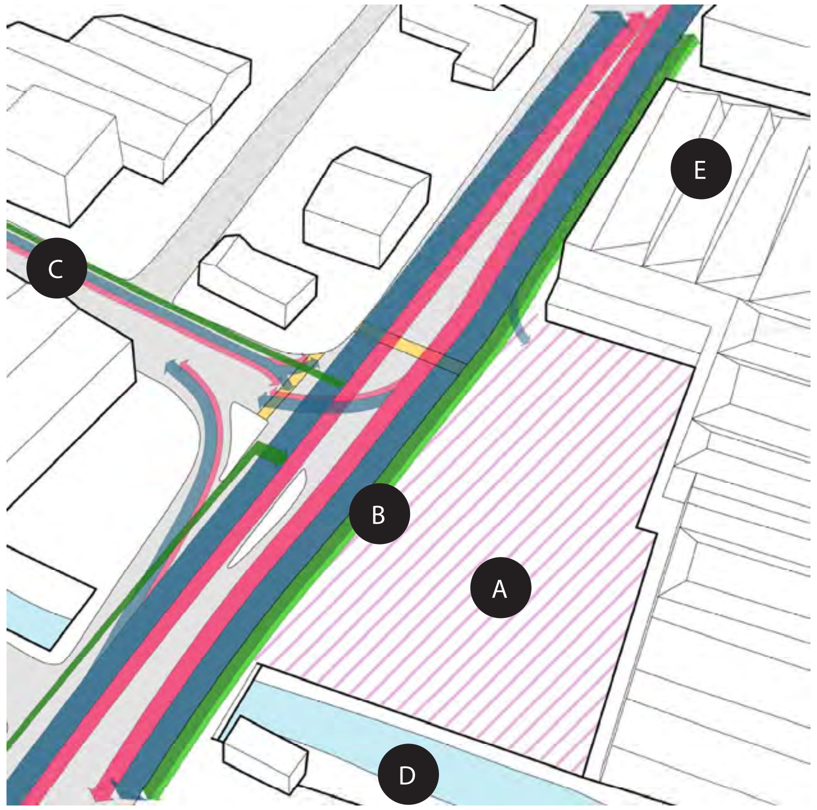
C — Angled car parking begins at the Tinakori/Hutt Road intersection and continues south along the length of Thorndon Quay, with few breaks for bus stops.

D — There is no pedestrian footpath along Tinakori Road to this intersection. At the intersection, cyclists are moved to the eastern side of Hutt Road and share a path in both directions. There is also a narrow pedestrian path.

E — One of many bus stops on Hutt Road sits hard up against the enormous Kennards Storage Building. The pedestrian realm here is minnowed by the adjacent road and building. There is no shelter.

F — The Wellington Motorway passes over the north extent of Thorndon Quay. It comes within touching distance of the adjacent building and shades the road below, asserting the dominance of the vehicular realm.

ANGLE CAR PARKING
CROSSING
CYCLEWAY
PEDESTRIAN PATHWAY
VEHICLES
BUSES



Kaiwharawhara Intersection

A A large, open carpark accesses Spotlight - one of many big box retail sites along Hutt Road. Vehicles entering and exiting must cross the dual cycle way and pedestrian path.

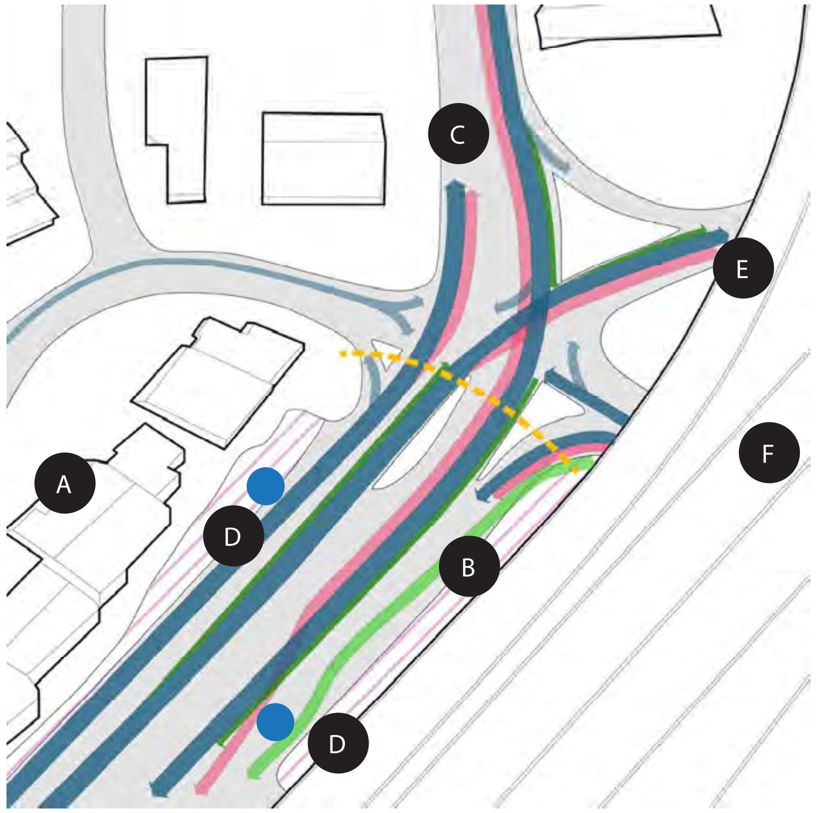
B A dual cycle way runs the length of Hutt Road, from Thorndon Quay to Jarden Mile. A pedestrian path also exists. Pedestrians and cyclists must be cautious of vehicles crossing into the many sites.

C Kaiwharawhara Road is a key access point to suburban Ngaio and Khandallah. Many daily commuters originate in these suburbs.

D Kaiwharawhara Stream passes under Hutt Road before discharging into Wellington Harbour.

E Like the Thorndon Quay Shops, big box retail in industrial buildings make up the fabric along Hutt Road. The urban fabric is less dense, however, with more yards and car parks.

RETAIL AREA CAR PARK
SAFE CROSSINGS
CYCLEWAY
PEDESTRIAN PATHWAY
VEHICLES
BUSES



Jarden Mile

A Large industrial / plant factory buildings make up Jarden Mile. Private vehicles and trucks dominate the access to these buildings.

B The dual cycleway ends at the Jarden Mile intersection. Hutt-bound cyclists must join the road here and share the road with vehicles, although there is a narrow cycle lane provided.

C Traffic to Newlands, Johnsonville and further north peel off into Ngauranga Gorge. More clusters of industrial buildings are found here.

D Bus stop locations. Pedestrians walk to intersection unsheltered to cross an unsignalised road that has heavy vehicular movement.

E State Highway 1 joins Ngauranga Gorge north-bound. South bound traffic gets its first view of Wellington Harbour and the city here.

F State Highway 2 continues towards the Hutt valley via a narrow strip of road between the hills and harbour.

CAR PARKING & PEDESTRIAN ACCESS
INFORMAL CROSSING
CYCLEWAY
PEDESTRIAN PATHWAY
VEHICLES
BUSES
BUS STOP

Appendix C

Risk Register

Project/Contract Description	Thordon Quay Hutt Road	NZTA Lead	Hannah Hyde
Contract ID	1909	Supplier Lead	Chris Dunlop
Contract Value	To be inserted	Supplier Risk Mgmt Specialist (if applicable)	Tracy Couchman
		Last Update	3/11/2021

Contract Risk Register

Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to Risk Tolerance Threshold (Y/N)	Planned Risk Trmt Actions Note: If more than one treatment action, either: . Include numbers to identify separate treatments, or: . Refer to Actions Register on separate tab	Treatment Owner(s)	Planned Treatment Implementation Date(s) (dd/mm/yyyy)	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
1	17/03/2020	There is a threat the business case will not be completed as programmed	The cause of the threat is lack of resources (pandemic) to complete the required assessments and write up the business case, Assess the stakeholders for input or feedback, loss of key staff - sick or reassigned	The consequence of threat is public complaints / reputation, resources to manage and remedy, catch-up comms or additional construction, delayed benefits, costs to recover programme	Beca	Andy Lightowler	Mar 20 - Resourcing sharing across delivery partners as required, by agreement, reliable remote working system access / provisions Mar 21 - ongoing monitoring and project management, strong communication with management team	Unlikely	Moderate	Health & Safety	Medium					20/7/7 - Stage 1 technical deliverables completed as per programme	Rare	Minor	Low	Closed	16/04/20 - Linked to RID3, RID7 6/7/20 risk closed. Covid not risk to SSBC delivery anymore
2	17/03/2020	There is a threat that approvals take longer than planned	The cause of the threat is that the TWG and/or OIMS have a large number of projects requiring input and the TQHR project engagement is less than ideal.	The consequence of the threat is additional effort to chase TWG & OIM's, additional engagement, poor feedback or inputs, wrong decisions made, poor benefits / outcomes	LGWM	Hannah Hyde	17/04/20 - TWG / OIMS spreadsheet setting out workshops and deliverable reviews so that TWG and OIMS can manage their workload 1/12/20: TWG and OIM's now have a comments prioritisation register	Unlikely	Moderate	Delivery	Medium	Y		Paul McGimpsey		20/7/7 - HH has been proactively managing input from OIM's and TWG. Raised today that there is a possibility of a new group called 'TAG' which may have approval rights. 1/12/20: There is now a TAG group, but we don't need their formal endorsement.	Unlikely	Moderate	Medium	Live-Treat	20/6/7 - risk description updated
3	17/03/2020	There is a threat of the business case approval process is interrupted	The cause of the threat is the business case is more complex than expected, the approval process changes, Covid19 impacts	The consequence of the threat is additional investigation & effort, programme delays, additional stakeholder engagement, possible	Beca	Andy Lightowler	16/04/20 - Weekly team Leads meetings, Weekly client meetings, one on one with NZTA and TWG members. Engagement and Comms	Likely	Moderate	Delivery	High		16/04/20 - ACTION Tim Brown - Right size discussion for SSBC with NZTA IQA team, agreed methodology for MCA and Economic Appraisal prior with TWG and Project leads.	Neil Trotter	30/04/2020	20/7/7 - Engagement with partners is occurring over the options development and	Likely	Moderate	High	Closed	16/04/20 - Linked to RID1, RID7 1/12/20: updated to include wider approvals. To date there have been three approvals interruptions, SC, LLSL,
4	17/03/2020	There is a threat of Technical KPIs are not met	NA	NA	Beca	Eric Whitfield														Rejected	Risk not defined, closed
5	17/03/2020	There is a threat of not maximising the network benefits outcomes	The cause of the threat is poor single stage business case assessment, change to ILM scope, poor engagement by SSBC stakeholders, sacrifice benefits over process	The consequence of threat is additional effort for rework & C&E programme, lost benefits, programme delays, stakeholder and public frustration, reputation, funding impacts, safety	Beca	Andrew Stewart		Possible	Moderate	Public/Media	Medium						Possible	Moderate	Medium	Closed	25/05/20 - closed as per Eric Whitfield
6	17/03/2020	There is a threat of a cost increase to the project budget & whole of life costs	The cause of the threat is market uncertainty (Covid), people availability, high post lockdown gear-up constraints, change of market forces, change in political funding decisions	The consequence of the threat is project does not proceed, increased costs, programme delays, benefits not realised, reputational impacts	Beca	Eric Whitfield		Almost certain	Moderate	Cost	High						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID10, RID59 12/05/20 - Combined RID10; Risk closed
7	17/03/2020	There is a threat of delay of the project shortlisting.	The cause of the threat is mis-alignment of problems/IO, and no ILM workshop (out of scope)	The consequence of the threat is public complaints/reputation, delayed programme.	GSP Ltd	Graham Spargo		Possible	Moderate	Cost	Medium						Possible	Moderate	Medium	Closed	02/04/2020 - Risk closed (ILM is out of scope, not just value for money approach - wider benefits realisation approach) 16/04/20 - Linked to RID1, RID3
8	17/03/2020	There is a threat of delays to the project	The cause of the threat is ramping-up delays with the partnering teams , opposing views not resolved (delays), duplicate effort across partners, confused comms & scope	The consequence of the threat is delay in programme, additional effort to resolve, complaints from stakeholders, confused engagement, benefits not realised, reputational impacts	Beca	Eric Whitfield		Possible	Moderate	Delivery	Medium									Closed	Pending Controls & Treatment Information from Risk Owner 25/05/20 - Closed as per Eric Whitfield
9	17/03/2020	There is a threat of the Quick Wins list not being approved, or taking a long time for approval.	The cause of the threat is the Quick Wins not being agreed between (team members/client?), robust information not available to decision makers, decision makers are not prepped sufficiently or in a timely manner, incorrect decision makers for required approvals	The consequence of threat is programme delay, additional effort to correct issues, incorrect decisions - poor benefits or outcomes, stakeholder / public complaints, additional costs to resolve / rework	Beca	Caron Greenough	08/07/2020 - Quick Wins approved	Possible	Severe	Public/Media	High						Possible	Severe	High	Closed	16/04/20 - Linked to RID51, RID81, RID61 08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
10	17/03/2020	There is a threat of a cost increase for the project and whole of life costs	The cause of the threat is changing the funding priority (Covid, etc); market uncertainty (Covid), people availability, high post lockdown gear-up constraints, change of market forces (reduced construction resources in the market due	The consequence of the threat is some aspects not having adequate funding, project does not proceed, increased costs, programme delays, benefits not realised, reputational impacts, safety benefits not realised	LGWM	Hannah Hyde	25/05/20 - Robust business case methodology with input from stakeholders and partners. Knowledge of market costs. Contractor relationships	Likely	Minor	Cost	High	N	01/05/20 - ACTION: Eric Whitfield to speak with QS team, to understand market forces impact on business case economic case. SSBC to consider and document possible impacts	Shirley Mendoza Cruz	30/06/2020	20/7/7 - feedback is that market remains competitive, shovel-ready and other stimulus projects are slow to come to market.	Possible	Severe	High	Live-Treat	16/04/20 - Linked to RID6, RID10, RID59 1/12/20: this risk will be reviewed for whole of project costs at next risk workshop 12/05/20 - RID6, RID59 combined 7/7/20 - residual risk likelihood reduced
11	17/03/2020	There is a threat the network is not a seamless integrated solution (journey for road users)	The cause of the threat is making assumptions or not have clarity of scope regarding the bus exchange integration for the shortlisted options within the project	The consequence of the threat is network integration, future proofing and resilience is compromised, potential rework to solve issues (redesign), programme delays, additional costs, stakeholder	Beca	Eric Whitfield	01/05/20 - Engaging with Greater Wellington re planned transport provisions - ongoing discussions	Likely	Moderate	Cost	High						Possible	Minor	Medium	Closed	17/03/20 - Linked to RID20 12/05/20 - Combined RID20, Risk closed
12	17/03/2020	There is a threat that the Investment Objectives are not achieved	The cause of the threat is not reviewing the Investment Objectives thoroughly to manage compliance with the RMA, lack of engagement with key stakeholders, lack of	The consequence of the threat business case fails, all recommendations for improvements are not accepted, protracted RMA	Beca	Eric Whitfield	'16/04/20 - ongoing assessment and discussion with TWG / Stakeholders regarding investment objects	Possible	Moderate	Delivery	Medium		'1/05/20 - ACTION - Eric Whitfield to provide regular communication with client and LGWM OIM's and TWG	Eric Whitfield	30/05/2020		Unlikely	Moderate	Medium	Closed	20/06/07. Closed as similar to risks 93 and 12 re investment objectives and project objectives.
13	17/03/2020	There is a threat of business owners objecting the cycleway, as they will loose parking for customers	The cause of the threat is the intentions and design of the cycleway not being cleared communicated with business owners during design stage.	The consequence of threat is public complaints and reputation, redesign.	Beca	Nathan Baker		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID77, RID 73, RID76, RID91, RID14 20/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined; Risk closed
14	17/03/2020	There is a threat of property owners objecting the new placement of bus stops/shelters.	The cause of the threat is a lack of engagement with property owners during design stage.	The consequence of threat is public complaints and reputation.	Beca	Nathan Baker		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID77, RID 73, RID76, RID91, RID13 20/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate
15	17/03/2020	There is a threat of the Urban Design benefits are not realised	The cause of the threat is the business case does not explore the urban design benefits sufficiently, key stakeholder inputs are missed, key data is not gathered - investigated, the business case approval declined urban design elements,	The consequence of the threat is solution does not meet social distancing requirements, costs and delays to remediate, complaints, benefits not realised, reputational impacts, not future proofed	Beca	Mark Sneddon		Likely	Moderate	Delivery	High						Likely	Moderate	High	Closed	20/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined; Risk closed

Project/Contract Description	*Thordon Quay Hutt Road*	NZTA Lead	*Hannah Hyde*
Contract ID	*1909*	Supplier Lead	*Chris Dunlop*
Contract Value	*To be inserted*	Supplier Risk Mgmt Specialist (if applicable)	*Tracy Couchman*
		Last Update	*3/11/2021*

Contract Risk Register

Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to Risk Tolerance Threshold (Y/N)	Planned Risk Trmt Actions *Note: If more than one treatment action, either: . Include numbers to identify separate treatments, or: . Refer to Actions Register on separate tab*	Treatment Owner(s)	Planned Treatment Implementation Date(s) (dd/mm/yyyy)	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
16	17/03/2020	There is a threat the preferred option is not aligning with the Placemaking Framework and Amenities Strategy / Urban Design	The cause of the threat is that placemaking has not been given priority and the project options have an engineering focus, rather than aligning with city aspirations. Recognition of different areas of character in different	The consequence of the threat is public complaints, difficulty for approval, benefits not realised, future network impacts and maintenance issues, programme delays, costs, reputational impacts, cultural and community	Beca	Tom Abbot	25/05/20 - Engagement with partners on placemaking strategy. Urban design and placemaking input at early in options development	Almost certain	Moderate	Cost	High	N	02/03/21 - ACTION: Develop with Key stakeholder engagement, the placemaking/urban design framework for TQHR, Feed into the Prelim Design 03/11/21 - Retest above in next design phase	Tom Abbot / Will Maguire	30/11/2021	20/7/20 - Shannon Joe has met with WCC urban design team to discuss placemaking and amenity on the project. WCC support short list options.	Almost certain	Moderate	High	Live-Treat	16/04/20 - Linked to RID17 08/05/20 - RID16, RID17 combined 20/06/07 - changed owner to project team 1/12/20: no agreed placemaking
17	17/03/2020	There is a threat of inconsistency of strategy between TQHR with surrounding land of projects	The cause of the threat is recognition of different areas of character in different ways, the various projects do not have a consistent placemaking and amenities strategy, poor comms, poor decision making, poor engagement, strategy not	The consequence of the threat is public complaints, benefits not realised, inconsistent journey, safety impacted, maintenance issues, programme delays, costs, reputational impacts, environmental compliance impacts	Wellington City Council	Emily Alleway		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID16 08/05/20 - RID16, RID17 combined, Risk closed
18	17/03/2020	There is a threat that moving buses off the motorway will not meet the same standards as the motorway.	The cause of the threat is that all day travel speeds on the corridor will need to be competitive with the bus on the motorway. Facilities for driver breaks will also need to be provided.	The consequence of threat is public complaints and reputation, redesign or corridor.	Beca	Eric Whitfield		Possible	Moderate	Health & Safety	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID46, RID39, RID40 08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
19	17/03/2020	There is a threat of poor journey outcomes on the wider corridor	The cause of the threat is the lack of clarity of the corridor requirements for cycle, bus, over-dimension, Centre-point area / Aotea Quay 4th lane impacts	The consequence of threat is poor journey outcomes, benefits not realised, reputational impacts, costs and delays to remedy	Beca	Neil Trotter	16/04/20 - (Tim Brown Note) The role of the corridor has already been established in that it is a key cycling and bus corridor, over-dimension corridor, primary access to	Possible	Moderate	Delivery	Medium		'1/05/20 - ACTION: Neil Trotter to make sure role of corridor, including using the Place and Movement Framework, is consistent through the options assessment process during business case development.	Neil Trotter	30/05/2020		Unlikely	Moderate	Medium	Closed	25/05/20 - closed as per Eric Whitfield
20	17/03/2020	There is a threat network is not a seamless integrated solution (journey for road users)	The cause of the threat is a lack of integration with the bus priority programme, lack of investigation, lack of stakeholder inputs, making assumptions or not have clarity of scope regarding the bus exchange and ferry terminal integration for the shortlisted options; constraints of Aotea Overbridge, and links outside of the	The consequence of threat is poor corridor connectivity, benefits not realised, complaints, reputational impacts, costs to remedy, future proofing and resilience compromised, potential rework to solve issues (redesign), programme delays, stakeholder complaints, dis-jointed	AE COM	Tim Brown	16/04/20 - Communication with the Bus Priority Programme team to clearly understand their programme of works, and how it could dovetail with Thorndon Quay	Likely	Moderate	Delivery	High		16/04/20 - ACTION: Eric Whitfield to communicate with client and LGWM OIM's to raise as an issue '1/5/20 -ACTION - Neil Trotter to consider this during alternatives and options assessment.	Eric Whitfield Neil Trotter	30/05/2020 30/05/2020		Unlikely	Moderate	Medium	Closed	17/03/20 - Linked to RID11, RID23 12/05/20 - combined RID11, RID23 '16/04/20 - (Tim Brown Note - This is a bus service planning issue, not an infrastructure one, unless there is a scope change whereby there is a new route proposed to connect to the Ferry Terminal)
21	17/03/2020	There is a threat of harm to peds & cyclist	The cause of the threat is lack of pedestrian or cycling crossing facilities at Ngauranga intersection.	The consequence of threat is harm to road users, complaints, costs to rework BC / designs, benefits not realised, reputational impacts	AE COM	Tim Brown	16/04/20 - Business case process followed - user requirements, options, assessment (filtering, then MCA) to come down to a preferred	Possible	Severe	Health & Safety	High						Unlikely	Moderate	Medium	Closed	25/05/20 - Closed as per Eric Whitfield
22	17/03/2020	There is a threat of the project does not align with the Place and Movement Framework	The cause of the threat is the business case does not explore all user requirements on the network - eg Peds & Cyclists (multi-modal), align with NZTA NOP (Place & Movement Framework), gaps or	The consequence of threat is poor BC and decisions, benefits not realised, stakeholder impacts, costs to remedy, programme delays, reputational impacts	AECOM	Tim Brown		Possible	Moderate	Delivery	Medium		16/04/20 - ACTION: - Hannah Hyde to provide the project leadership group with the NOF. This is to enable team to look for potential conflicts with other guiding document s/ principles	Hannah Hyde	30/06/2020	20/7/7 - it was raised today by HH that WCC have not adopted the Place and Movement Framework so status is	Unlikely	Moderate	Medium	Closed	17/03/20 - Linked to RID28 12/05/20 - RID28 combined 20/6/7 - updated risk description 1/12/20: closed. Captured in urban design risk above (placemaking)
23	17/03/2020	There is a threat the corridor journey is not integrated for road users	The cause of the threat is the constraints of Aotea Overbridge, and links outside of the study area are not considered, lack of engagement / data to close out in the BC	The consequence of threat is a dis-jointed journey to access ferry terminal, media / reputational impacts, ongoing economic effects, costs and delays to remedy	Beca	Neil Trotter	16/05/20 - (Tim Brown Note - This is a bus service planning issue, not an infrastructure one, unless there is a scope change whereby there is a new route proposed to connect to	Likely	Moderate	Stakeholders	High						Possible	Moderate	Medium	Closed	17/03/20 - Linked to RID23 12/05/20 - Combined RID20, Risk Closed
24	17/03/2020	There is a threat benefits from integration of safe systems are not realised	The cause of the threat is not investigating, documenting and designing in safe systems (e.g. Lighting)	The consequence of threat is lack of investigation at BC stage, requirements not captured, lack of early engagement, decision making & funding	Beca	Marcus Brown		Possible	Moderate	Health & Safety	Medium									Closed	Pending Controls & Treatment Information from Risk Owner 25/05/20 - Closed as per Eric Whitfield
25	17/03/2020	There is a threat of reduced access from Ngauranga Station to Jarden Mile.	The cause of the threat is the lack of inclusion into the design.	The consequence of threat is public complaints, user safety impacts, journey connectivity, reputational impacts	Beca	Eric Whitfield	16/04/20 - 'Status quo access provisions to Ngauranga Station	Likely	Moderate	Delivery	High						Possible	Moderate	Medium	Closed	08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
26	17/03/2020	There is a opportunity of increased network efficiencies	The cause of the opportunity is the Kaiwharawhara Intersection approach benefiting future freight logistics on the corridor, improved requirements and design	The consequence of opportunity is improved economic efficiencies, journey benefits, safety improvements	AECOM	Tim Brown	'16/04/20 - Communications and engagement plan – specifically the PRG to capture requirements for design and implementation	Possible	Moderate	Delivery	Medium		''1/5/20 - ACTION - Tim Brown to bring this option into the alternatives and options assessment	Tim Brown	30/05/2020		Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID32
27	17/03/2020	There is a opportunity to increase network efficiencies with Ngauranga Kiss and Ride	The cause of the opportunity is the Kiss and Ride at Ngauranga Intersection approach benefiting road users on the corridor, improved requirements and design	The consequence of opportunity is improved economic efficiencies, journey benefits, safety improvements	AECOM	Tim Brown	16/04/20 - Communications and engagement plan – specifically the PRG to capture requirements for design and implementation	Possible	Moderate	Delivery	Medium		1/5/20 - ACTION - Tim Brown to bring this option into the alternatives and options assessment	Tim Brown	30/05/2020		Possible	Moderate	Medium	Closed	20/6/7 - opportunity description updated
28	17/03/2020	There is a threat the investment objectives are not achieved	The cause of the threat is gaps or conflicts between framework and guidance principles	The consequence of threat is benefits not realised, additional costs to remedy, safety impacts to road users, reputational impacts	Beca	Eric Whitfield		Likely	Moderate	Public/Media	High						Unlikely	Severe	Medium	Closed	17/03/20 - Linked to RID22 12/05/20 - RID22 combined, Risk Closed
29	17/03/2020	There is a threat of duplication of activity across programmes	The cause of the threat is that the project scope is unclear within the LGWM programme & schedule of regional programmes, of works being unclear with the N2P cycling interface, capital	The consequence of the threat is mis-aligned scope (gaps, overlapping scope), public confusion re engagement, additional effort / rework, delays to programme	LGWM	Hannah Hyde	Coordination with other LGWM workstreams	Possible	Moderate	Delivery	Medium						Unlikely	Moderate	Medium	Closed	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83; Risk closed
30	17/03/2020	There is a threat the network does not meet the required level of resilience (future-proofed, event - Quake etc)	The cause of the threat is a lack of coordination during design with resilience strategy consultants, lack of investigations to understand issues and requirements, lack of expert inputs, lack of engagement (eg - maintenance, future needs / volumes)	The consequence of the threat is a network that does not withstand required quake levels, future traffic volumes not met, additional future works, maintenance cost impacts, delays to programme to resolve /	Wellington City Council	Emily Alleway		Possible	Severe	Stakeholders	High		08/05/20 - ACTION - Emily Alleway to speak with Mike Meudouca at WCC, LQHR business case considers the WCC Network Resilience strategy requirements	Emily Alleway	30/05/2020		Unlikely	Moderate	Medium	Closed	25/05/20 - Risk closed as per Eric Whitfield
31	17/03/2020	There is a threat of benefits not being realised and safety impacts to network users	The cause of the threat is constraints of infrastructure already existing on the corridor	The consequence of the threat is additional assessment of structural features on the network (additional effort), programme delays, benefits not realised, reputational impacts	Beca	Eric Whitfield		Possible	Moderate	Delivery	Medium		1/5/20: Eric Whitfield to discuss with LGWM prior to Stage 2 to allow for adequate survey and data collection prior to developing designs.	Eric Whitfield	1/05/2020	Closed	Possible	Moderate	Medium	Closed	08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
32	17/03/2020	There is a threat the Kaiwharawhara station is not accessible from the network corridor	The cause of the threat is a lack of clarity in the project scope, and the network corridor does not connect into key infrastructure assets	The consequence of the threat is that the design may not align with the requirements of the project scope.	Beca	Eric Whitfield		Possible	Moderate	Delivery	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID26 08/05/20 - Risk closed, refer to RID 26 as per Eric Whitfield and Hannah Hyde
33	17/03/2020	There is a threat the network does not meet the required future proofed level of service	The cause of the threat is the business case does not provide the required	The consequence of the threat is redesign to meet growth strategy	Beca	Neil Trotter	08/07/2020 - Long list and short list options reviews progressing -	Likely	Moderate	Delivery	High		16/04/20 - ACTION: Neil Trotter to latest growth strategy and forecast demand for	Neil Trotter	8/05/2020		Possible	Moderate	Medium	Closed	25/05/20 - Risk closed as per Eric Whitfield
34	17/03/2020	There is a threat the preferred option is not resilient to climate change (slip failure, tidal inundation and the like)	The cause of the threat is that the preferred option is not aligned to the climate change plan, lack of integration (with Wellington Lifelines project, lack of	The consequence of the threat is the corridor is not future proofed, additional costs to retrofit solutions, additional focus costs to maintain	Beca	Caron Greenough	25/05/20 - This project is not making any infrastructure changes related specifically to climate change mitigation	Unlikely	Minor	Health & Safety	Low						Unlikely	Minor	Low	Closed	16/04/20 - Linked to RID48 08/05/20 - Risks combined 20/06/07 - This project is not making

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35	17/03/2020	There is a threat of the overall network solution is not fit for purpose	The cause of the threat is there is currently a lack of integration between the programmes - integrating with the NZTA and LGWM Programme (Golden Mile, City	The consequence of the threat is public complaints and reputation, cost implications, programme delays, rework, long term economic regional	LGWM	Hannah Hyde		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83; Risk closed
36	17/03/2020	There is a threat the corridor is not available for construction of the TQHR project.	The cause of the threat is there will be works on State Highway 1 from other capital project or major maintenance works beside the corridor restricting access for the TQHR construction	The consequence of the threat delay to the project programme, additional effort for reprogramming, contract penalties to NZTA for contractor delays, resourcing availability window	LGWM	Hannah Hyde	'17/04/20 - LGWM programme shared with NZTA	Unlikely	Moderate	Delivery	Medium						Unlikely	Moderate	Medium	Closed	20/6/7 - combined with Risk 38 and closed
37	17/03/2020	There is a threat of poor investment outcomes	The cause of the threat is lack of knowledge sharing between other programmes -large road projects such as TG, PP2O, and N2P cycleway, lack of regional coordination, not exploring sufficiently in the BC to inform good decision making	The consequence of threat is poor user journeys, lost economic benefits, reputational impacts	Beca	Eric Whitfield		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
38	17/03/2020	There is a threat of lack of coordination with other regional projects having an effect on the programme progression of the corridor.	The cause of the threat is the wider effects in the area of the reassignment traffic to other/alternative routes during the gorge lane closure.	The consequence of threat is programme delays, complaints, reputational impacts, safety impacts for road users	LGWM	Hannah Hyde	25/05/20 - Coordination with other Waka Kotahi and partner programmes. 01/11/21 - Petone cycle way coordination via Hannah Hyde via LGWM	Possible	Moderate	Delivery	Medium	Y					Unlikely	Moderate	Medium	Live-Treat	12/05/20 - Risk owner changed from Tim Brown to Hannah Hyde as per Eric Whitfield instructions 01/11/21 - Controls updated, treatment closed Linked to Risk 117
39	17/03/2020	There is a threat of lack of clarity on the inclusion of the bus interchange.	The cause of the threat is the bus interchange being out of scope for both the Golden Mile and TQHR, lack of inter project comms between to two programmes	The consequence of the threat is that the end design may not be fit for purpose - redesign needed, programme and cost impacts, additional effort to remedy, stakeholder & public complaints	Wellington City Council	Gunther Wild		Likely	Moderate	Cost	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID39, RID18, RID46, RID40 17/04/20 - Transfer from Hannah Hyde to Gunther Wild - WCC led (Station precinct design is being led by WCC. MRT project for LGWM is the funnel for
40	17/03/2020	There is a threat of the Lambton Bus interchange having an impact on the corridor.	The cause of the threat is redesign of the bus interchange.	he consequence of the threat is that the end design may not be fit for purpose - redesign needed.	Wellington City Council	Gunther Wild		Possible	Minor	Stakeholders	Medium						Possible	Minor	Medium	Closed	16/04/20 - Linked to RID39, RID18, RID46, RID40 17/04/20 - Transfer from Hannah Hyde to Gunther Wild - WCC led; Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83; Risk closed
41	17/03/2020	There is a threat of other project changes having an impact of final results.	The cause of the threat is the possible changes to the Interisland ferry terminal, change in government funding / priorities post Covid, lack of clarity re other capital projects scope and interdependencies to TQHR, Kiwirail/Centreport Future Developments, Lambton bus interchange, WCC coordination with Wellington Water, roading maintenance, GasCo, TelCo, etc, mis-communication re maintenance programmes	The consequence of the threat is public complaints and reputation damage. Redesign needed, additional effort & rework, programme delays and cost impacts, benefits not optimised or realised..	LGWM	Hannah Hyde	25/05/20 - Coordination with LGWM and partner programmes. 03/11/21 - further design progress with Prelim design, and understandign of this project interdependancies with other projects	Possible	Moderate	Stakeholders	Medium	Y					Rare	Moderate	Low	Live-Treat	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83 20/6/7 - owning org changed to LGWM 03/11/21 - Controls updated, ranking reduced
42	17/03/2020	There is a threat of complaints and confusion regarding the transitional strategy	The cause of the threat is there is not a clear strategy for the transitional, lack of ongoing comms & engagement re the strategy, businesses are not prepared for the disruption - no continuity plans to	The consequence of threat is that the construction strategy may require extra planning - delays, business slowdown, additional effort re comms & engagement	Wellington City Council	Gunther Wild		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	17/04/2020 - Transferred from Hannah Hyde to Gunther Wild 08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
43	17/03/2020	There is a threat of the constraints on the corridor	The cause of the threat is a lack of integration and coordination with Wellington Water, roading maintenance, GasCo, TelCo, etc, mis-communication re maintenance programmes	The consequence of the threat is the construction programme clashes with maintenance programmes, delays to constructions & costs of delays, revised comms and additional costs to manage, reputational impacts	LGWM	Hannah Hyde		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83; Risk closed
44	17/03/2020	There is a threat of the construction programme not being completed as scheduled.	The cause of the threat is not having adequate resources for the construction and a lack of contractors to build projects, Covid19 impacts on "ability to work" (lockdown), conflicts with other major construction programmes & government drive for "shovel ready" projects.	The consequence of threat is public complaints, delays benefits, increased costs (market forces), change of funding priorities - SSBC Investment decision changes	LGWM	Hannah Hyde	'16/04/20 - Project is in the NLTP; contractors will have visibility of timing and scale	Unlikely	Moderate	Delivery	Medium		16/04/20 - ACTION: Hannah Hyde - Early conversations with Contractor to notify of project and seek interest. Potential look at innovative procurement processes to reduce tender costs and time - inputs into economic case	Hannah Hyde	30/06/2020		Unlikely	Moderate	Medium	Closed	16/04/20 - Mark Sneddon Note: Currently plenty of capacity in contractor industry but may come under pressure is closedown extended. May be competing with shovel ready CIP projects. 12/05/20 - Transferred from Mark
45	17/03/2020	There is a threat of the project not aligning with other city programmes.	The cause of the threat is a lack of integration with Planning for Growth, MUFT, Bus Interchange, N2P, and other LGWM projects.	The consequence of the threat is that the design is not fit for purpose - redesign and integration required, redesign needed, additional effort & rework, programme delays and cost impacts, benefits not optimised or realised	LGWM	Hannah Hyde		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83; Risk closed
46	17/03/2020	There is a threat of the proposed bus capacity does not meet required volumes or route schedules	The cause of the threat is asset infrastructure or network design does not support a future proofed public transport system to meet demand	The consequence of threat is additional private vehicles on the network (congestion), complaints, future roading improvements (cost); reputational impact; environmental	Greater Wellington Regional Council	Dave Humm		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID39, RID18, RID40 08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
47	17/03/2020	There is a threat of not knowing what projects may be happening in or near the corridor, and their impact.	The cause of the threat is utility companies doing work in or near the corridor, and the impact/constraints on constructing data collection.	The consequence of the threat is that the work of other projects may cause a delay to the programme, benefits not realised, additional effort / rework,	LGWM	Hannah Hyde		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47, RID83; Risk closed

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Contract Risk Register

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48	17/03/2020	There is a threat of future growth will cause stormwater issues.	The cause of the threat is that stormwater management is not taken into account in design.	The consequence of the threat is that it is not integrated into the design - redesign required.	Beca	Mark Sneddon		Possible	Moderate	Environmental	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID34 08/05/20 - Risks combined and closed
49	17/03/2020	There is a threat of safety benefits not being realised for cyclists and pedestrians on the network	The cause of the threat is a lack of integration of safety technology around cycle safety and pedestrians, poor design, lack of engagement & consultation with	The consequence of threat is the user complaints, possible user harm, loss of future benefits through tech-roads, objectives not achieved	Beca	Marcus Brown		Possible	Moderate	Health & Safety	Medium									Closed	Pending Controls & Treatment Information from Risk Owner 25/05/20 - Risk closed as per Eric Whitfield
50	17/03/2020	There is a threat of the harm to pedestrians and cyclists network users	The cause of the threat is the design does not meet the safe system approach	The consequence of threat is the design does not meet objectives, public complaints, harm to users, reputation, retro fit safety improvements (cost)	Beca	Marcus Brown	25/05/20 - Safe systems approach. Industry practice regarding designing for peds and cyclists	Possible	Moderate	Health & Safety	Medium						Unlikely	Moderate	Medium	Closed	Pending Controls & Treatment Information from Risk Owner 20/6/7 - risk closed as considered directly part of project scope
51	17/03/2020	There is a threat that Quick Wins benefits are not realised	The cause of the threat is the underground services quick wins initiative is not integrated into the design	The consequence of the threat is benefits are not realised, project delivery efficiencies are lost, additional costs, complaints & reputational impacts	Beca	Caron Greenough	08/07/2020 - Quick Wins approved	Possible	Moderate	Delivery	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID81, RID9, RID61 08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
52	17/03/2020	There is a threat of poor / mismanaged property acquisition activity	The cause of the threat is the LGWM Development / property team is yet to be established, lease opportunity to leverage land owners not realised, miscommunication of requirements, strategy does not meet project requirements	The consequence of the threat is lost opportunity for land acquisition, high expectations - market costs for land, additional costs to progress purchases, complaints / reputational impacts	LGWM	Hannah Hyde	17/04/20 - NZTA property purchase procedures will be followed when / if required at later stages of the project. (No planned purchases noted) 1/12/20: likely that WCC would need to purchase as roundabout will be WCC asset.	Unlikely	Minor	Public/Media	Low	Y					Unlikely	Minor	Low	Live-Parked	16/04/20 - Linked to RID14, RID53 20/6/7 - changed to live-parked until property impacts are known 1/12/20: review in next workshop for pre-imp phase. Identify owner and process 6/7/21: consequence lowered as Kiwirail are willing to lease land for AQ roundabout
53	17/03/2020	There is a threat of property acquisition being compromised.	The cause of the threat is that not enough guidance justification is documented and challenged.	The consequence of the threat is public complaints and reputation causing a delay for the programme, costs to remedy	Beca	Andrew Stewart	17/04/20 - NZTA property purchase procedures will be followed when / if required at later stages of the project.	Likely	Moderate	Public/Media	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID14, RID52 17/04/20 - Transferred from Hannah Hyde to Andrew Stewart; Risk merged with RID52 Risk closed
54	17/03/2020	There is a threat of poor business case outcomes	The cause of the threat is a lack of ensuring to obtain the latest information, data collection being out of date or inaccurate, lack of interdependent project inputs	The consequence of the threat is decision making flawed, design rework to correct, reduce benefits, complaints, reputational impacts	AE COM	Tim Brown		Possible	Moderate	Delivery	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID58, RID56, RID54, RID55, RID 57 17/04/20 - Duplicate risk with RID57 - closed as per Neil Trotter
55	17/03/2020	There is a threat the business case justification does not meet expectations of all LGWM partners	The cause of the threat is inadequate data analysis, lack of detailed (deep dive) investigations, lack of site or ground investigations at the correct phases, in accurate data, data gaps	The consequence of the threat is the business case is not based on sound information, incorrect assumptions are made, the project outcomes / benefits are not realised, additional effort and rework, cost & programme impacts, reputational impacts, potential RMA breaches, property acquisitions issues	Beca	Andy Lightowler	25/05/20 - Follow the Waka Kotahi business case development process. Engagement with partners, OIMs, IQA 08/07/2020 - Ongoing data analysis, stakeholder engagement; Strategic Case approved; IQA 01/11/21 - Consultation and Engagement re commencing	Unlikely	Moderate	Delivery	Medium	N				20/7/7 - project team continue to follow the published guidance.	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID54, RID56, RID57, RID58 08/05/20 - Related risks combined and closed, RID55 open 01/11/21 - Update control note, treatment closed
56	17/03/2020	There is a threat of a lack of data understanding affecting decisions and investment.	The cause of the threat is a lack of accurate data.	The consequence of threat is missing information in the design - design not fit for purpose.	Beca	Neil Trotter	08/07/2020 - Accurate parking data received (modelling processing - July / August)	Possible	Severe	Delivery	High						Possible	Severe	High	Closed	16/04/20 - Linked to RID54, RID55, RID57, RID58 08/05/20 Related risks combined and closed as per Eric Whitfield and Hannah Hyde
57	17/03/2020	There is a threat of not obtaining the required level of evidence for the size of the problem.	The cause of the threat is lack of accurate data and evidence.	The consequence of the threat is missing information in the design - design not fit for purpose.	Beca	Neil Trotter	08/07/2020 - Long list and short list options reviews progressing - informal acceptance at this stage, modelling of data progressing to support evidence based decisions	Possible	Moderate	Delivery	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID54, RID55, RID56, RID58 08/05/20 Related risks combined and closed as per Eric Whitfield and Hannah Hyde
58	17/03/2020	There is a threat the preferred option is based on incorrect assumptions / data in the SSBC	he cause of the threat is a lack of data to support assumptions and decisions for options	The consequence of the threat is missing information in the design - design not fit for purpose, loss effort & rework; reputation; costs and programme delays to remedy	Beca	Neil Trotter	08/07/2020 - Long list and short list options reviews progressing - informal acceptance at this stage; modelling of data progressing to support evidence based decisions on options	Possible	Moderate	Delivery	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID54, RID55, RID56, RID57 08/05/20 Related risks combined and closed as per Eric Whitfield and Hannah Hyde
59	17/03/2020	There is a threat the project is over budget & programme	The cause of the threat is high demand on consultancy services (Covid impacts), reduce construction resources in the market, high demand due to accelerated shovel ready activity	The consequence of the threat is delays to programme, increased costs of resources and materials	Beca	Eric Whitfield		Likely	Moderate	Cost	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID10, RID6 12/05/20 - Combined RID10, RID59; Risk closed
60	17/03/2020	There is a threat of the project extent is incorrect and economics planning not capturing the entire project.	The cause of the threat is the economics focus is transport economics only, does not include other aspects of the full project & network requirements (urban	The consequence of the threat is the outcomes are not fit for purpose, poor decision making, benefits not realised, stakeholder and user complaints	Beca	Neil Trotter	08/07/2020 - programme integration progressing via engagement with other LGWM programme teams (Rail precinct	Possible	Severe	Delivery	High		01/05/20 - ACTION - Neil Trotter to define the extent of any additional data requirements for the SSBC (Parking data received, chasing up gaps in ped data etc)	30/06/2020			Possible	Moderate	Medium	Closed	25/05/20 - Risk closed as per Eric Whitfield
61	17/03/2020	There is a threat benefits are not realised	The cause of the threat is a lacking ability to justify the quick wins and recommendations, poor quick win identification or justification in the BC, lack of data to support case, change of funding priority (Covid) (Over LCLR limits)	The consequence of threat is lost safety improvement benefits, lost economic benefits, complaints, reputational impacts	Beca	Caron Greenough	08/07/2020 - Quick Wins approved	Possible	Moderate	Delivery	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID51, RID81, RID9 08/05/20 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk

Project/Contract Description	*Thordon Quay Hutt Road*		NZTA Lead	*Hannah Hyde*
Contract ID	*1909*		Supplier Lead	*Chris Dunlop*
Contract Value	*To be inserted*		Supplier Risk Mgmt Specialist (if applicable)	*Tracy Couchman*
			Last Update	*3/11/2021*

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62	17/03/2020	There is a threat the Marae parking arrangements does not meet the user requirement	The cause of the threat is informal parking arrangements with WCC would be affected by the project, the new facilities are not designed to user requirements, insufficient funds to provide all user requirements (compromises), gaps in requirements data, lack of stakeholder engagement with both Iwi and Councils and Roading authority	The consequence of threat is unhappy stakeholders and complaints, infringement notices, harm to users, future remedial works (cost and programme), reputation	Beca	Nathan Baker	09/07/20 - SEB Bishop LGWM leading IWI engagement, including Pipitea Marae	Likely	Minor	Stakeholders	Medium	N	25/05/20 - ACTION: engagement with iwi and the council (progressing) 1/12/20: we need to determine what their requirements are 01/11/21 - Commence detailed design - will include marae in Q2 2022	Michael Flyger	30/11/2021		Possible	Moderate	Medium	Live-Treat	17/04/20 - Transferred from Rachel Dahlberg to Nathan Baker 1/12/20: likelihood changed to high, consequence minor 01/11/21 - Update treatment & action owner
63	17/03/2020	There is a threat of having a delay to the programme.	The cause of the threat is a delay in engagement with Mana Whenua, due to being slower than other stakeholders.	The consequence of threat the design may not include engagement from Mana Whenua - redesign required.	Beca	Nathan Baker		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID64, RID65 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks - Combined RID63, RID64, RID65; risk closed
64	17/03/2020	There is a threat of Iwi Relationships being compromised.	The cause of the threat is that Pipitea Marae is on the corridor as well as existing relationships with WCC.	The consequence of threat is public/Iwi complaints and reputation.	Beca	Nathan Baker		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID63, RID65 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks - Combined RID63, RID64, RID65; risk closed
65	17/03/2020	There is a threat of a delay to the programme due to poor engagement with iwi.	The cause of the threat is a lack of engagement with Iwi in early stages of the programme; delay in engagement with Mana Whenua, due to being slower than other stakeholders; Pipitea Marae is on the corridor as well as existing relationships with WCC.	The consequence of threat is programme delay and key engagement information is lacking. Also public complaints, design may not include engagement from Mana Whenua - redesign required	Beca	Nathan Baker	25/05/20 - comms and engagement plan developed and implemented 09/07/20 - Seb Bishop LGWM leading IWI engagement, including Pipitea Marae	Unlikely	Moderate	Stakeholders	Medium	N	1/12/20: there has been meeting with iwi partnership working group 01/11/21 - Iwi engagement planned for detailed design stage recommencing - Q4 2021	Nathan Baker	30/12/2021		Possible	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID63, RID64 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks - Combined RID63, RID64, RID65 20/6/7 - risk description updated 6/7/21: likelihood lowered as LGWM now involved in engagement, assessed options against mana whenua values 01/11/21 - Treatment updated
66	17/03/2020	There is a threat the project does not meet with RMA requirements	The cause of the threat is a lack of recording of some notable trees, and features around Mulgrave Street, cultural areas, historical features	The consequence of the threat is breach of RMA, cultural friction / delays, additional engagement, media, reputational impacts, delays and additional costs	Beca	Nathan Baker		Possible	Severe	Environmental	High						Possible	Severe	High	Closed	16/04/20 - Linked to RID67 12/05/20 - RID 67 Combined; Risk Closed
67	17/03/2020	There is a threat of RMA / construction delays	The cause of the threat is a lack of engagement with Heritage NZ & IWI, lack of archaeological &Iwi expertise impacts into business case & early investigations, key significance areas not identified (including notable trees, and features around Mulgrave Street, cultural areas, historical features)	The consequence of the threat is a delay to the programme, breach of RMA, Waitangi commitments not met, cultural friction, rework of C&E and investigations, cost and programme delays, reputational impacts	Beca	Paul McGimpsey	25/05/20 - RMA considerations in options assessment 01/11/21 - Prelim design SID review and RMA considerations assessment	Unlikely	Severe	Environmental	Medium	N	08/05/20 - ACTION - Emily Alleway to speak with Mark Lindsey at WCC regarding the RMA requirements to support the development of the business case 20/7/20 - ACTION - update social and env screen in Stage 2, for recommended option 01/11/21 - ACTION - SID review and noting heritage buildings along corridor to ensure they are identified through out design and construction programmes - next SID Q1 2022	Paul McGimpsey	1/12/2021	20/7/21 - social and env screen completed on short list options. No significant RMA issues are expected at present. Detailed assessment will be completed on recommended option.	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID67 12/05/20 - RID 66 Combined 1/12/20: review at beginning of stage 2, next risk workshop 01/11/21 - Treatment update
68	17/03/2020	There is a threat of the road being inappropriate for emergency services.	The cause of the threat is the new road layout	The consequence of threat is the design is not fit for purpose - redesign required.	AE COM	Tim Brown		Likely	Moderate	Health & Safety	High						Likely	Moderate	High	Closed	16/04/20 - RID 68 & 70 combined; RID68 closed; linked to RID70
69	17/03/2020	There is a threat of the project not being completed as programmed.	The cause of the threat is not being prepared for working through emergencies (eg: Covid) - a project continuity plan outlining responses / actions	The consequence of the threat is the project programme will not be able to continue if certain emergencies occur, delays, additional costs, additional C&E, reputational impacts	GSP Ltd	Graham Spargo		Likely	Moderate	Delivery	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID70, RID68 08/05/2020 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
70	17/03/2020	There is a threat of the corridor not being adequate for the specialist users of the corridor (Wellington Free Ambulance and Fire Station, Overwidth vehicles, police, accident response etc)	The cause of the threat is the corridor does not provide sufficient width for various vehicle user types, lack of stakeholder requirements gathering, lack of data, not captured in BC, not captured in design development	The consequence of threat is safety issues for road users, compounding access issues, complaints, costs to remedy, ongoing future issues, reputational impacts	AECOM	Tim Brown	25/05/20 - use of industry practice design standards. 01/11/21 - Prelim SID review	Unlikely	Severe	Stakeholders	Medium	Y	25/05/2020 - ACTION - Engagement with emergency service providers for detailed design phase 01/11/21 - SID workshop for detailed design - Q2 2022; DD engagement phase with emergency services on corridor	Will Maguire	30/04/2022	20/7/21 - continue to engage with emergency services during the development of a recommended option.	Unlikely	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID68, RID69 01/11/21 - Treatment updated
71	17/03/2020	There is a threat of a delay in the programme, due to the community being reluctant to engage.	The cause of the threat is that the community have previously been engaged for the project - both in 2015 and 2017, and some of the previous engagement is no longer relevant (out of date).	The consequence of threat is the design lacking information - engagement from key stakeholders missing	Beca	Nathan Baker		Likely	Moderate	Public/Media	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID72, RID88, RID89, RID90 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID71, RID72, RID88, RID89; risk closed

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72	17/03/2020	There is a threat of not having adequate engagement with key stakeholders.	The cause of the threat is that some stakeholders (e.g. Kiwirail) may not be interested in engaging.	The consequence of threat is the design is not fit for purpose - delay and redesign needed.	Beca	Nathan Baker		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID71, RID88, RID89, RID90 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID71, RID72, RID88, RID89; risk closed
73	17/03/2020	There is a threat of coordination with community resulting in a lack of support.	The cause of the threat is that the community may not support the short listed options.	The consequence of threat is delay to the programme, and design cost, community confidence reduced.	Beca	Nathan Baker		Possible	Severe	Public/Media	High						Possible	Severe	High	Closed	16/04/20 - Linked to RID77, RID14, RID76, RID91, RID13 20/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined; Risk closed
74	17/03/2020	There is a threat other project does not deliver on	The cause of the threat is lack of	The consequence of the threat	Wellington	Emily Alleway		Likely	Moderate	Stakeholders	High									Closed	Pending Controls & Treatment
75	17/03/2020	There is a threat of the community not	The cause of the threat is key messages	The consequence of the threat is a lack	Beca	Nathan Baker		Likely	Moderate	Public/Media	High						Likely	Moderate	High	Closed	17/04/20 - Transferred from Hannah
76	17/03/2020	There is a threat of other issues impacting the ability of LGWM to actively engage with	The cause of the threat is other prominent issues in the community such as the bus	The consequence of threat is the design not being fit for purpose and	Beca	Nathan Baker		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID77, RID14, RID73, RID91, RID13
77	17/03/2020	There is a threat of the community residents and retailers resisting the loss of car parking.	The cause of the threat is that options are likely to affect car parking in the corridor.	The consequence of threat is resident and retailer complaints, delay in programme regarding feedback	Beca	Nathan Baker		Likely	Moderate	Public/Media	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID76, RID14, RID73, RID91, RID13 20/04/20 - Transferred from Zoe
78	17/03/2020	There is a threat of a lack of public support having a delay on the programme.	The cause of the threat is conflicting messages from Councillors and influencers	The consequence of threat is public complaints	Beca	Nathan Baker		Possible	Severe	Public/Media	High						Possible	Severe	High	Closed	16/04/20 - Linked to RID79, RID80, RID81, RID84, RID85, RID86, RID87
79	17/03/2020	There is a threat of a delay to the programme.	The cause of the threat is long term impacts for residents and retailers not being clearly communicated.	The consequence of threat is the design is not suitable for long term options - redesign required.	Beca	Nathan Baker		Possible	Moderate	Public/Media	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID78, RID80, RID81, RID84, RID85, RID86, RID87 17/04/20 - Transferred from Zoe
80	17/03/2020	There is a threat of the public not being supportive of the project.	The cause of the threat is too much engagement across the programme leading to public confusion.	The consequence of threat is that the end design does not achieve the objectives - redesign needed. Public complaints and reputational risks also.	Beca	Nathan Baker		Likely	Moderate	Public/Media	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID78, RID79, RID81, RID84, RID85, RID86, RID87 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate
81	17/03/2020	There is a threat of the Quick Wins feedback and support causing a delay in the programme	The cause of the threat is that the limited budget will have some form of impact.	The consequence of threat is the Quick Wins list not being fit for purpose - reassessment required.	Beca	Caron Greenough	08/07/2020 - Quick Wins approved	Possible	Severe	Public/Media	High						Possible	Severe	High	Closed	16/04/20 - Linked to RID78, RID79, RID80, RID84, RID85, RID86, RID87, RID51, RID9, RID61 08/05/20 - Closed as per Eric Whitfield and Hannah Hyde - not TQHR risk
82	17/03/2020	There is a threat of an uncertainty about the future of the programme	The cause of the threat is changes to the elected team and officials working on the WCC wider strategy programme (change of approach, requirements or funding), lack of communication or conflicted decision making between officials, change in	The consequence of the threat is misaligned messaging, misaligned decision making, programme delays, misaligned C&E, effort and cost to rework, reputational impact, potentially loss benefits	Wellington City Council	Gunther Wild		Likely	Moderate	Stakeholders	High									Closed	Pending Controls & Treatment Information from Risk Owner 25/05/20 - Risk closed as per Eric Whitfield
83	17/03/2020	There is a threat of other project developments having an impact on the project programme.	The cause of the threat is the uncertainty of developments happening around Kiwirail and Centreport.	The consequence of the threat of public complaints and reputation re the end design may not be fit for purpose - redesign needed, additional effort & rework, programme delays and cost impacts, benefits not optimised or realised	LGWM	Hannah Hyde		Possible	Moderate	Stakeholders	Medium						Possible	Moderate	Medium	Closed	17/04/20 - Duplicate Risks combined RID29, RID35, RID40, RID41, RID43, RID45, RID47; Risk closed
84	17/03/2020	There is a threat of the programme not meeting the expectations/needs of all stakeholders - retailers high risk.	The cause of the threat is that certain stakeholders have a greater influence than most.	The consequence of threat is reputation and public complaint, and a programme delay to get input from all stakeholders.	Beca	Nathan Baker		Likely	Moderate	Stakeholders	High						Likely	Moderate	High	Closed	16/04/20 - Linked to RID78, RID79, RID80, RID81, RID85, RID86, RID87 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID78, RID79, RID80, RID84, RID84, RID85, RID86, RID87; Risk closed
85	17/03/2020	There is a threat of the extent of engagement causing a delay to the programme.	The cause of the threat is that the extent of engagement doesn't follow AP2 principles.	The consequence of threat is the design not being fully informed, causing a programme delay.	Beca	Nathan Baker		Possible	Moderate	Public/Media	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID78, RID79, RID80, RID81, RID84, RID86, RID87 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID78, RID79, RID80, RID84, RID84, RID85, RID86, RID87; Risk closed
86	17/03/2020	There is a threat of problems and opportunities not being accurately identified.	The cause of the threat is a focus on only opportunities, and problems not being confirmed.	The consequence of threat is the design not being fully informed, causing a programme delay.	Beca	Nathan Baker		Possible	Moderate	Public/Media	Medium						Possible	Moderate	Medium	Closed	16/04/20 - Linked to RID78, RID79, RID80, RID81, RID84, RID85, RID87 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID78, RID79, RID80, RID84, RID84, RID85, RID86, RID87; Risk closed

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Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to Risk Tolerance Threshold (Y/N)	Planned Risk Trmt Actions Note: If more than one treatment action, either: . Include numbers to identify separate treatments, or: . Refer to Actions Register on separate tab	Treatment Owner(s)	Planned Treatment Implementation Date(s) (dd/mm/yyyy)	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
87	17/03/2020	There is a threat of community and stakeholder expectations are not met or unrealistic	The cause of the threat is a lack of consideration of previous information and engagement, focus on only opportunities, and problems not being confirmed, lack of or too much engagement, certain stakeholders have a greater influence than most (loudest voice), extent of engagement doesn't follow AP2 principles.	The consequence of threat is a time delay to the programme, and information being duplicated, higher costs, problems and opportunities not being accurately identified, not meeting the expectations/needs of all stakeholders - retailers high risk; public confusion, long term options not suitable	Beca	Michael Flyger	25/05/20 Review of previous engagement processes and outcomes and incorporation into the project comms and engagement plan and strategic case 09/07/20 - Engagement strategic progressing with LGWM to support July shortlist public engagement activity	Likely	Moderate	Public/Media	High	N				20/7/7 - There is a plan in place for the upcoming engagement round, including the type of and scale of information to be included, as well as visualisations 20/2/11 - shortlist option engagement delayed until March/April 2021 21/11/5: Stakeholder meetings set up beginning Vovember 2021	Possible	Moderate	Medium	Live-Treat	16/04/20 - Linked to RID78, RID79, RID80, RID81, RID84, RID85, RID86 17/04/20 - Transferred from Zoe Thompson to Nathan Baker; Duplicate risks combined RID78, RID79, RID80, RID84, RID84, RID85, RID86, RID87
99	1/12/2020	There is a threat that the current recommended option does not proceed	The cause of the threat is project cost exceeds programme budget expectations	Project does not proceed or is scaled down	LGWM	Hannah Hyde	01/11/21 - Prelim design reviews & feedback into detailed design phase, ROC costs tested	Rare	Severe	Stakeholders	Low	Y					Rare	Moderate	Low	Live-Treat	01/11/21 - Controls updated
100	1/12/2020	There is an opportunity to implement parts of the project early	The cause of the opportunity is parts of the project are at different stages of development (previously designed by WCC).	The consequence is early realisation of benefits and reputational benefit	LGWM	Hannah Hyde		Rare	Moderate	Public/Media	Low	Y					Likely	Moderate	High	Live-Treat	1/12/20: revisit during prelim design and next risk workshop 6/7/21: likelihood raised as AQ now likely to go ahead of TQHR 01/11/21 - Treatment updated, risk ranking updated
101	2/03/2021	There is a threat of loss of trade for local business owners along the corridor wider area	The cause of the threat is the design solution does not accommodate easy access into businesses to do "trade"; lack of engagement, poor design solutions -	The consequence of the threat is complaints from impacted parties, costs to redesign / construct, reputation, delays to outcomes, loss of	LGWM	Hannah Hyde		Possible	Moderate	Public/Media	Medium						Unlikely	Minor	Low	Closed	19/03/21 - Instructed to merge RID 91 & 101, close 101
102	2/03/2021	There is a threat the desired safety and journey solutions can not be delivered within the corridor width	The cause of the threat is insufficient corridor width for full design standards (eg: link to Davis St); conflicting requirement for safety and urban design	The consequence of the threat is the solution does not meet user requirements, safety outcomes (IO's), or future proof the corridor	Beca	Will Maguire		Likely	Severe	Stakeholders	Critical		02/03/21 ACTION: Prepare Design plan to treat corridor width issues at key locations	Blaise Cummins	30/03/2021		Possible	Moderate	Medium	Closed	6/7/21: risk closed as min widths for modes included in prelim design, as per discussions with partner orgs
103	2/03/2021	There is a threat Utilities / Underground services are not identified	The cause of the threat is due diligence not completed, inaccurate As Built data, new assets included over course of project delivery	The consequence of the threat is design rework for new assets to "accommodate" UG services, relocation of services to accommodate design requirements, lost costs, reduces safety	Beca	Will Maguire	02/03/21 - Services investigations progressing with design development 01/11/21 - full survey completed including "lifting lids" approach	Possible	Moderate	Cost	Medium	N	01/11/21 - SID review for detailed design, survey data into design	Will Maguire	30/04/2022		Rare	Moderate	Low	Live-Treat	01/11/21 - Treatment update, risk ranking reduced
104	2/03/2021	There is a threat of conflict access points onto the corridor	The cause of the threat is the number and nature of business driveway / accesses on the corridor cross over other modes -	The consequence of the threat is vehicle / ped / cycle crashes as business owners access their premises	Beca	Will Maguire	02/03/2021 - Corridor and access ways design reviews, HSID reviews - identify access way clashes to	Likely	Moderate	Delivery	High	N	02/03/21 - ACTION: Progress design HSID access to design solution access points that do not clash with other modes such as Peds /	Will Maguire	30/04/2022		Unlikely	Moderate	Medium	Live-Treat	01/11/21 - Treatment update, risk ranking increased
105	2/03/2021	There is an opportunity to improve the Hutt Road and Thordon Quay Egress / access	The cause of the opportunity is to gain landowners agreement to combine business accessways	The consequence of the opportunity is reduced access points, improved safety for other modes, improved traffic flows	Beca	Will Maguire		Possible	Minor	Delivery	Medium	Y	02/03/21 - ACTION: Progress assessment of area, progress improved design solutions for access way points 03/11/21 - Discussion with urban design team	Will Maguire	1/03/2022		Likely	Moderate	High	Live-Treat	Linked to RID 70 Specialist users access on corridor (Fire, Ambulance, first responses, wide vehicles) 03/11/21 - treatment updated
106	2/03/2021	There is a threat the solution does not enable safe access / egress to existing key assets/facilities (pump stations, fire station) for maintenance and	The cause of the threat is the lack of investigation, stakeholder engagement / feedback, lack of HSID design assessment,	The consequence of the threat is the restriction of access to key facilities; time / costs to move assets (pump	Beca	Will Maguire	02/03/21 - Early identification of key assets / facilities; HSID design reviews, stakeholder engagement	Unlikely	Severe	Delivery	Medium	Y	02/03/21 - ACTION: Progress design investigations for facilities on the corridor; investigate "future consented" new assets /	Will Maguire	1/03/2022		Unlikely	Moderate	Medium	Live-Treat	Linked to RID 70 Specialist users access on corridor (Fire, Ambulance, first responses, wide vehicles)
107	2/03/2021	There is a threat of poor safety solutions at Davis St / Tinakori Rd	The cause of the threat is right turning traffic causing traffic delays (no right turn bay area) and cyclist access across main corridor	The consequence of the threat is poorly designed, or lack of right turning facilities, lack of turning stacking space - traffic disruption, safety of road users, cost to redesign and remediate in future	Beca	Will Maguire	02/03/21 - Early identification of known issue, progress HSID design improvements 03/11/21 - Davis St intersection design confirmed (no right turn); Tinakori Rd - traffic light solution confirmed (controlled intersection) &	Rare	Moderate	Delivery	Low	Y					Rare	Minor	Low	Live-Treat	Linked to RID 70 Specialist users access on corridor (Fire, Ambulance, first responses, wide vehicles) 03/11/21 - controls updated, treatment closed, ranking reduced
108	2/03/2021	There is a threat the intersection design approach / philosophy changes	The cause of the threat is the intersection modelling identifies design issues that require late design changes	The consequence of the threat is incorrect design assessments in the model, future design phases incorrect, additional late costs for rework or	Beca	Will Maguire	02/03 - Design approach in review, pending outcome / decision 03/11/21 - design model reviewed, philosophy agreed and applied to	Unlikely	Severe	Delivery	Medium	Y	03/11/21 - ongoing awareness and watching brief for improvement through SID and design process	Will Maguire	Ongoing		Rare	Moderate	Low	Live-Treat	03/11/21 - Treatment updated
109	2/03/2021	There is a threat of data gaps - such as lack of survey data; Ped counts; Business economics data / Metrics	The cause of the data gaps is insufficient information provided to the project team from external sources, lack of budget to fund investigations / on site surveys at the	The consequence of the threat is the design does not tie-in with the existing on-site reality; incorrect assumptions made in the business case, designs	Beca	Will Maguire		Possible	Moderate	Delivery	Medium	Y	03/11/21 - ongoing awareness and watching brief for improvement through SID and design process	Will Maguire	Ongoing		Unlikely	Minor	Low	Live-Treat	03/11/21 - Treatment updated
110	2/03/2021	There is a threat of additional tree related maintenance costs on the corridor or tree removals	The cause of the threat is existing trees on the corridor in the "wrong" location for the new design, poor choice of trees or poor locations for new planting; additional	The consequence of the threat is public complaints from tree removals, additional maintenance for culvert clearance, tree root damage to	Beca	Eric Whitfield		Likely	Minor	Public/Media	Medium		02/03/21 - ACTION: Manage tree selection and tree placement are detailed to reduce future impacts from trees, reduce any tree removal requirements, implement C&E to	Blaise Cummins	30/05/2021		Rare	Insignificant	Low	Closed	19/03/21 - Jardin Mile area outcomes included in core scope as investment objective. Risk closed
111	2/03/2021	There is an opportunity to improve the Jardin Mile area outcomes	The cause of the opportunity is to improve the urban design solution to the design process	The consequence of the opportunity is Improved safety outcomes for users and amenity usability	Beca	Will Maguire	03/11/21 - Prelim design solution completed, SID review, NZTA approval of prelim design	Almost certain	Minor	Stakeholders	Medium	Y	03/11/21 - Progress improvements through detailed design phase - urban design to improve look and feel of area	Will Maguire	30/04/2022		Likely	Moderate	High	Live-Treat	03/11/21 - Control update, treatment update, ranking increased (O)
112	2/03/2021	There is an opportunity to improve engagement for TQHR project with other regional programmes	The cause of the opportunity is to work with other C&E teams to improve sequencing of engagement and messaging	The consequence of the opportunity is improved engagement with the wider community and road users, improved outcomes	LGWM	Hannah Hyde		Unlikely	Minor	Public/Media	Low		02/03/21 - ACTION: - TQHR team work with wider key stakeholders to leverage C&E activity - progress C&E with other projects / programmes	Hannah Hyde	Ongoing through programme		Likely	Minor	Medium	Closed	Linked to RID 38 - Lack of coordination with other regional projects / programmes 19/03/21 - Duplicate risk with RID 38; close risk 112
113	2/03/2021	There is a threat critical heritage buildings, places of significance, cultural, protected flora / fauna species are not identified & managed	The cause of the threat is lack of cultural investigations, lack of council plans inputs / assessments or data provided, lack of user requirements assessments, lack of archaeological investigation during design phase	The consequence of the threat is breach of consents, / regulations / legal requirements; impact of value of buildings; cultural value impacts to key stakeholders; loss of critical historical values; loss of historical earth deposits	LGWM	Hannah Hyde	GIS Model layer to ringfence heritage , cultural values, Social and environment screening, heritage assessment in scope	Unlikely	Moderate	Legal/Compliance	Medium	N	02/03/21 - ACTION: Investigate the shared path - does this now go on the southern side of Hutt Road towards the Onslow Rd connection?; Investigate historic horse trough that juts out into the road berm at this point on the northern side- and is quite rare.	Paul McGimpsey	30/03/2022		Rare	Moderate	Low	Live-Treat	03/11/21 - reduce risk ranking Linked to RID 89 - lack of stakeholder engagement for specialist groups Note: We can mitigate this to a large extent by doing assessments of historic, archaeological and cultural heritage
114	2/03/2021	There is a threat the current corridor configuration will change before design & construction completed	The cause of the threat is changing assets on the corridor including changes to quake prone buildings, new buildings / infrastructure already consented is built	The consequence of the threat is late corridor design changes; impacts to asset owners; cost; reputation; programme delays	Beca	Andy Lightowler	03/11/21 - watching brief - "no real alternative options" to mitigate	Rare	Moderate	Delivery	Low	Y					Rare	Moderate	Low	Live-Parked	03/11/21 - control update, treatment closed, ranking reduced, parked
115	2/03/2021	There is a threat other transport mode requirements are omitted from the project	The cause of the threat is lack of stakeholder engagement and user requirements, poor design investigations,	The consequence of the threat is different user types can not use the corridor safely, complaints, costs and	Beca	Will Maguire	02/03/21 - Survey of "access requirements " completed	Unlikely	Severe	Public/Media	Medium	Y	02/03/21 - ACTION: Progress further investigations to corridor solutions accommodate other transport modes	Will Maguire	30/02/2022		Rare	Minor	Low	Live-Treat	03/11/21 - Controls updated, treatments updated, ranking reduced
116	2/03/2021	There is a threat the Cost Estimates for Business Case not accurate to support funding application	The cause of the threat is insufficient design to inform costs / lack of investigation & stakeholder engagement	The consequence of the threat is incorrect funding / business case decisions, design solutions	Beca	Andy Lightowler	02/03/21 - design development and stakeholder requirements feeding into funding case	Unlikely	Severe	Cost	Medium	Y	03/11/21 - Future cost estimate at detailed design phase to test accuracy of business case costs	Shirley Mendoza Cruz	30/06/2022	Costings based on preliminary design, risk items have been	Unlikely	Moderate	Medium	Live-Treat	03/11/21 - Controls updated, treatment updated Linked to RID 10 - Project and whole of
117	2/03/2021	There is a threat other projects/activities that could influence scope of TQHR project.	The cause of the threat is project / programme requirements / outcomes from Te Ara connection at Jardin Mile, MUFT, Railway Precinct, cycleway on Featherston	The consequence of the threat is poor safety and journey outcomes, reputation, costs and delays to remediate solution conflicts with other	LGWM	Hannah Hyde		Unlikely	Severe	Delivery	Medium						Unlikely	Minor	Low	Closed	Following sites listed in the WCC Plan: [Thorndon Quay Pt Lot 1 DP 11041 Railway Locomotive and Rolling Stock Depot 1937 15 18 457 Thorndon Quay
118	28/06/2021	There is a threat that individual property requirements such as refuse collection, driveways operation, driveway ramp are omitted from scope of project	The cause of the threat is insufficient design, investigation & stakeholder engagement to confirm requirements, lack of agreed solutions	The consequence of the threat is individual user and stakeholder requirements are not met, increased cost	Beca	Will Maguire	Stakeholder feedback and submissions from May/June engagement. 03/11/21 - detailed stakeholder engagement - business by business approach; SID review prelim &	Rare	Moderate	Cost	Low	Y					Rare	Minor	Low	Live-Treat	03/11/21 - Controls updated, treatment closed, rankign reduced

	Project/Contract Description	*Thordon Quay Hutt Road*		NZTA Lead	*Hannah Hyde*
	Contract ID	*1909*		Supplier Lead	*Chris Dunlop*
	Contract Value	*To be inserted*		Supplier Risk Mgmt Specialist (if applicable)	*Tracy Couchman*
				Last Update	*3/11/2021*

Contract Risk Register

Risk identifier	Date raised (dd/mm/yyyy)	Risk Description (include whether this is a threat or an opportunity)	Risk Cause(s)	Risk Consequence(s)	Risk Owning Organisation	Risk Owner	Controls	Current Risk Likelihood	Current Risk Consequence	Consequence Category	Current Controlled Risk Level	Level of risk acceptable, when compared to Risk Tolerance Threshold (Y/N)	Planned Risk Trmt Actions *Note: If more than one treatment action, either: . Include numbers to identify separate treatments, or: . Refer to Actions Register on separate tab*	Treatment Owner(s)	Planned Treatment Implementation Date(s) (dd/mm/yyyy)	Risk Treatment Progress Updates	Residual (Target) Risk Likelihood	Residual (Target) Risk Consequence	Residual (Target) Risk Level	Risk status	Comments
119	28/06/2021	There is a threat that the preferred option / corridor cross section cannot be achieved through the Onslow Road intersection	The cause of the threat is that the proposed prelim design layout and signal phasing is not approved by WCC	The consequence of the threat is the preferred option is not able to be implemented through Onslow Road, objectives not met (on this local section), increased cost	Beca	Will Maguire	WCC representatives have been involved in scope and road safety audit discussions 03/11/21 - Prelim SID; Safety Audit; Prelim approved by NZTA	Unlikely	Severe	Delivery	Medium	Y	03/11/21 - Progress survey for area to confirm design is acceptance (tight alignment in area) - via AE COM	Craig Pitchford	30/12/2021	03/11/21 - Survey fee estimate provided (refer AECOM)	Rare	Severe	Low	Live-Treat	03/11/21 - controls updated, treatment updated, ranking reduced
120	2/07/2021	There is a threat that the design of the Aotea Quay roundabout will require rescoping	The cause of the threat is insufficient investigation and stakeholder engagement during SSBC, as the previous WCC design was changed in short notice following RSA	The consequence of the threat is increased cost, delivery delays	Beca	Will Maguire	LGWM discussions with Kiwirail, new concept agreed through RSA process 03/11/21 - Additional optioneering completed (pending decision)	Likely	Moderate	Cost	High	N	03/11/2021 - GWRC to complete further modelling of approved option - AE COMM activity. Further engagement with Kiwirail / Port	Craig Pitchford	30/12/2021	03/11/2021 treatment updated and reassigned	Possible	Minor	Medium	Live-Treat	03/11/21 -controls updated, treatment updated
121																				Live-Treat	
122																				Live-Treat	
123																				Live-Treat	
124																				Live-Treat	
125																				Live-Treat	
126																				Live-Treat	

Appendix D

Preliminary Geotechnical Appraisal Report

Thorndon Quay Hutt Road

Preliminary Geotechnical Appraisal Report

Prepared for Let's Get Wellington Moving
Prepared by Beca Limited

20 April 2021

Creative people together transforming our world

Revision History

Revision Nº	Prepared By	Description	Date
1	Olivia Ross		20/04/2021

Document Acceptance

Action	Name	Signed	Date
Prepared by	Olivia Ross		20/04/2021
Reviewed by	Philip Robins		20/04/2021
Approved by	Eric Whitfield		20/04/2021
on behalf of	Beca Limited		

Contents

Appendices

1 Scope of this Appraisal

This preliminary geotechnical appraisal summarises soil conditions along the Thorndon Quay to Hutt Road (TQHR) project area as part of the Preliminary Design Philosophy Statement.

We have prepared this Preliminary Geotechnical Appraisal Report (PGAR) to provide an overview of the key geotechnical issues of influence on the proposed improvements along the TQHR project area. No intrusive geotechnical investigations have been undertaken. The data has been gathered from the NZGD and Beca databases.

2 Project Description

The TQHR project is one of Let's Get Wellington Moving (LGWM's) Early Delivery Projects. The objective of the project is to encourage the use of public transport through the central city, improve safety, and create a better environment for pedestrians and cyclists. The interim scope includes a number of changes to the road corridor, including additional lanes and road furniture as well as speed and layout alterations, which will each help achieve the project objectives.

3 Regional Geology

3.1 Stratigraphy

The published geological map for the area surrounding the TQHR route is shown in Figure 1 below. The map indicates that the area is expected to be underlain by reclamation fill, further underlain by alluvium, with greywacke basement rock at some depth (Begg & Johnston, 2000).

The active Wellington Fault runs alongside the route of TQHR, with an intersection near the Thorndon overbridge area.

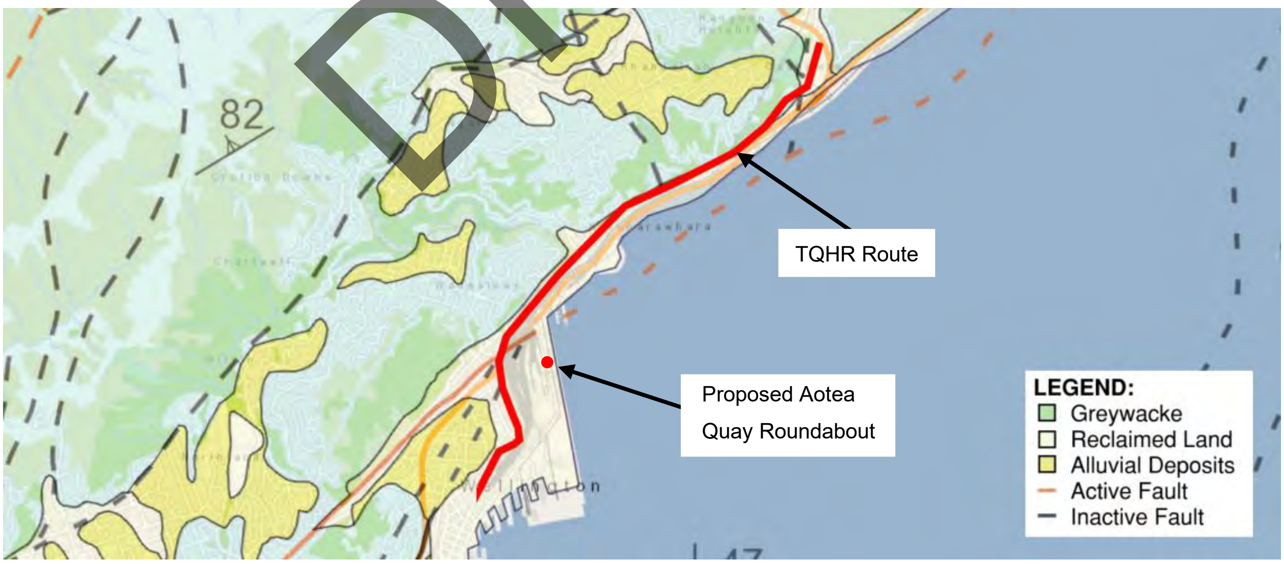
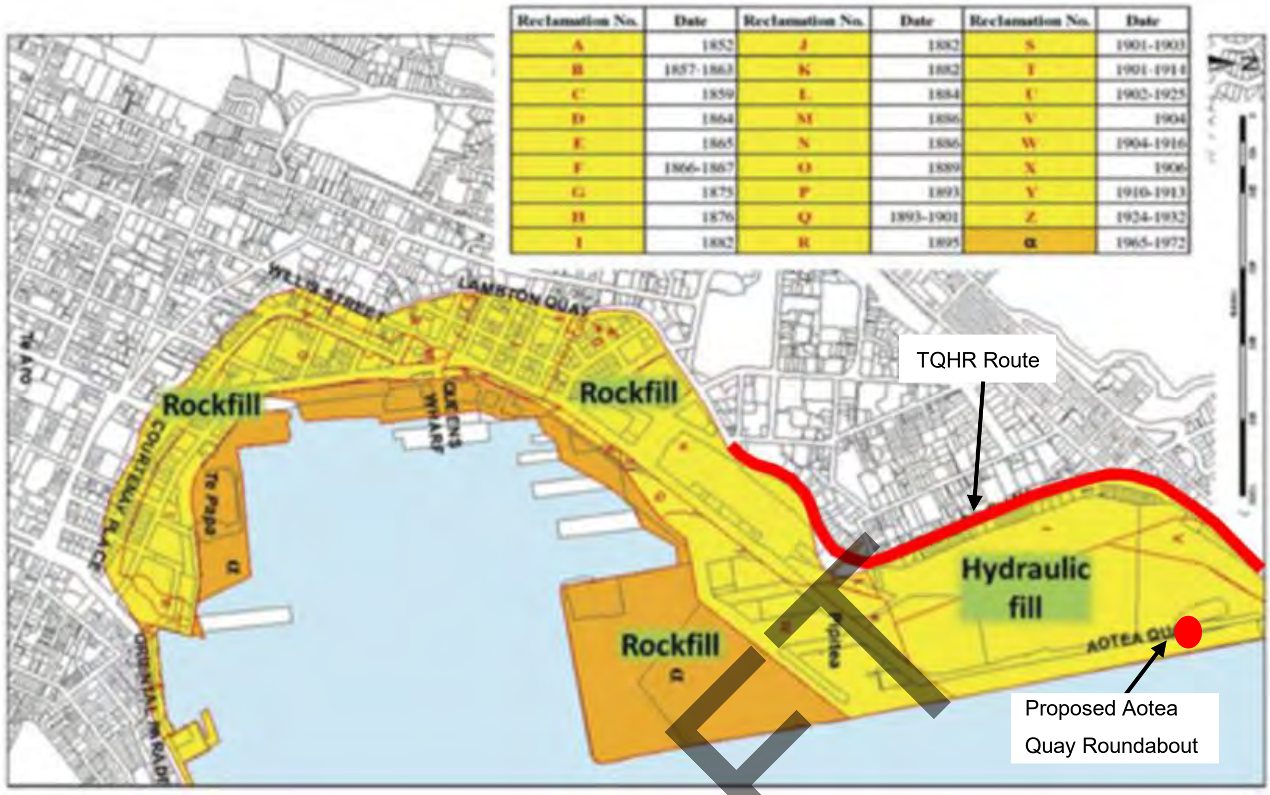


Figure 1. Geology and Fault Lines Surrounding Site (Begg & Johnston, 2000).

Figure 2 illustrates regions of Wellington Harbour where land was reclaimed. The Thorndon Quay section of TQHR follows the border between reclaimed land and existing land. According to Murashev & Palmer, 1998, the fill can be expected to vary from end-tipped quarried rock to pumped hydraulically placed marine silts and sands, extending up to 17 metres below ground level.



Reclamation No.	Date	Reclamation No.	Date	Reclamation No.	Date
A	1852	J	1882	S	1901-1903
B	1857-1863	K	1882	T	1901-1914
C	1859	L	1884	U	1902-1925
D	1864	M	1886	V	1904
E	1865	N	1886	W	1904-1916
F	1866-1867	O	1889	X	1906
G	1875	P	1893	Y	1910-1913
H	1876	Q	1893-1901	Z	1924-1932
I	1882	R	1895	α	1965-1972

Figure 2. Wellington Reclamations (Wotherspoon, Taylor, Palmer, & Chiaro, 2016).

3.2 Geomorphology

The TQHR project area extends along a relatively flat strip of land, neighbouring the foot of greywacke hills. It can be separated into four distinct regions: Hutt Road/Jarden Mile intersection, Hutt Road, Thorndon Quay and Aotea Quay Roundabout.

The Hutt Road/Jarden Mile intersection is located at the base of Ngauranga Gorge. South-East it is confined by Wellington Harbour and State Highway 1, while to North-East and South-West it is confined by steep greywacke hills.

To the west, Hutt Road is immediately confined by a steep greywacke hill and to the east it is confined by State Highway 1 and Wellington Harbour.

Thorndon Quay is located in an urban environment and bounded by retail and commercial properties, with State Highway 1 slightly further to the east. It is confined to the north by a steep greywacke hill, and the relatively flat reclaimed land continues to the south.

Aotea Quay Roundabout is at the northern end of Aotea Quay. It is immediately confined to the East by a narrow strip of CentrePort and Wellington Harbour and by Mainfreight Transport Yard to the West. To the north it is confined by the Thorndon Quay overbridge.

4 Seismic Hazards

Based on the seismic risk associated with the location of TQHR, the seismic hazards outlined below will be considered in the following sections:

- Fault Rupture
- Tsunami

- Liquefaction
- Lateral Spreading
- Earthquake Induced Slope Stability

4.1 Fault Rupture

The TQHR route is located in proximity to three active faults. Table 1 outlines key characteristics of these fault lines.

Table 1. Fault Lines and Characteristics Near TQHR Area (Stirling, McVerry, & Berryman, 2002).

Fault	Recurrence Interval of Rupture (yrs)	Characteristic Magnitude	Approx. Distance from TQHR (km)
Wellington Fault	600	7.5	1
Ohariu Fault	2,200	7.5	6
Shepherds Gully Fault	3,500	7.4	10

As stated in Section 2.1, the active Wellington Fault intersects the TQHR route near the Thorndon overbridge area. It passes from SW-NE through Thorndon Quay and continues roughly parallel to the remaining Hutt Road section of TQHR. Therefore, risk of fault rupture is a concern for the Thorndon section only.

4.2 Tsunami

Due to the low-lying nature of the TQHR area, the entirety of the route will be subject to tsunami risk. Figure 3 identifies evacuation zones depending on the risk level, according to GWRC.

The project area is predominately located in the yellow evacuation area, with the southern end of Thorndon Quay, the Kaiwharawhara intersection and the Aotea Quay Roundabout located in the orange area.

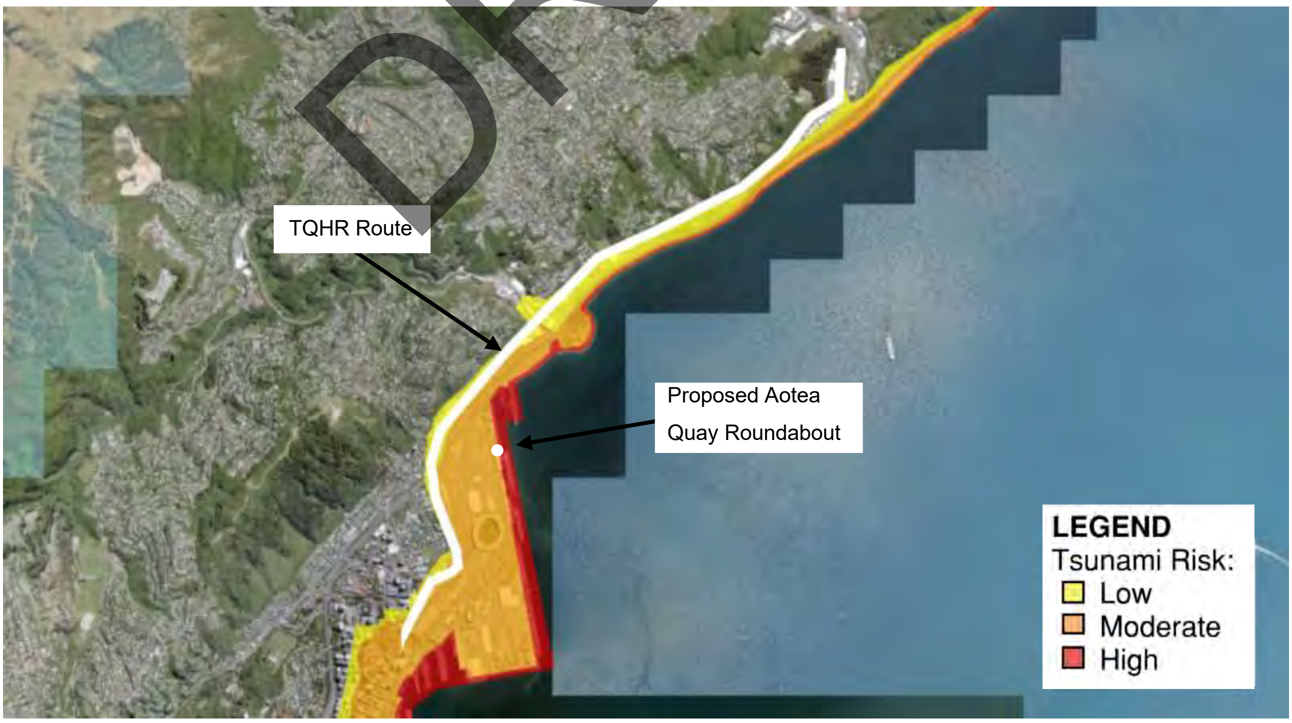


Figure 3. Tsunami Evacuation Zones Map (ESRI, 2021).

4.3 Liquefaction

4.3.1 Definition

Liquefaction describes the short-term loss of strength of a loosely packed sandy soil during an earthquake or other dynamic loading. Liquefaction occurs when the soil particles are disturbed and densify during the dynamic loading, temporarily raising pore water pressures and reducing the effective stress between particles to near zero. This causes the affected soil to behave essentially like a liquid until the excess pore pressures are dissipated.

Liquefaction can have a number of significant effects where it occurs, including large lateral displacements affecting coastal or river bank slopes (termed lateral spreading), post liquefaction settlements (due to the densification of the affected sandy layers and loss of material to the surface) and bearing capacity failures of shallow founded structures underlain by liquefiable soils.

4.3.2 Potential Risk

Zones of potential liquefaction risk along TQHR has been evaluated by GWRC and is presented in Figure 4. The risk for TQHR varies from low to very high, with the southern end being exposed to higher risk.

Figure 4. Liquefaction Hazard Zoning Map (ESRI, 2021).

Liquefaction potential of reclaimed land at the Wellington waterfront was assessed by Murashev, Palmer 1998. The study identified the sand hydraulic fills as having a high potential for liquefaction while the Holocene beach sands have a comparatively low potential for liquefaction. Of these reclamation fills, the hydraulic fill is located nearest to Thorndon Quay and Aotea Quay Roundabout.

4.4 Lateral Spreading

4.4.1 Definition

Unsaturated soils above the groundwater table are assumed not to be susceptible to liquefaction. However, if liquefaction occurs at shallow depth in a saturated soil, the overlying unsaturated soil may move toward a free face or over gently sloping ground in a semi-intact fashion; this process is known as lateral spreading.

Rupturing of the ground will tend to occur at the crest of the spreading movement, and compression at the toe of the movement.

4.4.2 Potential Risk

Previous studies and reports provide indications on the likelihood and magnitude of lateral spreading expected in the Thorndon to Ngauranga area. A report for the Ngauranga to Aotea project found a site within 20 metres of the reclamation slope could be estimated to have several hundred millimetres to metres of lateral spreading movements under shaking levels of PGA 0.25g to 0.32g (Beca, 2015). Evidence of lateral spreading was also found by the QuakeCoRE-GEER post-earthquake reconnaissance efforts at CentrePort Wellington following the November 2016 Kaikoura earthquake. Lateral spreading movements were found in the order of 1 metre or greater at the edge of reclamation ground deformation, in areas of both rock and hydraulic fill (Cubrinovski, et al., 2017).

While it is difficult to quantify the expected magnitude of lateral spreading, the reports identified above indicate risk of lateral spreading does exist and should be considered in design.

4.5 Earthquake Induced Slope Stability Hazard

GWRC have identified areas which are subject to varying earthquake induced slope stability hazards. These are shown in Figure 5 below, with the TQHR route shown in white. The zoning indicates that Hutt Road/Jarden Mile intersection and the Hutt Road sections are most at risk to earthquake induced slope stability, with the southern and northern ends of Hutt Road showing the greatest vulnerability.

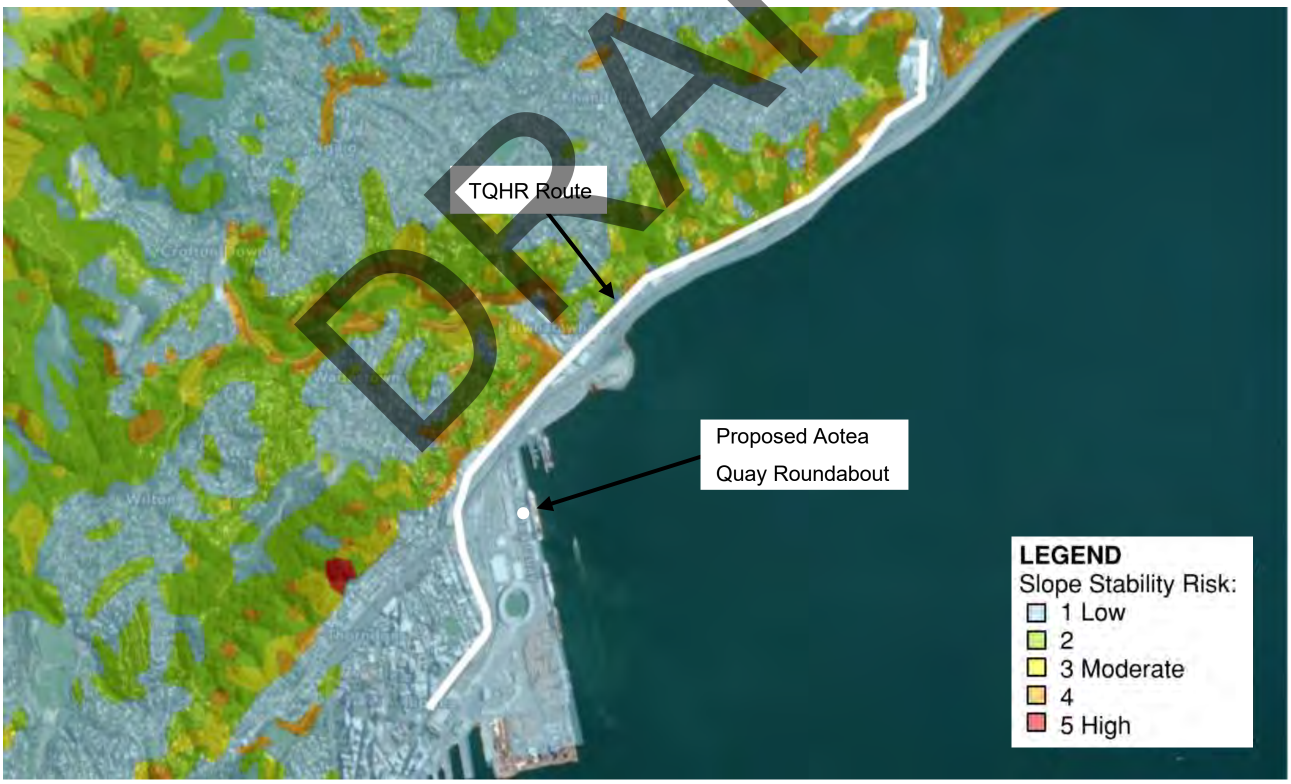


Figure 5. Earthquake Induced Slope Stability Hazard Zoning Map (ESRI, 2021).

5 Historical Geotechnical Investigations

5.1 Previous Studies

Below is a list of previous studies undertaken near the TQHR area.

Table 2. Previous Studies in Proximity to TQHR Project Area.

Title	Company	Date
Geotechnical Issues Associated with Development on Wellington's Waterfront	Beca Carter Hollings & Ferner Ltd	September 1998
Wellington Urban Motorway Thorndon to Petone – Summary of Existing Geotechnical Data and Interpretation	Beca Infrastructure Ltd	March 2010
Geotechnical Investigation and Design Report – Woolstore Design Centre, Thorndon	Tonkin and Taylor Ltd	March 2012
77 Thorndon Quay Seismic Strengthening – Preliminary Geotechnical Report	Beca Carter Hollings & Ferner Ltd	September 2012

5.2 Past Geotechnical Investigations and Observations

The following sections identify relevant historic investigations in close proximity to the TQHR route. These include boreholes, test pits, CPTs and hand augers. Details and copies of the relevant geotechnical investigations are included in Appendix A, B, C and D for Hutt Road/Jarden Mile Intersection, Hutt Road, Thorndon Quay and Aotea Quay Roundabout, respectively.

5.2.1 Hutt Road/Jarden Mile Intersection

Figure 6. Historical Investigations along Hutt Road/Jarden Mile Intersection of TQHR.

Fill was seen to reach the deepest depth near this section where it extended between 2-8 metres below ground level (bgl). BH_106077 and BH_106076 (investigations closest to site) tended to have slightly shallower fill, extending to around 4.5 metres bgl. The fill is underlain by marine and alluvial deposits. Greywacke was generally encountered at 11-15 metres bgl. However, two exceptions include BH_106073 where no greywacke was encountered and BH_106078 where it was encountered at two metres bgl.

5.2.2 Hutt Road

Figure 7. Historical Investigations along Hutt Road Section of TQHR.

The reclaimed fill beneath Hutt Road is expected to extend 3-4 metres bgl and is underlain by marine and alluvial deposits. Greywacke was generally encountered at depths ranging from 23-27 metres bgl, with the exception of BH_150986 where it was encountered at 15 metres bgl.

5.2.3 Thorndon Quay

Figure 8. Historical Investigations along Thorndon Quay Section of TQHR.

Information from the investigations identified above indicate the reclamation fill below Thorndon Quay reaches a depth of approximately 2-4.5 metres bgl. This fill is underlain by marine deposits and alluvium. There was no greywacke encountered in any boreholes and hence is expected to be found at any depth greater than 28 metres bgl.

5.2.4 Aotea Quay Roundabout

Figure 9. Historical Investigations along Aotea Quay Roundabout section of TQHR.

The Aotea Quay roundabout area is expected to have reclaimed fill extending to approximately 5.5-8.5 metres bgl. Marine deposits and alluvium is then identified as underlaying this material. Greywacke was not encountered in boreholes, so can be expected to be present at depths greater than 25 metres bgl.

6 Proposed Geotechnical Site Investigation

Based on the current scope of works for the TQHR Project, proposed geotechnical investigations in advance of detailed design are likely to consist of shallow test pits and pavement pits. Materials most importance to design will be “near surface”. A geotechnical site investigation programme will be developed once the preferred solution is developed and approved.

7 Applicability

This report has been prepared by Beca on the specific instructions of our Client. It is solely for our Client’s use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

Should you be in any doubt as to the applicability of this report and/or its recommendations for the proposed development as described herein, and/or encounter materials on site that differ from those described herein, it is essential that you discuss these issues with the authors before proceeding with any work based on this document.

8 References

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A

Appendix A – Historic Investigations: Hutt Road/Jarden Mile Intersection

A.1 Previous Geotechnical Investigations in Proximity to Hutt Road/Jarden Mile Intersection.

NZGD ID	Consultant	Year	Location	Type	Depth (m)
BH_106077	Opus	2014	South of Hutt Road/Ngauranga Gorge intersection	Machine Borehole	13.35
BH_106076	Opus	2014	Hutt Road/Ngauranga Gorge intersection	Machine Borehole	18.68
BH_106074	Opus	2012	SH1, east of intersection	Machine Borehole	13.40
BH_106075	Opus	2014	SH1, east of intersection	Machine Borehole	15.28
BH_106078	Opus	2014	SH1, east of intersection	Machine Borehole	10.35
BH_106073	Opus	2012	SH1, east of intersection	Machine Borehole	19.14

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BOREHOLE LOG

PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751883 E 5432125 N	R.L.: 3 m	SHEET: 1 of 2	HOLE NO.: BH103
LOCATION: Hutt Road Adjacent to Underpass	REF. GRID: NZTM	DATUM: MSL	HOLE LENGTH: 13.35 m	

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Main description

Geology/Unit	Depth (m)	Main Description	Detailed Description
Fill	0.0 – 2.3	Sandy GRAVEL with minor clay; brown, loose, moist, non-plastic.	Gravel is fine to 5 cm, subangular. Sand is medium. Matrix is sticky.
Fill	2.3 – 3.0	Sandy GRAVEL/Gravelly SAND; light brown, loose, dry. -	Gravel is fine to coarse (up to 3 cm), subangular. Sand is medium. Core loss between 2.53-3.0 m
Fill	3.0 – 4.2	Sandy GRAVEL with minor clay; dark brown-grey, loose, moist to wet.	Contact is unknown due to lost core. Gravel is fine to medium (up to 2 cm), subangular. Sand is fine to medium. Sticky matrix.
Alluvial Deposits or ?Fill?	4.2 – 6.4	Silty GRAVEL with some sand; mottled orange-brown and red-brown, dense, dry. Minor clay, low plasticity.	Gravel is mostly fine and coarse (up to 4 cm), subangular to subrounded. 4.3 - 4.4 m recovered mostly as gravel; ~5 cm, grey. Very dense appearance, looks like residual soil, extremely to very weak rock.
Alluvial Deposits or ?Fill?	6.4 –	Sandy GRAVEL with some clay; brown, dense, moist, wet in places, low plasticity matrix.	Contact in SPT sample. Gravel is fine to 5 cm, some larger fractured gravel up to 8 cm, angular. Sticky matrix.

Tests, core and drilling

Depth (m)	SPT 'N' Value	SPT Blow Counts	Total Core Recovery (%)	Sample Type	Drilling Method
0.0 – 1.5			0	JV	JetVac
1.5 – 1.95	5	3/3//1/2/1/1	31	SPT	Sonic Percussive Drilling
1.95 – 3.0			48	SC	Sonic Percussive Drilling
3.0 – 3.45	9	3/3//2/2/3/2	44	SPT	Sonic Percussive Drilling
3.45 – 4.5			100	SC	Sonic Percussive Drilling
4.5 – 4.95	37	2/2//3/8/12/14	65	SPT	Sonic Percussive Drilling
4.95 – 6.0			100	SC	Sonic Percussive Drilling
6.0 – 6.45	33	6/5//10/11/5/7	69	SPT	Sonic Percussive Drilling
6.45 –			100	SC	Sonic Percussive Drilling

Base of hole & water level: 12/03/2014 (approx. 2.8 m); 4.15m (PM) 10/03; 5.0m (AM) 11/03

NOTES

Water Levels during drilling:
10/3/14 pm reading: 4.15 m (BOH - 12.0 m)
11/3/14 am reading: 5.0 m (BOH - 12.0 m)
12/3/14 pm reading: 2.8 m (Piezometer BOH - 7.0 m)
11/4/14 reading: 2.87 m (Piezometer BOH - 7.0 m)

STARTED: 10/03/2014	FINISHED: 11/03/2014
DRILLER: Tim Johnson	DRILLING CO.: Griffiths Drilling
INCLINATION/AZIMUTH: -90°	DRILLING RIG: Sonic
LOGGED: E Williamson	CHECKED: E Gkeli
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04

BH103

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

Scale 1:25.0

NZGD ID: BH_106077

BOREHOLE LOG

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PROJECT	Ngauranga Walls Seismic Assessment	CO-ORD.	1751883 E 5432125 N	R.L.	3 m
LOCATION	Hutt Road Adjacent to Underpass	REF. GRID	NZTM	DATUM	MSL
HOLE NO.	BH103	SHEET	2 of 2	HOLE LENGTH	13.35 m

GEOLOGY/UNIT	MAIN DESCRIPTION	DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DETAILED DESCRIPTION	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD	CASING
Alluvial Deposits or ?Fill?	Sandy GRAVEL with some clay; brown, dense, moist, wet in places, low plasticity matrix.	7.5–10	Gravel	30	11/8//7/10/7/6			Contact in SPT sample. Gravel is fine to 5 cm, some larger fractured gravel up to 8 cm, angular. Sticky matrix.	62	SPT	Sonic Percussive Drilling	106 mm
		8							100	SC		
		9		50+	5/12//11/15/15/9 = 60mm				91	SPT		
	Mottled with blue-grey sand and gravel.							Minor iron staining.				
	Highly to completely weathered blue-grey gravel.							Gravel can be crushed to silt sized particles.	100	SC		
	Silty GRAVEL, light brown, very dense, dry to moist.	10		50+	8/6//5/12/33				61	SPT		
	Sandy GRAVEL with minor clay; mottled light brown and dark brown, very dense, areas of high plasticity but mostly low. Becomes dry at base.	11						Core is highly deformed - stuck in sonic barrel. Material is 'baked' in places and fractured. Could also be residual soil deposits.				
Greywacke Bedrock	GRAVEL with minor clayey matrix; mottled dark and light grey, very dense, dry, low plasticity. Altered and sheared SILTSTONE; with slickensided and polished gravels. Possible Fault Zone	11.2–13.35				EW	HW	Gravel is fine to 3 cm, some larger rock fragments, angular.	100	SC		
		12		50+	8/2//31/19 = 40mm				90	SPT		
									100	SC		
		13		50+	4/4//20/25/5 = 40mm				62	SPT		106 mm
		14										

DIP degrees 0 90

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NOTES

Water Levels during drilling:
10/3/14 pm reading: 4.15 m (BOH - 12.0 m)
11/3/14 am reading: 5.0 m (BOH - 12.0 m)
12/3/14 pm reading: 2.8 m (Piezometer BOH - 7.0 m)
11/4/14 reading: 2.87 m (Piezometer BOH - 7.0 m)

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

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STARTED	10/03/2014	FINISHED	11/03/2014
DRILLER	Tim Johnson	DRILLING CO.	Griffiths Drilling
INCLINATION/ AZIMUTH	-90°	DRILLING RIG	Sonic
LOGGED	E Williamson	CHECKED	E Gkeli
CLIENT	NZ Transport Agency	JOB NO:	5C1750.04

BH103

Scale 1:25.0

NZGD ID: BH_106076

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BOREHOLE LOG

PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751976 E 5432182 N	R.L.: 3 m	HOLE NO.: BH102	SHEET: 1 of 3
LOCATION: Hutt Road Compound	REF. GRID: NZTM	DATUM: MSL	HOLE LENGTH: 18.675 m	

Geology/Unit	Main Description	Depth (m)	SPT 'N' Value	SPT Blow Counts	Detailed Description	Total Core Recovery (%)	Sample Type	Drilling Method
Fill	Sandy GRAVEL with minor silt; brown, loose to medium dense, moist.	0–1.5			SPT was not undertaken as ground was highly disturbed. Gravel is fine to 10 cm, angular. Sand is fine.	0	JV	JetVac
Fill	Clayey, sandy GRAVEL; grey-brown, loose, dry, moderate plasticity, high plasticity in places. -	1.5–3.0			Gravel is fine to coarse (up to 3 cm), subangular. Sand is fine to medium.	67	SC	Sonic Percussive Drilling
Fill	Clayey, sandy GRAVEL; grey-brown, loose, dry, moderate plasticity, high plasticity in places. Less matrix material.	3.0–4.2	7	2/2//1/1/3/2	Gravel is fine to 3 cm, subangular. Sand is fine to medium.	44	SPT	Sonic Percussive Drilling
						100	SC	
Fill	GRAVEL with sand and clay to clayey sandy GRAVEL; blue-grey, loose, dry, moderate plasticity, high plasticity in places.	4.2–4.5			Gravel is fine to 3 cm, subangular. Sand is fine to medium.			
Alluvial Deposits	GRAVEL with some clay and sand; blue-grey, medium dense, moist, low plasticity.	4.5–6.25	17	5/6//4/3/5/5	Gravel is fine to coarse (up to 3 cm). Sand is fine to medium. Brown clay coating. Possibly same as unit above but matrix is more washed out.	62	SPT	
						100	SC	
			27	7/8//7/7/6/7		71	SPT	
Alluvial Deposits	GRAVEL with some sand and clay; brown, moist, medium dense, low plasticity.	6.25–7.5			Gravel is fine to medium (up to 2 cm) to 2 cm, subangular. Sand is medium. Sticky matrix.	100	SC	

Piezometer water levels: 12/03/2014, 11/03/2014, 10/03/2014

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NOTES

Water Levels during drilling:
5/3/14 pm reading: 2.2 m (BOH - 7.5 m)
6/3/14 am reading: 3.6 m (BOH - 7.5 m)
10/3/14 pm reading: 4.1 m (Piezometer BOH - 9.0 m)
11/3/14 am reading: 4.2 m (Piezometer BOH - 9.0 m)
12/3/14 am reading: 3.6 m (Piezometer BOH - 9.0 m)
11/4/14 reading: 2.8 m (Piezometer BOH - 9.0 m)

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SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

STARTED: 6/03/2014	FINISHED: 7/03/2014		
DRILLER: Tim Johnson	DRILLING CO.: Griffiths Drilling		
INCLINATION/AZIMUTH: -90°	DRILLING RIG: Sonic		
LOGGED: E Williamson	CHECKED: E Gkeli	BH102	
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04		

Scale 1:25.0

BOREHOLE_LOG_A3 5C1750.04 NGAURANGA WALLS SEISMIC ASSESSMENT.GPJ OPUS WLG REV080408.GDT 6/6/14

NZGD ID: BH_106076

BOREHOLE LOG

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PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751976 E 5432182 N	R.L.: 3 m	SHEET: 2 of 3	HOLE NO.: BH102
LOCATION: Hutt Road Compound	REF. GRID: NZTM	DATUM: MSL	HOLE LENGTH: 18.675 m	

GEOLOGY/UNIT: Alluvial Deposits (to approx. 14.8 m)

DRILLING METHOD: Sonic Percussive Drilling
CASING: 106 mm
BASE OF HOLE & WATER LEVEL: 3.6 m 6/03

Depth (m)	Main Description	SPT 'N' Value	SPT Blow Counts	Rock Strength	Rock Weathering	Detailed Description	Total Core Recovery (%)	Sample Type
7.5	GRAVEL with some sand and clay; brown, moist, medium dense, low plasticity.	32	3/5//7/9/10/6			Gravel is fine to medium (up to 2 cm) to 2 cm, subangular. Sand is medium. Sticky matrix.	89	SPT
8.0	Becomes sandy and blue-grey.						100	SC
8.9	Becomes brown.							
9.0		27	8/9//8/6/6/7				44	SPT
9.25	Sandy GRAVEL with minor clay; brown, medium dense, wet.					Contact is located in SPT sample. Gravel is up to 3 cm, subrounded, fractured. Sand is medium to coarse. Sticky matrix.	100	SC
10.0	Sandy GRAVEL with minor clay; brown, medium dense, wet.					Gravel is up to 3 cm, subrounded, fractured. Sand is medium to coarse. Sticky matrix.		
10.5		35	2/6//8/7/10/10				71	SPT
11.5	More sandy.					Clay coating.	100	SC
12.0		45	7/12//8/14/14/9				84	SPT
12.7	Sandy GRAVEL; brown becoming blue-grey, dense, wet.					Gravel is fractured, subangular to subrounded, up to 5 cm. Mostly <2 cm. Sand is medium.	86	SC
13.5	Silty CLAY to clayey SILT becoming gravelly and silty SAND. Firm to stiff, moist, moderate plasticity. Becomes more dense with depth.	26	5/6//9/6/5/6			Pockets could be silty, sandy GRAVEL. Mottled brown organics throughout. Gravel is fine to 2 cm, subangular to subrounded. Sand is medium to coarse.	58	SPT
14.0							100	SC
14.8	Residual soil to completely weathered, grey-brown SANDSTONE; very weak.			EW	RS	Alluvial soil deposits from surrounding hills, could be a boulder fragment.		

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NOTES

Water Levels during drilling:
5/3/14 pm reading: 2.2 m (BOH - 7.5 m)
6/3/14 am reading: 3.6 m (BOH - 7.5 m)
10/3/14 pm reading: 4.1 m (Piezometer BOH - 9.0 m)
11/3/14 am reading: 4.2 m (Piezometer BOH - 9.0 m)
12/3/14 am reading: 3.6 m (Piezometer BOH - 9.0 m)
11/4/14 reading: 2.8 m (Piezometer BOH - 9.0 m)

STARTED: 6/03/2014	FINISHED: 7/03/2014
DRILLER: Tim Johnson	DRILLING CO.: Griffiths Drilling
INCLINATION/AZIMUTH: -90°	DRILLING RIG: Sonic
LOGGED: E Williamson	CHECKED: E Gkeli
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04

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BOREHOLE LOG

HOLE NO.	BH102
PROJECT	Ngauranga Walls Seismic Assessment
LOCATION	Hutt Road Compound
CO-ORD.	1751976 E 5432182 N
REF. GRID	NZTM
R.L.	3 m
DATUM	MSL
SHEET	3 of 3
HOLE LENGTH	18.675 m

GEOLOGY/UNIT	MAIN DESCRIPTION	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DETAILED DESCRIPTION	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD	CASING
Wellington Greywacke	Residual soil, brown SANDSTONE; extremely weak [sandy GRAVEL; very dense, moist, some clay infill has high plasticity].	15.0	50+	35/5 = 2 mm	EW	RS	Possible gradual transtion to bedrock.	86	SPT	Sonic Percussive Drilling	106 mm
								84	SC		
	Becomes more clayey, less dense at ~16.3 m.	16.5	50+	13/14//16/ 12/12/10 = 45 mm				90	SPT		
	Residual soil, brown SANDSTONE; extremely weak [sandy GRAVEL; brown, very dense, dry].	16.9					Gravel is fine to 10 cm, highly weathered. Sand is very fine and friable.	100	SC		
	Residual soil, dark grey SANDSTONE; extremely weak [GRAVEL with some silt and sand; dark grey, very dense, moist].	18.0	50+	18/6//8/17/ 27			Gravel is fine to 2 cm, subangular. Sand is fine.	88	SPT		
		18.4	50+	4/12//15/10 = 50 mm				80	SC		106 mm

Depth scale: 16, 17, 18, 19, 20, 21, 22

Column headings also shown (no entries): R.L. (m), GRAPHIC LOG, DEFECT SPACING, DIP (degrees 0–90), RQD (%), DRILLING FLUID LOSS, BASE OF HOLE & WATER LEVEL, PIEZOMETER DETAILS, LABORATORY TESTING

NOTES

Water Levels during drilling:
5/3/14 pm reading: 2.2 m (BOH - 7.5 m)
6/3/14 am reading: 3.6 m (BOH - 7.5 m)
10/3/14 pm reading: 4.1 m (Piezometer BOH - 9.0 m)
11/3/14 am reading: 4.2 m (Piezometer BOH - 9.0 m)
12/3/14 am reading: 3.6 m (Piezometer BOH - 9.0 m)
11/4/14 reading: 2.8 m (Piezometer BOH - 9.0 m)

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STARTED	6/03/2014	FINISHED	7/03/2014
DRILLER	Tim Johnson	DRILLING CO.	Griffiths Drilling
INCLINATION/ AZIMUTH	-90°	DRILLING RIG	Sonic
LOGGED	E Williamson	CHECKED	E Gkeli
CLIENT	NZ Transport Agency	JOB NO.	5C1750.04

BH102

Scale 1:25.0

BOREHOLE_LOG_A3 5C1750.04 NGAURANGA WALLS SEISMIC ASSESSMENT.GPJ OPUS WLG REV080408.GDT 6/6/14

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BOREHOLE LOG

HOLE NO.	BH2			
PROJECT	Ngauranga 1/C Reinforced Earth Walls	CO-ORD.	1751873 E 5432031 N	R.L. Approx. 4m
SHEET	1 of 2			
LOCATION	Ngauranga Interchange	REF. GRID	NZTM	DATUM MSL
HOLE LENGTH	13.4 m			

Geology/Unit: Fill
Drilling method: Rotary percussive (concentrix)

Depth (m)	R.L. (m)	Main Description	SPT 'N' Value	SPT Blow Counts or Shear Value	Detailed Description	Total Core Recovery (%)	Sample Type	Laboratory Testing
0.0–1.0		GRAVEL with trace sand and silt, dark brown. Dry.			Medium to coarse, sub-angular to angular gravel clasts.		BULK	
1.0–1.45		Silty SAND with some gravel, brown. Dense, dry.	43	10//8/12/10/13	Fine to medium sand. Fine, angular gravel clasts.	100	SPT	
1.45–2.0		GRAVEL with some sand, trace silt, brown. Dry.			Medium to coarse, sub-angular to angular gravel. Fine sand.		BULK	
2.0–2.45	2	Gravelly SAND with minor clay, brown. Medium dense, moist.	18	17//6/4/3/5	Fine to coarse sand. Fine to medium, angular to sub-angular gravel clasts.	67	SPT	
2.45–3.0		Sandy GRAVEL with trace clay, brown. Moist.			Medium to coarse, angular to sub-angular gravel clasts. Fine to coarse sand.		BULK	
3.0–3.45		GRAVEL with some sand, trace clay, brown. Medium dense, wet.	18	7//4/5/6/3	Poorly graded, fine to coarse, sub-angular to angular gravel clasts. Coarse sand.	49	SPT	PSD
3.45–4.0		Sandy GRAVEL with minor clay, brown. Moist.			Fine to medium, angular to sub-angular gravel clasts. Fine sand.		BULK	
4.0–4.45	0	No Sample Recovery.	5	8//2/2/0/1	No Sample Recovery.	0	SPT	
4.45–5.0		GRAVEL with some sand and silt/clay, brown. Saturated.			Fine to medium, sub-angular to angular gravel clasts. Fine to medium sand.		BULK	
5.0–5.45		As above, trace silt. Very loose, wet.	2	2//1/1/0/0		44	SPT	PSD
5.45–6.0		No Sample Recovery.			No Sample Recovery.		BULK	
6.0–6.45	-2	Sandy GRAVEL with minor silt, dark brown. Loose, saturated.	5	3//1/1/1/2	Fine to medium sand. Medium, angular to sub-angular gravel clasts.	22	SPT	PSD
6.45–7.0		GRAVEL with some sand, trace silt, dark brown. Wel.			Fine to medium angular gravel. Fine sand.		BULK	
7.0–7.45		Sandy GRAVEL with some silt, light brown. Loose to medium dense, saturated.	10	4//2/2/2/4	Fine to coarse sand. Fine to coarse, angular to sub-angular gravel clasts.	44	SPT	PSD

NOTES
1) Coordinates taken with handheld GPS, accurate to +/- 6m.
2) PSD = Particle Size Distribution Test

STARTED	5/10/2012	FINISHED	5/11/2012
DRILLER	Nathan	DRILLING CO.	Griffiths
INCLINATION/AZIMUTH	-90° / Vertical°	DRILLING RIG	Tracked
LOGGED	T. Binczyk	CHECKED	E. Gkeli
CLIENT	John Wood Consulting Ltd.	JOB NO:	5-C2261.00

BH2

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Scale 1:25.0

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PROJECT: Ngauranga 1/C Reinforced Earth Walls	CO-ORD.: 1751873 E 5432031 N	R.L.: Approx. 4m	HOLE NO.: BH2
LOCATION: Ngauranga Interchange	REF. GRID: NZTM	DATUM: MSL	SHEET: 2 of 2
			HOLE LENGTH: 13.4 m

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	DETAILED DESCRIPTION	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD
Holocene Marginal Marine Deposits	No Sample Recovery.					No Sample Recovery.		BULK, BULK	Rotary percussive (concentrix)
	GRAVEL with trace silt, blue-grey. Dense, wet.	-4	8	32	11//7/7/8/10	Coarse, angular to sub-angular gravel clasts.	9	SPT	
	GRAVEL with some sand, trace silt, blue-grey. Wet.					Fine to medium, angular gravel clasts. Fine sand.		BULK	
	Gravelly SAND with some silt, blue-grey. Very dense, wet.		9	50+	12//14/20/16 for 40mm	Fine to medium, angular gravel clasts. Fine to coarse sand.	65	SPT	
	No Sample Recovery.					No Sample Recovery.		BULK	
	GRAVEL with some sand and silt, blue-grey. Very dense, wet.	-6	10	50+	37//50 for 20mm	Fine angular gravel clasts. Fine sand.	100	SPT	
	GRAVEL with some sand, blue grey. Wet.					Well graded, fine to coarse, angular gravel. Fine sand.		BULK	
	GRAVEL with some sand and silt, blue-grey. Very dense, wet.		11	50+	28//20/20/10 for 30mm	Fine to medium, angular gravel clasts. Fine sand.	97	SPT	
	GRAVEL with some sand, blue-grey. Wet.					Fine to medium, angular gravel. Fine to coarse sand.		BULK	
	GRAVEL with some silt, blue-grey. Very dense, wet.	-8	12	50+	31//50 for 30mm	Fine to medium angular gravel.	100	SPT	
Rakaia terrane	Moderately weathered, blue-grey ARGILLITE, highly fractured. Recoverd as GRAVEL with some silt.					Fine, angular argillite gravel.	35	HQ	Rotary triple tube wireline coring
			13				42	HQ	
	E.O.H. 13.40 m: Target Depth Reached.	-10	14						

DRAFT

NOTES

1) Coordinates taken with handheld GPS, accurate to +/- 6m.
2) PSD = Particle Size Distribution Test

STARTED: 5/10/2012	FINISHED: 5/11/2012
DRILLER: Nathan	DRILLING CO.: Griffiths
INCLINATION/ AZIMUTH: -90° / Vertical°	DRILLING RIG: Tracked
LOGGED: T. Binczyk	CHECKED: E. Gkeli
CLIENT: John Wood Consulting Ltd.	JOB NO: 5-C2261.00

BH2

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 NGAURANGA 1C REINFORCED EARTH WALLS.GPJ OPUS WLG REV080408.GDT 13/6/12

Scale 1:25.0

BOREHOLE LOG

OPUS
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www.opus.co.nz

PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751916 E 5432056 N	R.L.: 3 m	SHEET: 1 of 3	HOLE NO.: BH101
LOCATION: Railway Land - Effluent / Disposal Site	REF. GRID: NZTM	DATUM: MSL	HOLE LENGTH: 15.275 m	

GEOLOGY/UNIT	MAIN DESCRIPTION	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	DETAILED DESCRIPTION	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD	BASE OF HOLE & WATER LEVEL
Fill	Sandy GRAVEL; brown, medium dense, dry.	0.0			Gravel is fine to ~15 cm, angular. Sand is medium to coarse.	0	JV	JetVac	3.4 m 6/03
Fill	Sandy, clayey GRAVEL; grey-brown, medium dense, moist, moderate plasticity.	1.5	27	2/6//7/7/6/7	Contact is unknown due to lost core in JetVac sample. Gravel is fine to coarse (up to 3 cm), angular and unweathered.	69	SPT	Sonic Percussive Drilling	
Fill	Core loss between 1.95-2.5 m					48	SC		
Fill	Becomes dense.	3.0	39	2/5//10/14/9/6		98	SPT		
Fill	Clayey GRAVEL with some sand; brown, dense, moist to wet, very low plasticity.	3.25			Gravel is fine to 3 cm, angular. Sand is fine. Matrix is sticky.				
Fill	Becomes medium dense, moist, moderate plasticity.	4.0			Matrix no longer sticky.	96	SC		
Fill		4.5	13	5/4//5/2/3/3		44	SPT		
Fill	Core loss bewteen 4.95-5.4.								
Alluvial Deposits	GRAVEL with minor sand and silt; grey-brown, loose to medium dense, moist, non-plastic.	5.4			Contact is unknown due to lost core. Gravel is fine and coarse (up to 5 cm), angular-subangular and unweathered.	58	SC		
Alluvial Deposits		6.0	10	3/2//1/4/2/3	Gravel up to 3 cm.	56	SPT		
Alluvial Deposits	Clayey GRAVEL with some sand; brown, medium dense, moist to wet, moderate to high plasticity.	6.95			Gradational contact. Gravel is fine to coarse (up to 3 cm), angular to subangular. Sand is fine. Matrix is sticky.	100	SC		

Other columns: R.L. (m), GRAPHIC LOG, ROCK STRENGTH, ROCK WEATHERING, DEFECT SPACING, DIP (degrees 0–90), RQD (%), DRILLING FLUID LOSS, CASING, PIEZOMETER DETAILS, LABORATORY TESTING.

DRAFT

NOTES

Water Levels during drilling:
5/3/14 pm reading: 2.1 m (BOH - 10.5 m)
6/3/14 am reading: 3.4 m (BOH - 10.5 m)
6/3/14 pm reading: 1.8 m (BOH - 15.275 m)
11/4/14 reading: 3.78 m (BOH - 7.0 m)

STARTED: 5/03/2014	FINISHED: 6/03/2014
DRILLER: Tim Johnson	DRILLING CO.: Griffiths Drilling
INCLINATION/AZIMUTH: -90°	DRILLING RIG: Sonic
LOGGED: E Williamson	CHECKED: E Gkeli
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04

BH101

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

Scale 1:25.0

NZGD ID: BH_106075

BOREHOLE LOG

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PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751916 E 5432056 N	R.L.: 3 m	HOLE NO.: BH101
LOCATION: Railway Land - Effluent / Disposal Site	REF. GRID: NZTM	DATUM: MSL	SHEET: 2 of 3
			HOLE LENGTH: 15.275 m

GEOLOGY/UNIT	MAIN DESCRIPTION	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DETAILED DESCRIPTION	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL
Alluvial Deposits	Clayey GRAVEL with some sand; brown, medium dense, moist to wet, moderate to high plasticity.		12	2/2//4/2/3/3			Gradational contact. Gravel is fine to coarse (up to 3 cm), angular to subangular. Sand is fine. Matrix is sticky.	22	SPT	Sonic Percussive Drilling	106 mm	3.4 m 6/03
		8						81	SC			
Marine Deposits	SAND with some gravel and pockets of clay; dark blue-grey, loose to medium dense, wet. Clay pockets have moderate plasticity.	9	11	2/2//1/4/3/3			High abundance of shells. Sand is coarse.	49	SPT			
		10						100	SC			
	Silty SAND; dark grey-black, medium dense, moist. Pockets of more silty material.						Sand is fine, shell fragments throughout. Recovered as loose material.					2.1 mm 5/03
Alluvial Deposits	Sandy GRAVEL with some clay; grey-brown, medium dense, moist. Pockets of moderate plasticity.		18	4/3//4/5/4/5			Gradational contact. Gravel is fine to coarse (up to 3 cm), subangular to subrounded.	67	SPT			
		11						100	SC			
	Clayey, sandy GRAVEL; dense, moist, moderate to high plasticity.						Gravel is fine to coarse (up to 3 cm), subangular to subrounded. Sand is fine.					
		12	37	7/15//10/10/11/6				16	SPT			
	GRAVEL; grey-brown, very dense, dry.	13					Cobbles and pebbles of completely weathered, grey-brown SANDSTONE/SILTSTONE. Sonic rig struggling to drill through.	100	SC			
	Gradual transition to bedrock.		50+	13/16//15/16/10/9 = 25mm				80	SPT		106 mm	
Wellington Greywacke	Residual soil, grey-brown SANDSTONE; extremely weak [Clayey, sandy GRAVEL; dense, moist, moderate to high plasticity].	14			EW	RS	Gravel is fine to 4 cm, fractured.					
	Completely weathered, grey brown SANDSTONE; extremely weak [GRAVEL; grey-brown, very dense, dry].				EW	CW		100	SC			

DRAFT

NOTES

Water Levels during drilling:
5/3/14 pm reading: 2.1 m (BOH - 10.5 m)
6/3/14 am reading: 3.4 m (BOH - 10.5 m)
6/3/14 pm reading: 1.8 m (BOH - 15.275 m)
11/4/14 reading: 3.78 m (BOH - 7.0 m)

STARTED: 5/03/2014	FINISHED: 6/03/2014
DRILLER: Tim Johnson	DRILLING CO.: Griffiths Drilling
INCLINATION/AZIMUTH: -90°	DRILLING RIG: Sonic
LOGGED: E Williamson	CHECKED: E Gkeli
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04

BH101

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

Scale 1:25.0

NZGD ID: BH_106075

BOREHOLE LOG

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PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751916 E 5432056 N	R.L.: 3 m	SHEET: 3 of 3	HOLE NO. BH101
LOCATION: Railway Land - Effluent / Disposal Site	REF. GRID: NZTM	DATUM: MSL	HOLE LENGTH: 15.275 m	

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DIP (degrees 0–90)	DETAILED DESCRIPTION	RQD (%)	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD	DRILLING FLUID LOSS	CASING	BASE OF HOLE & WATER LEVEL	PIEZOMETER DETAILS	LABORATORY TESTING
	Completely weathered, grey brown SANDSTONE; extremely weak [GRAVEL; grey-brown, very dense, dry].				50+	22/13//25/ 25 = 50 mm	EW	CW					73	SPT				1.8 mm 6/03		
			16																	
			17																	
			18																	
			19																	
			20																	
			21																	
			22																	

DRAFT

NOTES

Water Levels during drilling:
5/3/14 pm reading: 2.1 m (BOH - 10.5 m)
6/3/14 am reading: 3.4 m (BOH - 10.5 m)
6/3/14 pm reading: 1.8 m (BOH - 15.275 m)
11/4/14 reading: 3.78 m (BOH - 7.0 m)

STARTED: 5/03/2014	FINISHED: 6/03/2014		
DRILLER: Tim Johnson	DRILLING CO.: Griffiths Drilling		
INCLINATION/ AZIMUTH: -90°	DRILLING RIG: Sonic		
LOGGED: E Williamson	CHECKED: E Gkeli	BH101	
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04		

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

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PROJECT	Ngauranga Walls Seismic Assessment	CO-ORD.	1751937 E 5432073 N	R.L.	3 m
LOCATION	Hutt Road South Of Underpass	REF. GRID	NZTM	DATUM	MSL

HOLE NO. BH104
SHEET 1 of 2
HOLE LENGTH 10.35 m

Geology/Unit	Main Description	Depth (m)	SPT 'N' Value	SPT Blow Counts or Shear Value	Rock Strength	Rock Weathering	Detailed Description	Total Core Recovery (%)	Sample Type	Drilling Method
Fill		0.0 – 1.5						0	JV	JetVac
Fill	Sandy GRAVEL with minor clay; brown, medium dense, low plasticity.	1.5 – 2.1	11	1/2//1/4/4/2			Gravel is angular up to 5 cm. Sand is medium.	22	SPT	Sonic Percussive Drilling
Greywacke Bedrock	Residual soil, mottled dark and light grey SANDSTONE/SILTSTONE; extremely weak [Gravelly SAND; very dense].	2.1 – 3.25	50+	7/11//16/22/12 = 50mm	EW	RS	Gravel and sand are fine. Sample has been highly disturbed from sonic barrel - potentially rock fragments.	100	SC	Sonic Percussive Drilling
Greywacke Bedrock	Residual soil; brown SANDSTONE/SILTSTONE; extremely weak [sandy GRAVEL; very dense].	3.25 – 4.0			EW	RS	Gravel is fine. Sand is medium.	100	SPT	Sonic Percussive Drilling
Greywacke Bedrock	Residual soil, mottled dark and light grey SANDSTONE/SILTSTONE; extremely weak [gravelly SAND; very dense].	4.0 – 4.5			EW	RS	Gravel and sand are fine. Sample has been highly disturbed from sonic barrel - potentially rock fragments.	100	SC	Sonic Percussive Drilling
Greywacke Bedrock	Residual soil, dark blue-grey SANDSTONE/SILTSTONE; extremely weak [clayey GRAVEL with some sand; dark blue-grey, very dense, low plasticity when moist]. Becomes dry.	4.5 – 5.3	50+	14/20//30/20 = 50 mm	EW	RS	Gravel is fine, angular. Matrix is stickey. Quartz veins and mottled throughout. Potential crush zone.	100	SPT	Sonic Percussive Drilling
Greywacke Bedrock	Residaul soil, light brown-greySANDSTONE/SILTSTONE; extremely weak [silty GRAVEL with minor sand; light brown-grey, very dense, dry].	5.3 – 5.75			EW	RS	Gravel is fractured, fine to 5 cm and angular. Sparse dark grey and white mottling. Crumbly.	100	SC	Sonic Percussive Drilling
Greywacke Bedrock	Completely weathered, dark grey SILTSTONE; extremely weak [GRAVEL with some silt; dark grey, very dense, moist]. -	5.75 – 6.0			EW	CW	Gravel is fine to 1 cm, angular.	63	HQ	Rotary Coring
Greywacke Bedrock		6.0 – 7.0						0	HQ	Rotary Coring
Greywacke Bedrock		7.0 – 7.5						0	HQ	Rotary Coring

Base of hole & water level: 1.56m 11/04

DRAFT

NOTES

Water Levels during drilling:
11/4/14 am reading: 1.56 m (BOH - 7.5 m)

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

STARTED	10/04/2014	FINISHED	11/04/2014
DRILLER	Nathan Gardiner	DRILLING CO.	Griffiths Drilling
INCLINATION/AZIMUTH	-90°	DRILLING RIG	Sonic
LOGGED	E Williamson	CHECKED	E Gkeli
CLIENT	NZ Transport Agency	JOB NO:	5C1750.04

BH104

Scale 1:25.0

BOREHOLE LOG

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PROJECT: Ngauranga Walls Seismic Assessment	CO-ORD.: 1751937 E 5432073 N	R.L.: 3 m	HOLE NO.: BH104
LOCATION: Hutt Road South Of Underpass	REF. GRID: NZTM	DATUM: MSL	SHEET: 2 of 2
			HOLE LENGTH: 10.35 m

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT SPACING	DETAILED DESCRIPTION	RQD (%)	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD	CASING
Greywacke Bedrock	-										40	HQ	Rotary Coring	106 mm
	Completely weathered, dark grey SILTSTONE; extremely weak [GRAVEL; dark grey, very dense].		8			EW	CW		Gravel is ~1 cm, angular. Quartz veins throughout. Likely to be in-situ rock, fragmented during drilling. Possible crush zone.		0	HQ		
			9								0	HQ		
											0	HQ		
	Somes zones of silty sand matrix.			50+	6/7//16/25 /9 = 25 mm	EW	CW				100	HQ		
											100	SPT		
	Slightly weathered blue-grey SILTSTONE; weak, joints are very close to closely spaced.		10	50+	3/4//4/7 /17/22 = 65 mm	W	SW	VC			100	HQ		
											100	SPT		106 mm
			11											
			12											
			13											
			14											

DIP: degrees 0 – 90

DRAFT

NOTES

Water Levels during drilling:
11/4/14 am reading: 1.56 m (BOH - 7.5 m)

STARTED: 10/04/2014	FINISHED: 11/04/2014		
DRILLER: Nathan Gardiner	DRILLING CO.: Griffiths Drilling		
INCLINATION/AZIMUTH: -90°	DRILLING RIG: Sonic		
LOGGED: E Williamson	CHECKED: E Gkeli	BH104	
CLIENT: NZ Transport Agency	JOB NO: 5C1750.04		

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

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BOREHOLE LOG

PROJECT: Ngauranga 1/C Reinforced Earth Walls	CO-ORD.: 1751972 E 5432111 N	R.L.: Approx. 4m	SHEET: 1 of 3	HOLE NO.: BH1
LOCATION: Ngauranga Interchange	REF. GRID: NZTM	DATUM: MSL	HOLE LENGTH: 19.14 m	

Geology/Unit	Main Description	R.L. (m)	Depth (m)	SPT 'N' Value	SPT Blow Counts	Detailed Description	Total Core Recovery (%)	Sample Type	Drilling Method	Laboratory Testing
Fill								BULK	Rotary percussive (concentrix)	
Fill	Sandy GRAVEL with some clay, brown. Medium dense, moist.		1	19	1//4/3/6/6	Fine to coarse, angular to sub-angular gravel clasts. Fine to medium sand.	84	SPT		PSD
Fill								BULK		
Fill	Sandy GRAVEL with some clay, brown. Dense, moist.	2	2	39	9//6/8/12/13	Fine to medium, rounded to sub-angular gravel clasts.	56	SPT		
Fill								BULK		
Fill	GRAVEL with some sand, brown. Dense, moist.		3	46	18//14/10/15/7	Fine to coarse, angular, blue-grey greywacke gravel clasts.	62	SPT		
Fill								BULK		
Fill	As above.	0	4	36	11//7/8/11/10		56	SPT		
Fill	Sandy GRAVEL with some clay, brown. Dense.					Fine to medium, angular, blue-grey gravel.				
Fill								BULK		
Fill	Sandy GRAVEL with some silt, blue-grey. Dense, moist.		5	45	7//9/14/12/10	Fine to coarse, angular greywacke gravel.	40	SPT		
Fill								BULK		
Holocene Marginal Marine Deposits	Gravelly SAND with minor silt, grey-blue. Medium dense, moist.	-2	6	24	16//7/4/6/7	Medium to coarse, angular gravel.	78	SPT		PSD
Holocene Marginal Marine Deposits								BULK		
Holocene Marginal Marine Deposits	Gravelly SAND with minor silt, blue-grey. Medium dense, moist.		7	20	12//3/5/6/6	Medium to coarse sand. Medium angular gravel.	78	SPT		

Other columns (Graphic Log, Rock Strength, Rock Weathering, Defect Spacing, Dip (degrees 0–90), RQD (%), Drilling Fluid Loss, Casing, Base of Hole & Water Level, Piezometer Details) contain no entries.

DRAFT

NOTES
1) Drill changed halfway through BH
2) Coordinates taken with handheld GPS, accurate to +/- 8m.
3) PSD = Particle Size Distribution Test

STARTED: 5/02/2012	FINISHED: 5/08/2012
DRILLER: Nathan	DRILLING CO.: Griffiths
INCLINATION/AZIMUTH: -90° / Vertical°	DRILLING RIG: Tracked
LOGGED: E. Gkeli	CHECKED: T. Binczyk
CLIENT: John Wood Consulting Ltd.	JOB NO: 5-C2261.00

BH1

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

BOREHOLE_LOG_A3 NGAURANGA 1C REINFORCED EARTH WALLS.GPJ OPUS WLG REV080408.GDT 13/6/12

Scale 1:25.0

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BOREHOLE LOG

Hole No.	BH1
Project	Ngauranga 1/C Reinforced Earth Walls
Location	Ngauranga Interchange
Co-ord.	1751972 E 5432111 N
Ref. Grid	NZTM
R.L.	Approx. 4m
Datum	MSL
Sheet	2 of 3
Hole Length	19.14 m

Geology/Unit: Holocene Marginal Marine Deposits

Drilling Method: Rotary percussive (concentrix) to approx. 14 m; Rotary triple tube wireline coring below.

R.L. (m)	Depth (m)	Main Description	SPT 'N' Value	SPT Blow Counts or Shear Value	Detailed Description	Total Core Recovery (%)	Sample Type	Laboratory Testing
		GRAVEL, blue grey.			Medium gravel clasts.		BULK	
							BULK	
-4	8	Gravelly SAND with minor silt, blue grey. Medium dense, moist.	19	8//6/4/6/3	Fine to medium sand. Medium to coarse angular gravel.	84	SPT	PSD
		Sandy GRAVEL with minor silt.					BULK	
	9	Gravelly SAND with some silt, brownish grey. Dense, moist.	33	6//3/5/12/13	Fine to coarse sand. Fine to medium angular gravel.	84	SPT	PSD
		Gravelly SAND with minor silt.					BULK	
-6	10	Gravelly SAND to sandy GRAVEL with minor clay, blue grey. Very dense, dry.	50+	10//10/14/16/10 for 10	Medium, angular, greywacke gravel.	100	SPT	
		GRAVEL, blue-grey.			Fine to medium, angular gravel.		BULK	
	11	Gravelly SAND to sandy GRAVEL, blue-grey. Very dense, dry to moist.	50	9//12/11/14/13		100	SPT	
		GRAVEL, blue-grey.			Rounded gravel clasts.		BULK	
-8	12	Gravelly SAND with some clay, blue-grey. Dense.	43	7//9/9/12/13		89	SPT	
		GRAVEL, blue-grey.			Fine to medium gravel clasts.		BULK	
	13	No sample recovery.	22	10//6/6/5/5	No sample recovery.	0	SPT	
							BULK	
-10	14	Greywacke BOULDER, grey.	15	4//4/2/5/4		11	SPT	
		GRAVEL, grey.			Medium to coarse gravel clasts.		BULK	

Other column headings (no entries): RQD (%), Rock Strength, Rock Weathering, Defect Spacing, Dip (degrees 0–90), Drilling Fluid Loss, Casing, Base of Hole & Water Level, Piezometer Details.

NOTES

1) Drill changed halfway through BH
2) Coordinates taken with handheld GPS, accurate to +/- 8m.
3) PSD = Particle Size Distribution Test

Started	5/02/2012	Finished	5/08/2012
Driller	Nathan	Drilling Co.	Griffiths
Inclination/Azimuth	-90° / Vertical°	Drilling Rig	Tracked
Logged	E. Gkeli	Checked	T. Binczyk
Client	John Wood Consulting Ltd.	Job No:	5-C2261.00

BH1

Logged in accordance with NZ Geotechnical Society (2005) guidelines

See attached key sheet for explanation of symbols

BOREHOLE_LOG_A3 NGAURANGA 1C REINFORCED EARTH WALLS.GPJ OPUS WLG REV080408.GDT 13/6/12

Scale 1:25.0

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BOREHOLE LOG

PROJECT: Ngauranga 1/C Reinforced Earth Walls	CO-ORD.: 1751972 E 5432111 N	R.L.: Approx. 4m	HOLE NO.: BH1
LOCATION: Ngauranga Interchange	REF. GRID: NZTM	DATUM: MSL	SHEET: 3 of 3
			HOLE LENGTH: 19.14 m

GEOLOGY/UNIT	MAIN DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	DETAILED DESCRIPTION	TOTAL CORE RECOVERY (%)	SAMPLE TYPE	DRILLING METHOD
Holocene Marginal Marine Deposits	Gravelly SAND to sandy GRAVEL with minor silt, grey. Dense, moist.			36	8//8/8/10/10	Fine to medium sand. FIne to medium gravel.	62	SPT	Rotary triple tube wireline coring
	GRAVEL with some sand, grey.					Fine to medium gravel.		BULK	
	Sandy GRAVEL with minor silt, blue-grey. Very dense, moist.	-12	16	50+	38//50 for 55mm		49	SPT	
	Moderately weathered sandstone (greywacke) BOULDERS, light blue.								
	Clayey SAND with some gravel, brown. Moist.		17			Fine to medium, blue-grey gravel clasts.	100	HQ	
	Very dense.			50+	50 for 140mm		57	SPT	
	No sample recovery.	-14	18			No sample recovery.	0	HQ	
	Gravelly SAND, grey. Very dense, moist.		19	50+	50 for 140mm	Coarse sand. Fine to medium gravel.	43	SPT	
	E.O.H. at 19.14m Target Depth Reached	-16	20						
			21						
		-18	22						

Other columns (Graphic Log, Rock Strength, Rock Weathering, Defect Spacing, Dip (degrees 0–90), RQD (%), Drilling Fluid Loss, Casing, Base of Hole & Water Level, Piezometer Details, Laboratory Testing): no entries.

DRAFT

NOTES
1) Drill changed halfway through BH
2) Coordinates taken with handheld GPS, accurate to +/- 8m.
3) PSD = Particle Size Distribution Test

STARTED: 5/02/2012	FINISHED: 5/08/2012		
DRILLER: Nathan	DRILLING CO.: Griftiths		
INCLINATION/ AZIMUTH: -90° / Vertical°	DRILLING RIG: Tracked		
LOGGED: E. Gkeli	CHECKED: T. Binczyk	BH1	
CLIENT: John Wood Consulting Ltd.	JOB NO: 5-C2261.00		

LOGGED IN ACCORDANCE WITH NZ GEOTECHNICAL SOCIETY (2005) GUIDELINES

SEE ATTACHED KEY SHEET FOR EXPLANATION OF SYMBOLS

Scale 1:25.0

BOREHOLE_LOG_A3 NGAURANGA 1C REINFORCED EARTH WALLS.GPJ OPUS WLG REV080408.GDT 13/6/12

B

Appendix B – Historical Investigations: Hutt Road

B.1 Previous Geotechnical Investigations in Proximity to Hutt Road.

NZGD ID	Consultant	Year	Location	Type	Depth (m)
CPT_112572(01-03)	Pattle Delamore Partners	2018	35 Hutt Road	CPT	5.04
TP_107045	Beca Ltd	2008	Wellington Station Entry	Test Pit	2.00
BH_107038	Beca Ltd	2008	Wellington Station Entry	Machine Borehole	8.75
BH_150985	Tonkin & Taylor Ltd	2020	Thorndon overbridge	Machine Borehole	30.20
BH_150986	Tonkin & Taylor Ltd	2020	Hutt Road, beneath Thorndon overbridge	Machine Borehole	17.10
BH_150987	Tonkin & Taylor Ltd	2020	Hutt road, north Thorndon overbridge	Machine Borehole	5.35
TP_107044	Beca Ltd	2008	90 Hutt Road	Test Pit	1.85
BH_150357	ENGEO Ltd	2019	126 Hutt Road	Machine Borehole	28.75
CPT_150495	ENGEO	2020	126 Hutt Road	CPT	8.20
BH_150358	ENGEO	2019	126 Hutt Road	Machine Borehole	30.50
TP_101991	Tonkin & Taylor Ltd	2008	North of Onslow/Hutt Road intersection	Test Pit	2.20

295 Blenheim Road
Upper Riccarton
Christchurch 8041
www.pdp.co.nz

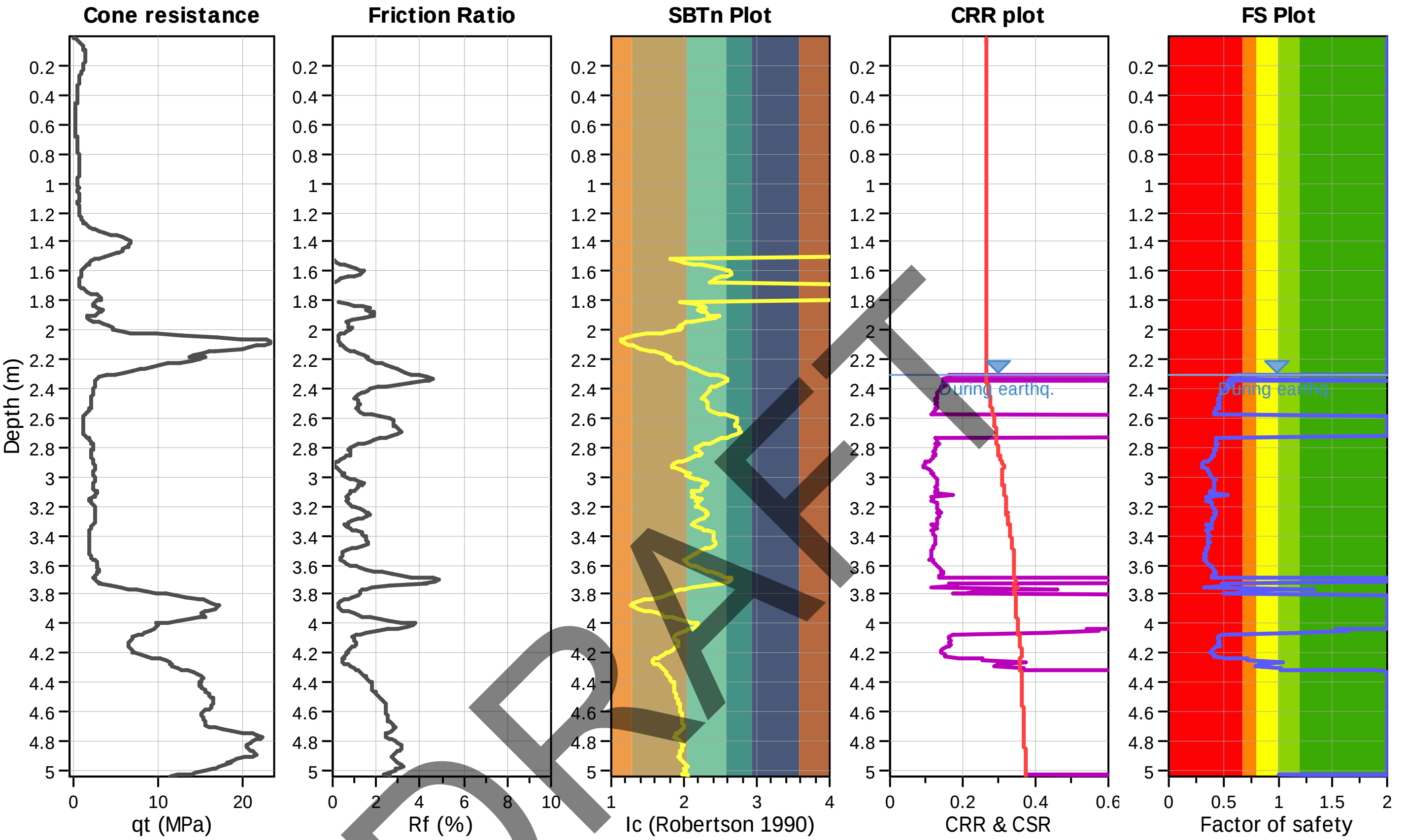
LIQUEFACTION ANALYSIS REPORT

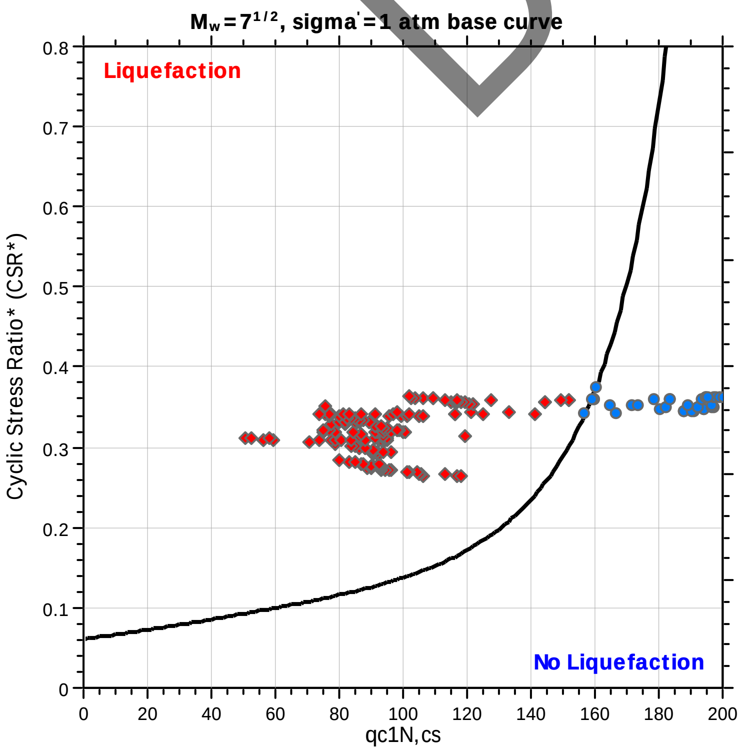
Project title : 24 - 26 Hutt Road **Location : Thorndon, Wellington**

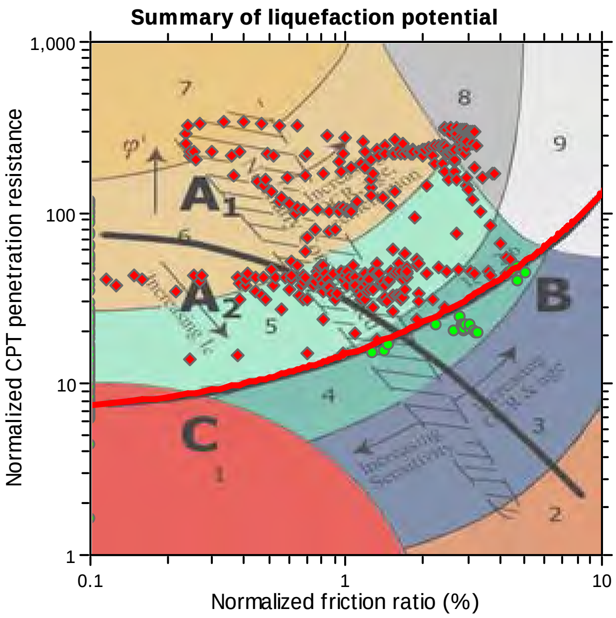
CPT file : CPT_01

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.30 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.30 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.45	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		



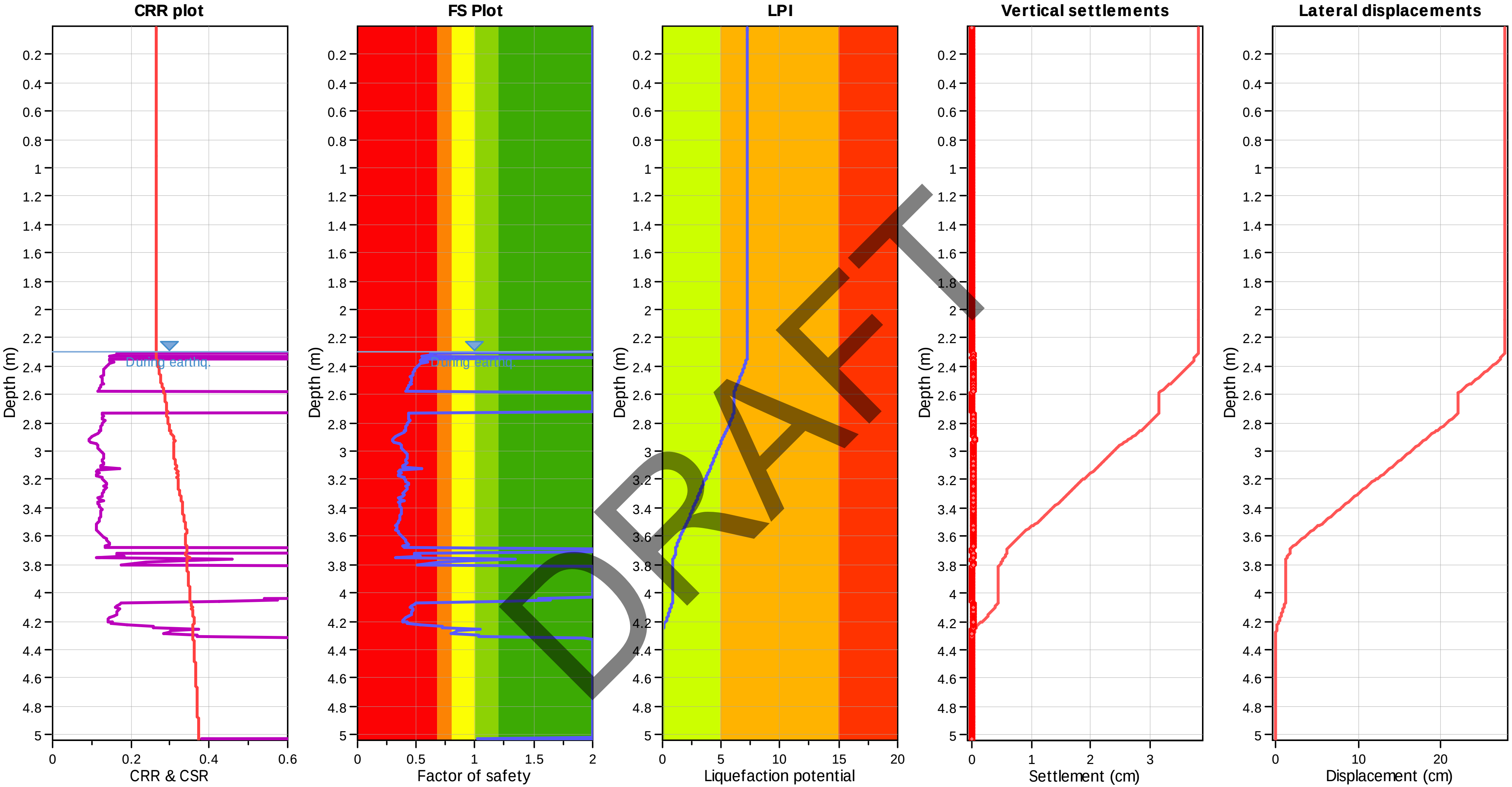




Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

 CPT name: CPT_01

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.30 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.45	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.30 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

GRIFFITHS DRILLING
RESULT DRIVEN GEOTECHNICAL SPECIALISTS

CPT ZERO TEST

Job:	24 Hutt Road, Thorndon

Date:	1/09/2018	**Operator**	Kenton

Hole #		Point Resistance (Qc)	Pore Pressure (u)	Local Friction (fs)	Tilt Angle
1	*Before*	12343	12428	12588	-
		11.0464 Mpa	250.7 Kpa	129.7 Kpa	
	After	12391	12538	12603	-
		11.1104 Mpa	251.1 Kpa	130.6 Kpa	

Time at Start of Test:	8:15am	**S:**	-
Time at End of Test:	8:40am	**E:**	-

Reason for Refusal:	Anchor		Could Not Push	X

Other (Explain): … Friction high. Could not push. Anchors pulled.

…………………………………………………………………………………………

…………………………………………………………………………………………

Pre-Drill Depth:	1.50m
Final Test Depth:	5.44m

Hole #		Point Resistance (Qc)	Pore Pressure (u)	Local Friction (fs)	Tilt Angle
2	*Before*	12314	12392	12589	-
		11.0205 Mpa	250 Kpa	129.7 Kpa	
	After	12383	12412	12603	-
		11.071 Mpa	250.7 Kpa	130.4 Kpa	

Time at Start of Test:	9:18am	**S:**	-
Time at End of Test:	9:45am	**E:**	-

Reason for Refusal:	Anchor		Could Not Push	X

Other (Explain): … Friction stopped test.

…………………………………………………………………………………………

…………………………………………………………………………………………

Pre-Drill Depth:	1.50m
Final Test Depth:	9.587m

Hole #		Point Resistance (Qc)		Pore Pressure (u)		Local Friction (fs)		Tilt Angle
3	*Before*	12253		12400		12671		-
		10.9659	Mpa	250.1	Kpa	130.6	Kpa	
	After	12267		12418		12703		-
		11.0125	Mpa	250.45	Kpa	131.3	Kpa	

Time at Start of Test:	10:45am	**S:**	-
Time at End of Test:	11:05am	**E:**	-

Reason for Refusal:	Anchor		Could Not Push	X

Other (Explain): … Friction stopped test

....

....

Pre-Drill Depth:	1.50m
Final Test Depth:	7.935m

CALIBRATION CERTIFICATE FOR CPT PROBE 4616

Probe No	4616
Date of Calibration	2017-09-12
Calibrated by	Christoffer Hurtig....................................
Run No	523
Test Class:	ISO 1

Point Resistance **Tip Area 10cm²**

Maximum Load	100	MPa
Range	100	MPa
Scaling Factor	**852**	
Resolution	0,8955	kPa
Area factor (a)	0,834	

ERRORS
Max. Temperature effect when not loaded 60,856 kPa
Temperature range 5 –40 deg. Celsius.

Local Friction **Sleeve Area 150cm²**

Maximum Load	0,5	MPa
Range	0,5	MPa
Scaling Factor	**3700**	
Resolution	0,0103	kPa
Area factor (b)	0	

ERRORS
Max. Temperature effect when not loaded 0,566 kPa
Temperature range 5 –40 deg. Celsius.

Pore Pressure

Maximum Load	2	MPa
Range	2	MPa
Scaling Factor	**3780**	
Resolution	0,0202	kPa

ERRORS
Max. Temperature effect when not loaded 1,069 kPa
Temperature range 5 –40 deg. Celsius.

Tilt Angle. **Scaling Factor: 0,95**

Range	0 - 40	Deg.

Backup memory

NZGD ID: CPT_112572

Calibration Certificate. **Loading Point Resistance** Göteborg:2017-09-14

Probe No: **4616**
Date of Calibration: **2017-09-12**
Calibration Run No: **523**
Calibrated by: **Christoffer Hurtig**
Scaling Factor: 852
Reference Cell: 75672

Applied Load MPa	PointRes. MPa	Difference MPa	Accuracy %/MV	Friction MPa	PorePress MPa
0,000	0,000	0,000	0,000	0,000	0,000
10,004	10,047	-0,043	-0,429	0,000	0,000
20,047	20,135	-0,088	-0,439	0,000	-0,001
30,033	30,148	-0,115	-0,382	0,001	-0,001
40,009	40,136	-0,127	-0,317	0,002	-0,001
50,041	50,151	-0,110	-0,219	0,002	-0,002
59,993	60,069	-0,076	-0,126	0,003	-0,002
69,969	69,992	-0,023	-0,032	0,004	-0,002
80,004	79,949	0,055	0,068	0,005	-0,002
90,032	89,890	0,142	0,157	0,006	-0,002
100,018	99,763	0,255	0,255	0,007	-0,003
90,029	89,879	0,150	0,166	0,005	-0,001
80,001	79,927	0,074	0,092	0,004	-0,001
69,997	69,990	0,007	0,010	0,003	0,000
60,017	60,060	-0,043	-0,071	0,002	0,000
50,041	50,119	-0,078	-0,155	0,001	0,000
40,031	40,128	-0,097	-0,242	0,001	0,000
30,039	30,142	-0,103	-0,342	0,000	0,000
20,014	20,106	-0,092	-0,459	0,000	0,000
10,025	10,061	-0,036	-0,359	0,000	0,000
0,003	-0,002	0,005	0,000	0,000	0,000

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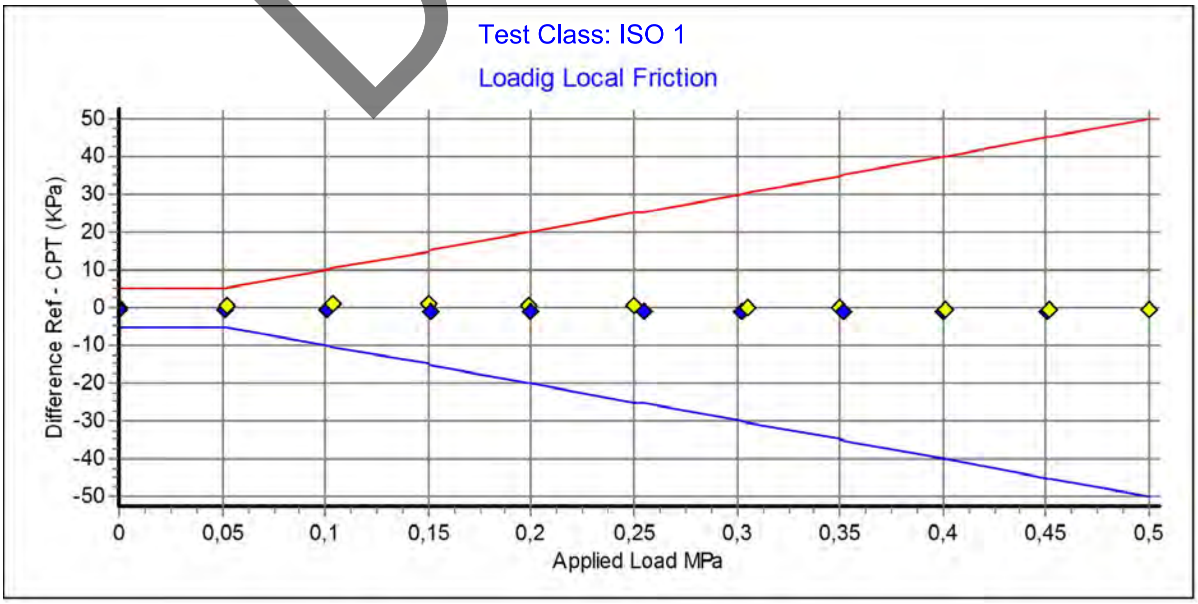
Datavägen 53 +46 (0)31-68 16 39 VAT No.
SE-436 32 ASKIM, Sweden SE556098559901

Calibration Certificate. **Loading Local Friction** Göteborg:2017-09-14

Probe No: **4616**
Date of Calibration: **2017-09-12**
Calibration Run No: **523**
Calibrated by: **Christoffer Hurtig**
Scaling Factor: **3700**
Reference Cell: 76360

Ref MPa	Friction MPa	Difference KPa	Accuracy %/MV	PointRes. MPa	PorePress MPa
0,000	0,000	0,000	0,000	0,000	0,000
0,052	0,051	0,653	0,000	0,010	0,000
0,104	0,103	0,792	0,000	0,014	0,000
0,150	0,149	0,846	0,000	0,017	0,000
0,199	0,198	0,674	0,000	0,018	0,000
0,250	0,250	0,397	0,158	0,019	0,000
0,305	0,304	0,218	0,071	0,021	0,000
0,350	0,350	0,066	0,019	0,023	0,000
0,401	0,401	-0,271	-0,067	0,024	0,000
0,452	0,452	-0,403	-0,089	0,025	0,000
0,500	0,501	-0,778	-0,155	0,025	0,000
0,451	0,452	-1,047	-0,231	0,021	0,000
0,400	0,402	-1,212	-0,301	0,018	0,000
0,352	0,354	-1,252	-0,353	0,017	0,000
0,302	0,303	-1,141	-0,375	0,015	0,000
0,255	0,256	-1,104	-0,431	0,011	0,000
0,200	0,201	-0,993	-0,492	0,010	0,000
0,151	0,152	-0,849	0,000	0,008	0,000
0,101	0,102	-0,567	0,000	0,008	0,000
0,051	0,051	-0,300	0,000	0,005	0,000
0,000	0,000	-0,340	0,000	0,000	0,000



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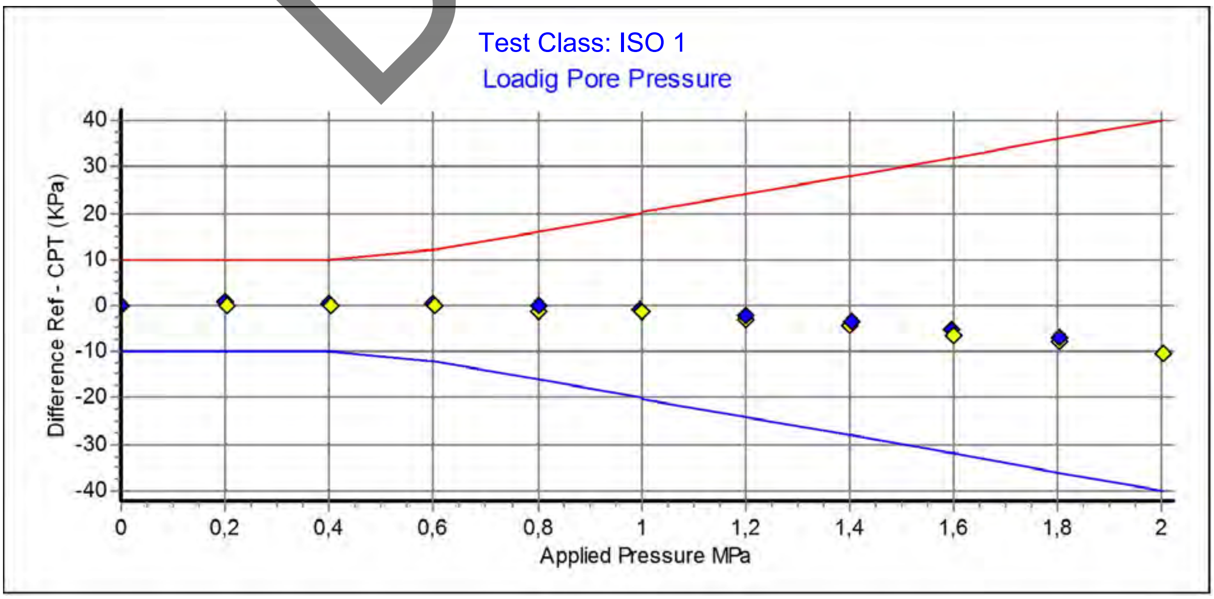
Calibration Certificate. **Loading Pore Pressure** Göteborg:2017-09-14

Probe No: **4616**
Date of Calibration: **2017-09-12**
Calibration Run No: **523**
Calibrated by: **Christoffer Hurtig**
Scaling Factor: **3780**
Reference Cell: 44410026

Appl. Press MPa	PorePress MPa	Difference KPa	Accuracy %/MV	PointRes. MPa	Friction MPa	Area Factor A = PR/PP	Area Factor B = LF/PP
0,000	0,000	0,100	0,000	0,000	0,000		
0,202	0,202	-0,129	-0,064	0,162	0,000	0,802	0,000
0,402	0,402	-0,154	-0,038	0,319	0,000	0,793	0,000
0,603	0,603	-0,177	-0,029	0,490	0,000	0,812	0,000
0,801	0,803	-1,426	-0,177	0,660	0,000	0,821	0,000
1,002	1,003	-1,470	-0,146	0,832	0,000	0,829	0,000
1,202	1,205	-2,805	-0,232	1,005	0,000	0,834	0,000
1,401	1,405	-4,495	-0,319	1,176	0,000	0,837	0,000
1,598	1,604	-6,245	-0,389	1,346	0,000	0,839	0,000
1,802	1,810	-7,907	-0,436	1,523	0,000	0,841	0,000
2,002	2,012	-10,277	-0,510	1,697	0,000	0,843	0,000
1,803	1,809	-6,976	-0,385	1,525	0,000	0,843	0,000
1,597	1,602	-5,181	-0,323	1,350	0,000	0,842	0,000
1,403	1,406	-3,230	-0,229	1,184	0,000	0,842	0,000
1,202	1,204	-2,079	-0,172	1,014	0,000	0,842	0,000
0,998	0,999	-0,709	-0,071	0,842	0,000	0,842	0,000
0,801	0,800	0,183	0,022	0,673	0,000	0,841	0,000
0,600	0,600	0,530	0,088	0,503	0,000	0,838	0,000
0,400	0,399	0,513	0,128	0,333	0,000	0,834	0,000
0,200	0,199	0,702	0,000	0,163	0,000	0,819	0,000
0,000	0,000	0,100	0,000	-0,002	0,000		



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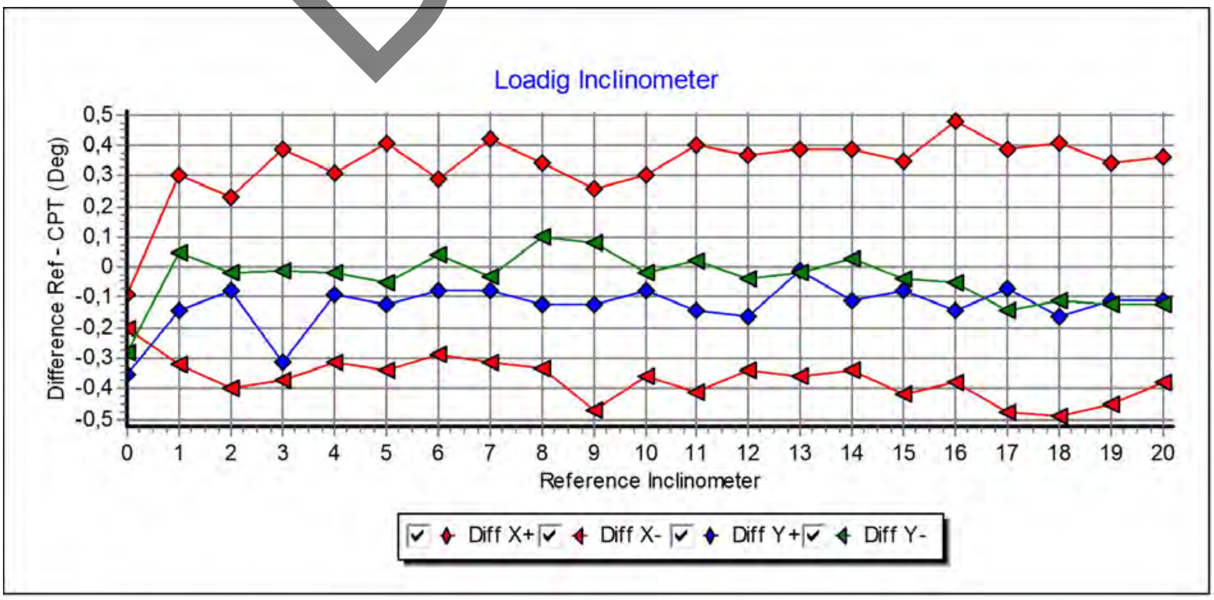
Calibration Certificate. **Loading Inclinometer** Göteborg:2017-09-14

Probe No: **4616**
Date of Calibration: **2017-09-12**
Calibration Run No: **523**
Calibrated by: **Christoffer Hurtig**
Scaling Factor: 0,95

Appl. Incin. Deg	X+ Deg	X- Deg	Y+ Deg	Y- Deg	Diff X+ Deg	Diff X- Deg	Diff Y+ Deg	Diff Y- Deg
0,00	0,09	0,20	0,35	0,28	-0,09	-0,20	-0,35	-0,28
1,00	0,70	1,32	1,14	0,95	0,30	-0,32	-0,14	0,05
2,00	1,77	2,40	2,08	2,02	0,23	-0,40	-0,08	-0,02
3,00	2,61	3,37	3,31	3,01	0,39	-0,37	-0,31	-0,01
4,00	3,69	4,31	4,09	4,02	0,31	-0,31	-0,09	-0,02
5,00	4,59	5,34	5,12	5,05	0,41	-0,34	-0,12	-0,05
6,00	5,71	6,29	6,08	5,96	0,29	-0,29	-0,08	0,04
7,00	6,58	7,31	7,08	7,03	0,42	-0,31	-0,08	-0,03
8,00	7,66	8,33	8,12	7,90	0,34	-0,33	-0,12	0,10
9,00	8,74	9,47	9,12	8,92	0,26	-0,47	-0,12	0,08
10,00	9,70	10,36	10,08	10,02	0,30	-0,36	-0,08	-0,02
11,00	10,60	11,41	11,14	10,98	0,40	-0,41	-0,14	0,02
12,00	11,63	12,34	12,16	12,04	0,37	-0,34	-0,16	-0,04
13,00	12,61	13,36	13,01	13,02	0,39	-0,36	-0,01	-0,02
14,00	13,61	14,34	14,11	13,97	0,39	-0,34	-0,11	0,03
15,00	14,65	15,42	15,08	15,04	0,35	-0,42	-0,08	-0,04
16,00	15,52	16,38	16,14	16,05	0,48	-0,38	-0,14	-0,05
17,00	16,61	17,48	17,07	17,14	0,39	-0,48	-0,07	-0,14
18,00	17,59	18,49	18,16	18,11	0,41	-0,49	-0,16	-0,11
19,00	18,66	19,45	19,11	19,12	0,34	-0,45	-0,11	-0,12
20,00	19,64	20,38	20,11	20,12	0,36	-0,38	-0,11	-0,12



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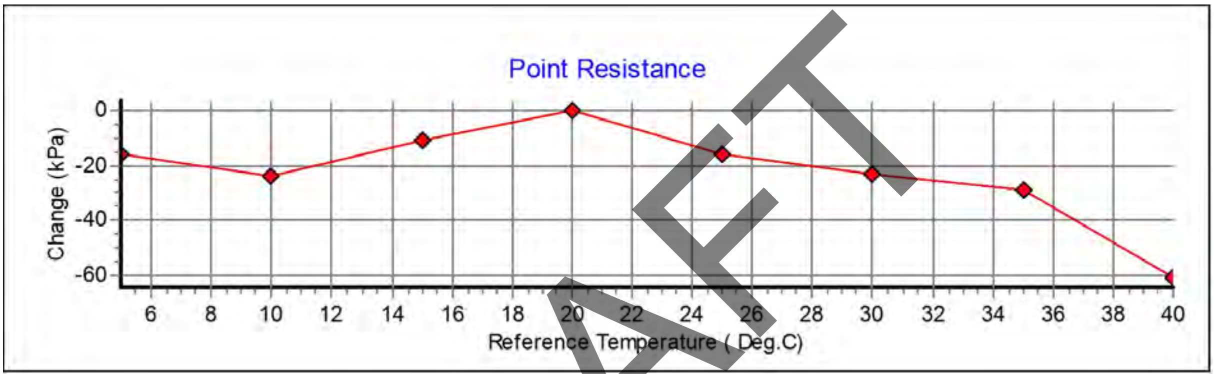
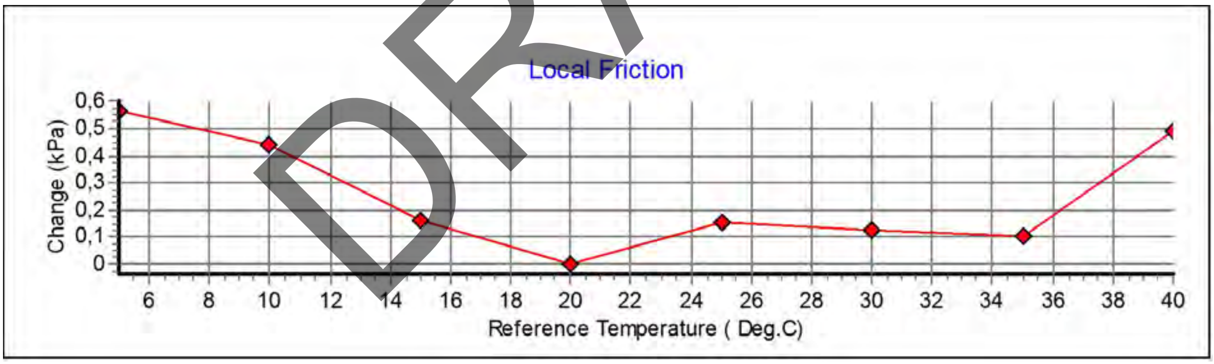
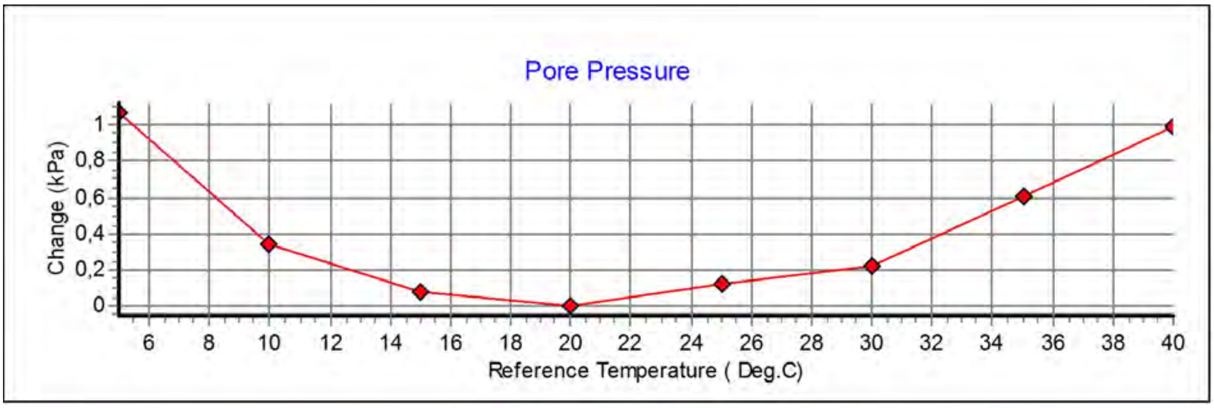
Calibration of temperature effect when not loaded.

Göteborg:2017-09-14

Probe No: **4616**
Date of Calibration: **2017-09-12**
Calibration Run No: **523**
Calibrated by: **Christoffer Hurtig**







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Calibration procedure.

Göteborg: 2017-09-14

We are following the procedure that is described in the European Standard **EN ISO22476-1:**

Point resistance.

The point resistance is calibrated from 0 to maximum range in 10 steps up and down.
Then we adjust the calibration factor to fit the best linearity.

Local friction.

A special adapter unit substitutes the cone and transfers the axial forces to the lower end of the friction sleeve. The friction is calibrated from 0 to maximum range in 10 steps up and down then the sleeve is turned 90 degrees and the calibration repeated.
Then we adjust the calibration factor to fit the best linearity.

Pore pressure & Area ratio a and b.

The completed probe is installed in a special chamber and the pore pressure sensor are calibrated from 0 to maximum range in 10 step up and down.
Then we adjust the calibration factor to fit the best linearity.
At half range the pressure of the point and friction is registered and used for calculation of the area factor.

Tilt inclination.

The tilt sensor is calibrated +/- 20deg. from vertical line in steps of 1 deg.
This will be done in 2 orthogonal directions.

Temperature.

The temperature sensor are calibrated in steps of 5°C from 5 to 40 °C.

Temperature compensation.

The Point, Friction and the Pore pressure sensors in the probe is temperature compensated and tested in the range 5 to 40 °C.

Calibration reference equipment.

Reference	Load cell	HBM C2/100kN FB088 no.N75672
Reference	Load cell	HBM C2/20kN FB088 no.N76360
Reference	Pressure sensor	HBM P3MB 1MPa no.160410072
Reference	Pressure sensor	HBM P3MB 2MPa no.44410026
Reference	Pressure sensor	HBM P3MB 50MPa no.140510158

The reference sensors are connected to the Geotech black box together with the CPT probe. The measuring data from the reference sensors are simultaneously send to the computer and stored in the Geotech calibration software. The completed systems are recalibrated at RISE Research Institutes of Sweden once a year.

Environment.
Air pressure: 990,6 hPa.
Temperature: 25,5 °C.

Cptlog Cone data base information

Göteborg: 2017-09-14

Cone name

4616

Serial number

4616

Date of purchase

User.

Ranges

Point resistance: 100 (Mpa)

Local friction: 0,5 (Mpa)

Pore pressure: 2 (Mpa)

Tilt sensor: 40 (Deg)

temperature: ©

Elect. Conductivity: (mS/m)

Geometric parameters

Area factor a: 0,834

Area factor b: 0

Tip area: 10 (cm^2)

Sleeve area: 150 (cm^2)

Scaling factors

Point resistance: 852

Local friction: 3700

Pore pressure: 3780

Tilt sensor: 0,95

temperature: 1

Elect. Conductivity A:

Elect. Conductivity B:

Type

NOVA cone

Memory option

With memory

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Beca

TEST PIT LOG

TEST PIT No: **TP E**

PROJECT	Wellington Station Entry Project 602	JOB NUMBER	3320677/240
SITE LOCATION	Wellington Station Yard	CLIENT	ONTRACK

TESTPIT LOCATION: Eastern side of Johnsonville Line embankment

COORDINATES: N 703,816 m, E 300,629 m

R L: 3.25 m

DATUM: Horizontal: Wellington Geodetic 1949; Vertical: Wellington 1953 (MSL)

GEOLOGICAL UNIT	R L (m)	DEPTH (m)	WATER LEVEL	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL DESCRIPTION	SAMPLES	Scala (Blows/150mm)	SV (kPa)	τ (kPa)
Fill	3				ML	D	L	Loosely packed, 'loose', dark brown sandy gravelly SILT, trace clay; dry, slightly plastic (when wetted), matrix supported. Gravel: Strong, MW, grey/brown, medium to coarse, poorly graded, rounded to subangular greywacke.				
					GM	M	L	Loosely packed, 'loose', silty sandy GRAVEL, trace clay; moist, slightly plastic (matrix when wetted), gravel supported. Gravel: Strong,				
					GM	M	St	MW-SW, grey, stained orange, medium to coarse, minor cobbles, subrounded to subangular greywacke.				
					MH	M	St	Stiff, black/ dark brown, silty GRAVEL, minor clay; moist, moderately plastic (when wetted), matrix supported.				
								Stiff, light brown, gravelly SILT, some sand, some clay; moist, highly plastic (when wetted). Gravel: Strong, MW-SW, grey, stained orange, medium to coarse, minor cobbles, subrounded to subangular greywacke.				
					GP	M	L	Loosely packed, 'loose', grey GRAVEL, trace silt and sand; moist, non plastic, gravel supported. Gravel: Strong, MW-SW, grey, medium to coarse, poorly graded, subangular and angular greywacke.				
	2	1			ML	M	St	Stiff, light brown gravelly sandy SILT, trace clay; moist, slightly plastic (when wetted). Gravel: Strong, MW-SW, grey, stained brown, medium to coarse gravel, and cobble and boulder sized, well graded, rounded to subangular.	D1			
					SP	M	L	Loosely packed, 'loose', dark brown silty gravelly SAND; moist, non plastic. Gravel: MW-SW, grey/brown, fine to medium, some cobbles, poorly graded, subrounded to rounded greywacke. Sand: Medium to coarse.	D2			
	1	2						End of Test Pit 2 m.				

DRAFT

DATE DRILLED: 23/2/08	EXCAVATION METHOD: Hitachi EX60	COMMENTS: No seepage encountered
LOGGED BY: JUB	CONTRACTOR: HRS	
PILCON VANE No:		

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Test Pit Location (embankment)

Test Pit Photos

TP E

NZGD ID: TP_107045

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **BH3**

PROJECT: Wellington Station Entry Project 602 JOB NUMBER: 3320677/400
SITE LOCATION: East of Johnsonville Line Embankment CLIENT: ONTRACK

CIRCUIT: Wellington Geodetic Datum 1949 BOREHOLE LOCATION: North end of proposed retaining wall
COORDINATES: N 703,824.00 m R L: 1.6 m
E 300,637.00 m DATUM: Wellington 1953 (MSL)

Depth (m)	Core recovery	Method	SPT 'N'	USCS	Moisture	Soil / Rock Description	Geological Unit
0.0–1.0	0 %	Vacuum				Vacuum excavation for service check - no recovery, logged downhole and from spoil. Tightly packed, clast supported GRAVEL, minor sandy silt matrix, yellowish brown; non plastic (matrix). Gravel: Medium to coarse, subangular to subrounded, greyish brown, stained brown, MW, moderately strong greywacke.	Reclamation Fill
1.0–1.45	67 %	SPT	1, 2, 1, N=3	ML	M	Soft gravelly sandy SILT, trace clay, yellowish brown; moist, low plasticity. Gravel: Fine to medium, angular, greyish brown, stained brown, MW greywacke.	Reclamation Fill
1.45–2.0	0 %	TT				No recovery.	Reclamation Fill
2.0–2.45	13 %	SPT	3, 3, 3, N=6	GP	S	Poor recovery. Loose, clast supported (or matrix lost?) GRAVEL; saturated. Gravel: Fine to medium, angular, grey stained brown, MW moderately strong greywacke.	Reclamation Fill
2.45–3.0	45 %	TT				No recovery.	Reclamation Fill
				GP	S	Poor recovery. Loose, clast supported with trace matrix (washed out) coarse GRAVEL, and COBBLES; saturated. Gravel and cobbles: Subangular, grey stained brown, MW and SW greywacke. Matrix: Dark grey silty sand.	Reclamation Fill
3.0–4.5	0 %	TT				No recovery - SPT at 3.0 m obstructed by cobbles, wash drilled until clear - (ash /slag /hyraulic fill?)	Reclamation Fill
4.5–4.95	11 %	SPT	14, 4, 2, N=6	GP	W	Poor recovery - coarse gravel lodged in end of SPT. Loose GRAVEL, minor shelly sand and fine angular gravel fragments; wet, non plastic. Gravel: Medium to coarse, brown/grey, MW-SW, moderately strong greywacke.	Marine sediments
4.95–		TT	2	GM	S	Poor recovery. Loose clast supported (or matrix lost?) shelly sandy GRAVEL; saturated. Gravel: Fine to medium, subrounded, and coarse subangular,	Marine sediments

Water level: 23/8/08 (10.10am), approx. 1.95 m depth.

RL (m): 1, 0, -1, -2, -3

DATE STARTED: 23/8/08	DRILLED BY: Griffiths Drilling (NZ) Ltd	COMMENTS:	
DATE FINISHED: 23/8/08	EQUIPMENT: Longyear H170	Water level inferred from soil saturation. SPT @ 3m obstructed by gravel.	
LOGGED BY: JUB	DRILL METHOD: TT/OB/CC/SPT	Air-cored to 3.0 m. RL estimated from site plan. Coordinates approximate only.	
SHEAR VANE No:	DRILL FLUID: Water + mud/compressed air	+/- 2m, measured on site by tape.	
VANE CALIBRATION:	DIAMETER/INCLINATION: - / 90°		

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET Revision A

A4 Scale 1:25

MACHINE_BOREHOLE P:\3321\3320677\400\TGE\WELLINGTON STATION ENTRY PROJECT 602.GPJ BECA.GDT 26/9/08

DRAFT

NZGD ID: BH_107038

Beca

BOREHOLE No: **BH3**

MACHINE BOREHOLE LOG

PROJECT:	Wellington Station Entry Project 602	JOB NUMBER:	3320677/400
SITE LOCATION:	East of Johnsonville Line Embankment	CLIENT:	ONTRACK

CIRCUIT: Wellington Geodetic Datum 1949
COORDINATES: N 703,824.00 m
E 300,637.00 m

BOREHOLE LOCATION: North end of proposed retaining wall
R L: 1.6 m
DATUM: Wellington 1953 (MSL)

Core recovery	Method	SV (kPa)	T' (kPa)	SPT 'N'	Depth (m)	USCS	Moisture	Soil / Rock description	Geological unit	RL (m)
				3		MH	M	green and grey stained brown and black, MW and SW greywacke.	Marine sediments (Contd.)	
38 %	SPT			2 N=5				Poor recovery. Firm clayey SILT, trace gravel, greyish green; moist, high plasticity. Gravel: Fine to medium, subangular, CW-HW, extremely weak sandstone, trace fine subangular siltstone.		
11 %	TT							Poor recovery - logged from SPT overdrill. Stiff, some gravel, blue-grey. Gravel: Fine, subrounded and subangular poorly cemented/ extremely weak sandstone.		-4
100 %	SPT			2 4 6 N=10	6	MH	M	Firm sandy gravelly SILT, some clay, blue/green grey; moist, high plasticity. Gravel: Coarse, green/grey, stained orange, extremely weak sandstone.	Pleistocene deposits	
		UTP	UTP				W	Thin soft lens (drilling disturbed?). Wet.		
50 %	UT					ML	M	Undisturbed tube sample - poor recovery. Described from base of tube: Stiff SILT, some sand, some gravel, trace clay, orange-brown; moist, low plasticity. Gravel: Medium, subangular, brown MW, greywacke.		-5
100 %	SPT			6 10 9 N=19	7	SM	M	Firm to stiff gravelly sandy SILT, trace clay, orange-brown; moist, low plasticity to non plastic. Gravel: Fine, trace medium, subangular and rounded, brown stained grey, extremely weak sandstone/greywacke.		
100 %	TT					SM	W	Soft (drilling disturbed?) sandy SILT, some gravel, minor clay, orange-brown; wet, low plasticity. Gravel: Fine to medium, subangular to subrounded, extremely weak sandstone/greywacke.		-6
						MH	M	Stiff SILT, some clay, minor fine sand, minor gravel, orange/grey mottled dark orange; moist, high plasticity. Gravel: Coarse, angular, greyish brown, MW, very weak greywacke.		
						MH	W			
						MH	M			
					8	SM	M	Stiff gravelly SILT, some sand, minor clay, orange-brown; wet, high plasticity. Gravel: Medium to coarse, angular, brown, MW, extremely to very weak greywacke/sandstone.		
100 %	SPT			5 8 11 N=19				Stiff SILT, some clay, some sand, some gravel, orange-brown; moist, high plasticity. Gravel: Medium to coarse, angular, MW, very weak greywacke.		
								Medium dense, silty fine SAND, minor gravel, trace clay, greenish grey; moist, low plasticity to non plastic. Gravel: Medium, subangular, greenish grey, HW, extremely weak, sandstone/greywacke.		
83 %	TT					ML	M	Very stiff fine sandy SILT, minor clay, minor gravel, green/grey; moist, low plasticity.		-7
								Trace clay.		
								END OF LOG @ 8.75 m		
					9					
										-8

DATE STARTED:	23/8/08	DRILLED BY:	Griffiths Drilling (NZ) Ltd
DATE FINISHED:	23/8/08	EQUIPMENT:	Longyear H170
LOGGED BY:	JUB	DRILL METHOD:	TT/OB/CC/SPT
SHEAR VANE No:		DRILL FLUID:	Water + mud/compressed air
VANE CALIBRATION:		DIAMETER/INCLINATION:	- / 90°

COMMENTS:
Water level inferred from soil saturation. SPT @ 3m obstructed by gravel. Air-cored to 3.0 m. RL estimated from site plan. Coordinates approximate only, +/- 2m, measured on site by tape.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

Borehole Location

Downhole View
(vacuum excavated):

DEPTH: 0 to 1.0m

NZGD ID: BH_107038

BOX: 1 **DEPTH: 1.0 to 8.75m**

Borehole Photos

BH3

NZGD ID: BH_107038

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH2

SHEET: 1 OF 7

DRILLED BY: Rodney
LOGGED BY: ANPO
CHECKED: TH
START DATE: 01/10/2020
FINISH DATE: 02/10/2020
CONTRACTOR: ProDrill

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: To the west of Aotea Quay bridge, north of railway lines.

CO-ORDINATES (NZTM2000): 5430323.40 mN, 1749504.16 mE
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.00m
R.L. COLLAR: 3.30m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

DESCRIPTION OF CORE
SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

Geological Unit	Description	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Additional Observations
Fill	Air vaccum excavation.	AC	0		3	0.0–1.5	Water level 02/10/2020
	Core loss.	SPT	0	1/1 1/2 15 for 75mm N>=50 bouncing	2	1.5	
	Fine to coarse SAND with some gravel; dark brown and black. Very dense, moist. Gravel is fine to medium, subangular, greywacke.				1	2.0	
	Wellington Water 900 dia. stormwater drain.	SNC	8			2.5	
	Fine to coarse SAND with some gravel, minor silt; dark brown. Very dense, moist. Gravel is fine to medium, subangular, greywacke.	SPT	66	3/12 for 75mm N>=50 bouncing	0	3.0	
	Core loss.						
	Fine to coarse GRAVEL; dark grey. Very dense, moist. Subangular, well graded, greywacke and concrete material. (Fines flushed)	SNC	74			3.5	
	Gravelly SILT with some sand; orange brown. Firm to stiff, moist. Gravel is fine to coarse, subangular, greywacke. Sand is fine to coarse.						
	Fine to coarse SAND with minor gravel and silt; dark brown. Medium dense, moist. Gravel is fine to medium, subrounded, greywacke.				-1	4.0	*4.00m:* changes to some gravel.
	SILT with some sand, minor gravel; grey. Medium dense, moist. Sand is fine to coarse. Gravel is fine to coarse, subrounded, greywacke.						*4.15 - 4.20m:* changes to black, hydrocarbon smell.
	SILT with some clay, minor sand and gravel; grey mottled brownish orange. Firm, moist. Highly plastic. Sand is fine to medium. Gravel is fine, subrounded, greywacke.	SPT	33	6/13 8/6 5/4 N=23		4.5	
	Core loss.						

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

General Log - 30/11/2020 8:16:25 AM - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH2

SHEET: 2 OF 7

PROJECT: Aotea Quay	DRILLED BY: Rodney
JOB No.: 1008981.0010	LOGGED BY: ANPO
LOCATION: To the west of Aotea Quay bridge, north of railway lines.	CHECKED: TH
CO-ORDINATES (NZTM2000): 5430323.40 mN 1749504.16 mE	START DATE: 01/10/2020
DIRECTION: 90°	FINISH DATE: 02/10/2020
ANGLE FROM HORIZ.: -90°	CONTRACTOR: ProDrill
R.L. GROUND: 3.00m	R.L. COLLAR: 3.30m
DATUM: NZVD2016	SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT: Pleistocene Alluvium / Colluvium and Fan Deposits

DESCRIPTION OF CORE — SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation

Description of core	Sampling Method	Core Recovery (%)	Testing	Depth (m)
Sandy SILT with some clay, minor sand and gravel; grey mottled brownish orange. Firm, moist. Slightly plastic. Sand is fine to medium. Gravel is fine, subrounded, greywacke.	SNC	100	Atterberg @ 5.60m	
	SPT	44	1/2 2/3 5/4 N=14	
Core loss.				
Sandy SILT with minor clay; grey mottled brownish orange. Medium dense, moist. Slow dilatancy. Sand is fine.				
Sandy SILT with some gravel; grey mottled brownish orange. Medium dense, moist. Slow dilatancy. Sand is fine. Gravel is fine to medium, angular, greywacke.	SNC	100		
Gravelly silty fine to coarse SAND; brown mottled grey. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.			PSD @ 7.25m	
	SPT	55	1/3 4/6 4/6 N=20	
Core loss.				
Fine SAND with some silt, minor gravel; brownish orange. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.	SNC	100	Small bag @ 8.80m	
Core loss.	SPT	66	1/4 6/6 7/7 N=26	
Fine SAND with some silt and gravel; grey. Medium dense, moist. Poorly graded. Gravel is fine to medium, subangular, greywacke.				
Fine to medium SAND with minor silt and gravel; orange brown. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.				

Depth (m): 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

RL (m): -3, -4, -5, -6, -7

ROCK DEFECTS — Description & Additional Observations: *6.80m:* changes to brownish orange.

Core Box No: Box 1, 0.0-6.6m; Box 2, 6.6-9.9m

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH2

SHEET: 3 OF 7

DRILLED BY: Rodney
LOGGED BY: ANPO
CHECKED: TH
START DATE: 01/10/2020
FINISH DATE: 02/10/2020
CONTRACTOR: ProDrill

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: To the west of Aotea Quay bridge, north of railway lines.

CO-ORDINATES (NZTM2000): 5430323.40 mN, 1749504.16 mE
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.00m
R.L. COLLAR: 3.30m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

Geological unit: Pleistocene Alluvium / Colluvium and Fan Deposits

Depth (m)	Description of core	Sampling Method	Core Recovery (%)	Testing
to ~10.7	Fine SAND with minor silt and gravel; orange brown. Dense, moist. Poorly graded. Gravel is fine to medium, subangular, greywacke.	SNC	100	
~10.7–11.0	Fine SAND with minor gravel, trace silt; grey mottled brown. Dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.	SPT	88	2/4 4/6 7/7 **N=24**
~11.0–11.05	Core loss.			
~11.05–12.2	Fine SAND with minor gravel, trace silt; grey mottled brown. Dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.	SNC	100	
~12.2–12.9	Gravelly sandy SILT; brown. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular, greywacke.	SPT	100	PSD @ 12.20m; 1/0 2/3 5/6 **N=16**
~12.9–13.2	Fine SAND with some silt, minor gravel; brownish grey mottled orange brown. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.	SNC	100	
~13.2–14.1	Fine SAND wtih some silt, minor gravel; orange brown. Dense, moist. Poorly graded. Gravel is fine to medium, subangular, greywacke.	SPT	100	2/7 7/8 8/10 **N=33**
~14.1–14.9	Fine to medium SAND with some gravel, minor silt; orange brown. Dense, moist. Poorly graded. Gravel is fine to medium, subangular, greywacke.			
~14.9–	Fine to medium SAND with some gravel, minor silt;			

RL (m): -8, -9, -10, -11, -12
Depth (m): 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5

Core Box No: Box 3, 9.6-12.7m

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

NZGD ID: BH_150985

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH2**

SHEET: 4 OF 7

PROJECT: Aotea Quay	CO-ORDINATES (NZTM2000): 5430323.40 mN, 1749504.16 mE
JOB No.: 1008981.0010	DIRECTION: 90°
LOCATION: To the west of Aotea Quay bridge, north of railway lines.	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 3.00m	DRILLED BY: Rodney
R.L. COLLAR: 3.30m	LOGGED BY: ANPO
DATUM: NZVD2016	CHECKED: TH
SURVEY: GIS\Web map viewer	START DATE: 01/10/2020
	FINISH DATE: 02/10/2020
	CONTRACTOR: ProDrill

DESCRIPTION OF CORE — SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation

GEOLOGICAL UNIT: Pleistocene Alluvium / Colluvium and Fan Deposits

Depth (m)	Description of core	Sampling Method	Core Recovery (%)	Testing
~15.0–15.2		SNC	100	
~15.2–15.6		SPT	100	4/7 8/9 12/12 N=41
15.5–15.6	Fine to medium SAND with minor silt and gravel; brown. Dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.			
15.6–16.2	Fine SAND with minor silt and gravel; grey. Medium dense, moist. Poorly graded. Gravel is fine to medium, subangular, greywacke.	SNC	52	
16.2–16.7	Core loss.			
16.7–17.95	Fine SAND with some gravel, minor silt; grey. Medium dense, moist. Subhorizontal bedding. Poorly graded. Gravel is fine to medium, subangular to subrounded, greywacke.	SPT (16.7–17.15)	100	5/5 6/6 6/8 N=26
		SNC (17.15–18.3)	100	
17.95–18.65	Silty fine SAND with trace gravel; grey mottled brownish orange. Medium dense, moist. Subhorizontal bedding. Poorly graded. Gravel is fine to medium, subangular, greywacke.	SPT (18.3–18.75)	77	2/4 4/6 8/9 N=27
18.65–18.75	Core loss.			
18.75–19.1	Gravelly fine to coarse SAND with trace silt; grey. Medium dense, moist. Gravel is fine to medium, angular to subangular, greywacke.	SNC	100	
19.1–19.8	Silty fine SAND with minor gravel; grey. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.			
19.8–20.0	Core loss.	SPT		1/2 3/3 4/4 N=14

RL (m): -13 at 16.0 m; -14 at 17.0 m; -15 at 18.0 m; -16 at 19.0 m; -17 at 20.0 m

ROCK DEFECTS — Description & Additional Observations: *18.30m:* changes to light grey.

Core Box No: Box 4, 12.7-15.7m; Box 5, 15.7-18.8m

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

General Log - 30/11/2020 8:16:25 AM - Produced with Core-GS by GeRoc

DRAFT

NZGD ID: BH_150985

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH2

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: To the west of Aotea Quay bridge, north of railway lines.

CO-ORDINATES (NZTM2000): 5430323.40 mN, 1749504.16 mE
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.00m
R.L. COLLAR: 3.30m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

DRILLED BY: Rodney
LOGGED BY: ANPO
CHECKED: TH
START DATE: 01/10/2020
FINISH DATE: 02/10/2020
CONTRACTOR: ProDrill

GEOLOGICAL UNIT: Pleistocene Alluvium / Colluvium and Fan Deposits

DESCRIPTION OF CORE
SOIL: Classification, colour, consistency / density, moisture, plasticity
ROCK: Weathering, colour, fabric, name, strength, cementation

Description of core	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)
	SPT	0			
SILT with some gravel, minor sand and clay; grey mottled orange brown and brown. Medium dense, moist. Moderately plastic, slow dilatancy. Gravel is fine to coarse, angular, greywacke. Sand is fine.	SNC	100		-18	20.5, 21.0
Core loss.	SPT	0	1/3 3/3 3/5 N=14		21.5
Silty fine SAND with some gravel; grey mottled dark grey. Medium dense, moist. Poorly graded. Gravel is fine to medium, angular to subangular, greywacke.	SNC	100		-19	22.0
Silty fine SAND with some organic material; grey mottled brown and black. Medium dense, moist. Poorly graded. Organic material is fibrous tree material.					22.5
Sandy SILT with some gravel; grey. Medium dense, moist. Sand is fine to medium. Gravel is fine to medium, angular, greywacke.	SPT	100	1/3 3/3 4/5 N=15	-20	23.0
SILT with some sand and gravel; grey mottled brownish orange. Medium dense, moist. Sand is fine to coarse. Gravel is fine to medium, angular to subrounded, greywacke.	SNC	100		-21	23.5, 24.0
Gravelly SILT with some sand; brownish grey. Dense, moist. Gravel is fine to medium, subangular, greywacke. Sand is fine to coarse.	SPT	100	3/5 7/8 11/12 N=38	-22	24.5

ROCK DEFECTS – Description & Additional Observations: 24.20m: changes to grey.

Core Box No: Box 6, 18.8-21.3m; Box 7, 21.3-24.3m

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH2

DRILLED BY: Rodney
LOGGED BY: ANPO
CHECKED: TH
START DATE: 01/10/2020
FINISH DATE: 02/10/2020
CONTRACTOR: ProDrill

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: To the west of Aotea Quay bridge, north of railway lines.

CO-ORDINATES: 5430323.40 mN 1749504.16 mE (NZTM2000)
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.00m
R.L. COLLAR: 3.30m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

Geological Unit	Description of Core	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)
Pleistocene Alluvium / Colluvium and Fan Deposits	Gravelly fine SAND with minor silt; brownish orange. Dense, moist. Poorly graded. Gravel is fine to medium, subangular, greywacke.	SNC	100			25.5
	Core loss.	SPT	22	3/2 5/4 6/6 N=21	-23	26.0
	Fine to medium GRAVEL with some sand, minor silt; brownish orange. Medium dense, moist. Poorly graded. Sand is fine to coarse.	SNC	100		-24	26.5, 27.0
		SPT	100	15/35 for 55mm N>=50 Solid		27.5
Torlesse Terrane	Moderately weathered, dark grey with orange ironstaining along defects, fine, SANDSTONE. Moderately strong. Defects are closely spaced, steeply inclined to very steeply inclined, ironstained and clay veneer on some defect surfaces.	RC	100		-25	28.0, 28.5
	Core loss due to hole collapsing, core washed away.	SPT	0	21/29 for 50mm N>=50 Solid	-26	29.0
		RC	0		-27	29.5

Core Box No: Box 8, 24.3-27.4m

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH2

DRILLED BY: Rodney
LOGGED BY: ANPO
CHECKED: TH
START DATE: 01/10/2020
FINISH DATE: 02/10/2020
CONTRACTOR: ProDrill

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: To the west of Aotea Quay bridge, north of railway lines.

CO-ORDINATES (NZTM2000): 5430323.40 mN, 1749504.16 mE
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.00m
R.L. COLLAR: 3.30m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	Solid cone SPT- no recovery.			SPT	0	18/28 50 for 45mm N>=50 Solid												Box 9, 27.4-30.2m
	30.2m: END OF BOREHOLE												*30.20m:* backfilled with grout, one PVC 50mm pipe was installed for shear wave velocity testing.					

Depth scale: 30.5, 31.0, 31.5, 32.0, 32.5, 33.0, 33.5, 34.0, 34.5
RL scale: -28, -29, -30, -31

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 30.2m

Scale 1:25

Rev.: A

Tonkin+Taylor

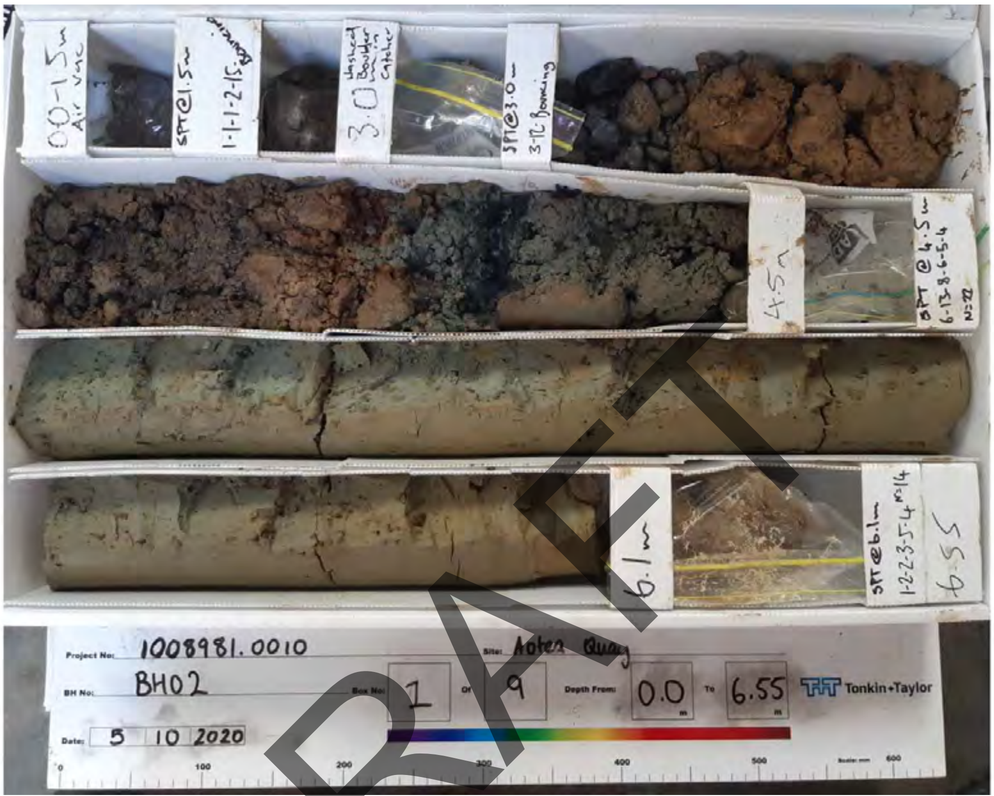
CORE PHOTOS

BOREHOLE No.: **BH2**

Hole Location: To the west of Aotea Quay bridge, north of railway lines.

SHEET: 1 OF 5

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430323.40 mN 1749504.16 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 01/10/2020 HOLE FINISHED: 02/10/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH



0.00-6.55m

6.55-9.55m

Tonkin+Taylor

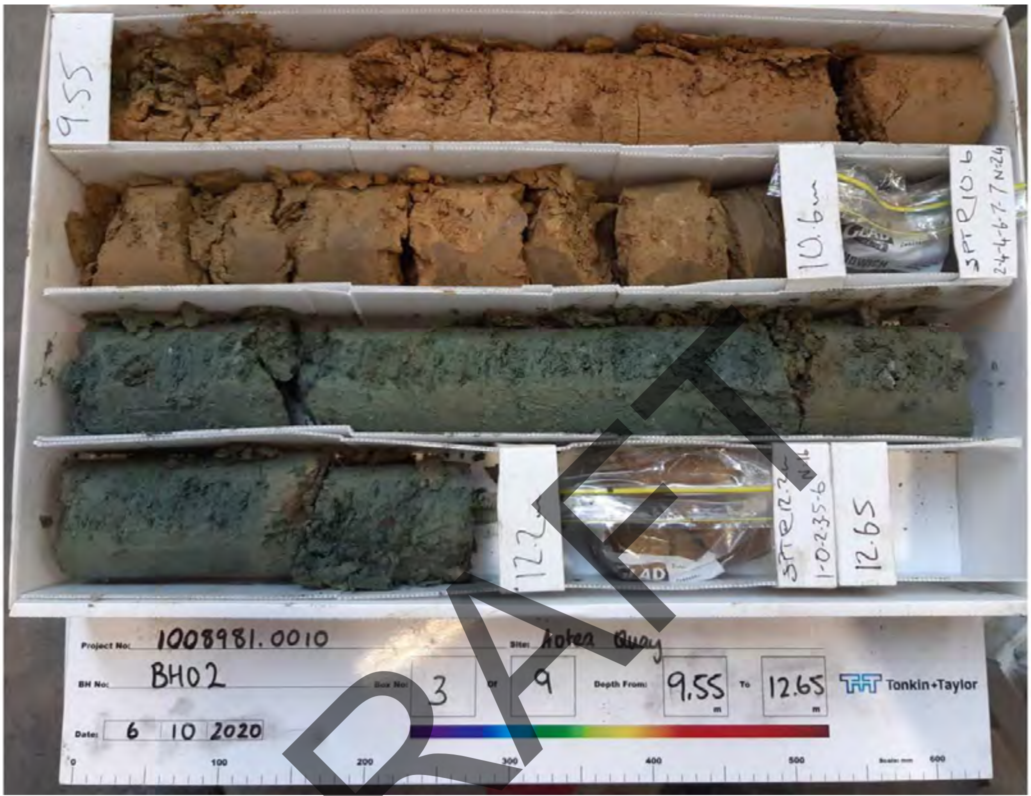
CORE PHOTOS

BOREHOLE No.: **BH2**

Hole Location: To the west of Aotea Quay bridge, north of railway lines.

SHEET: 2 OF 5

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430323.40 mN 1749504.16 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 01/10/2020 HOLE FINISHED: 02/10/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH



9.55-12.65m

12.65-15.65m

DRAFT

CORE PHOTOS

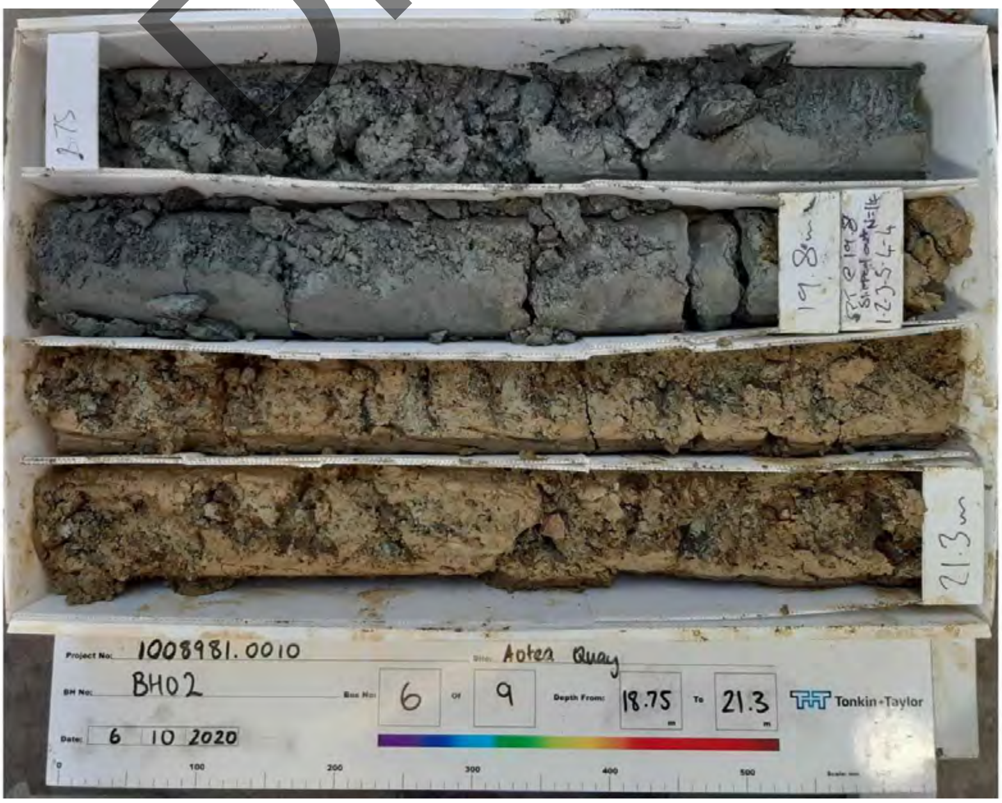
BOREHOLE No.: **BH2**

Hole Location: To the west of Aotea Quay bridge, north of railway lines.

SHEET: 3 OF 5

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430323.40 mN 1749504.16 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 01/10/2020 HOLE FINISHED: 02/10/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

15.65-18.75m



18.75-21.30m

CORE PHOTOS

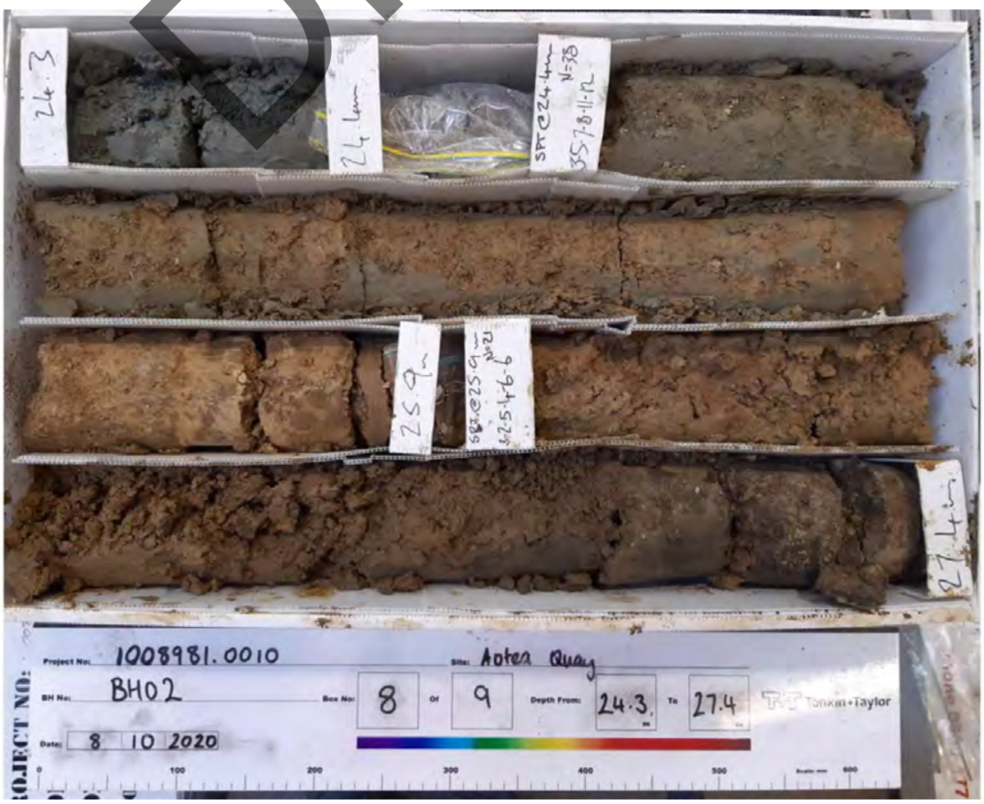
BOREHOLE No.: **BH2**

Hole Location: To the west of Aotea Quay bridge, north of railway lines.

SHEET: 4 OF 5

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430323.40 mN 1749504.16 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 01/10/2020 HOLE FINISHED: 02/10/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

21.30-24.30m



24.30-27.40m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH2**

Hole Location: To the west of Aotea Quay bridge, north of railway lines.

SHEET: 5 OF 5

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430323.40 mN 1749504.16 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 01/10/2020 HOLE FINISHED: 02/10/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

27.40-30.20m

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH4**

SHEET: 1 OF 2

PROJECT: Aotea Quay	CO-ORDINATES: (NZTM2000) 5430425.00 mN 1749519.00 mE
JOB No.: 1008981.0010	DIRECTION: 90°
LOCATION: Beneath the northern end of Aotea Quay bridge off ramp, north of the railway tracks.	ANGLE FROM HORIZ.: -90°

R.L. GROUND: 4.00m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

DRILLED BY: Chris
LOGGED BY: ANPO
CHECKED: TH
START DATE: 21/09/2020
FINISH DATE: 21/09/2020
CONTRACTOR: ProDrill

DESCRIPTION OF CORE — SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation

Geological Unit	Description of Core	Sampling Method	Core Recovery (%)	Testing
Fill	Medium to coarse GRAVEL; dark brown. Dense, moist. Poorly graded, subrounded, greywacke.			
Fill	Concrete core.			
Torlesse Terrane	Core loss.	RC	30	
Torlesse Terrane		RC	0	
Torlesse Terrane	Solid cone SPT. (2.0 m)	SPT	0	9/15 16/18 16 for 50mm **N>=50** Solid
Torlesse Terrane	Core loss.	RC	8	
Torlesse Terrane	Moderately weathered, dark grey with orange ironstaining along defects, fine, SANDSTONE. Moderately strong. Defects are closely spaced, steeply inclined to very steeply inclined, ironstained and clay veneer on some defect surfaces.			
Torlesse Terrane	Solid cone SPT. (3.5 m)			7/10 13/16 21 for 30mm **N>=50** Solid
Torlesse Terrane	Moderately weathered, dark grey with orange ironstaining along defects, fine, SANDSTONE. Moderately strong. Defects are closely spaced, steeply inclined to very steeply inclined, ironstained and clay veneer on some defect surfaces.	RC	10	
Torlesse Terrane	Core loss.			

Column headings: Rock Weathering (UW SW MW HW CW), Rock Strength (ES VS S MS W VW EW), Sampling Method, Core Recovery (%), Testing, RL (m), Depth (m), Graphic Log, ROCK DEFECTS: Defect Log, Fracture Spacing (mm) (2000 600 200 60 20), RQD (%), Description & Additional Observations; Fluid Loss (%) (25 50 75), Water Level, Casing, Installation, Core Box No

RL (m): 3, 2, 1, 0
Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 82.7%. 2. No casing.

Hole Depth 5.35m

Scale 1:25

Rev.: A

General Log - 30/11/2020 8:17:17 AM - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: **BH4**

DRILLED BY: Chris
LOGGED BY: ANPO
CHECKED: TH
START DATE: 21/09/2020
FINISH DATE: 21/09/2020
CONTRACTOR: ProDrill

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: Beneath the northern end of Aotea Quay bridge off ramp, north of the railway tracks.

CO-ORDINATES (NZTM2000): 5430425.00 mN, 1749519.00 mE
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 4.00m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

Geological Unit	Description of Core (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Torlesse Terrane	Solid cone SPT.			SPT	0	12/17 17/23 10 for 50mm **N>=50** Solid							*5.05m:* backfilled with grout.					Box 1, 0.0-5.4m
	5.35m: END OF BOREHOLE																	

Depth scale: 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5
RL scale: -2, -3, -4, -5

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 82.7%. 2. No casing.

Hole Depth 5.35m

Scale 1:25

Rev.: A

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH4**

Hole Location: Beneath the northern end of Aotea Quay bridge off ramp, north of the railway tracks.

SHEET: 1 OF 1

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430425.00 mN 1749519.00 mE R.L.: 4.00m DATUM: NZVD2016	DRILL TYPE: Kioti 1 DRILL METHOD: SNC	HOLE STARTED: 21/09/2020 HOLE FINISHED: 21/09/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

0.00-5.35m

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH3

SHEET: 1 OF 4

PROJECT: Aotea Quay	CO-ORDINATES: 5430378.00 mN 1749514.44 mE (NZTM2000)	R.L. GROUND: 3.00m	DRILLED BY: Rodney
JOB No.: 1008981.0010		R.L. COLLAR: 3.30m	LOGGED BY: ANPO
LOCATION: Near Hutt Road bus stop to the east of Aotea Quay bridge.	DIRECTION: 90°	DATUM: NZVD2016	CHECKED: TH
	ANGLE FROM HORIZ.: -90°	SURVEY: GIS\Web map viewer	START DATE: 28/09/2020
			FINISH DATE: 29/09/2020
			CONTRACTOR: ProDrill

DESCRIPTION OF CORE — SOIL: Classification, colour, consistency / density, moisture, plasticity. ROCK: Weathering, colour, fabric, name, strength, cementation

ROCK DEFECTS — Description & Additional Observations

Geological Unit	Description of Core	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)
Fill	Hydro-excavation.	HVAC	0		3 – 1.5	0.0–1.5
Fill	Sandy fine to medium GRAVEL with minor silt; orange brown. Very loose, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.	SPT	33	1/0 1/0 1/0 N=2		1.5–1.65
Fill	Core loss.	SPT				1.65–1.95
Fill	Sandy fine to medium GRAVEL with minor silt; orange brown. Very loose, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.	SNC	100		1	1.95–2.95
Pleistocene Alluvium / Colluvium and Fan Deposits	Gravelly fine to coarse SAND with some silt; brown. Very dense, moist. Well graded. Gravel is fine to medium, angular, greywacke.	SPT	100	7/13 18/14 22 for 20mm N>=50	0	2.95–3.32
Pleistocene Alluvium / Colluvium and Fan Deposits	Core loss.					3.32–3.45
Pleistocene Alluvium / Colluvium and Fan Deposits	Gravelly fine to coarse SAND with some silt; brown. Very dense, moist. Well graded. Gravel is fine to medium, angular, greywacke.	SNC / SPT	100 / 94	10/11 17/20 13 for 55mm N>=50	-1	3.45–4.85
Pleistocene Alluvium / Colluvium and Fan Deposits	Core loss.					4.85–5.0

Water Level: 29/09/2020 (approx. 4.0m)

Core Box No: Box 1, 0.0-4.8m

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 17.1m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: **BH3**

SHEET: 2 OF 4

PROJECT: Aotea Quay	CO-ORDINATES (NZTM2000): 5430378.00 mN, 1749514.44 mE
JOB No.: 1008981.0010	DIRECTION: 90°
LOCATION: Near Hutt Road bus stop to the east of Aotea Quay bridge.	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 3.00m	DRILLED BY: Rodney
R.L. COLLAR: 3.30m	LOGGED BY: ANPO
DATUM: NZVD2016	CHECKED: TH
SURVEY: GIS\Web map viewer	START DATE: 28/09/2020
	FINISH DATE: 29/09/2020
	CONTRACTOR: ProDrill

GEOLOGICAL UNIT: Pleistocene Alluvium / Colluvium and Fan Deposits

DESCRIPTION OF CORE — SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation

Description of core	Sampling Method	Core Recovery (%)	Testing
Gravelly fine to coarse SAND with some silt; brown. Very dense, moist. Well graded. Gravel is fine to medium, angular, greywacke.	SNC	56	
Fine to coarse SAND with some silt and gravel; brown mottled brownish orange. Very dense, moist. Well graded. Gravel is fine to medium, angular to subangular, greywacke.			
Core loss.			
Fine to medium GRAVEL with some sand, minor silt; brown. Very dense, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.	SPT	100	8/17 13/26 13 for 75mm **N>=50**
Core loss.	SNC	84	
Fine to medium GRAVEL with some sand, minor silt; brown. Very dense, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.			
Core loss.			
Fine to medium GRAVEL with some sand, minor silt; brown. Very dense, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.	SPT	100	11/23 16/19 15 for 10mm **N>=50**
Core loss.	SNC	100	
Fine to medium GRAVEL with some sand, minor silt; brown. Very dense, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.			
Sandy fine to medium GRAVEL with trace silt; brown mottled light brown. Very dense, dry. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.	SPT	77	10/13 13/8 11/10 **N=42**
Core loss.			
Sandy fine to medium GRAVEL with trace silt; brown mottled light brown. Very dense, dry. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.			
Sandy fine to medium GRAVEL with minor silt; brown. Dense, moist. Poorly graded, angular to			

RL (m): -3, -4, -5, -6, -7

Depth (m): 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5

Description & Additional Observations:

5.30m: changes to brown mottled light grey.

7.91m: fines from core has been washed away leaving gravel clasts.

Core Box No: Box 2, 4.8-7.9m

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 17.1m

Scale 1:25

Rev.: A

General Log - 30/11/2020 8:16:53 AM - Produced with Core-GS by GeRoc

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.: BH3

SHEET: 3 OF 4

PROJECT: Aotea Quay	CO-ORDINATES: 5430378.00 mN 1749514.44 mE (NZTM2000)
JOB No.: 1008981.0010	DIRECTION: 90°
LOCATION: Near Hutt Road bus stop to the east of Aotea Quay bridge.	ANGLE FROM HORIZ.: -90°
R.L. GROUND: 3.00m	DRILLED BY: Rodney
R.L. COLLAR: 3.30m	LOGGED BY: ANPO
DATUM: NZVD2016	CHECKED: TH
SURVEY: GIS\Web map viewer	START DATE: 28/09/2020
	FINISH DATE: 29/09/2020
	CONTRACTOR: ProDrill

GEOLOGICAL UNIT: Pleistocene Alluvium / Colluvium and Fan Deposits

DESCRIPTION OF CORE — SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation

Description of core	Sampling Method	Core Recovery (%)	Testing	Depth (m)	RL (m)
(continued from previous sheet)	SNC	100		10.5	
	SPT	66	6/9 10/9 7/8 N=34		
Core loss.				11.0	-8
Sandy fine to medium GRAVEL with minor silt; brown. Dense, moist. Poorly graded, angular to subangular, greywacke. Sand is fine to coarse.	SNC	100			
Fine to medium GRAVEL with some sand, trace silt; orange brown. Very stiff, moist. Poorly graded. Sand is fine to coarse.				11.5 – 13.5	-9, -10
	SPT	100	11/20 15/10 11/10 N=46	12.0–12.5	
	SNC	100		13.0	
Silty fine to coarse GRAVEL with some sand; brown. Very dense, moist. Well graded, angular, greywacke. Sand is fine to coarse.				13.5	
Fine to coarse GRAVEL with trace silt; brown. Very dense, moist. Well graded, angular, greywacke.	SPT	88	9/13 11/7 6/12 N=36	14.0	-11
Core loss.					
Fine to coarse GRAVEL with trace silt; brown. Very dense, moist. Well graded, angular, greywacke.				14.5	
Silty fine to coarse GRAVEL with minor sand; brown. Very dense, moist. Well graded, angular, greywacke. Sand is fine to coarse.					-12

Column headings: Rock Weathering; Rock Strength; Sampling Method; Core Recovery (%); Testing; RL (m); Depth (m); Graphic Log; ROCK DEFECTS: Defect Log, Fracture Spacing (mm), RQD (%), Description & Additional Observations; Fluid Loss (%); Water Level; Casing; Installation; Core Box No

Core Box No: Box 3, 7.9-11.1m; Box 4, 11.1-14.2m

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 17.1m

Scale 1:25

Rev.: A

BOREHOLE LOG

Tonkin+Taylor

BOREHOLE No.: BH3

SHEET: 4 OF 4

PROJECT: Aotea Quay
JOB No.: 1008981.0010
LOCATION: Near Hutt Road bus stop to the east of Aotea Quay bridge.

CO-ORDINATES: 5430378.00 mN 1749514.44 mE (NZTM2000)
DIRECTION: 90°
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 3.00m
R.L. COLLAR: 3.30m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

DRILLED BY: Rodney
LOGGED BY: ANPO
CHECKED: TH
START DATE: 28/09/2020
FINISH DATE: 29/09/2020
CONTRACTOR: ProDrill

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	RQD (%)	Description & Additional Observations	Core Box No
		SNC	100						Box 5, 14.2-15.5m
Torlesse Terrane	Slighly weathered, grey with orange and white between defects, fine SANDSTONE. Moderately strong. Defects are very closely spaced, steeply inclined to very steeply inclined, ironstained and clay veneer on some defect surfaces.	SPT	100	16/22 27/23 for 40mm **N>=50**		15.5		*15.50 - 15.70m:* core disturbed through drilling process. 15.75 - 15.80m: B, 20° dip, B 20 °, PL, SM, N-VN, CN *15.90 - 16.06m:* core disturbed through drilling process.	
Torlesse Terrane	Unweathered, grey and greyish white, fine SANDSTONE. Moderately strong. Defects are very closely spaced, steeply inclined to very steeply inclined, clay veneer on few defect surfaces.	RC	100		-13	16.0	0	16.05 - 16.15m: B, 80° dip, B 80 °, ST, SM, N-VN, white clay infill 16.20 - 16.25m: B, 45° dip, B 45 °, ST, SM, N-VN, white clay infill. 16.35 - 16.40m: B, 45° dip, B 45 °, PL, SM, VN, white clay infill. 16.40 - 16.45m: B, 45° dip, B 45 °, PL, SM, VN, white clay infill.	Box 6, 15.5-17.1m
						16.5			
		SPT	0	35/15 for 20mm **N>=50** Solid	-14	17.0		*16.10m:* core disturbed through drilling process.	
	17.1m: END OF BOREHOLE							*17.10m:* backfilled with grout, sand and gravel. One PVC 50 mm pipe with a response zone between 1.5 - 4.7m bgl was installed for groundwater monitoring.	
						17.5			
					-15	18.0			
						18.5			
					-16	19.0			
						19.5			

Other columns: Rock Weathering (UW SW MW HW CW), Rock Strength (ES VS S MS W VW EW), Graphic Log, Defect Log, Fracture Spacing (mm) (2000 600 200 60 20), Fluid Loss (%) (25 50 75), Water Level, Casing, Installation.

DRAFT

COMMENTS: 1. Hammer efficiency for the SPT hammer was 91.1%.

Hole Depth 17.1m

Scale 1:25

Rev.: A

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH3**

Hole Location: Near Hutt Road bus stop to the east of Aotea Quay bridge.

SHEET: 1 OF 3

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430378.00 mN 1749514.44 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 28/09/2020 HOLE FINISHED: 29/09/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

0.00-4.84m

4.84-7.91m

DRAFT

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CORE PHOTOS

BOREHOLE No.: **BH3**

Hole Location: Near Hutt Road bus stop to the east of Aotea Quay bridge.

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430378.00 mN 1749514.44 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 28/09/2020 HOLE FINISHED: 29/09/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

7.91-11.05m

11.05-14.15m

Tonkin+Taylor

CORE PHOTOS

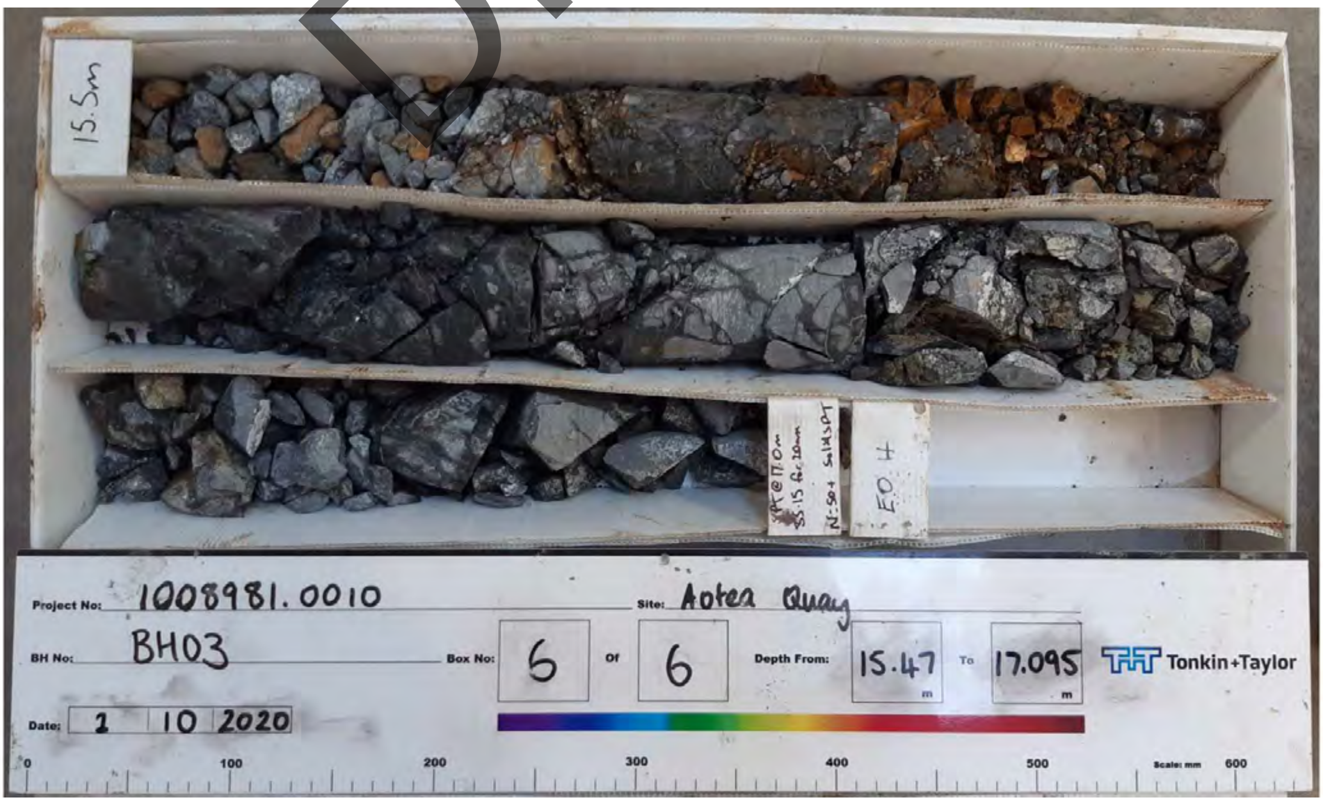
BOREHOLE No.: **BH3**

Hole Location: Near Hutt Road bus stop to the east of Aotea Quay bridge.

SHEET: 3 OF 3

PROJECT: Aotea Quay	LOCATION: Aotea Quay, Wellington	JOB No.: 1008981.0010
CO-ORDINATES: (NZTM2000) 5430378.00 mN 1749514.44 mE R.L.: 3.00m DATUM: NZVD2016	DRILL TYPE: Fraste DRILL METHOD: SNC	HOLE STARTED: 28/09/2020 HOLE FINISHED: 29/09/2020 DRILLED BY: ProDrill LOGGED BY: ANPO CHECKED: TH

14.15-15.47m



15.47-17.10m

DRAFT

NZGD ID: BH_150986

Beca

TEST PIT LOG

TEST PIT No: **TP 2.15**

SHEET 1 of 1

PROJECT:	Wellington Station Entry Project 602	JOB NUMBER:	3320677/240
SITE LOCATION:	Wellington Station Yard	CLIENT:	ONTRACK

TESTPIT LOCATION: Approx. 2.15 km from Wellington Station

COORDINATES: N 704,158 m E 300,928 m

R.L.: 1.81 m

DATUM: Horizontal: Wellington Geodetic 1949; Vertical: Wellington 1953 (MSL)

GEOLOGICAL UNIT	R.L (m)	DEPTH (m)	WATER LEVEL	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL DESCRIPTION	SAMPLES	Scala (Blows/150mm)	SV (kPa)	T (kPa)
Fill					GM	D	L	Loosely packed, 'loose', brown/grey silty sandy GRAVEL; dry, non plastic, gravel supported. Gravel: Moderately strong, MW-SW, grey, stained brown, fine gravel to cobble size, well graded, subangular greywacke.				
						M		Matrix at 0.2 m: Brown SILT, minor clay; moist, moderately plastic.				
					GM	W	L	Loosely packed, 'loose', brownish grey sandy GRAVEL, some silt; wet, non plastic, matrix supported. Gravel: Strong, SW, grey, minor black (coal?), medium to coarse, subrounded and subangular, greywacke. 1x rusted 200 mm bolt.	D1			
	1				GM	W	F	Firm, yellowish brown, silty sandy GRAVEL - BOULDERS, some clay; moist, highly plastic (matrix); cohesive matrix dominates behaviour. Gravel and boulders: Moderately strong, MW-SW, grey, stained orange, coarse gravel, cobbles, boulders, subangular.	D2			
		1			GM	W	F	Firm, yellowish brown, clayey silty sandy GRAVEL; wet, highly plastic (matrix); cohesive matrix dominates behaviour. Gravel: Moderately strong, MW-SW, grey, stained brown, fine to medium, minor coarse, well graded, subangular greywacke.	D3			
								Some cobbles and boulders (max. dia. 300 mm). Strong, MW-SW, grey stained brown, subangular and angular greywacke.				
	0		▽ 23/2/08 (10:00 am)									
								End of Test Pit 1.85 m.				
		2										
	-1											

DRAFT

DATE DRILLED: 23/2/08	EXCAVATION METHOD: Hitachi EX60	COMMENTS: Pit located at 2.25 m offset west of NIMTL up main. Tidal conditions - falling
LOGGED BY: JUB	CONTRACTOR: HRS	
PILCON VANE No:		

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Beca

3320677/240

Test Pit Photos

TP 2.15

NZGD ID: TP_107044

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LOG OF BORING BH01

Geotechnical Investigation
126 Hutt Road
Kaiwharawhara, Wellington
15926.000.000

Client	TM Consultants	**Core Diameter**	83 mm
Date	11/03/2019	**Hammer Efficiency**	88.9 %
Hole Depth	28.75 m	**Logged By/Reviewed By**	CM / RC
Drilling Method	Rotosonic	**Latitude**	-41.260061
Drilling Contractor	Griffiths Drilling	**Longitude**	174.790204

Columns: Depth (m) | Material | Sample Type | USCS Symbol | DESCRIPTION | Log Symbol | Water Level | Moisture | Consistency/ Density Index | SPT N-Value | Pocket Pen. UCS (kPa) | Torvane Shear (kPa) | Total Core Recovery (%) (25, 50, 75) | Notes

Depth (m)	Material	USCS Symbol	Description	Consistency/ Density Index	SPT N-Value
0.0	FILL		CONCRETE.	-	
		SP	Gravelly coarse SAND; dark brown. Poorly graded; gravel is medium to coarse, poorly graded, angular.		
			CONCRETE.		
1.0		GP	Medium to coarse GRAVEL with trace sand; grey mixed brown. Poorly graded, angular to subangular; sand is coarse, poorly graded. Contains glass and cobbles of greywacke sandstone.		3/2//1/1/1/1 N=4
			NO RECOVERY.		
2.0		SW	Fine to coarse SAND with minor silt, minor gravel; brown. Well graded; gravel is fine to medium, poorly graded, angular to subangular.	Medium Dense	
		GW	Sandy fine to coarse GRAVEL; brown mixed dark grey. Well graded, angular to rounded; sand is fine to coarse, well graded. Contains red brick and glass.		2/3//4/4/3/4 N=15
4.0	MARGINAL MARINE DEPOSIT	SW	Gravelly fine to coarse SAND with minor silt; dark grey speckled white. Well graded; gravel is fine to coarse, well graded, angular to subrounded. Contains organics and shell fragments.		5/6//6/5/5/5 N=21
5.0		GP	Medium to coarse GRAVEL; dark grey. Poorly graded, angular to subangular.		
		SW	Gravelly fine to coarse SAND with minor silt; dark grey speckled white. Well graded; gravel is fine to coarse, well graded, angular to subrounded. Contains organics and shell fragments.		2/1//2/1/4/3 N=10
6.5		PT	Fibrous PEAT.	-	
		SP	Fine to medium SAND with some silt, minor gravel; dark grey mottled brown speckled white. Poorly graded; gravel is fine to medium, poorly graded, subrounded. Contains organics and shell fragments.		
			NO RECOVERY.		
7.5	COLLUVIUM	GW	Fine to coarse GRAVEL with some sand; dark grey mixed grey. Well graded, subangular to rounded; sand is fine to coarse, well graded.	Medium Dense	6/9//5/4/2/3 N=14
8.5			8.50 m - Becomes brown mixed grey in colour.		
9.0				Dense	4/8//9/8/7/11 N=35
10.5					

GEOSCIENCE MACHINE BORING 15926 - BH LOGS.GPJ NZ DATA TEMPLATE 2.GDT 3/26/19

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LOG OF BORING BH01

Geotechnical Investigation
126 Hutt Road
Kaiwharawhara, Wellington
15926.000.000

Client : TM Consultants
Date : 11/03/2019
Hole Depth : 28.75 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 83 mm
Hammer Efficiency : 88.9 %
Logged By/Reviewed By : CM / RC
Latitude : -41.260061
Longitude : 174.790204

Depth (m)	Material	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
10.55–12.50	COLLUVIUM	GW	Fine to coarse GRAVEL with some sand; dark grey mixed grey. Well graded, subangular to rounded; sand is fine to coarse, well graded. 10.95 m - Becomes with trace sand. 11.40 m - Becomes brown mixed dark grey in colour. 12.00 m - Becomes with some sand.	Dense	4/9//11/7/7/8 N=33 5/9//10/5/8/8 N=31
12.50–14.45	COLLUVIUM	SW	Gravelly fine to coarse SAND with minor silt; grey. Well graded; gravel is fine to coarse, well graded, subangular to rounded. 13.20 m - Becomes dark grey.	Medium Dense	5/7//7/6/2/2 N=17
14.45–14.60	COLLUVIUM	GP	Medium to coarse GRAVEL; dark grey. Well graded, angular to subrounded.	Very Dense	
14.60–15.25	COLLUVIUM	GW	Sandy fine to coarse GRAVEL with minor silt; grey. Well graded, subangular to rounded; sand is fine to coarse, well graded.	Very Dense	9/10//50 for 50 mm N=50+
15.25–15.40	COLLUVIUM	GP	Fine to coarse GRAVEL; dark grey. Well graded, angular to subrounded.	Very Dense	
15.40–20.00	COLLUVIUM	GW	Sandy fine to coarse GRAVEL; grey mixed brown. Well graded, angular to rounded. Contains cobbles. 18.70 m - Becomes brown mixed dark grey.	Very Dense	6/10//50 for 35 mm N=50+ 8/12//13/37 for 70 mm N=50+ 5/10//11/10/9/8 N=38
20.00–21.00	COLLUVIUM	SW	Gravelly fine to coarse SAND with minor silt; brown mixed dark grey. Well graded; gravel is fine to medium, poorly graded, subangular to rounded. Contains cobbles.	Dense	

Columns also printed: Sample Type, Log Symbol, Water Level, Moisture, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25 50 75), Notes.

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LOG OF BORING BH01

Geotechnical Investigation
126 Hutt Road
Kaiwharawhara, Wellington
15926.000.000

Client : TM Consultants
Date : 11/03/2019
Hole Depth : 28.75 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling

Core Diameter : 83 mm
Hammer Efficiency : 88.9 %
Logged By/Reviewed By : CM / RC
Latitude : -41.260061
Longitude : 174.790204

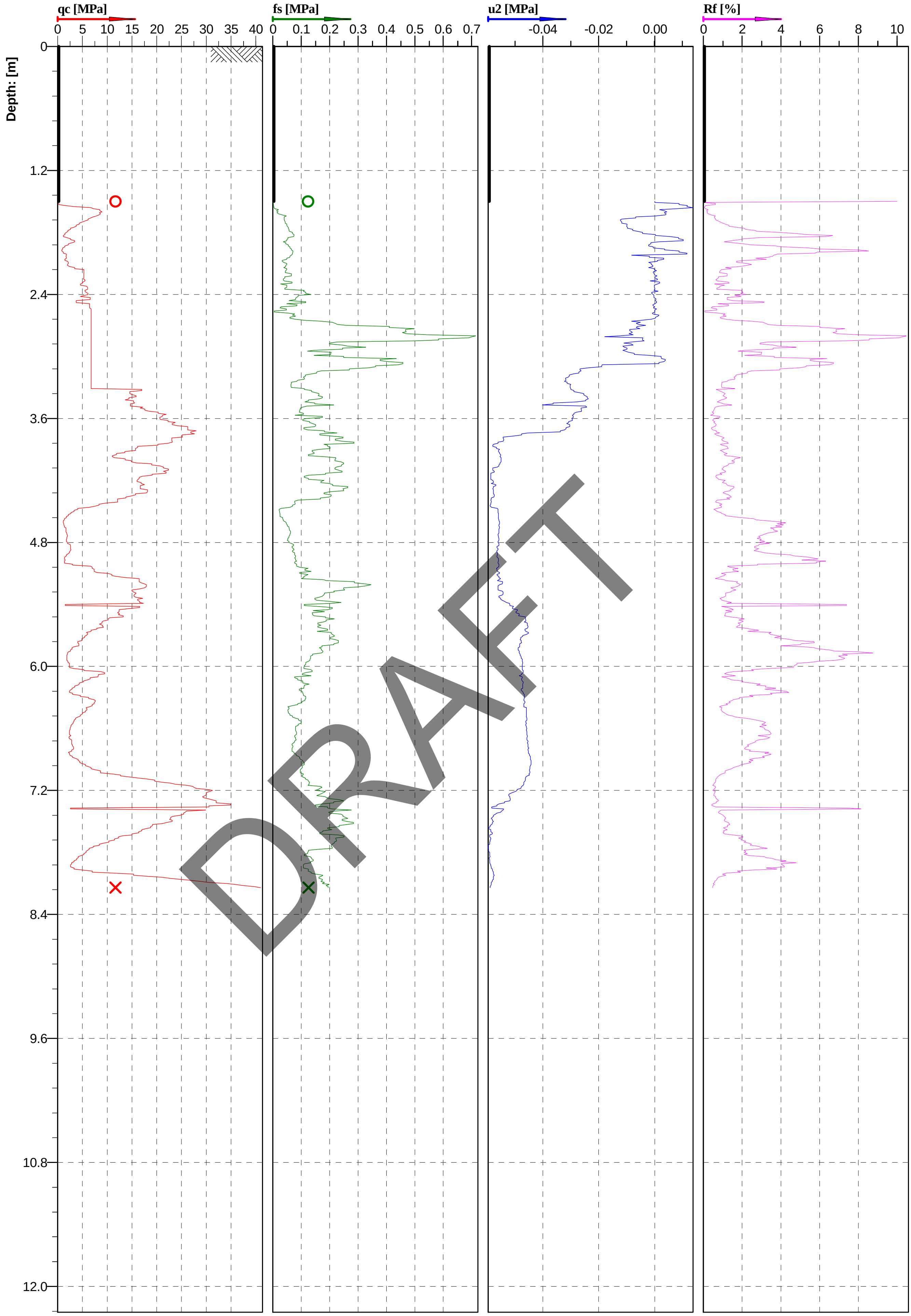
Depth (m)	Material	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
21.0–21.5	COLLUVIUM	GP	Medium to coarse GRAVEL with trace sand; brown mixed grey. Poorly graded, angular to subrounded.	Medium Dense	4/6//6/5/4/2 N=17
21.5–23.1	COLLUVIUM	GW	Sandy fine to coarse GRAVEL with trace silt; brown mixed dark grey. Well graded, angular to subrounded; sand is fine to coarse, well graded.	Very Dense	6/6//4/6/40 for 10 mm N=50+
23.1–23.4	GREYWACKE SANDSTONE	GW	Completely weathered Greywacke SANDSTONE recovered as sandy fine to coarse GRAVEL; brown mixed grey. Well graded, subangular to rounded; sand is coarse, poorly graded.		
23.4–26.4	GREYWACKE SANDSTONE		Highly weathered, weak, reddish brown Greywacke SANDSTONE. Highly fractured joints are very closely spaced, planar and rough.	-	50 for 5 mm N=50+
26.4–28.75	GREYWACKE SANDSTONE		Moderately weathered, weak, grey SANDSTONE. Fractured joints are moderately spaced, planar and rough.		

Column headers also include: Sample Type, Log Symbol, Water Level, Moisture, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes.

Depth scale: 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5

End of Hole Depth: 28.75 m
Termination: Target depth

NZGD ID: BH_150357



u2

Cone No: 5336
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Inside Building	Position: -, -	Ground level: 0.00	Test No.: TEST2
Project ID: 2	Client:	Date: 22/03/2019	Scale: 1 : 50
Project: 126 Hutt Rd		Page: 1/1	Fig.:
		File: cpt1 spotlight round 2.cpt	

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LOG OF BORING BH02

Geotechnical Investigation
126 Hutt Road
Kaiwharawhara, Wellington
15926.000.000

Client : TM Consultants
Date : 13/03/2019
Hole Depth : 30.5 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 83 mm
Hammer Efficiency : 88.9 %
Logged By/Reviewed By : CM / RC
Latitude : -41.260019
Longitude : 174.791046

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
0.0–1.5	-	NR		JET VACUUM.	-	
1.5–3.0	FILL		SW	Gravelly fine to coarse SAND with some silt; brown. Well graded; gravel is fine to medium, poorly graded, angular to subangular. 2.40 m - Becomes light brown in colour.	Loose	2/1//2/1/1/1 N=5
3.0–3.7	FILL		GW	Sandy fine to coarse GRAVEL; light brown mixed grey. Well graded, angular to subrounded; sand is fine to coarse, well graded.	Loose	4/2/2/2/1/1 N=6
3.7–5.15	MARGINAL MARINE DEPOSIT		GW	Fine to coarse GRAVEL with some sand; dark grey. Well graded, angular to rounded; sand is medium to coarse, poorly graded.	Medium Dense	6/3//4/3/4/2 N=13
5.15–6.45	MARGINAL MARINE DEPOSIT		GW	Sandy fine to coarse GRAVEL; light brown mixed grey. Well graded, angular to subrounded; sand is fine to coarse, well graded.	Medium Dense	4/2//1/3/3/3 N=10
6.45–6.65	MARGINAL MARINE DEPOSIT		PT	Fibrous PEAT.	-	
6.65–8.15	MARGINAL MARINE DEPOSIT		SW	Fine to coarse SAND with some gravel, some silt; dark grey speckled white. Well graded; gravel is fine to medium, poorly graded, subangular to rounded. Contains shell fragments and organics. 7.50 m - Becomes minor gravel.	Loose	3/1//1/1/2/2 N=6
8.15–8.3	MARGINAL MARINE DEPOSIT		PT	Fibrous PEAT.	-	
8.3–10.5	MARGINAL MARINE DEPOSIT		SW	Fine to coarse SAND with some silt, minor gravel; dark grey speckled white. Well graded; gravel is fine to medium, poorly graded, subangular to rounded. Contains shell fragments and organics.	Medium Dense	2/2//2/3/3/5 N=13

Column headings: Depth (m), Material, Sample Type, USCS Symbol, DESCRIPTION, Log Symbol, Water Level, Moisture, Consistency/ Density Index, SPT N-Value, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes

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LOG OF BORING BH02

Geotechnical Investigation
126 Hutt Road
Kaiwharawhara, Wellington
15926.000.000

Client : TM Consultants
Date : 13/03/2019
Hole Depth : 30.5 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 83 mm
Hammer Efficiency : 88.9 %
Logged By/Reviewed By : CM / RC
Latitude : -41.260019
Longitude : 174.791046

Depth (m)	Material	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
10.5–12.0	COLLUVIUM	GW	Sandy fine to coarse GRAVEL; dark grey mixed grey. Well graded; angular to subrounded; sand is fine to coarse, well graded. 10.95 m - Becomes some sand and contains cobbles.	Medium Dense	5/4//3/3/5/7 N=18
12.0				Medium Dense	4/4//5/5/8/8 N=26
13.5				Dense	3/4//7/7/9/14 N=37
15.0				Medium Dense	6/3//2/6/5/5 N=18
16.5				Very Dense	9/9//14/17/19 for 50 mm N=50+
17.50			17.50 m - Becomes grey mixed brown.		
18.0				Dense	7/8//9/9/10/13 N=41
19.5				Dense	7/12//10/11/10/12 N=43

Depth scale: 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0

Columns: Sample Type, Log Symbol, Water Level, Moisture, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes

NZGD ID: BH_150358

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LOG OF BORING BH02

Geotechnical Investigation
126 Hutt Road
Kaiwharawhara, Wellington
15926.000.000

Client : TM Consultants
Date : 13/03/2019
Hole Depth : 30.5 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling

Core Diameter : 83 mm
Hammer Efficiency : 88.9 %
Logged By/Reviewed By : CM / RC
Latitude : -41.260019
Longitude : 174.791046

Depth (m)	Material	USCS Symbol	DESCRIPTION	Log Symbol	Consistency/ Density Index	SPT N-Value
21.0–21.5	COLLUVIUM	GW				5/9//9/7/7/8 N=31
21.5–21.7	COLLUVIUM	GP	Medium to coarse GRAVEL; dark grey. Poorly graded, angular to subrounded.		Dense	
21.7–22.2	COLLUVIUM	GW	Sandy fine to coarse GRAVEL; dark grey mixed grey. Well graded; angular to subrounded; sand is fine to coarse, well graded.			
22.2–22.5	COLLUVIUM		NO RECOVERY.	NR	-	
22.5–23.9	COLLUVIUM	SM	Silty fine to medium SAND; light grey. Poorly graded.		Medium Dense	2/2//2/3/3/3 N=11
23.9–24.9	COLLUVIUM	GW	Sandy fine to coarse GRAVEL; brown. Well graded, angular to subrounded; sand is fine to coarse, well graded.		Very Dense	16/19//24/25/1 for 5 mm N=50+
24.9–25.6	GREYWACKE SANDSTONE	SW	Completely weathered SANDSTONE recovered as gravelly fine to coarse SAND; dark grey. Well graded; gravel is fine to medium, poorly graded, subangular to subrounded.			50 for 70 mm N=50+
25.6–26.4	GREYWACKE SANDSTONE		Moderately weathered, weak, dark grey SANDSTONE. Fractured joints are moderately spaced, planar and rough.			
26.4–28.7	GREYWACKE SANDSTONE	GW	Completely weathered SANDSTONE recovered as sandy fine to coarse GRAVEL; dark grey. Well graded, angular to subangular; sand is fine to coarse, well graded.		-	
28.7–29.2	GREYWACKE SANDSTONE		Moderately weathered, weak, dark grey SANDSTONE. Fractured joints are moderately spaced, planar and rough.			
29.2–30.5	GREYWACKE SANDSTONE	GW	Completely weathered SANDSTONE recovered as sandy fine to coarse GRAVEL; dark grey. Well graded, angular to subangular; sand is fine to coarse, well graded.			

Other columns: Sample Type, Water Level, Moisture, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes.

Depth scale: 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5

End of Hole Depth: 30.5 m
Termination: Target depth

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GEOSCIENCE MACHINE BORING 15926 - BH LOGS.GPJ NZ DATA TEMPLATE 2.GDT 3/26/19

TONKIN & TAYLOR LTD.

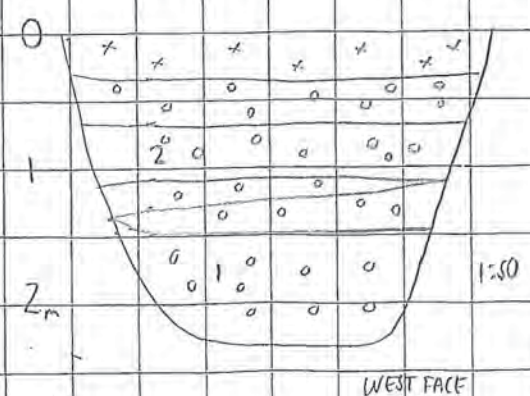
EXCAVATION LOG

EXCAVATION NO: TP1
SHEET 1 OF 1

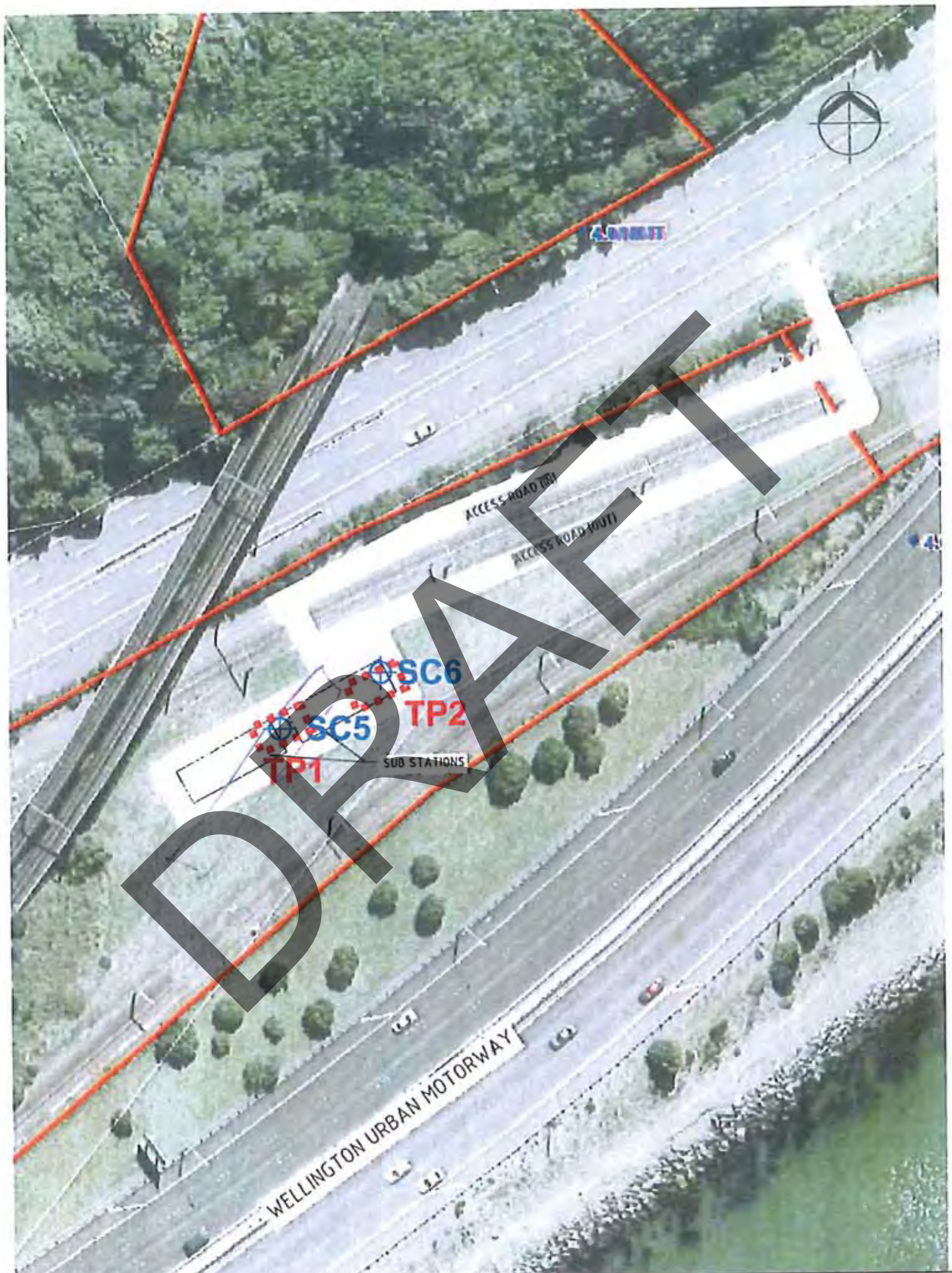
PROJECT: ONTRACK SUBSTATIONS	LOCATION: KAIWHARAWHARA		JOB NO: 24616
CO-ORDINATES: See Fig. 2.2	EXPOSURE TYPE: TEST PIT	HOLE STARTED:	27-8-08
	EQUIPMENT: 8t	HOLE FINISHED:	27-8-08
RL:	OPERATOR: HRS.	LOGGED BY:	GRW
DATUM:	EXCAVATION DIMENSIONS: 2.2m d, 4m L, 2m w	CHECKED BY:	NP

PENETRATION 1 2 3	SUPPORT	WATER	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SHEAR STRENGTH OR RELATIVE DENSITY	ESTIMATED SHEAR STRENGTH, kPa (10 25 50 100 200)	ORIGIN TYPE, MINERAL COMPOSITION, DETECTS, STRUCTURE	UNIT
	N/A		SCS.		0–0.3	x x x	–	SILT. Brown. Top soil	M	–		FILL (Reclaimation) ?	1
					0.3–0.6	o o oo	GP	GRAVEL. Dark brown. Medium. Metal	D	MD			2
					0.6–1	o o o o oo	GW	GRAVEL. Grey. Medium to coarse angular greywacke.	D	MD/D			
					1–1.2	o o	GW	GRAVEL. Light orange-brown. Medium angular greywacke.	M	MD/D			
					1.2–1.4	o o	GW	GRAVEL. Grey. Medium to coarse angular greywacke.	M	MD/D			
		▽			1.4–2.2	o o x o o x oo	GW	GRAVEL, Minor silt. Orange brown. Medium to coarse angular greywacke	W	MD.		FILL ?	3
					2.2			EOTP @ 2.2m – Refusal					

SKETCH



DRAFT



TP1 Test pit locations

SC1 Scala penetrometer Test

Not to scale

DRAWN	GEM	05/08	ONTRACK SUBSTATIONS
DRAFTING CHECKED	ND	05/08	Geotechnical Investigations
APPROVED			
CADFILE: Figures.ppt			
SCALES (AT A4 SIZE) As shown			
PROJECT No. 84616		FIG. No.	Figure 2.2 – Kaiwharawhara Site — REV. 0

Tonkin & Taylor
Environmental & Engineering Consultants
☐ Hamilton ☐ Nelson ■ Wellington ☐ Christchurch ☐ Auckland ☐ Dunedin ☐ Tauranga

NZGD ID: TP_101991

C

Appendix C – Historical Investigations: Thorndon Quay

C.1 Previous Geotechnical Investigations in Proximity to Thorndon Quay.

NZGD ID	Consultant	Year	Location	Type	Depth (m)
BH_88550	Tonkin & Taylor Ltd	2013	33 Lambton Quay	Machine Borehole	25.50
BH_88552	Aurecon	2014	33 Lambton Quay	Machine Borehole	10.67
BH_88788	Tonkin & Taylor Ltd	2013	33 Lambton Quay	Machine Borehole	25.45
BH_72662	Connell Wagner Ltd	1996	Wellington Railway Station	Machine Borehole	18.00
BH_131204	Beca Ltd	1986	Thorndon Quay and Featherston St Intersection	Machine borehole	28.30
BH_72654	ENGEO Ltd	2015	Wellington Railway Station	Machine Borehole	24.42
CPT_130607	Beca Ltd	1997	Westpac Trust Stadium	CPT	4.80
BH_131205	Beca Ltd	1986	Wellington Railway Station	Machine Borehole	23.00
CPT_156073	McMillian Drilling	2020	81 Thorndon Quay	CPT	5.39
BH_136415	ENGEO Ltd	2018	121 Thorndon Quay	Machine Borehole	20.00
HA01-02	ENGEO	2018	121 Thorndon Quay	Hand Auger	0.45
BH_107036	Beca Ltd	2008	Wellington Station Entry	Borehole	8.45
TP_107039	Beca Ltd	2008	Wellington Station Entry	Test Pit	2.00
TP_107040	Beca Ltd	2008	Wellington Station Entry	Test Pit	1.80
HA_106180	Tonkin & Taylor Ltd	2000	2 Tinakori Road	Hand Auger	1.35

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: To the south od Rutherford House
SHEET 1 OF 6

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990433 mN, 2659017 mE
R.L.: approx. 3.0m
DATUM: NZMG, MSL

DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A

HOLE STARTED: 31/8/13
HOLE FINISHED: 1/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: EBB | CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	TESTS	DEPTH (m)	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION
PAVEMENT		0	Jet Vac		0–0.2			Asphalt
RECLAMATION FILL					0.2–2.0	M	N/A	GRAVEL with some sand; brown. Moist, poorly graded. Gravel is medium to coarse grained with some cobbles.
	1/9	67	SPT	N=4	2.0–2.5			Silty, sandy GRAVEL; brown. Loose, moist, well graded. Gravel is fine to coarse grained, angular to sub-angular. Sand is fine to medium grained.
		57	HFC		2.5–3.55			Core loss.
MARINE DEPOSITS		73	SPT	N=12	3.55–3.75	M	MD	SAND with some shell fragments and thin layers of brown organic silt; dark grey. Medium dense, wet. Sand is fine to medium. grained
					3.75–4.1	M		Organic SILT; dark brown and light grey. Moist. Low plasticity. Wood/fibrous. PI=12, LL=45, WC=32.3%, FC=92.36%
		67	SPT	N=11	4.1–4.35	M	MD	GRAVEL; dark to light brown. Medium dense, poorly graded. Gravel is fine to medium grained.
PLEISTOCENE ALLUVIUM					4.35–4.65	M	S	SAND with some shell fragments and thin layers of brown organic silt; dark grey. Medium dense, wet. Sand is fine to medium. grained
		89	SPT	N>50	4.65–4.8	M	VD	Clayey organic SILT with traces of wood/fibrous; dark brown matrix.
					4.8–5			Gravelly SAND; blue. Very dense, moist, poorly graded. Sand is fine to coarse

DRAFT

T+T DATATEMPLATE.GDT ebb

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: To the south od Rutherford House

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990433 mN 2659017 mE
R.L.: approx. 3.0m
DATUM: NZMG, MSL
DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A
HOLE STARTED: 31/8/13
HOLE FINISHED: 1/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: EBB
CHECKED: NCP

GEOLOGICAL: PLEISTOCENE ALLUVIUM

Depth (m)	Core Recovery (%)	Method	Tests	Moisture	Strength/Density	Soil Description
5.0	78	SPT	N=49	M	D	grained, angular. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
						Silty GRAVEL with some sand. Dense, moist, poorly graded. Sand is fine to coarse grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
5.5	84	SPT	N=39	M		Sand is fine to coarse.
				M	D	SILT with some wood fibers; grey.
				M		Gravelly SAND. Sand is fine to coarse grained. Dense. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
6.0	100	HFC				SILT; grey. Medium to high plasticity.
6.9				M	VS	PEAT; dark brown.
7.0	100	SPT	N=14	M	St	SILT becoming sandier with depth; grey. Sand is fine grained. PI=7, LL=35, WC=30.4%, FC=95.5%
7.45	100	HFC				
8.5	73	SPT	N=23	M	VSt	Gravelly SILT with minor sand. Very stiff, moist. Sand is fine to coarse grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
8.8				M		SILT; grey.
9.2	100	HFC		M		Silty GRAVEL with minor sand; grey. Moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
10						

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: To the south od Rutherford House
SHEET 3 OF 6

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990433 mN, 2659017 mE
R.L.: approx. 3.0m
DATUM: NZMG, MSL

DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A

HOLE STARTED: 31/8/13
HOLE FINISHED: 1/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: EBB CHECKED: NCP

GEOLOGICAL: PLEISTOCENE ALLUVIUM

Core Recovery (%)	Method	Tests	Depth (m)	Moisture	Strength/Density	Soil Description
67	SPT	N>50	~10.0			Silty GRAVEL with minor sand; grey. Moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
100	HFC		10.5–11.0			
			~11.3	M		GRAVEL; bluish grey. Gravel is medium to coarse grained.
89	SPT	N>50	11.5	M	VD	Silty GRAVEL with minor sand; grey. Very dense, moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke. Thin beds (100mm thick) of silt throughout.
100	HFC		~12.2	M		SILT with minor sand and traces of wood fibres. Sand is fine to medium grained. Low plasticity.
			~12.85	M	VD	Silty GRAVEL with minor sand; grey. Very dense, moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
89	SPT	N>50	13.0			
			~13.3	M		SILT with some gravels and traces of wood fibres; grey. Gravel is fine to medium grained. Low plasticity.
100	HFC		~13.6	M	S	PEAT; dark brown.
			~13.7	M		SILT with trace shell fragments; grey.
93	SPT	N>50	14.5	M	VSt	SILT with minor sand becoming gravelly with depth; grey. Very Stiff. Sand is fine to medium grained.

Depth scale: 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15

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T+T DATATEMPLATE.GDT ebb

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: To the south od Rutherford House

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS	LOCATION: 33 LAMBTON QUAY	JOB No: 85725
CO-ORDINATES: 5990433 mN 2659017 mE	DRILL TYPE: WD-SD100 HELIPORT	HOLE STARTED: 31/8/13
		HOLE FINISHED: 1/9/13
R.L.: approx. 3.0m	DRILL METHOD: Sonic	DRILLED BY: WEBSTER DRILLING
DATUM: NZMG, MSL	DRILL FLUID: N/A	LOGGED BY: EBB CHECKED: NCP

GEOLOGICAL — ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.

Columns: FLUID LOSS; WATER; CORE RECOVERY (%); METHOD; CASING; TESTS; SAMPLES; R.L. (m); DEPTH (m); GRAPHIC LOG; CLASSIFICATION SYMBOL; MOISTURE CONDITION / WEATHERING; STRENGTH/DENSITY CLASSIFICATION; SHEAR STRENGTH (kPa) 10 25 50 100 200; COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250; DEFECT SPACING (mm) 50 250 1000 2000

SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour.
ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.

Geological unit: PLEISTOCENE ALLUVIUM

Depth (m)	Core recovery (%)	Method	Tests	Moisture	Strength/Density	Description
15.0–16.0	100	HFC		M	VD	Silty GRAVEL with minor sand; grey. Very dense, moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
16.0–16.1	89	SPT	N>50	M	VD	SAND; grey. Very dense, moist.
16.1–18.0	89 / 100 / 67	SPT / HFC / SPT	N=23 (17.5)	M	VD	Silty GRAVEL with minor sand; grey. Very dense becoming medium desne, moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke. Becoming medium dense with depth.
18.0–18.75	100	HFC		M		SILT; bluish grey. Low plasticity.
18.5						- becoming mottled greenish bluish grey.
18.75–19.3	100 / 67	HFC / SPT	N=39 (19.0)	M		SILT with minor gravel; bluish dark grey. Gravel is fine grained.
19.0						- becoming very dense; greenish grey. Gravel is fine grained.
19.15						- bluish dark grey. Well graded gravels.
19.3–19.4				M		Sandy SILT; greenish grey. Low plasticity. Sand is fine grained.
19.4–20.0	100	HFC		M		Silty GRAVEL with minor sand; grey. Moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: To the south od Rutherford House

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990433 mN 2659017 mE
R.L.: approx. 3.0m
DATUM: NZMG, MSL
DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A
HOLE STARTED: 31/8/13
HOLE FINISHED: 1/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: EBB
CHECKED: NCP

GEOLOGICAL: PLEISTOCENE ALLUVIUM

Depth (m)	Core recovery (%)	Method	Tests	Moisture	Strength/Density	Soil description
20.3				M		Clayey SILT; bluish grey. Sand is fine to coarse grained. High plasticity.
20.5	78	SPT	N=23			- becoming dark grey with some gravels. Soft. Gravel is fine to medium grained.
20.6				M	VSt	SILT; greenish grey. Very stiff, moist. Low plasticity.
21.0–21.5	100	HFC				
21.65				M		Sandy SILT; brown. Sand is fine grained. Medium plasticity.
21.85				M	VD	Sandy, silty GRAVEL with minor sand; grey. Very dense, moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
22.0	53	SPT	N>50			
22.3				M	VD	GRAVEL with minor silt and sand; bluish grey. Very dense.
22.7						- becoming grey. Gravel is angular, cemented.
23.5	93	SPT	N>50	M	St	SILT with minor sand; grey. Hard, moist.
23.7				M		PEAT, brown. Stiff, moist. Wood fibres.
23.8				M	H	SILT with minor sand; grey. Stiff, moist. Low plasticity.
24.0–24.5	100	HFC				
24.5				M		Silty GRAVEL with minor sand; grey. Moist, well graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
25						

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T+T DATATEMPLATE.GDT ebb

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: To the south od Rutherford House
SHEET 6 OF 6

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS	LOCATION: 33 LAMBTON QUAY	JOB No: 85725
CO-ORDINATES: 5990433 mN 2659017 mE	DRILL TYPE: WD-SD100 HELIPORT	HOLE STARTED: 31/8/13
	DRILL METHOD: Sonic	HOLE FINISHED: 1/9/13
R.L.: approx. 3.0m		DRILLED BY: WEBSTER DRILLING
DATUM: NZMG, MSL	DRILL FLUID: N/A	LOGGED BY: EBB CHECKED: NCP

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
PLEISTOCENE ALLUVIUM			44	SPT		N>50											Refusal.
									25.5								End of borehole (target depth reached 25.5m). Standpipe installed.
									26.0								
									26.5								
									27.0								
									27.5								
									28.0								
									28.5								
									29.0								
									29.5								
									30								

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T+T DATATEMPLATE.GDT ebb

Log Scale 1:25

BORELOG 85725_BH1-BH3.GPJ 16-Dec-2013

NZGD ID: BH_88552

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NZGD ID: BH_88552

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86@-53>ĀĀ$ - .! F* ĀKH @Ā "&* +!F*
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K	9W						.			+					
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K		W					.			+					
Ā1P	9f					OQR- =ĀG I $#ZĀ3$ĀĀ F; IĀB$ZĀ;$34$RĀ65-IĀB I $#Ā3$Ā-6@ <4$RĀ#M6H3=$=Ā6Ā#MBD H#<Ā3-$<I 5N$=Ā5EĀ <$Ā6D 35@. Ā9 =Ā(. :m OQR- =ĀG =$4Ā-6Ā$Ā F; Ā5EĀ6! $Ā#ĀB$ZĀ;34RĀ65-I 2-$<I 5N$=Ā5EĀ-<@Ā6Ā6D 35@. %86DD$=ĀJ-$Ā ?Ā-$-RĀ"-Ā3=Ā6-6! Ā<$Ā6S36U3'	Ā1 Ā0	:** &+* f* d* && ĀĀFĀ)f	()	f,				W(:! Ā A2ĀP\7B ĀAF PBFPĀV 0 18B	
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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Carpark adjacent to eastern side of Rutherford House
SHEET 1 OF 6

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS	LOCATION: 33 LAMBTON QUAY	JOB No: 85725
CO-ORDINATES: 5990484 mN 2659045 mE	DRILL TYPE: WD-SD100 HELIPORT	HOLE STARTED: 21/9/13
	DRILL METHOD: Sonic	HOLE FINISHED: 21/9/13
R.L.: approx. 3.6m		DRILLED BY: WEBSTER DRILLING
DATUM: NZMG, MSL	DRILL FLUID: N/A	LOGGED BY: DTG CHECKED: NCP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	CORE RECOVERY (%)	METHOD	TESTS	DEPTH (m)	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION
RECLAMATION FILL	0	JET VAC		0.0–0.1	M-W	MD	ASPHALT
				0.1–0.7			Sandy, silty FILL with concrete and steel.
				0.7–1.05			CONCRETE
				1.05–4.6			Sandy, silty fine to coarse GRAVEL with trace brick; brown. Loose to medium dense, moist to wet, poorly graded. Sand is fine to medium grained. Gravel is slightly to moderately weathered, sub-angular greywacke.
	78	SPT	N=44	2.0			Layer of dense GRAVEL
	100	SONIC					
	56	SPT	N=6	3.5			
	0	SPT	N=12	4.0			
PLEISTOCENE ALLUVIUM	67	SPT	N=16	4.5–5.0	W	MD	

Log Scale 1:25

T+T DATATEMPLATE.GDT ebb

BORELOG 85725_BH1-BH3.GPJ 16-Dec-2013

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BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Carpark adjacent to eastern side of Rutherford House
SHEET 2 OF 6

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS	LOCATION: 33 LAMBTON QUAY	JOB No: 85725
CO-ORDINATES: 5990484 mN 2659045 mE	DRILL TYPE: WD-SD100 HELIPORT	HOLE STARTED: 21/9/13
R.L.: approx. 3.6m	DRILL METHOD: Sonic	HOLE FINISHED: 21/9/13
		DRILLED BY: WEBSTER DRILLING
DATUM: NZMG, MSL	DRILL FLUID: N/A	LOGGED BY: DTG CHECKED: NCP

GEOLOGICAL: PLEISTOCENE ALLUVIUM

Core recovery (%)	Method	Tests	Depth (m)	Moisture condition	Strength/density	Soil description
100	SPT	N=18	5.0–5.5			Silty fine to coarse GRAVEL with minor sand; light bluish grey. Medium dense to dense, wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
56	SPT	N=16	5.5			
78	SPT	N=47	6.0			
89	SPT	N=50+	6.5	W	VD	Sandy, silty fine to coarse GRAVEL; light bluish grey. Very dense, wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke. Becoming medium dense with depth.
89	SPT	N=25	7.0			
			7.3	W	St	Organic SILT; brownish grey. Stiff, wet, medium plasticity. Organic material is wood/fibrous.
100	SONIC		7.6	W	St	SILT with minor organics and trace sand; light brownish grey. Stiff, wet, low plasticity. Sand is fine grained.
			8.4	W	St	Organic SILT; light brownish grey. Stiff, wet, medium plasticity.
100	SPT	N=14	8.6	W	L	Fine to medium SAND with some silt; light bluish grey. Loose, wet, poorly graded.
100	SONIC		8.8–10	W	St	SILT with minor organics; brownish grey. Stiff, wet, medium plasticity. Organic SILT between 9.2 - 9.3 m.

Water: 22/9 (at approx. 6.25 m)

Log Scale 1:25

T+T DATATEMPLATE.GDT ebb

BORELOG 85725_BH1-BH3.GPJ 16-Dec-2013

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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Carpark adjacent to eastern side of Rutherford House

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990484 mN 2659045 mE
R.L.: approx. 3.6m
DATUM: NZMG, MSL

DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A

HOLE STARTED: 21/9/13
HOLE FINISHED: 21/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: DTG CHECKED: NCP

GEOLOGICAL: PLEISTOCENE ALLUVIUM

Depth (m)	Core Recovery (%)	Method	Tests	Moisture	Strength/Density	Soil Description
to ~10.2	67	SPT	N=22	W	VSt	Sandy SILT with trace gravel; light bluish grey. Very stiff, wet, low plasticity. Sand is fine medium grained. Beds of silty SAND.
~11.2 – 11.6	100	SONIC		W	MD	Silty fine to medium SAND; light bluish grey. Medium dense, wet, poorly graded. Beds of sandy SILT. Organic SILT between 11.3 - 11.5 m.
11.6 – 12.0	89	SPT	N=30	W	MD	Silty fine to medium SAND with minor gravel; light bluish grey. Medium dense, wet, poorly graded. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
12.0 – 12.7	100	SONIC		W	St	Sandy SILT; light bluish grey. Stiff, wet, low plasticity. Sand is fine grained. SILT with some organics between 12.6 -12.7 m.
12.7 – 12.9				W		Sandy fine to coarse GRAVEL with some silt; light bluish grey. Wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
12.9 – 13.3	84	SPT	N=34	W	St	SILT with trace organics; brownish grey. Stiff, wet, low plasticity.
13.3 – 14.5	100	SONIC		W	D	Silty fine to coarse GRAVEL with some sand; light bluish grey. Dense, wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
14.5 – 15	82	SPT	N=20	W	VSt	SILT with minor organics and trace clay; light brownish grey. Very stiff, wet, medium plasticity.

Depth markers: 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15

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TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Carpark adjacent to eastern side of Rutherford House

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990484 mN, 2659045 mE
R.L.: approx. 3.6m
DATUM: NZMG, MSL
DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A
HOLE STARTED: 21/9/13
HOLE FINISHED: 21/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: DTG
CHECKED: NCP

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	CORE RECOVERY (%)	METHOD	TESTS	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SOIL / ROCK DESCRIPTION
PLEISTOCENE ALLUVIUM	100	SONIC		15.1–15.5			SILT with minor organics and trace clay; light brownish grey. Very stiff, wet, medium plasticity.
				15.5	W		Organic SILT; light greyish brown.Wet, low plasticity.
	33	SPT	N=7 (350mm under hammer weight)	16.0	W	F	SILT with trace organics, clay and shell fragments; light bluish grey. Wet, high plasticity.
	100	SONIC		16.5	W		Silty fine SAND; light bluish grey. Wet, poorly graded.
	38	SPT	N=8 (350mm under hammer weight)	17.5	W	VD	Silty fine to coarse GRAVEL with some sand; light bluish grey. Very dense, wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke. Thin layers (100mm thick) layers of SILT. SPT sank 350mm in cuttings at base of hole, recorded N value likely to be under-measured.
	100	SONIC		18.0–19.0			
	76	SPT	N=50+	19.0			
	100	SONIC		19.5–20			

Depth scale: 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20

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BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Carpark adjacent to eastern side of Rutherford House
SHEET 5 OF 6

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990484 mN 2659045 mE
R.L.: approx. 3.6m
DATUM: NZMG, MSL
DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A
HOLE STARTED: 21/9/13
HOLE FINISHED: 21/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: DTG CHECKED: NCP

Geological unit	Core recovery (%)	Method	Tests	Depth (m)	Moisture condition	Strength/density classification	Description
PLEISTOCENE ALLUVIUM				20.0–20.5			Silty fine to coarse GRAVEL with some sand; light bluish grey. Very dense, wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke. Thin layers (100mm thick) layers of SILT. SPT sank 350mm in cuttings at base of hole, recorded N value likely to be under-measured. Layer of SILT between 20 - 20.5m.
	78	SPT	N=50+	20.5			
	100	SONIC		21.0–22.0			
	33	SPT	N=31 (bouncing)	22.0			
	100	SONIC		22.5	W	VSt	SILT with some sand; grey. Wet, medium plasticity. Sand is fine grained.
				23.0			Layer of completely weathered, extremely weak, silty GRAVEL between 23 - 23.4m.
	100	SPT	N=25	23.5			
	100	SONIC		24.0	W		Sandy, silty fine to coarse GRAVEL; light bluish grey. Very dense, wet, poorly graded. Sand is fine to medium grained. Gravel is completely to moderately weathered, weak to extremely weak, angular to sub-angular greywacke.
				24.5–25			

DRAFT

T+T DATATEMPLATE.GDT ebb

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Carpark adjacent to eastern side of Rutherford House

PROJECT: 33 LAMBTON QUAY GROUND INVESTIGATIONS | LOCATION: 33 LAMBTON QUAY | JOB No: 85725

CO-ORDINATES: 5990484 mN 2659045 mE
R.L.: approx. 3.6m
DATUM: NZMG, MSL

DRILL TYPE: WD-SD100 HELIPORT
DRILL METHOD: Sonic
DRILL FLUID: N/A

HOLE STARTED: 21/9/13
HOLE FINISHED: 21/9/13
DRILLED BY: WEBSTER DRILLING
LOGGED BY: DTG CHECKED: NCP

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
PLEISTOCENE ALLUVIUM			87	SPT		N=50+											
									25.5								End of borehole (target depth reached 25.5m). Borehole backfilled with imported gravel and capped with cold mix asphaltic concrete.
									26.0								
									26.5								
									27.0								
									27.5								
									28.0								
									28.5								
									29.0								
									29.5								
									30								

BORE 1

Weiington Railway Station
Thorndon Quay, WELLINGTON

DATE DRILLED July 1996

PERCENT FINES (%)	TYPE OF TEST	SURCHARGE PRESSURE (kPa)	MAX SHEAR STRESS (kPa)	NATURAL WATER CONTENT (%)	NATURAL DRY DENSITY (kg/m3)	PENETRATION RESISTANCE	DEPTH IN METRES	DESCRIPTION
							0	Greyish Brown SANDY GRAVEL (GP) (hardfill)
								Brown SILTY GRAVEL (GM) (loose, gravels angular up to 35mm, filling)
							1.0	
						N=4	2.0	
						N=7		
							3.0	Grey GRAVELLY SAND (SP) (loose, sand fine to coarse)
						N=12		
						N=36	4.0	Brownish Grey SANDY GRAVEL (GP) (dense, sand fine to coarse, gravel angular)
						N=38	5.0	(grades grey, some silt)
						N=39		Grey GRAVELLY SAND (SP) (medium dense, sand fine)
							6.0	
						N=11		Grey SILT (ML) (firm, random organic silt lens)
						N=13	7.0	
								Grey SANDY GRAVEL (GP) (very dense, sand fine, gravel angular, small, slightly silty)
						N=48	8.0	
						N=56		
							9.0	Brown SILT (ML) (soft, slightly organic)
						N=56		Grey SANDY GRAVEL (GP) (very dense, sand fine to coarse, gravel angular)
						N=70	10.0	(grades slightly silty)
							11.0	Grey SILT (ML) (firm, some organic content)
						N=27		Grey SILTY SAND (SM) (medium dense, sand fine)
							12.0	(grades very silty)
							13.0	Brown ORGANIC SILT (OL) (firm)
						N=24		Grey SANDY SILT (ML) (moderately stiff, sand fine)
							14.0	(occasional lens of brown organic silt)
						N=24	15.0	Grey SILTY SAND (SM) (medium dense, sand fine)
							16.0	
						N=33		
							17.0	Grey SILT (ML) (stiff, finely laminated horizontal layers)
						N=26	18.0	BORE DEPTH 18.0 metres
							19.0	
							20.0	
							21.0	
							22.0	

DRAFT

Job No 2305 00 CC Logged by AGM Drawn by RJM Date 12/7/96

Connell Wagner Limited

Plate 2a

BECA CARTER HOLLINGS & FERNER LTD
CONSULTING ENGINEERS AND SURVEYORS

RECORD OF BOREHOLE No. B1

JOB NAME: GATEWAY
CLIENT: MAINZEAL
JOB No. 266970

LOCATION: WELLINGTON
CO-ORDINATES:
ELEVATION: DATUM:

DRILLING: METHOD	RECOVERY %	R.Q.D. %	DEPTH (m)	LEGEND	SYMBOL	DESCRIPTION	GROUND WATER	SAMPLES: DEPTH (m)	SAMPLE TYPE	FIELD TESTS: S.P.T. (N Value)	SHEAR VANE OR	OTHERS	LAB TESTS
			0.1			Black bituminous asphaltic concrete.							
inch auger	100%					Firm to stiff, light brown, sandy gravelly SILT, dry (FILL) - subgrade.							
			0.7			hard concrete obstacle, fragments of brick and concrete.							
			1.0					1.0					
SPT	50%		1.5		ML	Becoming orange/brown and damp.		1.5	1	2, 2, 4 N=6			
inch auger	100%		2.0				2/11/86 low tide	2.0					
	100%		3.0			Approximate change 3.0 - 3.6m		3.0	2				
SPT	100%				SW	Compact, dark grey, slightly silty, medium to coarse SAND, minor gravel. Composed of subangular fresh (BEACH DEPOSITS).		3.6	3	4, 8, 15 N=23			
WB	cuttings		3.8 / 4.0		GM	Compact orange/brown silty sandy GRAVELS (weathered alluvial greywacke gravels).		4.0 / 4.05					
SPT	100		4.5			Becoming blue-grey.		4.5	4	8, 16, 22 N=38			
	cuttings		5.0					5.0					
SPT	100		6.0			Becoming dense to very dense.		6.0	5	12, 29, 21/100mm N=50+			
WB	cuttings												
	60%		7.0		ML	Stiff green fine sandy SILT, moist, non-plastic with trace organics.		7.0	6				
WB	cuttings		7.2		SW	Dense green gravelly fine to medium SAND. Rare gravels - fresh - grey, green, and weathered orange brown.		7.5					
	100%		7.8						7	15, 16, 13 N=29			
			8.0		ML	Very stiff green fine sandy SILT, moist with rare fine organics, non-plastic.		8.0					
			8.4		GW	100mm: blue-grey fine gravels.							
WB	cuttings				ML								
			9.0		ML	(Cuttings indicate) grey-brown SILT with woody fibres and pieces.		9.0					
	100		9.5		SM	Very dense light bluish grey silty gravelly SAND, moist.		9.5	8	16, 31, 19/70mm N=50+			

DATE STARTED: 28/10/86
DATE FINISHED: 31/10/86
CONTRACTOR: Lemon Piling & Drilling Co
DRILLING RIG: Ingersoll-Rand
LOGGED BY: A. SMITHSON

DRILLING METHOD
- Wash Bore
- Open Barrel
- TT - Triple Tube
- TR - Tricone Rockbit
- Push Tube Sample
- Standard Penetration Test

LABORATORY TESTS
- WC - Water Content
- DD - Dry Density
- UCS - Unconfined Comp. Strength
- CON - Consolidation-Oedometer
- PI - Atterberg Limits

Triaxial Compression Tests
- UU - Unconsolidated Undrained
- CD - Consolidated Drained
- CU - Consolidated Undrained with p.w.p. measurement

SAMPLES
- Small disturbed sample
- Large disturbed sample
- Undisturbed 100mm ø tube sample
- Undisturbed core sample
- Standard Penetration Test (SPT)
- Other samples specified

FIELD TESTS
- N - SPT blows/300mm
- K - Permeability (cm/sec)
- PP - Pocket penetrometer (kPa)

Shear Vane
- C - Undrained cohesion (kPa) direct dial reading
- CC - as C but corrected reading
- CR - remoulded C

RECORD OF BOREHOLE No. B1

JOB NAME: GATEWAY
CLIENT: MAINZEAL
JOB No. 266970

LOCATION: WELLINGTON
CO-ORDINATES:
ELEVATION: DATUM:

METHOD	RECOVERY %	R.Q.D. %	DEPTH (m)	SYMBOL	DESCRIPTION	SAMPLE DEPTH (m)	SAMPLE TYPE	S.P.T. (N Value)
TT	56cm / 75cm			SW	Very dense greenish-grey fine to medium sandy GRAVELS (2-30mm diameter) with lenses of silty fine SAND containing minor black and brown decomposed wood.		9	
SPT	100%		11.0		Becoming gravelly SAND, minor silt with woody fibres in cuttings.	10.75 / 11.0	10	15, 24, 26/100mm N=50+
WB	cuttings		12.0	SW	Becoming lensed with grey-brown clayey SILT from cuttings.	12.0		
			12.5		Becoming lensed with dark brown clayey SILT, organic, minor gravels.	12.5		
SPT	100%				APPROXIMATE CHANGE 12.0 - 13.0m		11	18, 27, 20 N=47
	cuttings		13.0	ML	Very stiff greenish grey clayey SILT, moist, low plasticity contains flecks of brown organics.	13.0		
			14.0			14.0 / 14.5		
T	100%		14.9		30mm dark brown, moderately organic clayey SILT.		12	7, 10, 15 N=25
UT	100%		15.0 / 15.3		Becoming slightly clayey SILT, trace fine sand.	15.0	13	
TT	1.22cm / 1.50		15.7	ML	Becoming light green, pale brown and dark brown layered with brown and black fibres.	15.5		
Core lost 16.1-16.4m			16.0 / 16.1	ML	Stiff, greenish-grey slightly clayey sandy SILT and silty SAND.	16.0		
			16.6		Becomes greenish-grey slightly clayey SILT, low plasticity slightly dilatant.			
SPT	100%		17.0	ML		17.0	14	5, 10, 11 N=21
	cuttings		18.0			18.0	15a	
TT	1.25cm / 1.25cm					18.34	15b	
	100%		18.9 / 19.0	MH	Stiff, greenish-grey speckled white, clayey SILT, moist, high plasticity. White specks turn blue when weathered overnight	18.64 / 19.0	15c / 15d	
SPT	100		19.6		Becoming reddish grey with green-grey lenses.	19.25 / 19.7	16	9, 11, 13 N=24
	cuttings							

DATE STARTED: 28/10/86
DATE FINISHED: 31/10/86
CONTRACTOR Lemon Piling & Drilling Co.
DRILLING RIG: Ingersoll Rand
LOGGED BY: A. SMITHSON

DRILLING METHOD

- WB - Wash Bore
- OB - Open Barrel
- TT - Triple Tube
- TR - Tricone Rockbit
- UT - Push Tube Sample
- SPT - Standard Penetration Test

LABORATORY TESTS

- WC - Water Content
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Triaxial Compression Tests
- UU - Unconsolidated Undrained
- CD - Consolidated Drained
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SAMPLES

- ● Small disturbed sample
- Large disturbed sample
- Undisturbed 100mm ∅ tube sample
- Undisturbed core sample
- Standard Penetration Test (SPT)
- Other samples specified

FIELD TESTS

- N - SPT blows/300mm
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Shear Vane
- C - Undrained cohesion (kPa) direct dial reading
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BECA CARTER HOLLINGS & FERNER LTD
CONSULTING ENGINEERS AND SURVEYORS

RECORD OF BOREHOLE No. B1

JOB NAME: GATEWAY
CLIENT: MAINZEAL
JOB No. 266970

LOCATION: WELLINGTON
CO-ORDINATES:
ELEVATION: DATUM:

Method	Recovery %	R.Q.D. %	Depth (m)	Symbol	Description	Sample depth (m)	Sample type	S.P.T. (N Value)
				ML	Hard dark greenish grey clayey SILT, moist, moderately plastic.	20.3	17a	
T	1.50 / 1.50 100%		20.6 / 20.7 / 20.9	ML	300-500mm: pockets of fine shells, soft green greywacke gravels. 100mm intervals oysters and cockle shells.	20.6	17b	
			21.0	ML	Becoming sandy clayey SILT, minor gravel.	20.9 / 21.0	17c	
			21.3	GM	Very dense green silty sandy GRAVEL, moist, gravels 2mm-15mm.	21.2	17d	
			21.5 / 21.6 / 21.7	ML	21.6m Becoming gravelly sand SILT. Hard, green, fine sandy SILT, moist non-plastic.	21.5	17e	
SPT	100						18	13 / 26 / 37 N=63
			22.0	SW	Very dense green SAND and fine GRAVEL.	22.0		
			22.3 / 22.4 / 22.65		Horizontal joint, orange-brown staining 250mm core loss.	22.3 / 22.4	19	
T	1.26 / 1.50			ML	Hard, brown clayey SILT, minor gravels, moist, low-moderately plastic. Becoming green with orange stained horizontal layers.	22.7	20	
			23.0 / 23.2	GM	Very dense green slightly silty sandy GRAVEL, moist.	23.0 / 23.1	21	
SPT	100		23.5	SW	Very dense silty coarse SAND and fine GRAVEL.	23.5	22	21 / 29/130mm N=50+
B		core fell out of barrel	24.0			24.0		
T / B	0% cutting							
			25.0 / 25.35	ML	Cuttings and drilling indicate clayey SILT.	25.0		
B	cutting			SW	Very dense greenish grey silty SAND and GRAVEL, moist.	25.5 / 25.8	23	23 / 27/120mm N=50+
			26.0		26-27m cuttings indicate sands and gravels.	26.0		
			27.0		27.0-28.0m cutting indicate interlayered sandy gravels and silts.	27.0		
			28.0 / 28.15	ML	Hard, brown clayey SILT, moist, moderately plastic, moderately organic, becoming greenish-grey at 28.1m.	28.0	24	17 / 50/120mm N=50+
			28.3	GW	Very dense greenish grey sandy GRAVELS, moist.	28.3		
					END OF HOLE 28.3m			
			29.0			29.0		

DATE STARTED: 28/10/86
DATE FINISHED: 31/10/86
CONTRACTOR: LEMON PILE DRILLING CO
DRILLING RIG: Ingersoll-Rand
LOGGED BY: A. SMITHSON

DRILLING METHOD
WB - Wash Bore
OB - Open Barrel
TT - Triple Tube
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PT - Push Tube Sample
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LABORATORY TESTS
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PI - Atterberg Limits
Triaxial Compression Tests
UU - Unconsolidated Undrained
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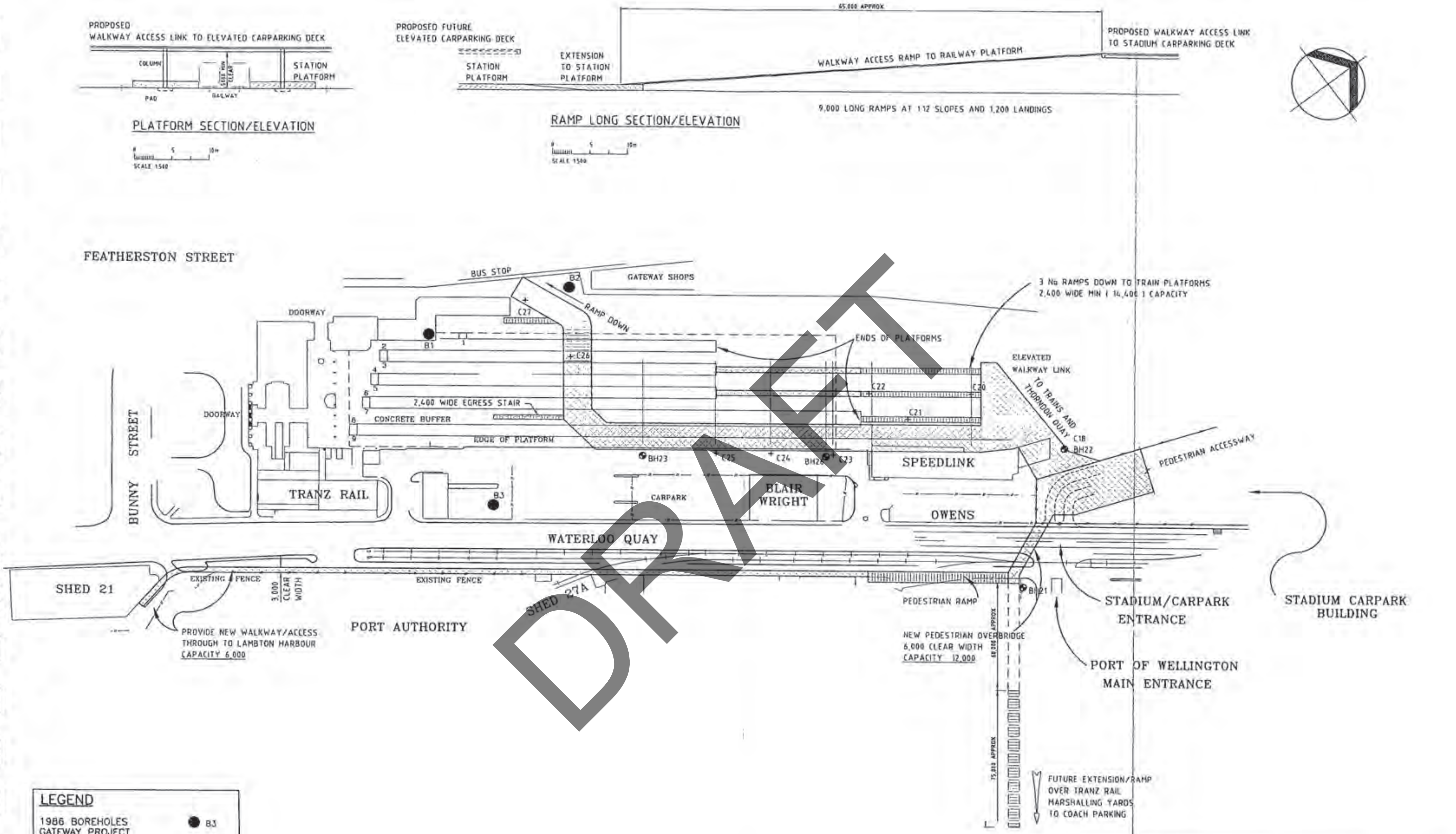
SAMPLES
Small disturbed sample
Large disturbed sample
Undisturbed 100mm ⌀ tube sample
Undisturbed core sample
Standard Penetration Test (SPT)
Other samples specified

FIELD TESTS
N - SPT blows/300mm
K - Permeability (cm/sec)
PP - Pocket penetrometer (kPa)
Shear Vane
C - Undrained cohesion (kPa) direct dial reading
CC - as C but corrected reading
CR - remoulded C

NZGD ID: BH_131204



LEGEND

1986 BOREHOLES GATEWAY PROJECT	● B3
BOREHOLE	BH17
CONE PENETROMETER TEST	+ C14

INVESTIGATION LOCATION PLAN

ELEVATED WALKWAYS

FIGURE 3

BECA

14.11.97

3401154/F003

SCALE 1:2000

NZGD ID: BH_131204

ENGEO Expect Excellence

LOG OF BORING BH7

Wellington Railway Station
Pipitea
Wellington 6011
12638

Client : KiwiRail
Date : 19/11/15
Hole Depth : 24.42 m
Drilling Method : Mud Rotary
Drilling Contractor : Griffiths Drilling
Core Diameter : 60 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 5428848.2
Longitude : 1749113.3

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Water Level	Moisture	Consistency/ Density Index	SPT N-Value
0.0	FILL			Asphalt.				
			GW	Sandy fine to coarse GRAVEL; grey. Subbase. Concrete fragments. Jet vacuumed. [FILL]				
			GW	Sandy fine to coarse GRAVEL with minor silt; brown. Gravel is angular. Brick fragments. Jet vacuumed. [FILL]				
0.5		NR	GW	Sandy fine to coarse GRAVEL with minor cobbles; grey. Gravel is predominantly angular with some subrounded to rounded gravel. Jet vacuumed. [FILL]			LP	
1.5			GM	Silty fine to coarse GRAVEL with some sand; orange brown. Gravel is subangular to subrounded. Sand is fine to coarse. [FILL]			VL	1/2//1/0/1/1 N=3
2.8		NR		Lost core.	▼		NR	
3.0				Silty fine to coarse GRAVEL with some sand; orange brown. Gravel is subangular to subrounded. Sand is fine to coarse. [FILL]		M	L	1/0//1/0/3/3 N=7
3.5			GW	Fine to coarse GRAVEL with minor sand and minor silt; orange brown. Gravel is angular to subangular. Sand is fine to coarse. [FILL]				
			GM	Silty fine to coarse GRAVEL with some sand; orange brown. Gravel is subangular to subrounded. Sand is fine to coarse. [FILL]				
4.0		NR	GM	Silty fine to coarse GRAVEL with some sand; grey. Gravel is angular to subrounded. Sand is fine to medium.			NR	
				Lost core.				
4.5			ML	Gravelly SILT with some sand; grey. Low plasticity. Gravel is angular to subangular. Sand is fine to medium.			VSt	5/7//8/6/8/9 N=31
5.0								

Columns also shown: Log Symbol, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes.

NR - no recovery
Standpipe installed

Bedrock was not encountered.

DRAFT

LOG OF BORING BH7

ENGEO Expect Excellence

Wellington Railway Station
Pipitea
Wellington 6011
12638

Client : KiwiRail
Date : 19/11/15
Hole Depth : 24.42 m
Drilling Method : Mud Rotary
Drilling Contractor : Griffiths Drilling
Core Diameter : 60 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 5428848.2
Longitude : 1749113.3

Material: INTERBEDDED MARGINAL MARINE/OUTWASH FAN DEPOSITS

Depth (m)	USCS Symbol	DESCRIPTION	Moisture	Consistency/ Density Index	SPT N-Value
	ML				
5.5	ML	SILT with minor sand; grey with brown laminations. Low plasticity. Sand is fine. 5.4 m to 5.5 m some fine to coarse gravel, subrounded to rounded. From 5.5 m some fine sand.		VSt	
6.0	SP	Fine to medium SAND with some silt; grey.		D	
	ML	Sandy SILT with minor gravel; grey. Low plasticity. Sand is fine to medium. Gravel is fine to coarse, subangular to subrounded.			5/11//12/12/11/7 N=42
6.5		From 6.45 m trace fine gravel, subrounded. From 6.6 m minor fine sand, no gravel. From 6.77 m to 6.9 m some fine sand.		H	
7.0	ML	SILT with minor sand; greyish brown. Low plasticity. Sand is fine. From 7.05 m some fine to medium sand. Wood fragments.			
	SM	Silty fine SAND; grey.		D	
7.5	ML	SILT with minor sand; greyish brown. Low plasticity. Sand is fine. From 7.4 m some sand and trace gravel. Sand is fine to medium. Gravel is fine, subangular to subrounded.	M	VSt	5/9//7/4/6/8 N=25
8.0	ML	Sandy SILT; greyish brown. Low plasticity. Sand is fine to medium.			
	SM	Silty fine to coarse SAND with trace gravel; bluish grey. Gravel is fine, subangular to subrounded.		MD	
8.5	ML	SILT with trace sand; greyish brown. Low plasticity. Sand is fine. From 8.55 m minor fine to medium sand; grey. From 8.7 m some sand.		VSt	
	NR	Lost core.		NR	
9.0	ML	Sandy SILT; bluish grey. Low plasticity. Sand is fine.		VSt	3/3//5/6/7/8 N=26
9.5	SM	Silty fine SAND; grey.		MD	
	ML	SILT with trace sand; grey. Low plasticity. Sand is fine.		VSt	
	NR	Lost core.		NR	
10.0					

NR - no recovery
Standpipe installed

Bedrock was not encountered.

DRAFT

GEOSCIENCE MACHINE BORING 12638_BOREHOLE LOGS.GPJ NZ DATA TEMPLATE 2.GDT 7/12/15

ENGEO
Expect Excellence

LOG OF BORING BH7

Wellington Railway Station
Pipitea
Wellington 6011
12638

Client : KiwiRail
Date : 19/11/15
Hole Depth : 24.42 m
Drilling Method : Mud Rotary
Drilling Contractor : Griffiths Drilling
Core Diameter : 60 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 5428848.2
Longitude : 1749113.3

Material: INTERBEDDED MARGINAL MARINE/OUTWASH FAN DEPOSITS

Depth (m)	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Moisture	Consistency/ Density Index	SPT N-Value
10.0–10.5	NR		Lost core.	NR		NR	
10.5–10.95		SM	Silty fine SAND; grey.			MD	3/4//6/8/7/8 N=29
10.95–12.5	NR		Lost core. Steel bar lost in the hole at 12.0 m depth. Unable to retrieve. Unable to perform SPT at 12.0 m.	NR		NR	
12.5–12.6		SM	Silty fine SAND; grey.		M	MD	
12.6–15.0		ML	SILT; greyish brown. Low plasticity. From 12.7 m grey. From 12.87 m to 13.0 m contains organic matter. From 13.45 m to 13.55 m dark brown with light brown laminations. From 13.55 m to 13.65 m brown with light brown mottles. From 13.95 m to 14.0 m brown. From 14.0 m to 14.05 m some fine sand. From 14.43 m to 14.58 m minor fine sand. From 14.65 m greyish brown. From 14.75 m grey with blue mottles.			St	2/2//2/3/3/5 N=13

Other column headings: Water Level, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes

NR - no recovery
Standpipe installed

Bedrock was not encountered.

ENGEO Expect Excellence

LOG OF BORING BH7

Wellington Railway Station
Pipitea
Wellington 6011
12638

Client : KiwiRail
Date : 19/11/15
Hole Depth : 24.42 m
Drilling Method : Mud Rotary
Drilling Contractor : Griffiths Drilling
Core Diameter : 60 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 5428848.2
Longitude : 1749113.3

Depth (m)	Material	USCS Symbol	DESCRIPTION	Moisture	Consistency/ Density Index	SPT N-Value
	INTERBEDDED MARGINAL MARINE/OUTWASH FAN DEPOSITS	ML	SILT; greyish brown. Low plasticity.			
			From 15.15 m to 15.6 m brown with 1 mm thin layers of organic matter.			2/3//3/4/5/5 N=17
15.5			From 15.6 m to 15.9 m cointains organic matter.			
16.0			From 15.95 m minor fine sand; bluish grey.			
			From 16.2 m no sand; grey.			
16.5			From 16.4 m to 17.15 m trace fine sand; bluish grey.			4/4//6/7/6/10 N=29
17.0			From 17.15 m bluish grey.			
17.5			From 17.45 m grey.	M	VSt	
			From 17.65 m bluish grey.			
18.0						3/3//5/5/6/7 N=23
18.5						
19.0			From 18.87 m 1 mm thin layers of organic matter. From 18.9 m to 19.15 m trace gravel and trace sand. Gravel is fine, subangular to subrounded; light yellow. Sand is fine to medium; yellow. From 19.15 m bluish grey.			
19.5			From 19.5 m to 19.95 m blue and yellow mottles.			3/3//5/7/8/11 N=31
20.0						

Other columns: Sample Type, Log Symbol, Water Level, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25, 50, 75), Notes.

NR - no recovery
Standpipe installed

Bedrock was not encountered.

DRAFT

GEOSCIENCE MACHINE BORING 12638_BOREHOLE LOGS.GPJ NZ DATA TEMPLATE 2.GDT 7/12/15

ENGEO Expect Excellence

LOG OF BORING BH7

Wellington Railway Station
Pipitea
Wellington 6011
12638

Client : KiwiRail
Date : 19/11/15
Hole Depth : 24.42 m
Drilling Method : Mud Rotary
Drilling Contractor : Griffiths Drilling
Core Diameter : 60 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 5428848.2
Longitude : 1749113.3

Material: INTERBEDDED MARGINAL MARINE/OUTWASH FAN DEPOSITS

Depth (m)	USCS Symbol	DESCRIPTION	Moisture	Consistency/ Density Index	SPT N-Value
	ML	From 19.95 m grey. SILT; greyish brown. Low plasticity. From 20.25 m to 20.45 m shell fragments. From 20.45 m bluish grey. From 20.45 m to 20.6 m moderately plastic, soft. From 20.6 m grey. From 20.6 m to 20.9 m white and blue mottles. From 21.0 m to 21.15 m shell fragments.		VSt	
	ML	Sandy SILT with some gravel; grey. Low plasticity. Sand is fine to coarse. Gravel is fine to medium, angular to subangular. Shell fragments. From 21.45 m some sand. From 21.6 m to 21.65 m gravel is fine to coarse. At 21.63 m cobble.		H	2/5//5/6/10/14 N=35
	SM	Silty fine to coarse SAND with some gravel; greyish blue. Gravel is fine to coarse, angular to subrounded.	M	D	
		Lost core.		NR	
	SM	Silty fine to coarse SAND with minor gravel; greyish blue. Gravel is fine to medium, angular to subrounded.		D	8/9//10/10/14/16 N=50
	SM	Silty fine to coarse SAND with some gravel; greyish blue. Gravel is fine to coarse, angular to subrounded.		D	
	ML	Sandy SILT; greyish blue. Low plasticity. Sand is fine to coarse.		H	
		Lost core.		NR	
	ML	Sandy SILT with minor gravel; greyish blue. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.		H	3/10//18/20/12 N=50+

Depth scale: 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0

End of Hole Depth: 24.42 m
Termination: Target depth

NR - no recovery
Standpipe installed

Bedrock was not encountered.

DRAFT

GEOTECH DRILLING
CONE PENETROMETER

CLIENT: BECA CARTER

CPT No: 27
of

PROJECT: STADIUM

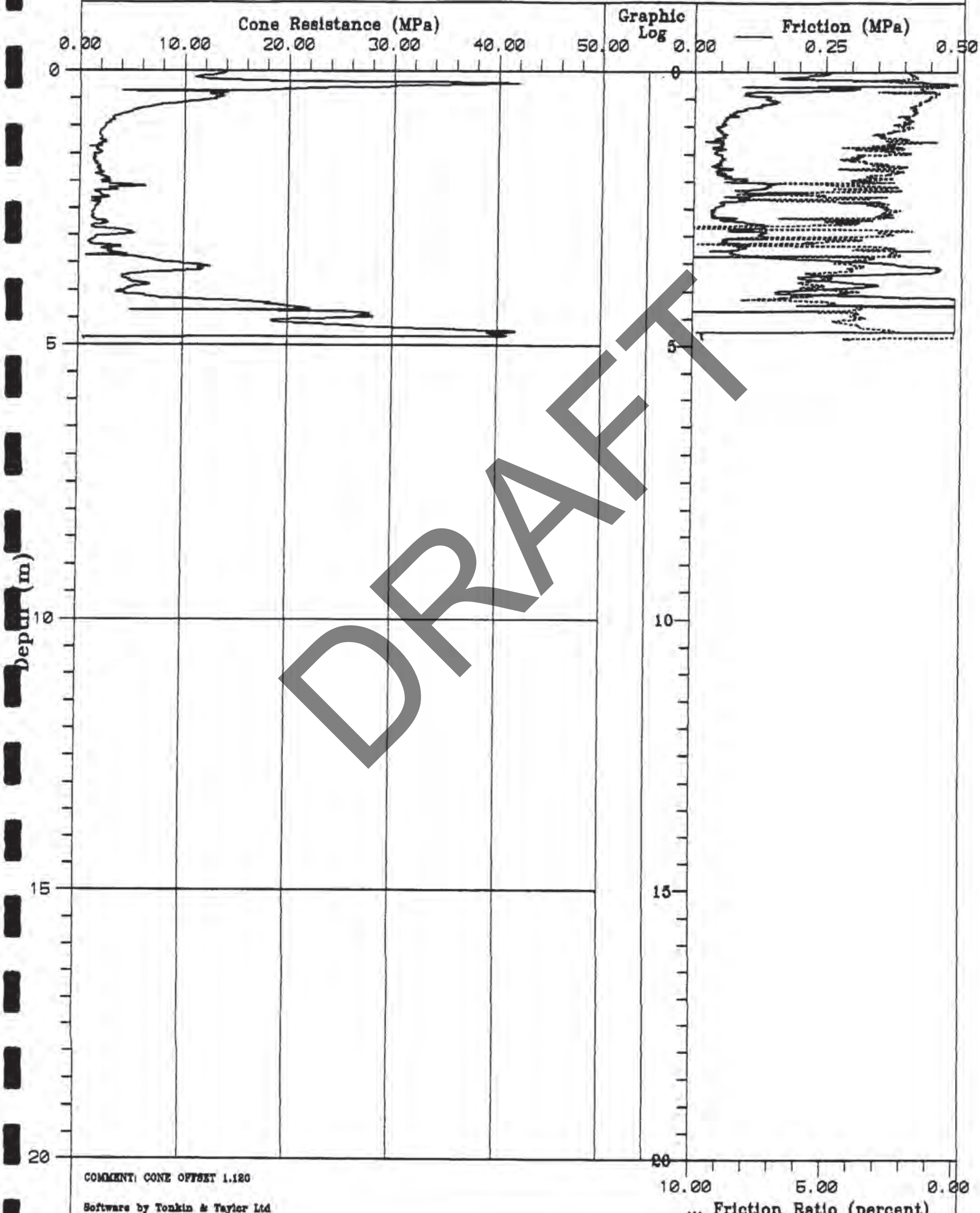
LOCATION: RAILYARD

JOBNO:

Date: 7 Nov 1997
R.L.:
Datum:

Cone Range:
Operator: S PURVIS
Grid Ref:

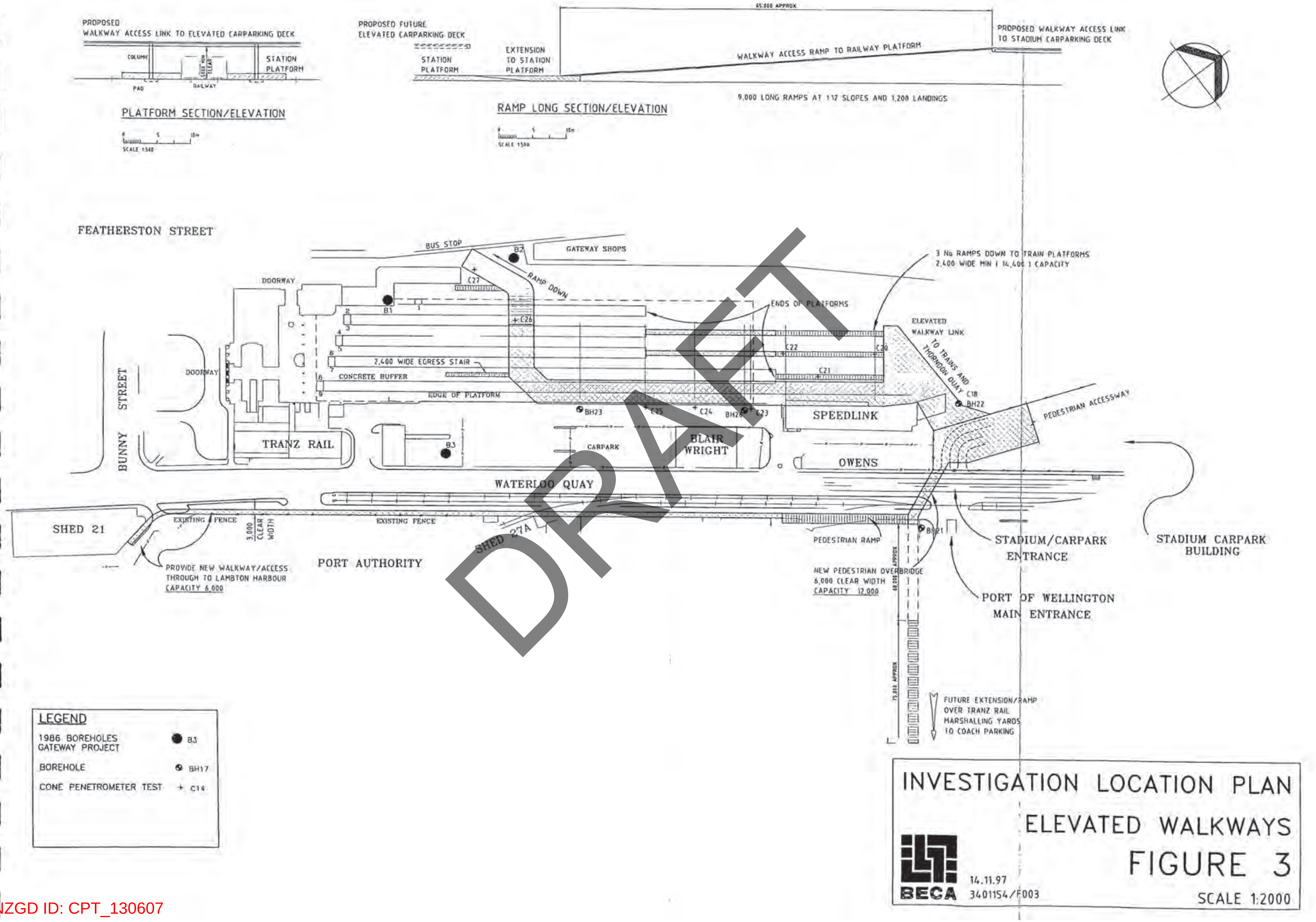
Client Ref:
East:
North:



COMMENT: CONE OFFSET 1.120

Software by Tonkin & Taylor Ltd

NZGD ID: CPT_130607



NZGD ID: CPT_130607

BECA CARTER HOLLINGS & FERNER LTD
CONSULTING ENGINEERS AND SURVEYORS

RECORD OF BOREHOLE No. B2

JOB NAME: GATEWAY
CLIENT: MAINZEAL
JOB No. 266970

LOCATION: WELLINGTON
CO-ORDINATES:
ELEVATION: DATUM:

Drilling method	Recovery %	Depth (m)	Symbol	Description	Ground water	Sample depth (m)	Sample type	S.P.T. (N value)	Shear vane / Others
5 inch auger		0.1		Black asphaltic concrete.					
	100%		ML	Firm to stiff, orange-brown gravelly sandy SILT, damp, low plasticity (FILL).		0.7	• 1		
		1.0				1.0			
SPT	60%					1.5		2, 3, 2	
SPT	100%	2.0		Becoming moist to wet.		2.0		N=5	
UT	100%				2/11/86	2.5	2		
AUGER	100	3.0				3.0			
		3.3	SP	Compact blue-green silty gravelly SAND, moist. (Old beach and near-shore deposits).		3.5	3		
UT	100	3.8				3.8			
SPT	100	4.0	ML	Very stiff blue-green gravelly sandy SILT (gravels highly weathered greywacke). At 4.1 for 40mm; horizontal limonite stained zone (seepage joint).		4.0	4	7, 13, 20	
AUGER	100					4.25		N=33	
WB	cuttings	5.0				5.0			
UT	100%	6.0	ML	Very stiff blue-green slightly fine sandy SILT, moist, non-plastic.		6.0	5		c=120+
SPT	100%	6.6	SP	Very dense blue-green silty gravelly SAND, moist.		6.5	6	13, 40	
		7.0				6.85		N=50+	
WB	cuttings	7.5	ML	Approximate change 7.5m from cuttings. Very stiff blue-green slightly clayey sandy SILT, moist, low to moderately plastic with fine layers of brown clayey SILT, moderately plastic. Becoming sandy SILT non-plastic.		7.0			
UT	100%	8.0	ML			8.0	7		c=120+
SPT	100%	8.5	SP	Very dense silty gravelly SAND, moist.		8.5	8	50/240mm	
WB	cuttings	8.7	ML	Hard, blue-green-grey fine sandy SILT, moist, non-plastic.		8.75		N=50+	
UT	50%	9.0				9.0	9		
	- (9.5-10 lost from barrel)	9.5		100mm brown layered fine organics. 20mm gravelly SILT.					
		10.0				10.0			

DATE STARTED: 31/10/86
DATE FINISHED: 1/11/86
CONTRACTOR: LEMON PILING & DRILLING CO
DRILLING RIG: Ingersoll-Rand
LOGGED BY: A. SMITHSON

DRILLING METHOD

- WB - Wash Bore
- OB - Open Barrel
- TT - Triple Tube
- TR - Tricone Rockbit
- PT - Push Tube Sample
- SPT - Standard Penetration Test

LABORATORY TESTS

- WC - Water Content
- DD - Dry Density
- UCS - Unconfined Comp. Strength
- CON - Consolidation - Oedometer
- PI - Atterberg Limits
- Triaxial Compression Tests
- UU - Unconsolidated Undrained
- CD - Consolidated Drained
- CU - Consolidated Undrained with p.w.p. measurement

SAMPLES

- • Small disturbed sample
- Large disturbed sample
- Undisturbed 100mm ø tube sample
- Undisturbed core sample
- Standard Penetration Test (SPT)
- Other samples specified

FIELD TESTS

- N - SPT blows/300mm
- K - Permeability (cm/sec)
- PP - Pocket penetrometer (kPa)
- Shear Vane
- C - Undrained cohesion (kPa) direct dial reading
- CC - as C but corrected reading
- CR - remoulded C

NZGD ID: BH_131205

BECA CARTER HOLLINGS & FERNER LTD
CONSULTING ENGINEERS AND SURVEYORS

RECORD OF BOREHOLE No. B2

SHEET 2 OF 3

JOB NAME: GATEWAY
CLIENT: MAINZEAL
JOB No. 266970

LOCATION: WELLINGTON
CO-ORDINATES:
ELEVATION: DATUM:

DRILLING METHOD	RECOVERY %	R.Q.D. %	DEPTH (m)	SYMBOL	DESCRIPTION	SAMPLE DEPTH (m)	SAMPLE TYPE	S.P.T. (N Value)
SPT	100			ML	Hard, green-grey fine sandy SILT, moist, non-plastic with rare brown layers.	10.45	10	7, 23, 32, N=55
WB	cuttings		11.0			11.0		
				ML	Very stiff green-grey clayey SILT with 5 - 10mm layers of brown clayey SILT, and fine black and brown organics.			
SPT	100		12.0			12.0	11	8, 14, 16, N=30
T	100						12	
			13.0	ML	Grey-brown clayey SILT with brown and black layers.	13.0		
SPT	100					13.5	13	6, 11, 12, N=23
			13.8		50mm: thin sandy gravelly layer.			
WB	cuttings		14.0		From 14.0 - contains less brown and organic layers mostly blue-green clayey SILT.	14.0		
			15.0		Blue-grey slightly clayey SILT, non-plastic, low plasticity sensitive.	15.0		
SPT	100%						14	7, 14, 17, N=31
T	100%		16.0	ML	Very finely laminated (blue grey and brownish grey) horizontally.	16.0		
						16.3 – 16.7	15	
			17.0		Becoming just blue-grey finely laminated.	17.0		
SPT	100						16	7, 13, 16, N=29
WB	cuttings		18.0			18.0		
			18.6		Contains fine layers of sand and gravel.			
			19.0			19.0		
			19.3	ML	Becoming sandy SILT.			
SPT	100%		19.5	SP	Very dense greenish grey silty gravelly SAND, moist.	19.5	17	10, 35, 15/60mm, N=50+

DATE STARTED: 31/10/86
DATE FINISHED: 1/11/86
CONTRACTOR: Lemmon Piling & Drilling Co
DRILLING RIG: Ingersoll-Rand
LOGGED BY: A. SMITHSON

DRILLING METHOD
- WB . Wash Bore
- OB . Open Barrel
- TT . Triple Tube
- TR . Tricone Rockbit
- PT . Push Tube Sample
- SPT . Standard Penetration Test

LABORATORY TESTS
- WC . Water Content
- DD . Dry Density
- UCS . Unconfined Comp. Strength
- CON . Consolidation - Oedometer
- PI . Atterberg Limits

Triaxial Compression Tests
- UU . Unconsolidated Undrained
- CD . Consolidated Drained
- CU . Consolidated Undrained with p.w.p. measurement

SAMPLES
- Small disturbed sample
- Large disturbed sample
- Undisturbed 100mm ø tube sample
- Undisturbed core sample
- Standard Penetration Test (SPT)
- Other samples specified

FIELD TESTS
- N . SPT blows/300mm
- K . Permeability (cm/sec)
- PP . Pocket penetrometer (kPa)

Shear Vane
- C . Undrained cohesion (kPa) direct dial reading
- CC . as C but corrected reading
- CR . remoulded C

BECA CARTER HOLLINGS & FERNER LTD
CONSULTING ENGINEERS AND SURVEYORS

RECORD OF BOREHOLE No. B2

SHEET 3 OF 3

JOB NAME: GATEWAY
CLIENT: MAINZEAL
JOB No. 266970

LOCATION: WELLINGTON
CO-ORDINATES:
ELEVATION: DATUM:

DRILLING			STRATA				GROUND WATER	SAMPLES		FIELD TESTS			LAB TESTS
HOD	RECOVERY %	R.Q.D. %	DEPTH (m)	LEGEND	SYMBOL	DESCRIPTION	WATER	DEPTH (m)	SAMPLE TYPE	S.P.T. (N.Value)	SHEAR VANE	OTHERS	
			20.2 20.3 20.4			Very stiff, green-grey, slightly clayey SILT, non-plastic. 20.3m: Brown with black flecked organics. 20.4m: Slightly gravelly (weathered green-grey greywacke).		20.25		18	DR		
T	0.86m 1.00m		20.6 20.8			Interbedded layers of very dense, silty gravelly SAND, moist and very dense silty sandy GRAVEL; moist.		20.5 20.8		19 20			
PT	100		21.0					21.0 21.1		21	14/44 N=50+		
B	cuttings		22.0					22.0					
PT	100%		23.0			END OF HOLE 23.0m		23.0		22	23/27/100mm N=50+		

DATE STARTED: 31/10/86
DATE FINISHED: 1/11/86
CONTRACTOR: Lemon Pile & Drilling Co
DRILLING RIG: Ingersoll-Rand
LOGGED BY: A. SMITHSON

DRILLING METHOD
- Wash Bore
- Open Barrel
- TT . Triple Tube
- TR . Tricone Rockbit
- Push Tube Sample
- Standard Penetration Test

LABORATORY TESTS
- WC . Water Content
- DD . Dry Density
- UCS . Unconfined Comp. Strength
- CON . Consolidation - Oedometer
- PI . Atterberg Limits
- Triaxial Compression Tests
- UU . Unconsolidated Undrained
- CD . Consolidated Drained
- CU . Consolidated Undrained with p.w.p. measurement

SAMPLES
- Small disturbed sample
- Large disturbed sample
- Undisturbed 100mm ϕ tube sample
- Undisturbed core sample
- Standard Penetration Test (SPT)
- Other samples specified

FIELD TESTS
- N . SPT blows/300mm
- K . Permeability (cm/sec)
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- Shear Vane
- C . Undrained cohesion (kPa) direct dial reading
- CC . as C but corrected reading
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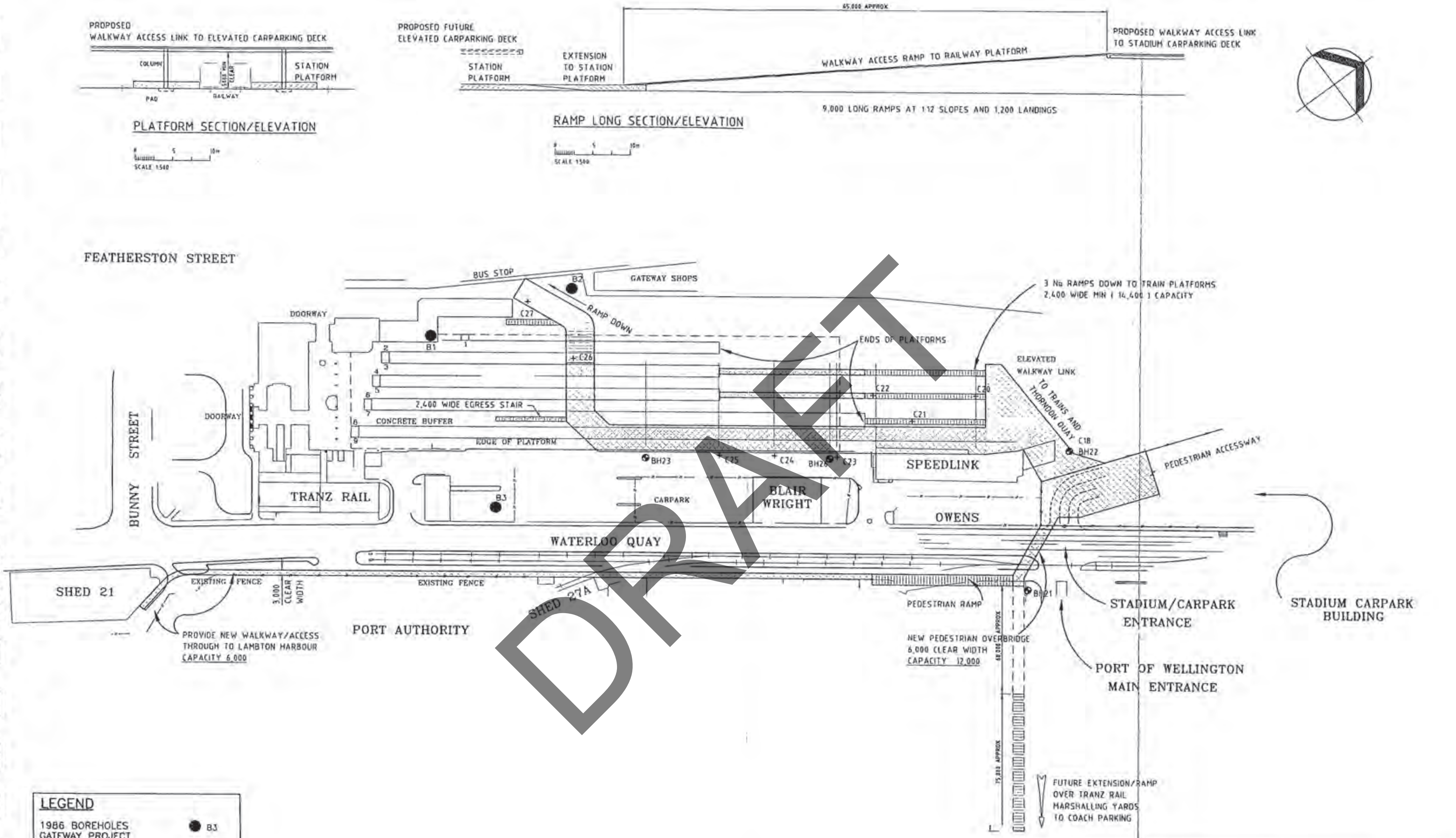


LEGEND

1986 BOREHOLES GATEWAY PROJECT	●	B3
BOREHOLE		BH17
CONE PENETROMETER TEST	+	C14

INVESTIGATION LOCATION PLAN

ELEVATED WALKWAYS

FIGURE 3

BECA

14.11.97

3401154/F003

SCALE 1:2000

CONE PENETRATION TEST (CPT) REPORT

Client: University of Canterbury

Location: CentrePort Wellington
Various locations, Wellington

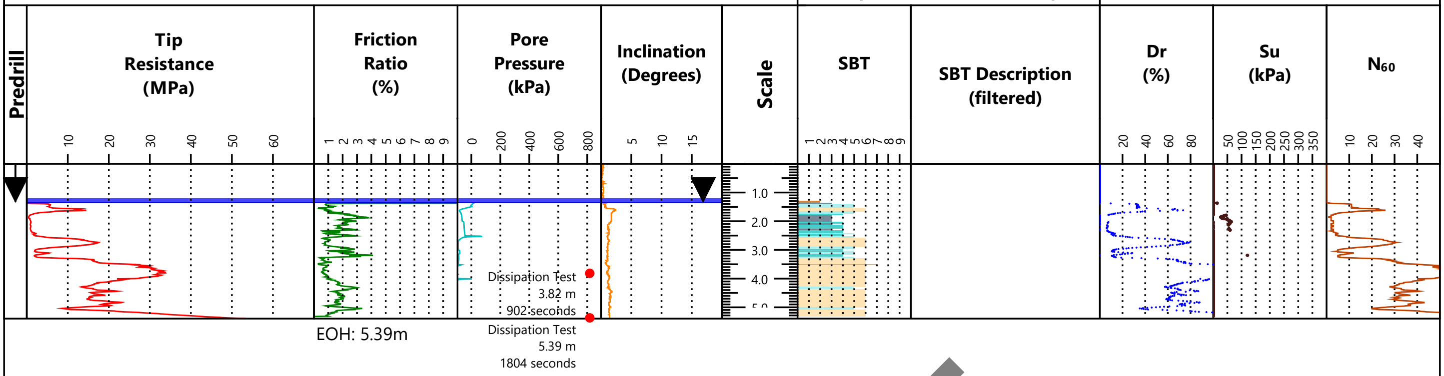
Printed: 19/08/2020

McMILLAN Drilling

Client: University of Canterbury	Bore No.: sCPTu1017
Project: CentrePort Wellington	Job No.: 18563

Site Location: Various locations, Wellington **Date:** 11/7/2020
Grid Reference: 1749286.2m E, 5429121.34m N (NZTM) - Map or aerial photograph **Rig Operator:** R. Wyllie
Elevation: 0.00m **Datum:** Ground **Equipment:** Geomil Panther 100

RAW DATA | SOIL BEHAVIOUR TYPE (NON-NORMALISED) | ESTIMATED PARAMETERS



DRAFT

Cone Type: I-CFXYP100-10 - Compression
Cone Reference: 140912
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: 1.3m
Water Level: 1.3m
Collapse: 2.8m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	-0.2003	-0.1382
Local Friction	0.0008	0.0002
Pore Pressure	-0.0094	-0.1097

Termination

Target Depth: ☐

Effective Refusal

Tip: ☑
Gauge: ☐
Inclinometer: ☐

Soil Behaviour Type (SBT) - Robertson et al. 1986

0 Undefined	5 Sand mixtures: silty sand to sandy silt
1 Sensitive fine-grained	6 Sands: clean sands to silty sands
2 Clay - organic soil	7 Dense sand to gravelly sand
3 Clays: clay to silty clay	8 Stiff sand to clayey sand
4 Silt mixtures: clayey silt & silty clay	9 Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

Generated with Core-GS by Geroc

TEST DETAIL

PointID: sCPTu1017

Sounding: 7

Operator:	R. Wyllie	**Date:**	11/7/2020
Cone Type:	I-CFXYP100-10 - Compression	**Predrill:**	1.3m
Cone Reference:	140912	**Water Level:**	1.3m
Cone Area Ratio:	0.75	**Collapse:**	2.8m

Termination

Target Depth: ☐

Effective Refusal

Tip: ☑

Gauge: ☐

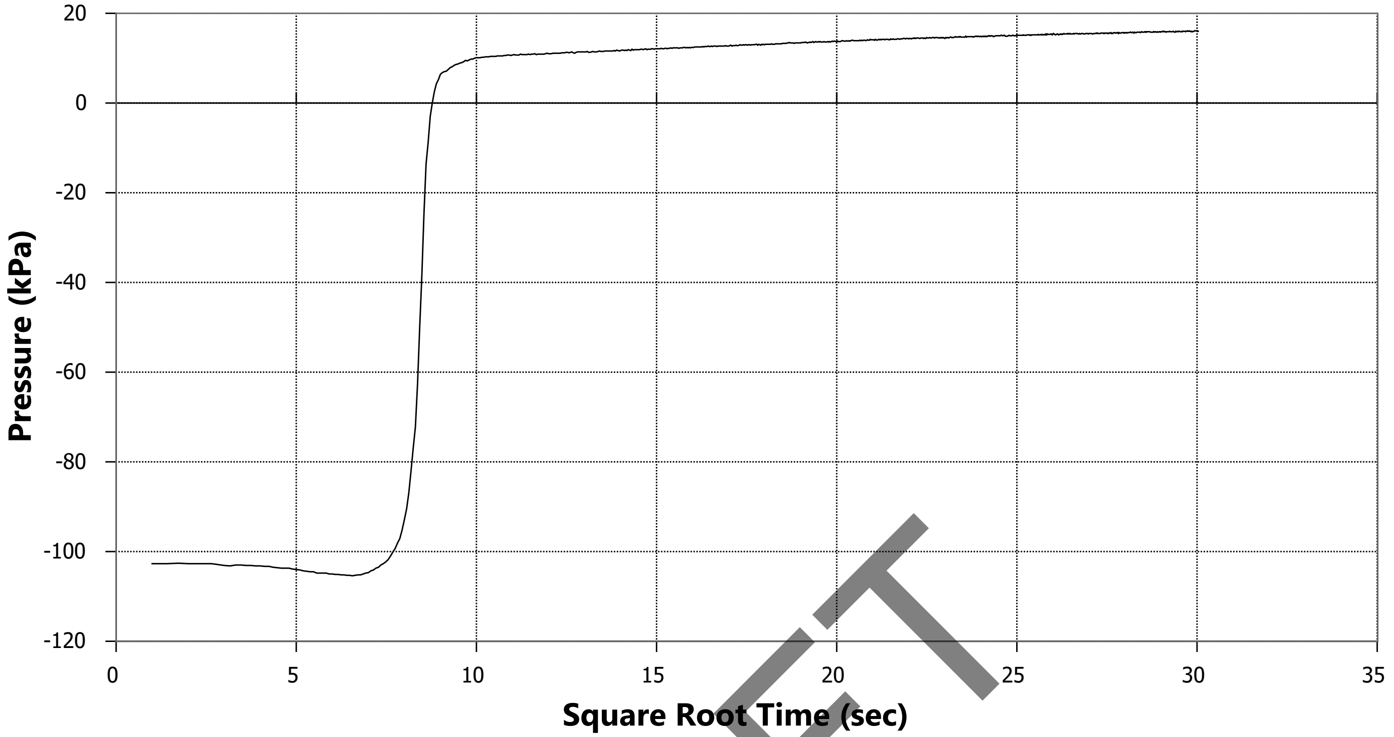
Inclinometer: ☐

Zero load outputs (MPa)	**Before test**	**After test**
Tip Resistance	-0.2003	-0.1382
Local Friction	0.0008	0.0002
Pore Pressure	-0.0094	-0.1097

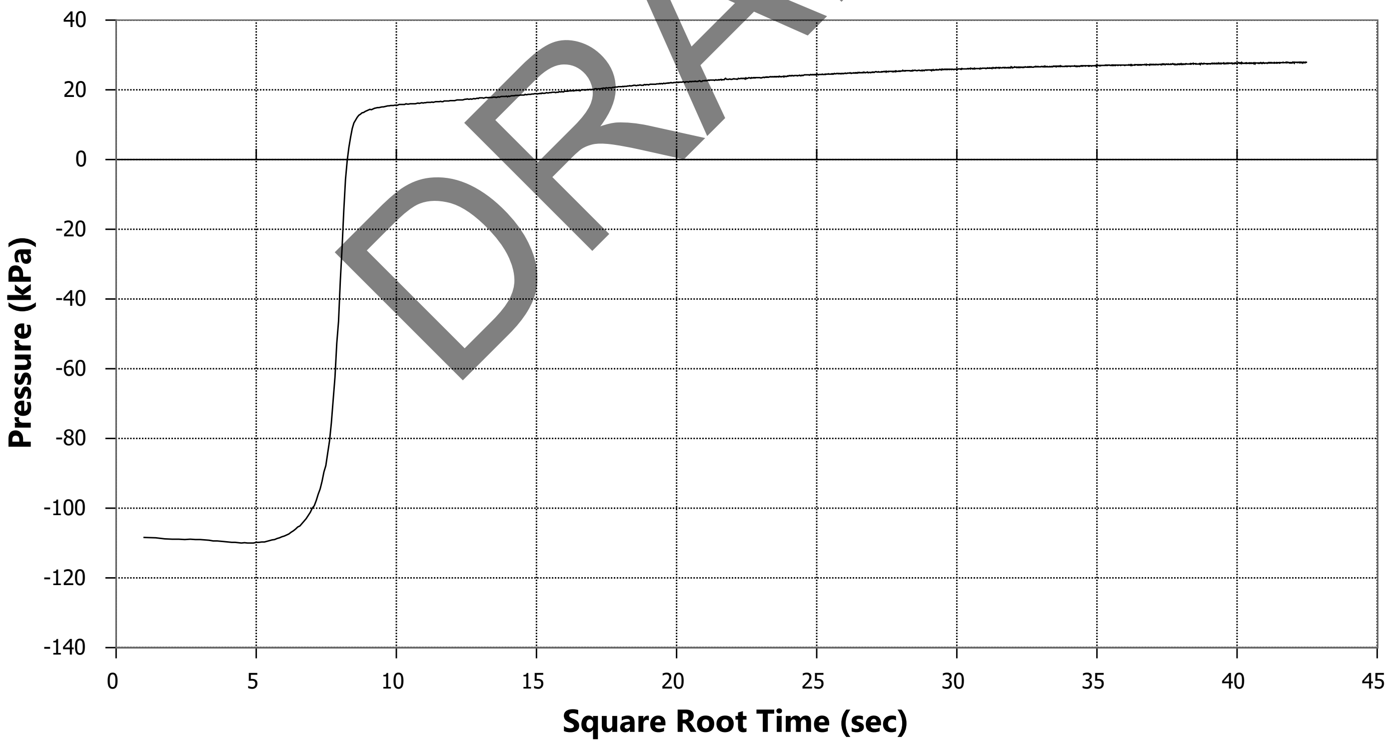
DISSIPATION TESTS

PointID: sCPTu1017

Test Depth: 3.82 **Duration:** 902 seconds



Test Depth: 5.39 **Duration:** 1804 seconds

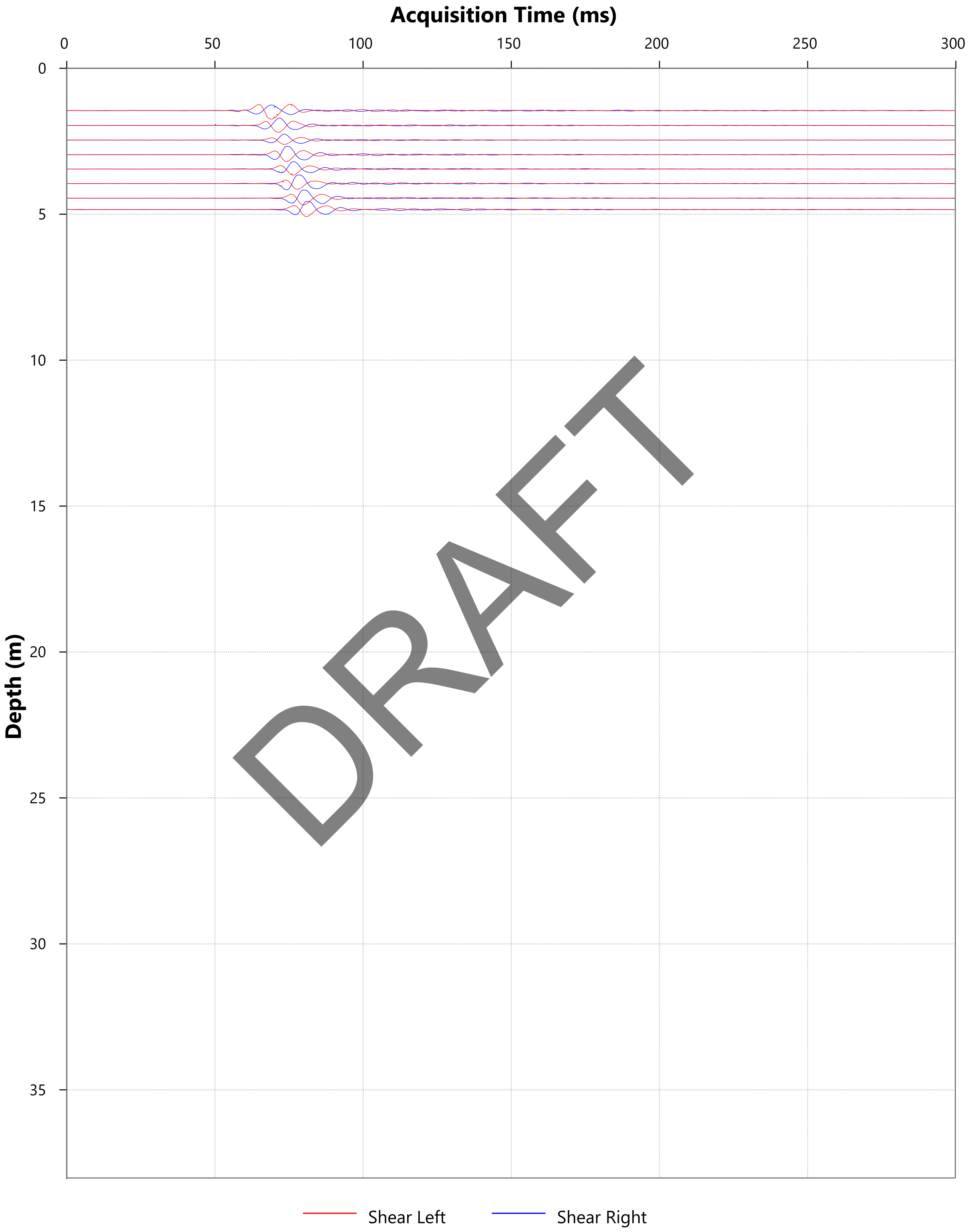


McMILLAN Drilling

SEISMIC TESTS

PointID: sCPTu1017

Horizontal source offset: 1.65m



McMILLAN Drilling

CPT CALIBRATION AND TECHNICAL NOTES

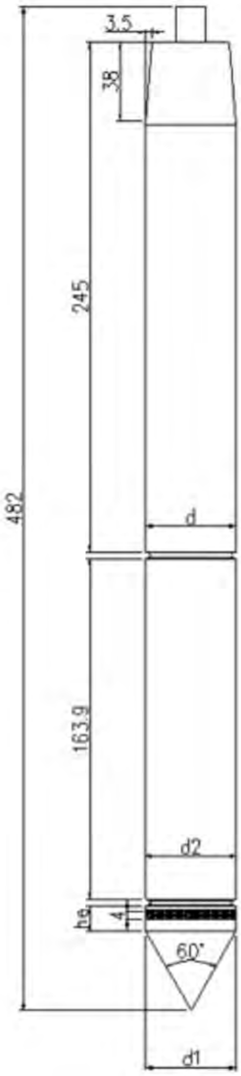
These notes describe the technical specifications and associated calibration references pertaining to the following cone types:

- I-CFXY-10 measuring cone resistance, sleeve friction and inclination (standard cone, $10cm^2$);
- I-CFXY-15 measuring cone resistance, sleeve friction and inclination (standard cone, $15cm^2$);
- I-CFXYP20-10 / I-CFXYP100-10 measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, $10cm^2$);
- I-CFXYP20-15 measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, $15cm^2$);
- I-C5F0p15XYP20-10 measuring sensitive cone resistance, sleeve friction, inclination and pore pressure (piezocone, $10cm^2$).

Dimensions

Dimensional specifications for all cone types are detailed below. All tolerances are routinely checked prior to testing and measurements

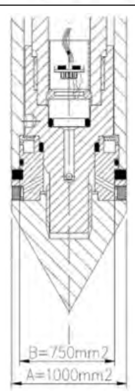
A.P. van den Berg Machinefabriek tel.: +31 (0)513-631355 info@apvandenberg.com	DEVIATION of Straightness + MINIMUM Dimensions tip, friction jacket, cone adapter	Standards: EN ISO 22476-1 APB-standard
Type of cone:	Icone 10 cm^2	Icone 15 cm^2
ALLOWABLE SIZE VARIATION		
Diameter of tip:	$35,3 \le d1 \le 36,0$	$43,2 \le d_1 \le 44,1$
Diameter of centering ring CFP	$35,3 \le d1 \le 36,0$	$43,2 \le d_1 \le 44,1$
Diameter of friction jacket:	$d_1 \le d_2 < d_1 + 0,35$	$d_1 \le d_2 < d_1 + 0,43$
Height dimension of tip edge:	$7 \le h_e \le 10$	$9 \le h_e \le 12$
PRODUCTION DIMENSIONS		
Tip:	$d_1 = 35,7\ ^{+0,2}_{0}$	$d_1 = 43,8\ ^{+0,2}_{0}$
Jacket (C-cone):	$d_2 = 35,7\ ^{+0,2}_{0}$	$d_2 = 43,7\ ^{+0,2}_{0}$
Friction jacket (CF-cone):	$d_2 = 35,9\ ^{+0,1}_{0}$	$d_2 = 44,0\ ^{+0,1}_{0}$
Tip for used cone:	$d_1 = 35,5\ ^{+0,1}_{0}$	$d_1 = 43,5\ ^{+0,1}_{0}$
MINIMUM DIMENSIONS		
Minimum diameter jacket (C-cone):	$d_2 = 35,2$ (APB standard)	$d_2 = 43,0$ (APB standard)
Minimum diameter friction jacket (CF-cone):	$d_2 = 35,3$	$d_2 = 43,2$
Use "used cone"-tip when friction jacket diameter:	$d_2 \le 35,65$	$d_2 \le 43,7$
Minimum diameter of cone adaptor:	d = 35,3	d = 43,8
Maximum deviation of straightness:	1 mm on a length of 1000 mm (max. oscillation 1,0 mm.)	1 mm on a length of 1000 mm (max. oscillation: 2.0 mm)



Tip and Local Friction sensor displacement

The different distances of the sensors are compensated depending on the cone types:

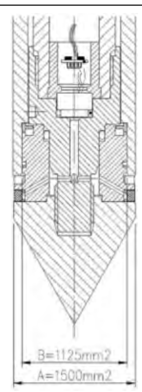
- $10cm^2$ cones: 80mm
- $15cm^2$ cones: 100mm



Cone area ratio

$\alpha = B / A = 0.75$

$\beta = 1 - B / A = 0.25$



McMILLAN Drilling

CPT CALIBRATION AND TECHNICAL NOTES

Calibration

Each cone has a unique identification number that is electronically recorded and reported for each CPT test. The identification number enables the operator to compare 'zero-load offsets' to manufacturer calibrated zero-load offsets.

The recommended maximum zero-load offset for each sensor is determined as ± 5% of the nominal measuring range.

In addition to maximum zero-load offsets, the difference in zero load offset before and after the test is limited as ± 2% of the maximum measuring range. See table below:

	Tip (MPa)	Friction (MPa)	Pore Pressure (MPa)
Maximum Measuring Range:	150	1.50	3.00
Nominal Measuring Range:	75	1.00	2.00
Max. 'zero-load offset':	7.5	0.10	0.20
Max 'before and after test':	3	0.03	0.06

Note: The zero offsets are electronically recorded and reported for each test in the same units as that of each sensor.

McMILLAN Drilling

NZGD ID: CPT_156073

CONE CERTIFICATES

Calibration Certificate

a.p. van den berg

1.1 General

Cone number:	140912
Cone type:	I-CFXYP100-10
Description:	Tip 75 MPa Sleeve 1.00 MPa Inclinometer 20° Pore 10MPa
Part number:	010027BB
Certificate number:	140912-6
Client:	Mc Millan Drilling

1.2 Calibration equipment

	calibrated
Autolog 3000	
Autolog 3000	August 2017 (Peekel: SN# 2628009)
Autolog 3000	August 2017 (Peekel: SN# 2628009)
Autolog 3000	August 2017 (Peekel: SN# 2628009)
Reference Loadcell 100kN 93280	Sept 2017 (HBM: 64604 2017-09)
Reference Loadcell 20kN H22789	Sept 2017 (HBM: 64567 2017-09)
Reference Sensor 200 Bar 1149206	April 2018 (Trescal: 1803-17622)
Reference ACS-080-SC00-HP2-PM 08/11 470481	March 2015 (Trescal: 1503-02689)
Reference ACS-080-SC00-HP2-PM 08/11 470481	March 2015 (Trescal: 1503-02689)

1.3 Standard
EN ISO 22476-1 2012 Class 2

1.4 Result
The sensor complies to the above standard

Calibrated by: C.J. Cuwejan
Date: 19/09/2018
Signature:

QA Manager: N.R.E. de Jong
Date: 19/09/2018
Signature:

140912-6 page 1/4

Calibration Certificate

a.p. van den berg

Zero Value Cone -0,015 [MPa]
Sleeve 0,041 [MPa]
Pore(u2) -3,1 [kPa]

Max. Deviation from Zero Value Cone 3.75 [MPa]
Sleeve 0.05 [MPa]
Pore(u2) 500.0 [kPa]

Ref [MPa]	Cone [MPa]	Cone-Ref [kPa]
-0.018	-0.013	5
1.000	1.015	15
2.104	2.095	-9
4.022	4.023	1
8.491	8.494	3
12.349	12.331	-18
20.978	20.975	-3
30.487	30.531	44
41.759	41.798	39
49.899	49.955	56
61.619	61.687	68
75.456	75.470	14

Ref [MPa]	Sleeve [MPa]	Sleeve-Ref [kPa]
0.000	0.000	0
0.036	0.036	0
0.067	0.067	0
0.104	0.105	1
0.130	0.131	1
0.198	0.200	2
0.296	0.299	3
0.421	0.424	3
0.568	0.571	3
0.675	0.678	3
0.752	0.755	3
1.023	1.023	0

Ref [MPa]	Pore(u2) [MPa]	Pore(u2)-Ref [kPa]
0.001	-0.002	-3
0.211	0.209	-2
0.402	0.400	-2
0.740	0.739	-1
1.202	1.203	1
2.013	2.020	7
2.652	2.659	7
3.972	3.979	7
4.813	4.827	14
5.762	5.787	25
7.858	7.867	9
9.819	9.810	-9

140912-6 page 3/4

ENGEO
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LOG OF BORING BH01

Silvester Clark Consulting Engineers
121 Thorndon Quay
Thorndon, Wellington
15394.000.000
-

Client	: Silvester Clark Consulting	**Core Diameter**	: 83 mm
Date	: 11/09/2018	**Hammer Efficiency**	: 89.2 %
Hole Depth	: 20.38 m	**Logged By/Reviewed By**	: CM / KJ
Drilling Method	: Rotosonic	**Latitude**	: -41.274451
Drilling Contractor	: Griffiths Drilling	**Longitude**	: 174.783359

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
0.0–1.5	NO RECOVERY	NR		JET VAC	NR			-					
1.5	MARGINAL MARINE		GP	Sandy fine to medium GRAVEL with trace silt; brownish orange mottled grey. Poorly graded, angular to subrounded; sand is fine to coarse, well graded.				MD	3/4//6/5/4/4 N=19				
2.0			GP	Sandy fine GRAVEL with some silt; grey. Poorly graded, subangular; sand is fine to coarse, well graded.				VS		0			
			ML	SILT with trace gravel; grey. Moderate plasticity; gravel is fine, poorly graded, subangular.						0			
2.5			ML	Gravelly SILT with minor sand; brownish grey. Moderate plasticity; gravel is fine to medium, poorly graded, angular to subangular; sand is fine to coarse, well graded.				S	2/2//1/1/0/1 N=3				
3.0			ML	SILT with minor gravel; brownish grey. Low to moderate plasticity; gravel is fine to medium, poorly graded, angular to subangular.				St	2/3//5/3/3/3 N=14				
3.85				3.85 m - Additional minor fine to coarse sand, well graded.					1/2//2/2/3/4 N=11	100			
4.6			GP	Sandy fine GRAVEL; bluish grey. Poorly graded, angular to subangular; sand is fine, poorly graded.				-					
4.75			SP	Fine SAND with minor gravel, minor silt; bluish grey. Poorly graded; gravel is fine, poorly graded, angular to subangular.				MD	4/5//5/5/7/6 N=23				
5.5			SP	Gravelly fine to medium SAND with trace silt; bluish grey. Poorly graded; gravel is fine to medium, poorly graded, angular to subangular.									
6.0			SP	Fine SAND with minor gravel, minor silt; bluish grey. Poorly graded; gravel is fine, poorly graded, angular to subangular.					2/4//8/5/6/6 N=25				
			SP	Gravelly fine to medium SAND with trace silt; bluish grey. Poorly graded; gravel is fine to medium, poorly graded, angular to subangular.									
6.5			GP	Sandy fine to medium GRAVEL; bluish grey. Poorly graded, subangular to subrounded; sand is fine, poorly graded.									
7.0													

VS = Very Soft, S = Soft, St = Stiff, VSt = Very Stiff, H = Hard
MD = Medium Dense, D = Dense, VD = Very Dense
Water level recorded at 0.2 m after 20.0m had been drilled on 14/09/18. Water level recorded at 0.56 m on 19/09/18.

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LOG OF BORING BH01

Silvester Clark Consulting Engineers
121 Thorndon Quay
Thorndon, Wellington
15394.000.000
-

Client : Silvester Clark Consulting
Date : 11/09/2018
Hole Depth : 20.38 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 83 mm
Hammer Efficiency : 89.2 %
Logged By/Reviewed By : CM / KJ
Latitude : -41.274451
Longitude : 174.783359

Depth (m): 7.5, 8.0, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0

Material: MARGINAL MARINE

USCS Symbol	DESCRIPTION	Log Symbol	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)
ML	SILT with some clay, minor gravel; brownish orange. Low to moderate plasticity; gravel is fine to medium, poorly graded, subangular to subrounded.		VSt	4/5//5/3/8/8 N=24	
	CORE LOSS	NR	-		
ML	SILT with some clay, minor gravel; brownish orange. Low to moderate plasticity; gravel is fine to medium, poorly graded, subangular to subrounded.				
GP	Sandy fine to medium GRAVEL; bluish grey. Poorly graded, subangular to subrounded; sand is fine, poorly graded.		H	4/15//17/13/15/5 for 25mm N=50+	
ML	Gravelly SILT with some clay, minor sand; brownish orange mottled grey. Low plasticity; gravel is fine to medium, angular to subangular; sand is fine, poorly graded.		-		
GP	Fine to medium GRAVEL; brownish grey. Poorly graded, subangular to subrounded.		VSt	2/4//6/7/6/8 N=27	250
ML	SILT with some clay, minor gravel; brownish orange. Low to moderate plasticity; gravel is fine to medium, poorly graded, subangular to subrounded.				
SP	Fine to medium SAND with some gravel; bluish grey. Poorly graded; gravel is fine to coarse, well graded, angular to subangular.		VD	4/9//10/20/20 for 50mm N=50+	
SM	Silty fine to coarse SAND with some gravel; grey. Well graded; gravel is fine to coarse, angular to subangular, poorly graded.		D	3/15//20/6/8/7 N=41	
GW	Sandy fine to coarse GRAVEL with minor silt; bluish grey. Well graded, angular to subangular; sand is fine to coarse, well graded.		-		
ML	SILT with minor sand; bluish grey mottled brown. Low plasticity; sand is fine to medium, poorly graded.		H	5/8//13/11/17/9 for 25mm N=50+	
SW	Gravelly fine to coarse SAND with minor silt; bluish grey. Well graded; gravel is fine to coarse, well graded, angular to subangular.		D	5/6//9/10/17/11 N=47	
SM	Silty fine to coarse SAND with minor gravel; bluish grey. Well graded; gravel is fine to medium, poorly graded, angular to subangular.		VD		

Other columns: Material, Sample Type, Water Level, Moisture, Torvane Shear (kPa), Total Core Recovery (%) (25 50 75), Notes

VS = Very Soft, S = Soft, St = Stiff, VSt = Very Stiff, H = Hard
MD = Medium Dense, D = Dense, VD = Very Dense
Water level recorded at 0.2 m after 20.0m had been drilled on 14/09/18. Water level recorded at 0.56 m on 19/09/18.

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LOG OF BORING BH01

Silvester Clark Consulting Engineers
121 Thorndon Quay
Thorndon, Wellington
15394.000.000
-

Client : Silvester Clark Consulting
Date : 11/09/2018
Hole Depth : 20.38 m
Drilling Method : Rotosonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 83 mm
Hammer Efficiency : 89.2 %
Logged By/Reviewed By : CM / KJ
Latitude : -41.274451
Longitude : 174.783359

Material: MARGINAL MARINE

Depth (m) scale: 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0

USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
SM	Silty fine to coarse SAND with minor gravel; bluish grey. Well graded; gravel is fine to medium, poorly graded, angular to subangular. 14.0 m - Becomes some fine to coarse gravel, well graded, angular to subangular.	VD	9/13//30/20 for 50mm N=50+ 10/16//26/24 for 70mm N=50+
GW	Fine to coarse GRAVEL with some sand; grey. Well graded, subangular to subrounded; sand is fine to coarse, well graded.		5/15//16/12/6/10 N=44
SM	Sandy SILT with minor gravel; grey mottled brown. Low plasticity; sand is fine to medium, poorly graded; gravel is fine to medium, poorly graded, angular to subangular.		
SP	Fine to medium SAND with some silt; grey mottled brown. Poorly graded. 17.45 m - Contains blackened carbon rich organics. 17.60 m - Sand becomes fine.	D	5/6//7/8/9/11 N=35 3/6//7/7/8/9 N=31
	Silty, plastic PEAT.	-	
SP	Fine SAND with some silt; grey mottled brown. Poorly graded.	D	3/3//4/5/6/7 N=22
SM	Silty fine SAND; grey mottled brown. Poorly graded.		
SP	Fine SAND with some silt; grey mottled brown. Poorly graded.	VD	6/9//13/17/17/3 for 5mm N=50+

Total Core Recovery (%): 25 50 75

End of Hole Depth: 20.38 m
Termination: Target depth

VS = Very Soft, S = Soft, St = Stiff, VSt = Very Stiff, H = Hard
MD = Medium Dense, D = Dense, VD = Very Dense
Water level recorded at 0.2 m after 20.0m had been drilled on 14/09/18. Water level recorded at 0.56 m on 19/09/18.

ENGEO Expect Excellence

LOG OF AUGER HA01

Core Education
121 Thorndon Quay
Thorndon, Wellington
15394.000.000

Client : Matt Tippen
Client Ref. : -
Date : 04/10/2018
Hole Depth : 0.45 m
Hole Diameter : 50 mm

Shear Vane No : N/A
Logged By : CM
Reviewed By :
Latitude : 174.783341
Longitude : -41.274464

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm (2 4 6 8 10 12)
	CONCRETE		Reinforced Concrete.				-		
	FILL	SW	Fine to coarse SAND with minor gravel; brown mixed yellowish brown. Well graded; gravel is fine to medium, poorly graded, angular to subrounded. Contains shell and organic fragments.			M	Medium dense		
							Dense		
0.5			End of Hole Depth: 0.45 m Termination Condition: Practical refusal						>>

DRAFT

Hand auger met practical refusal at 0.45 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 0.6 m depth.
Investigation termanated due to suspected services

NZGD ID: HA-DCP_136416

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LOG OF AUGER HA02

Core Education
121 Thorndon Quay
Thorndon, Wellington
15394.000.000

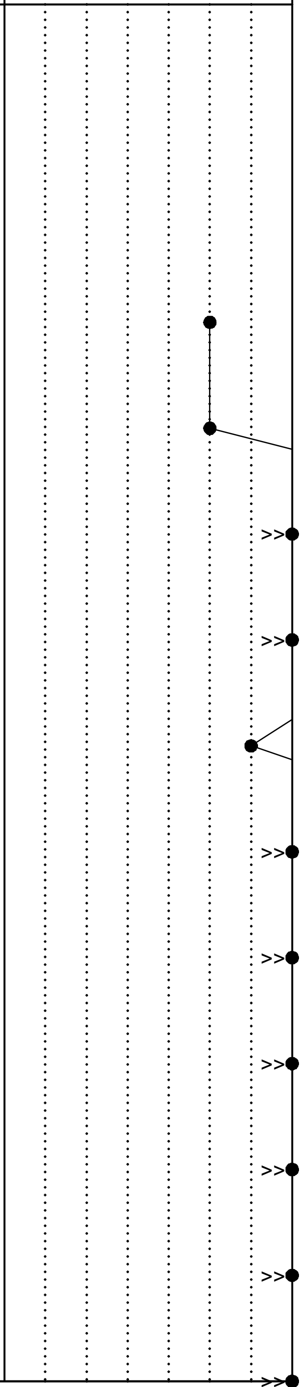
Client : Matt Tippen
Client Ref. : -
Date : 04/10/2018
Hole Depth : 0.3 m
Hole Diameter : 50 mm

Shear Vane No : N/A
Logged By : CM
Reviewed By :
Latitude : 174.783304
Longitude : -41.274357

Depth (m)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	CONCRETE		Reinforced Concrete.			M	-	
	FILL	GP	Sandy fine to medium GRAVEL; grey mixed dark brown. Poorly graded, angular to subangular; sand is course, poorly graded.				Dense	
0.5			End of Hole Depth: 0.3 m Termination Condition: Practical refusal					
1.0								

Scala Penetrometer

Blows per 100mm



Hand auger met practical refusal at 0.3 m depth on inferred gravel.
Scala Penetrometer met practical refusal at 1.3 m depth.

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **BH1**

PROJECT:	Wellington Station Entry Project 602	JOB NUMBER:	3320677/400
SITE LOCATION:	East of Johnsonville Line Embankment	CLIENT:	ONTRACK

CIRCUIT: Wellington Geodetic Datum 1949
COORDINATES: N 703,005.00 m
E 300,603.00 m

BOREHOLE LOCATION: South end of proposed retaining wall
R L: 1.6 m
DATUM: Wellington 1953 (MSL)

Water level: 24/8/08 (2.15pm) (approx. 1.3 m depth)

Depth (m)	Core recovery	Method	SPT 'N'	USCS	Moisture	Soil / Rock Description	Geological unit
0 – 1.0	0 %	Vacuum				Vacuum excavation for service check - no recovery, logged downhole and from spoil. Loosely packed silty GRAVEL; moist, clast supported. Gravel: Coarse, subangular, grey/brown, SW greywacke. Minor subangular, MW greywacke cobbles. Tightly packed, clast supported medium to coarse grey/brown MW greywacke GRAVEL, minor silty matrix; moist. Coarse gravel, and cobbles.	Reclamation Fill
1.0	89 %	SPT	3, 2, 2 N=4	ML	M	Stiff gravelly sandy SILT, trace clay, orange-brown; moist, low plasticity. Gravel: Medium, greyish brown, brown stained, subrounded to subangular, HW greywacke.	Reclamation Fill
	100 %	OB		ML	M	Very stiff (compacted by drilling), sandy SILT, some gravel, minor clay, trace cobbles, orange-brown; moist, low plasticity. Gravel: Medium to coarse, subangular, MW and SW, grey stained brown, strong greywacke. Trace cobbles: MW and SW, grey stained brown, strong greywacke.	Reclamation Fill
2.0	62 %	SPT	2, 5, 7 N=12	MH	M	Very stiff (compacted by drilling) SILT, some sand, some clay, some gravel; moist, high plasticity. Gravel: Fine to coarse, subangular, grey stained brown, MW, moderately strong greywacke.	Reclamation Fill
				GP	W	Firm silty sandy GRAVEL, trace clay, orange-brown; wet, low plasticity. Gravel: Medium to coarse, greyish brown, stained brown HW, poorly cemented sandstone, and MW moderately strong greywacke.	Reclamation Fill
	0 %	CC				Concentrix - no recovery, described from cuttings: Gravelly sandy SILT, minor clay, orange-brown; wet, high plasticity.	Reclamation Fill
						Concentrix - no recovery, described from cuttings: Silty SAND, minor fine gravel, minor clay, greenish/brownish grey; wet, high plasticity. Gravel: Subangular, HW-MW greywacke.	Marine sediments
3.0	11 %	SPT	2, 1, 1 N=2	MH	W	Poor recovery, sample disturbed: Soft sandy SILT, some clay, minor gravel, brownish green/orange; wet, high plasticity. Gravel: Fine, subangular sandstone/greywacke.	Marine sediments
	0 %	TT/CC		MH	S	Poor recovery, sample disturbed (partially drilled with concentrix): Soft gravelly fine sandy SILT, minor to some clay, yellowish brownish green; saturated, high plasticity. Gravel: Medium to coarse, subrounded, brown and black stained MW and SW greywacke.	Pleistocene deposits
4.0	100 %	SPT	4, 8, 9 N=17		M	Firm, some clay, yellowish brown; moist, high plasticity. Gravel: Medium, subangular, greyish brown, stained orange-brown, HW, extremely to very weak sandstone/greywacke.	Pleistocene deposits
	69 %	TT	3	ML	W	Stiff, trace clay; wet, low plasticity. Gravel: Fine to medium, subangular, greyish brown, stained orange brown, HW, extremely weak sandstone, and MW, moderately strong greywacke.	Pleistocene deposits

RL (m) scale: 1, 0, -1, -2, -3

DATE STARTED:	24/8/08	DRILLED BY:	Griffiths Drilling (NZ) Ltd
DATE FINISHED:	24/8/08	EQUIPMENT:	Longyear H170
LOGGED BY:	JUB	DRILL METHOD:	TT/OB/CC/SPT
SHEAR VANE No:		DRILL FLUID:	Water + mud/compressed air
VANE CALIBRATION:		DIAMETER/INCLINATION:	- / 90°

COMMENTS:
Water level measured after drilling ceased, with all drill equipment removed. RL estimated from site plan. Coordinates approximate only, +/- 2m, measured on site by tape. CC = Concentrix drilling, no recovery with this method.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

Revision A

A4 Scale 1:25

NZGD ID: BH_107036

Beca

MACHINE BOREHOLE LOG

BOREHOLE No: **BH1**

PROJECT: Wellington Station Entry Project 602
SITE LOCATION: East of Johnsonville Line Embankment
JOB NUMBER: 3320677/400
CLIENT: ONTRACK

CIRCUIT: Wellington Geodetic Datum 1949
COORDINATES: N 703,005.00 m
E 300,603.00 m
BOREHOLE LOCATION: South end of proposed retaining wall
R L: 1.6 m
DATUM: Wellington 1953 (MSL)

Core recovery	Method	SPT 'N'	Depth (m)	USCS	Moisture	Soil / Rock Description	Geological unit	RL (m)
100 %	SPT	6, 11, N=17		MH	S		Pleistocene deposits (Contd.)	
					M	Moderately thin zone of stiff fine sandy SILT, minor gravel, trace clay; moist, low plasticity.		
100 %	TT					Gravel: Medium to coarse.		-4
100 %	SPT	9, 18, 14, N=32	6					
91 %	TT					Minor clay.		-5
100 %	SPT	6, 8, 13, N=21	7	MH	M	Stiff SILT, some fine sand, some clay, minor gravel, yellowish orange-brown; moist, high plasticity. Gravel: Fine to medium, subangular, brownish grey, stained brown, HW, very weak greywacke.		
100 %	TT			ML		Some medium to coarse subangular gravel, trace clay; low plasticity.		-6
						Thin zone of laminated bedding.		
					W	Thin lens of clayey SILT; moist, high plasticity. Wet.		
100 %	SPT	8, 16, 17, N=33	8	ML	M	Stiff sandy SILT, some gravel, minor clay, yellowish brown, mottled grey; moist, low plasticity. Gravel: Fine to medium, subangular, orange/brown, HW, extremely to very weak greywacke.		
						END OF LOG @ 8.45 m		-7
			9					
								-8

DRAFT

DATE STARTED:	24/8/08	DRILLED BY:	Griffiths Drilling (NZ) Ltd
DATE FINISHED:	24/8/08	EQUIPMENT:	Longyear H170
LOGGED BY:	JUB	DRILL METHOD:	TT/OB/CC/SPT
SHEAR VANE No:		DRILL FLUID:	Water + mud/compressed air
VANE CALIBRATION:		DIAMETER/INCLINATION:	- / 90°

COMMENTS: Water level measured after drilling ceased, with all drill equipment removed. RL estimated from site plan. Coordinates approximate only, +/- 2m, measured on site by tape. CC = Concentrix drilling, no recovery with this method.

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

A4 Scale 1:25

Revision A

MACHINE_BOREHOLE P:\332\3320677\400\TGE\WELLINGTON STATION ENTRY PROJECT 602.GPJ BECA.GDT 26/9/08

NZGD ID: BH_107036

Borehole Location

Downhole View (vacuum excavated):

DEPTH: 0 to 1.0m

Beca

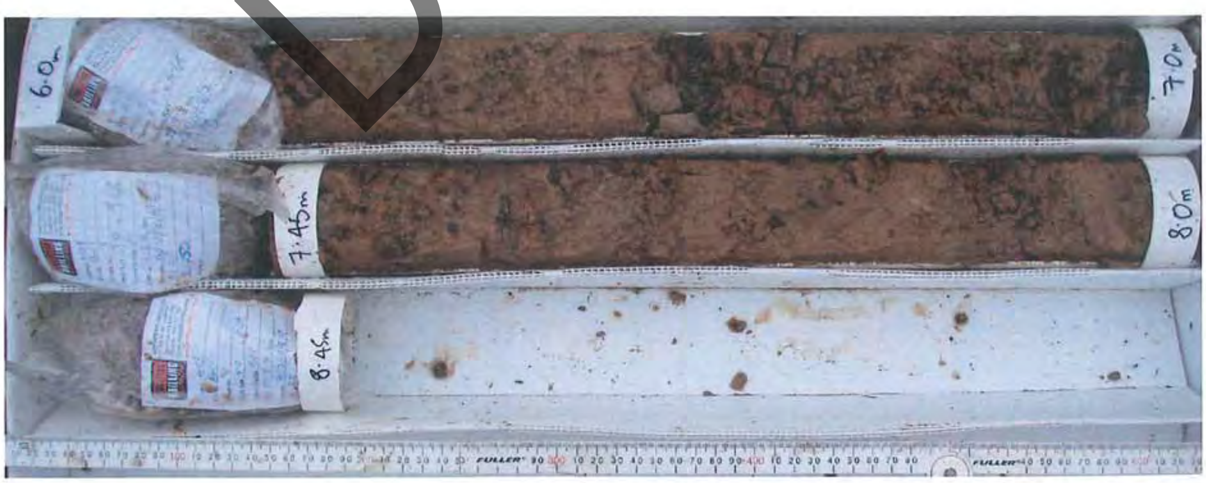
Borehole Photos

3320677/400

BH1

NZGD ID: BH_107036

BOX: 1 **DEPTH: 1.0 to 6.0m**



BOX: 2 **DEPTH: 6.0 to 8.45m**

NZGD ID: BH_107036

Beca

TEST PIT LOG

TEST PIT No: TP 0.8

SHEET 1 of 1

PROJECT:	Wellington Station Entry Project 602	JOB NUMBER	3320677/240
SITE LOCATION:	Wellington Station Yard	CLIENT:	ONTRACK

TESTPIT LOCATION: Approx. 0.8 km from Wellington Station, near the stadium

COORDINATES: N 703,005 m E 300,608 m

R L: 1.87 m

DATUM: Horizontal: Wellington Geodetic 1949; Vertical: Wellington 1953 (MSL)

GEOLOGICAL UNIT	R L (m)	DEPTH (m)	WATER LEVEL	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL DESCRIPTION	SAMPLES	Scala (Blows/150mm)	SV (kPa)	τ (kPa)
Fill					GM	D	MD	Tightly packed, 'medium dense', brown and grey layered silty GRAVEL; dry, non plastic, matrix supported				
					GW	D	MD	Loosely packed, 'medium dense', brown/grey GRAVEL, minor silt, minor sand; dry, non plastic, gravel supported. Gravel: Strong, SW, grey, fine to coarse, minor cobbles, well graded, subrounded and rounded greywacke				
						M		Dark brown, silty sandy GRAVEL; moist				
					GM	M	MD	Tightly packed, 'medium dense', grey GRAVEL, some silt, some sand, trace clay; moist, non plastic, gravel supported. Gravel: Strong, SW, grey, medium, some coarse, poorly graded, subangular greywacke				
					SP	M	L	Tightly packed, 'loose/medium dense', brownish grey silty gravelly SAND, trace clay; moist, slightly plastic (matrix), matrix supported. Gravel: Strong, SW, grey, fine to medium, subrounded and subangular greywacke. Sand: Medium				
	1	1			GM	M	MD	Thin (20 mm) layer of black, silty gravelly SAND; moist, non plastic. Tightly packed, 'medium dense', orange-brown, silty sandy GRAVEL, trace clay; moist, slightly plastic (matrix), gravel supported. Gravel: Weak to moderately strong, HW-MW, orange/brown, medium to coarse (well graded), subangular greywacke	D1			
	0	2	24/2/08 (10.45 am)					End of Test Pit 2 m				
	-1											

DATE DRILLED:	24/2/08	EXCAVATION METHOD: Hitachi EX60	COMMENTS: Pit located at 7.1 m offset east of NIMTL down main. Tidal conditions - falling
LOGGED BY:	JUB	CONTRACTOR: HRS	
PILCON VANE No:			

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_TP P:\3320\3320677\240\TGE\TESTPITS.GPJ BCHFMB2.GDT 25/3/08

NZGD ID: TP_107039

Beca

3320677/240

Test Pit Photos

TP 0.8

NZGD ID: TP_107040

Beca

TEST PIT LOG

TEST PIT No: **TP 1.15**

SHEET 1 of 1

PROJECT:	Wellington Station Entry Project 602	JOB NUMBER:	3320677/240
SITE LOCATION:	Wellington Station Yard	CLIENT:	ONTRACK

TESTPIT LOCATION: Approx. 1.15 km from Wellington Station

COORDINATES: N 703,370 m E 300,462 m

R.L: 1.88 m

DATUM: Horizontal: Wellington Geodetic 1949; Vertical: Wellington 1953 (MSL)

GEOLOGICAL UNIT	R.L (m)	DEPTH (m)	WATER LEVEL	GRAPHIC LOG	CLASSIFICATION	MOISTURE	CONSISTENCY	SOIL DESCRIPTION	SAMPLES	Scala (Blows/150mm)	SV (kPa)	τ (kPa)
Fill					GM	D	D	Tightly packed, 'dense', brown sandy GRAVEL, some silt; dry, non plastic, gravel supported. Gravel: Strong, SW, grey, fine to medium, minor coarse, well graded, subrounded and subangular greywacke.				
					GM	M	D	Tightly packed, 'dense', dark brown silty GRAVEL, some sand, trace clay, minor refuse (rags, timber); moist, non plastic. Gravel: Strong, SW, grey, medium to coarse, minor cobbles, well graded, rounded and subangular greywacke.				
					GM	M	D	Tightly packed, 'dense', black and dark grey, silty sandy GRAVEL, trace clay; moist, slightly plastic (matrix), matrix/gravel supported. Gravel: Strong, SW, grey, medium to coarse, poorly graded, subangular to angular, greywacke and black, subangular coal.				
					GM	M	MD	Tightly packed, 'medium dense', greyish brown, sandy silty GRAVEL, moist, non plastic, gravel supported. Gravel: Strong, SW, grey, medium to coarse, poorly graded, subrounded and subangular greywacke.				
	1	1			SP	W	L	Loosely packed, 'loose', dark brown gravelly SAND, some refuse (bricks, broken terracotta pipe); wet, non plastic, matrix supported, hydrocarbon odour. Gravel: Strong, SW, grey, medium to coarse, poorly graded, subrounded greywacke and black coal. Sand: Medium to coarse.	D1			
	0	2	24/2/08 (9.45 am)					End of Test Pit 1.8 m				
	-1											

DATE DRILLED: 24/2/08	EXCAVATION METHOD: Hitachi EX60	COMMENTS:	
LOGGED BY: JUB	CONTRACTOR: HRS	Pit located at 5.0 m offset east of NIMTL down main. Tidal conditions - falling	
PILCON VANE No:			

FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS SEE KEY SHEET

BIL_TP P:\3320677\240\TGE\TESTPITS.GPJ BCHFMB2.GDT 25/3/08

DRAFT

NZGD ID: TP_107040

Test Pit Photos

TP 1.15

NZGD ID: TP_107040

T82749.003-HA1

TONKIN & TAYLOR LTD.

BOREHOLE LOG

BOREHOLE NO: HA1
SHEET 1 OF 1

PROJECT: WCC-1 STONE HILL
LOCATION: 1 Stone Hill, Thorndon
JOB NO: 82749.003-HA1
CO-ORDINATES:
DRILL TYPE: Hand Auger
DRILL METHOD:
HOLE STARTED: 5 September 2000
HOLE FINISHED: "
RL: 1.15m below AC surface @ SC1
DRILLED BY: MRT
DATUM:
DRILL FLUID: None
LOGGED BY: MRT
CHECKED BY: BS

FLUID LOSS	WATER	CORE RECOVERY	METHOD/CASING	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SHEAR STRENGTH OR RELATIVE DENSITY	ESTIMATED SHEAR STRENGTH, kPa (10 25 50 100 200)	ORIGIN TYPE, MINERAL COMPOSITION, DETECTS, STRUCTURE	UNIT
N/A	DRY ON COMPLETION	N/A	N/A					ML	SILT, slightly plastic, brown, some CLAY, some ORGANICS, minor GRAVELS (med. subangular)	M	VL		TOPSOIL	
						0.5		ML	... as above, mixed brown, light grey, orange-brown, minor GRAVELS	M	F		FILL	
						1.0								
						1.35		ML	SILT, slightly plastic, lightgrey with orange mottles, some GRAVELS (fine, angular) trace fine SAND	M	H			
									REFUSAL @ 1.35m					

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D

Appendix C – Historical Investigations: Aotea Quay Roundabout

D.1 Previous Geotechnical Investigations in Proximity to Aotea Quay Roundabout.

NZGD ID	Consultant	Year	Location	Type	Depth (m)
BH_72203	ENGEO Ltd	2015	North-West of roundabout	Machine Borehole	19.91
BH_137712	ENGEO Ltd	2018	North-West of roundabout	Machine Borehole	1.50
CPT_72648	ENGEO Ltd	2016	North-West of roundabout	CPT	9.00
BH_72202	ENGEO Ltd	2015	South-West of roundabout	Machine Borehole	19.95
CPT_72644	ENGEO Ltd	2015	South-West of roundabout	CPT	9.00
BH_115248	Tonkin & Taylor Ltd	2008	East of roundabout	Machine Borehole	24.18

ENGEO Expect Excellence

LOG OF BORING BH4

Aotea Quay Toll Depot
151 Aotea Quay
Wellington 6011
12051

Client : KiwiRail
Date : 05/05/15
Hole Depth : 19.91 m
Drilling Method : Sonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 100 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 1749588.9
Longitude : 5429825.7

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Pocket Pen. UCS (kPa)	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
0.0–1.2	SITE FILL	NR		Core loss.	NR								
1.2–1.4	RECLAMATION FILL		ML	Sandy gravelly SILT, brown. Low plasticity. Sand is coarse. Gravel is fine, subangular to subrounded.				S					
1.4–1.95			SP	SAND with minor gravel and a trace of silt, grey. Sand is medium to coarse. Gravel is fine to medium, subangular to subrounded. Shell fragments.				MD	4/3//3/3/3/3 N=12				
1.95–2.05		NR		Core loss.	NR								
2.05–4.45			SP	Gravelly fine to coarse SAND with minor silt, brown. Gravel is fine to coarse, subangular to subrounded. Shell fragments and rootlets.		▼		L	3/3//2/2/2/3 N=9				
4.45–4.55			ML	Sandy SILT with some gravel, grey. Low plasticity.				F					
4.55–5.0			ML	Sand is medium to coarse. Gravel is fine to medium, subangular to subrounded. Shell fragments.				VS	1/1//1/0/1/0 N=2				
5.0–5.3		NR		Clayey SILT with minor sand and a trace of gravel, grey. Moderate plasticity. Core loss.	NR								
5.3–7.0			MH	Clayey SILT, grey. High plasticity. - 5.25 m to 5.75 m with minor sand and a trace of fine gravel.				VS	0/0//0/1/1/0 N=2				

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NZGD ID: BH_72203

LOG OF BORING BH4

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Aotea Quay Toll Depot
151 Aotea Quay
Wellington 6011
12051

Client : KiwiRail
Date : 05/05/15
Hole Depth : 19.91 m
Drilling Method : Sonic
Drilling Contractor : Griffiths Drilling

Core Diameter : 100 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 1749588.9
Longitude : 5429825.7

Material: INTERBEDDED MARGINAL MARINE / FAN DEPOSITS

Depth (m)	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
	MH	Clayey SILT, grey. High plasticity. - 5.25 m to 5.75 m with minor sand and a trace of fine gravel.	VS	
7.5				0/0//1/0/1/1 N=3
8.0				
8.5		- 8.75 m to 8.95 m layer of black organic silt.	S	
9.0	ML	Sandy SILT with some gravel, dark grey. Moderate plasticity. Sand is medium to coarse. Gravel is fine to medium, subangular to subrounded. Shell fragments.		2/1//0/1/1/2 N=4
9.5	ML	SILT with some sand and gravel, dark grey. Moderate plasticity. Sand is coarse. Gravel is fine to medium, subangular to subrounded. - 9.45 m to 9.55 m layer of black organic silt. - at 9.8 m becomes gravelly and sandy. Low plasticity. Gravel is fine to coarse, subangular to subrounded. - at 10.0 m becomes bluish grey, sandy with some fine gravel.	F	
10.5		- from 10.95 m with some sand and fine gravel. Moderate plasticity.	St	3/4//2/2/3/6 N=13
11.0	MH	SILT with minor sand, bluish grey. High plasticity. - 11.4 m to 11.7 m with some sand and gravel. Low plasticity. Gravel is fine to medium, subangular to subrounded.	S	
11.5			F	
12.0	ML	Sandy gravelly SILT, bluish grey. Low plasticity. Sand is coarse. Gravel is fine to medium, subangular to subrounded.	H	9/11//11/10/10/13 N=44
13.0			VSt	
13.5	ML	SILT, grey with purple laminations. Moderate plasticity.	St	7/3//2/2/2/4 N=10
14.0				

Columns also present: Material, Sample Type, Log Symbol, Water Level, Moisture, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25 50 75), Notes

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NZGD ID: BH_72203

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LOG OF BORING BH4

Aotea Quay Toll Depot
151 Aotea Quay
Wellington 6011
12051

Client	: KiwiRail	**Core Diameter**	: 100 mm
Date	: 05/05/15	**Hammer Efficiency**	: 87.9 %
Hole Depth	: 19.91 m	**Logged By/Reviewed By**	: GL / KJ
Drilling Method	: Sonic	**Latitude**	: 1749588.9
Drilling Contractor	: Griffiths Drilling	**Longitude**	: 5429825.7

Material: INTERBEDDED MARGINAL MARINE / FAN DEPOSITS

Depth (m)	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
14.5	ML	SILT, grey with purple laminations. Moderate plasticity. - at 14.3 m becomes with some gravel and minor sand. Gravel is fine to coarse, subangular.	St	
15.0	ML	Sandy SILT with some gravel, bluish grey. Low plasticity. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded.	H	7/11//13/13/13/11 N=50
15.5		- 15.45 m to 15.55 m core loss. - from 15.55 m moderate plasticity. - 15.75 m to 16.05 m with a trace of fine gravel and sand.		
16.0		- 16.05 m to 16.4 m low plasticity. - from 16.4 m with a trace of sand.		
16.5	ML	SILT with minor sand, grey. Moderate plasticity.	VSt	2/5//3/3/5/6 N=17
17.0				
17.5	ML	Sandy SILT with some gravel, bluish grey. Moderate plasticity. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded.		
18.0	ML	SILT with minor sand and a trace of gravel, grey. Moderate plasticity. Sand is coarse. Gravel is fine to medium, subangular to subrounded.	St	7/7//11/10/9/8 N=38
18.5	ML	SILT with some sand and a trace of gravel, bluish grey. Moderate plasticity. Sand is fine to medium. Gravel is fine, subangular to subrounded. - from 18.6 m with minor sand and no gravel.		
19.0		- at 19.0 m becomes partially cemented.	H	
19.5				8/12//13/13/16/8 for 35 mm N=50+

End of Hole Depth: 19.91 m
Termination: Target depth

Columns: Depth (m), Material, Sample Type, USCS Symbol, DESCRIPTION, Log Symbol, Water Level, Moisture, Consistency/ Density Index, SPT N-Value, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) 25 50 75, Notes

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GEOSCIENCE MACHINE BORING BOREHOLES REV 01.GPJ NZ DATA TEMPLATE 2.GDT 1/3/16

NZGD ID: BH_72203

GEOTECHNICS

BOREHOLE LOG

BOREHOLE No.: **WS 24**
Hole Location: Refer to TLP
SHEET: 1 OF 1

PROJECT: GWN TOLL AOTEA QUAY ENGEO | LOCATION: Aotea Quay, Pipitea, Wellington | JOB No.: 1006494.0000

CO-ORDINATES: (NZTM)
R.L.:
DATUM

DRILL TYPE: Window Sampler
DRILL METHOD: WS
DRILL FLUID: N/A

HOLE STARTED: 27/03/2018
HOLE FINISHED: 27/03/2018
DRILLED BY: GEOTECHNICS
LOGGED BY: JMG CHECKED: ABB

GEOLOGICAL (geological unit, generic name, origin, material composition)	Core recovery (%)	Casing	Tests	Depth (m)	Moisture condition / weathering	Strength/density classification	Description and Additional Observations
	100	100mm Concrete cutter					Concrete.
	100		WS24-1 @ 0.5m		M	D	SAND (SP), with minor silt, with trace gravel; orange brown. Dense; moist; poorly graded; sand, fine to medium; gravel, fine, subangular to subround.
						MD	*0.60m:* Medium dense.
		35mm		1			Silty SAND (SP); grey . Medium dense; moist; poorly graded; sand, fine.
	100					VL	*1.15m:* Very loose.
		35mm				MD	SAND (SW), with trace shell fragments; grey . Medium dense; Moist; well graded; sand, fine to coarse.
							1.5m: Target depth

Water: DRY 27/03/2018

COMMENTS

Hole Depth 1.5m

Scale 1:9

Rev.: A

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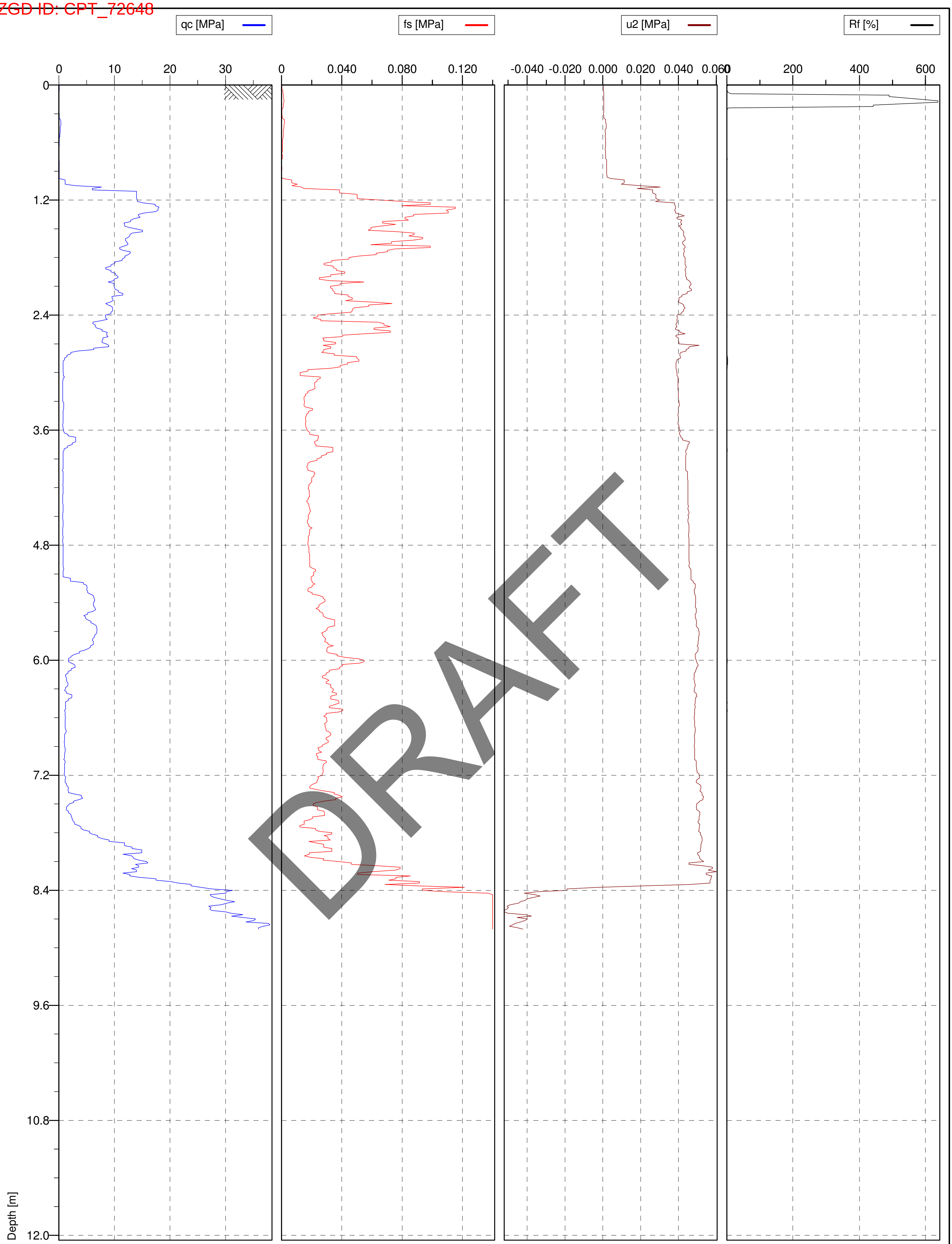

GRIFFITHS DRILLING

U2

Cone No: 3842
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Aotea Quay	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: 3
Project ID: 3	Client: ENGEO	Date: 5/05/2015	Scale: 1 : 50
Project: AOTEA		Page: 1/1	Fig:
		File: Aotea CPT3.cpt	

ENGEO
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LOG OF BORING BH3

Aotea Quay Toll Depot
151 Aotea Quay
Wellington 6011
12051

Client : KiwiRail
Date : 04/05/15
Hole Depth : 19.95 m
Drilling Method : Sonic
Drilling Contractor : Griffiths Drilling

Core Diameter : 100 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 1749607.7
Longitude : 5429756.5

Depth (m)	Material	Sample Type	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
0.0 – 0.3	SITE FILL			Concrete.		
0.3 – 0.7	SITE FILL		SP	Fine to coarse SAND with a trace of gravel, dark brown. Gravel is coarse, subangular.	L	
0.7 – 0.9	SITE FILL		GW	Sandy fine to coarse GRAVEL with a trace of silt, brown. Gravel is subangular to subrounded. Sand is medium to coarse.	L	
0.9 – 1.3	SITE FILL		MH	SILT with occasional pockets of coarse sand and gravel, grey. High plasticity. Shell fragments and occasional steel fragments.	S	
1.3 – 1.4	SITE FILL	NR		Core loss.		
1.4 – 1.9	RECLAMATION FILL		MH	SILT with occasional pockets of coarse sand and gravel, grey. High plasticity. Shell fragments and occasional steel fragments.	St	2/2//3/3/4/4 N=14
1.9 – 2.1	RECLAMATION FILL	NR		Core loss.		
2.1 – 2.3	RECLAMATION FILL		ML	SILT with some sand, grey. Moderate plasticity. Sand is medium to coarse. Shell fragments.	St	
2.3 – 3.5	RECLAMATION FILL		SP	Gravelly coarse SAND with minor silt, grey. Gravel is fine to coarse, subrounded to rounded. Shell fragments.	L	2/1//3/1/2/1 N=7
3.5 – 7.0	RECLAMATION FILL		MH	Clayey SILT, grey. Moderate to high plasticity. Shell fragments.	VS	0/0//0/0/0/0 N=0; 0/0//0/0/0/0 N=0

Log Symbol | Water Level | Moisture | Pocket Pen. UCS (kPa) | Torvane Shear (kPa) | Total Core Recovery (%) 25 50 75 | Notes

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0

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GEOSCIENCE MACHINE BORING BOREHOLES REV 01.GPJ NZ DATA TEMPLATE 2.GDT 1/3/16

NZGD ID: BH_72202

ENGEO Expect Excellence

LOG OF BORING BH3

Aotea Quay Toll Depot
151 Aotea Quay
Wellington 6011
12051

Client : KiwiRail
Date : 04/05/15
Hole Depth : 19.95 m
Drilling Method : Sonic
Drilling Contractor : Griffiths Drilling
Core Diameter : 100 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 1749607.7
Longitude : 5429756.5

Depth (m)	Material	USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value
7.5	RECLAMATION FILL	MH	Clayey SILT, grey. Moderate to high plasticity. Shell fragments. - 7.45 m to 7.95 m with a trace of coarse gravel.	VS / S	0/0//1/1/1/1 N=4
8.0		OH	Organic SILT with some sand, black. Moderate plasticity. Sand is medium to coarse. Rootlets and wood fragments.	S	
		SM	Silty coarse SAND, dark grey. Shell fragments.	L	
8.5	INTERBEDDED MARGINAL MARINE / FAN DEPOSITS	GW	Sandy fine to coarse GRAVEL with some silt, grey. Gravel is subangular to subrounded. Sand is medium to coarse. - 8.85 m to 9.45 m brown. - at 9.65 m becomes more sandy.	D	4/7//7/6/9/8 N=30
10.0		SP	Gravelly coarse SAND with some silt, brown. Gravel is fine to coarse, subangular to subrounded.	MD	
		ML	SILT, bluish grey. Low plasticity. - from 10.5 m with some sand. - 10.5 m to 10.95 m with some fine gravel. - at 10.95 m becomes high plasticity.	St	1/0//1/1/5/7 N=14
11.0		ML	Gravelly SILT with some sand, bluish grey. Moderate plasticity. Gravel is fine to coarse, subangular to subrounded. Sand is coarse.		
		ML	SILT, grey. Moderate plasticity. - 11.4 m to 11.5 m with some fine gravel.	F	
		ML	Sandy SILT with some gravel, bluish grey. Low plasticity. Sand is medium to coarse. Gravel is fine to medium, subangular to subrounded.	VSt	
12.0		SP	Silty gravelly medium to coarse SAND, bluish grey. Gravel is fine to medium, subangular to subrounded.	D	7/9//12/10/10/10 N=42
12.9		MH	SILT, bluish grey. High plasticity.	F	
13.0		ML	Sandy gravelly SILT, bluish grey. Low plasticity. Sand is coarse. Gravel is fine to coarse, subangular to subrounded.	H	1/11//12/9/11/9 N=41
14.0					

Columns also shown: Sample Type, Log Symbol, Water Level, Moisture, Pocket Pen. UCS (kPa), Torvane Shear (kPa), Total Core Recovery (%) (25 50 75), Notes

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GEOSCIENCE MACHINE BORING BOREHOLES REV 01.GPJ NZ DATA TEMPLATE 2.GDT 1/3/16

ENGEO Expect Excellence

LOG OF BORING BH3

Aotea Quay Toll Depot
151 Aotea Quay
Wellington 6011
12051

Client : KiwiRail
Date : 04/05/15
Hole Depth : 19.95 m
Drilling Method : Sonic
Drilling Contractor : Griffiths Drilling

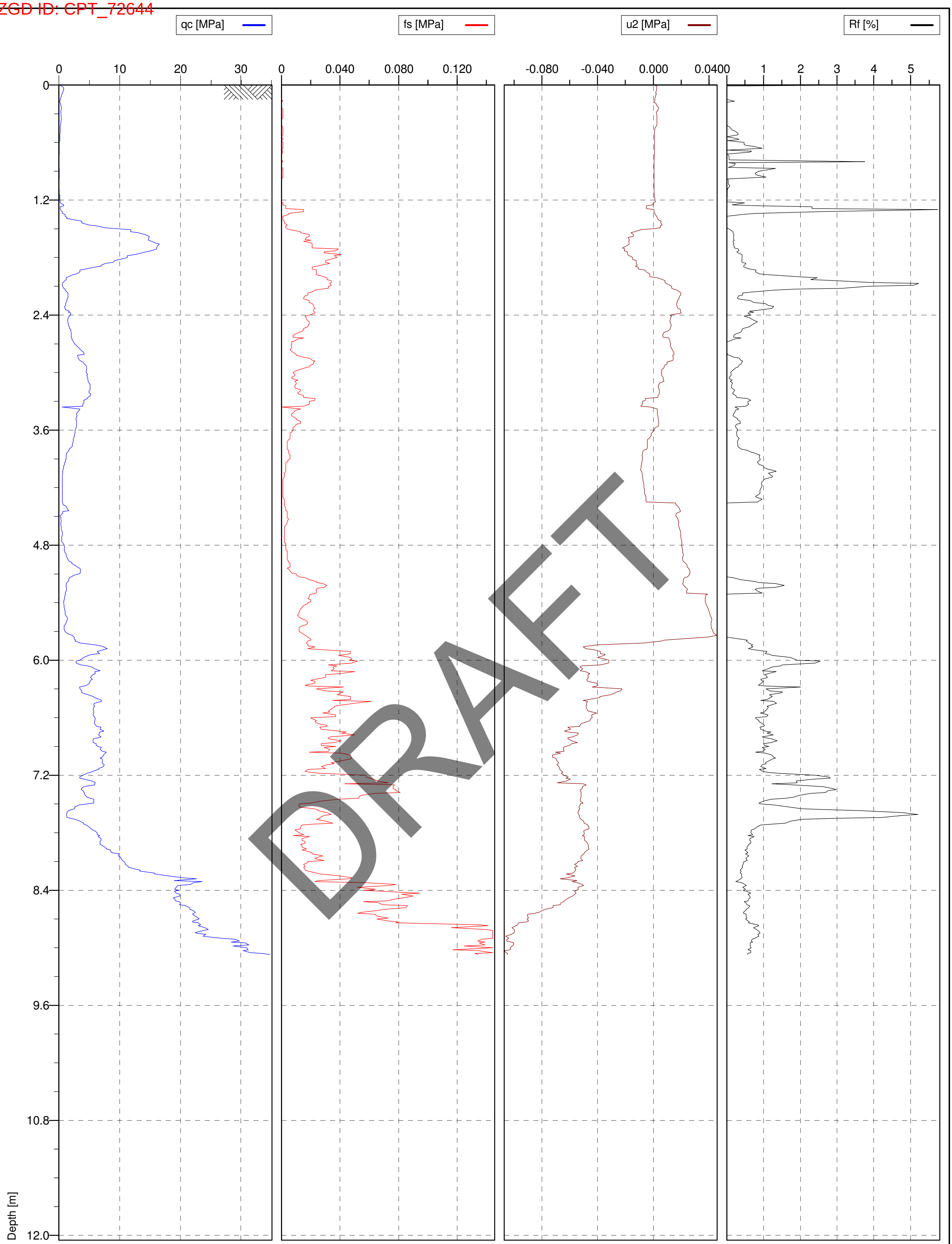
Core Diameter : 100 mm
Hammer Efficiency : 87.9 %
Logged By/Reviewed By : GL / KJ
Latitude : 1749607.7
Longitude : 5429756.5

Material: INTERBEDDED MARGINAL MARINE / FAN DEPOSITS

Depth (m): 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5

USCS Symbol	DESCRIPTION	Consistency/ Density Index	SPT N-Value	Notes
SM	Silty medium to coarse SAND with some gravel, bluish grey. Gravel is fine to coarse, subangular to subrounded.	D		
ML	Sandy SILT with some gravel, grey. Low plasticity. Sand is medium to coarse. Gravel is fine to coarse, subrounded to subangular. - at 14.7 m becomes more sandy and gravelly.	H		
ML	SILT with minor sand and gravel, bluish grey with brown laminations. Moderate plasticity. Gravel is fine, subangular.			
GP	Silty sandy fine to medium GRAVEL, bluish grey. Gravel is subangular to subrounded. Sand is coarse.	VD	9/12//13/14/16/7 for 30 mm N=50+	
ML	Sandy SILT with some gravel, bluish grey. Low plasticity. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded.	VSt, H	5/12//11/12/9/7 N=39	
ML	SILT, bluish grey with brown laminations. Moderate plasticity. Wood fragments. - at 17.7 m becomes gravelly with minor sand and yellow discolourations.	VSt	6/6//4/4/8/12 N=28	
ML	SILT with some gravel and minor sand, bluish grey. Low plasticity. Gravel is fine to coarse, subangular to subrounded.			
ML	SILT with minor sand and a trace of gravel, bluish grey. Low plasticity, partially cemented.	St	0/2//2/4/3/4 N=13*	* SPT result appears annomalous. Consistency based on visual assessment.

End of Hole Depth: 19.95 m
Termination: Target depth



GRIFFITHS DRILLING

U2

Cone No: 3842
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Aotea Quay	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test no: 5
Project ID: 5	Client: ENGEO	Date: 7/05/2015	Scale: 1 : 50
Project: AOTEA		Page: 1/1	Fig:
		File: Aotea CPT5.cpd	

NZGD ID: CPT_72644

TONKIN & TAYLOR LTD.

BOREHOLE LOG

BOREHOLE NO: 103
SHEET 1 OF 2

PROJECT: Centreport Springer Piles
LOCATION: Centreport
JOB NO: 84464
CO-ORDINATES: Refer to figure 1
DRILL TYPE
DRILL METHOD: Rotary Wash drilling & SPT
HOLE STARTED: 11/4/08
HOLE FINISHED: 11/4/08
RL:
DRILLED BY: Griffiths Drilling
DATUM:
DRILL FLUID: water + Quick Mud
LOGGED BY CWP
CHECKED BY: [illegible]

DRILLING AND TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

FLUID LOSS	WATER	CORE RECOVERY	METHOD/CASING	SAMPLES, TESTS	RL (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SHEAR STRENGTH OR RELATIVE DENSITY	ESTIMATED SHEAR STRENGTH, kPa (10 25 50 100 200)	ORIGIN TYPE, MINERAL COMPOSITION, DEFECTS, STRUCTURE	UNIT
					15			Depth from wharf to sea-bed. Drilling commenced at 15.73m					
SLOW LOSS					16		SM	Gravelly SAND with some Silt. Dark greenish grey; Sand, well graded, medium grained; Gravel, Sub angular particles, up to 30mm diameter; low plasticity;	M	D		Alluvial/Colluvial derived sediments	
			SPT 1	13//14/11/13/12 N=50 R=280	17								
			SPT 2	6//11/11/11/17 N=50 R=440			OH	Silty Clay Dark brown; uniformly graded; Moderate plasticity; Traces of organics: bark & plant material.	M	H		Harbour sediments	
					18		SM	Gravelly SAND with some Silt. Dark greenish grey; Sand, well graded, medium grain size; Gravel, Sub angular particles, up to 30mm diameter; low plasticity;	M	D		Alluvial/colluvial derived sediments	
							OH	Silty Clay - Dark brown; uniformly graded; Mod plasticity; Trace of organics: bark & other plant material	M	VS		Harbour sed.	
			SPT 3	21//12/8/7/7 N=34 R=420	19		GM	Silty GRAVEL with some Sand Dark greenish brown; Gravel, fine to medium, sub angular, up to 20mm diameter; Sand, well graded, fine to coarse; Silt, concentrates in uniformly graded peckets, low plasticity.	M	D		Alluvial/colluvial derived sediments	
			SPT 4	6//9/12/24/5 (5mm) N=50+ R=400	20				M	VD			

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NZGD ID: BH_115248

TONKIN & TAYLOR LTD.

BOREHOLE LOG

BOREHOLE NO: 103
SHEET 1 OF 2

PROJECT: Centreport Springer Piles
LOCATION: Centreport
JOB NO: 84464
CO-ORDINATES:
RL:
DATUM:
DRILL TYPE
DRILL METHOD: Rotary Wash drilling & SPT
DRILL FLUID: Water + Quick Mud
HOLE STARTED:
HOLE FINISHED:
DRILLED BY: Griffiths Drilling
LOGGED BY CWP
CHECKED BY: RP

FLUID LOSS	WATER	CORE RECOVERY	METHOD/CASING	SAMPLES, TESTS	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	SHEAR STRENGTH OR RELATIVE DENSITY	ESTIMATED SHEAR STRENGTH, kPa	ORIGIN TYPE, MINERAL COMPOSITION, DEFECTS, STRUCTURE	UNIT
				N=50+		20		GM	(continued) Silty GRAVEL with some Sand	M	VD		Alluvial/ Colluvial derived Sediments	
			SPT 5	60 (90mm) N=50+ REFUSAL R=NIL		21								
			SPT 6	16/12/17/16/5(15mm) N=50+ R=380		22		GM		M	VD			
SLOW LOSS								OH	Silty Clay with traces of gravel. Dark brown; Uniformly graded; Mod plasticity; traces of organics - plant material; Gravel, fine to med, sub angular, up to 20mm	M	VS		Marine Sediments	
			SPT 7	9/7/14/20/9-(35mm) N=50+ R=420		23		GM	Sandy GRAVEL with some Silt. Dark Greenish Brown; Low plasticity; Gravel well graded, fine to coarse, up to 40mm diameters; Sand, well graded; fine to medium; Particles are sub angular; Traces of organic material: Plant matter.	M	VD		Alluvial/ Colluvial derived sediments	
			SPT 8	35/50 (60mm) N=50+ R=240		24								
						25			Borehole Terminated at 24.18m. Target depth achieved.					

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NZGD ID: BH_115248

Appendix E

Safety in Design Register

Safety in Design Risk Assessment Register

Let's Get Wellington Moving | Beca | AECOM

Author (Role):	Blaise Cummins	Job No:	3821501
Approved By:	Will Maguire	Date	7 October 2021
Revision:	2	Stage of Design / Project:	Preliminary Design
Project Name:	LGWM - Thorndon Quay & Hutt Road		

Green = Thordon Quay; Orange = Hutt Rd; Purple = Aotea Quay; Blue = General

(Note: minimum of 2 reviews per project)

RISKS ASSOCIATED WITH DESIGN ELEMENTS					Risk Matrix			PROPOSED & APPROVED MITIGATION MEASURES	Mitigated Risk & Resolution							RESIDUAL RISK	
Ref	Chainage	Hazard (Guideword)	Cause & Outcome	Existing controls, if any	L	C	LR	Proposed Control (1 Eliminate, 2 Substitute, 3 Reduce, 4 Control)	L	C	LR	Risk Owner	Client Approved	Design Status	Date	Risk Owner	Action Required
1 Construction Phase																	
1.001		*Position / Location*	Working in close proximity to live road hence the potential to causing accidents		2	4	H	Contractor to have appropriate training and produce safe working systems/STMS plans. Construction work will need to be split into manageable sections.	1	4	M						
1.002		*Position / Location*	Working in close proximity to power poles and under ground services results in services being struck.		2	4	H	Obtain the information on service location from DialB4UDig and representatives from Chorus/Gas operators to be present during excavation.	1	3	M						
1.003		*External safety interfaces*	Lack of communication with local residents causes issues.		2	2	L	Adequate communication with locals prior to construction via letter drops etc.	1	1	L						
1.004		*Position / Location*	Improper removal of vegetation causes issues		2	2	L	Adequate consultation with locals and use of professional arborists.	1	1	L						
1.005		Signals and telecommunications	Underground KiwiRail assets get struck during construction eg signals cables		3	4	H	Contractor to arrange for on-site mark out of all services prior to construction and arrange for a copy of the current services plans.	1	4	M						
1.006		Signals and telecommunications	Underground telecommunications assets get struck during construction		3	4	H	Contractor to arrange for on-site mark out of all services prior to construction and arrange for a copy of the current services plans.	1	4	M						
1.007		*Position / Location*	Provision of access to properties during construction phase may be difficult to impossible, Off street parking and the like		2	1	L	Contractor to arrange good traffic management	1	1	L						
1.008		*Position / Location*	Road to be kept operational at all times.		2	1	L	Phasing and programme to be developed to suit safely maintaining operation of the highway at all times	1	1	L						
1.009		*Position / Location*	work to be carried out adjacent to operational rail land, with live overhead catinery.		1	5	H	Agreement with Kiwi Rail on the risks and mitigations will be necessary	1	1	L						
2 Operation & Maintenance Phase																	
2.001	CH 220m	*Egress / Access*	Cyclists collide with pedestrians and / or vehicles at Sky Stadium entrance	Is TMP in use already when a large event is held?	4	4	E	Landscaping / fencing to guide pedestrians at such points should be considered.	2	2	L						
2.002	CH240m, CH320m, CH460m, CH540m	*Egress / Access*	Cyclists collide with vehicles at accessways of existing Capital Gateway car parks		3	4	H	Appropriate width for traffic coming in and out, enough warning for traffic to think about cyclists. Remove the first car park on the north of the most southern exit of Capital Gateway car park. Rumble strips to slow cyclists either side of driveways. Working with Capital Gateway to have proper infrastructures installed at the car park exits to make drivers more aware of path users - include during next phase of design (RSA for Prelim Design - Finding 4.6)	2	2	L						
2.003	Various	*External safety interfaces*	On Thorndon Quay corridor: conflicts between cyclists and pedestrians on the proposed new shared path with segregation	A step to delineate between the users	3	2	M	A different colour and texture is preferred to delineate different road users on the shared path.	1	2	L						
2.004	CH 160m - CH 1500m	*External safety interfaces*	On Thorndon Quay corridor: Cyclists and motorcyclists may use the space between on-street parallel parking and central carriageway and maybe crash into doors opening on them		3	3	H	Add appropiate signage such as all cyclists to use cyclepath etc	2	2	L						
2.005	CH 240m - CH 1500m	*Egress / Access*	Western side of Thorndon Quay corridor: Business vehicles reversing out of properties collide with pedestrians	It is an existing issue. Adequate footpath width will be retained.	2	3	M	Possible addition of signage	1	2	L						

Sensitivity: General

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Approved By:	Will Maguire	Date	7 October 2021
Revision:	2	Stage of Design / Project:	Preliminary Design
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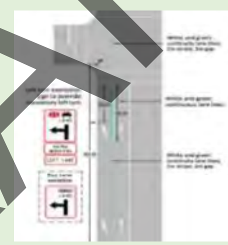
2.006	CH 700m	*Position / Location*	Davis St/TQ intersection: The right turn in movement on TQ would block the southbound traffic. Southbound vehicles may jump lanes (undercutting) to go around the vehicle which increases the potential for accidents.		3	3	H	Confirmed constrained by available width (not enough room for separate right turn lane)	3	3	H						
2.007	CH1500m	*Position / Location*	Tinakori Rd/TQ intersection: Left turn in vehicles on TQ may collide with the vehicles on the right lane of Tinakori Road due to the tight and sharp turn.		4	3	H	Share turn issue still remains however: 1. The left turn and through movement should be allowed in the same phase. 2. Understand the demand of left turn in movements. If the demand of left turn in movement is significant, the designation of lanes can follow the design from Auckland Transport Code of Practice Figure 22. Change the shared lane to a left turn only lane. Buses can proceed straight ahead in a left turn only lane where signage allowing this movement has been provided. 3. Consider the continuity to Sars St intersection. It is likely that no parking or special vehicle lane or bus lane will be provided between Sars St and Tinakori Rd intersections as they are so close to each other. After drivers are familiar with the new layout, it is likely that they will intend not to use this lane for going straight in order to avoid changing lanes movement. 	2	2	L						
2.008	CH 1500m	*External safety interfaces*	Tinakori Rd/TQ intersection: Northbound vehicles on the jump lanes in order to go around other vehicles which increases the potential for conflict accidents.		3	3	H		2	2	L						
2.009	Various	*External safety interfaces*	Parked vehicle users getting out of cars step off separator into cycle lane		3	3	H	Increase buffer to 0.8m wide	1	3	M			Done			
2.010	Sheet 1	*Position / Location*	(RSA for Prelim Design - Finding 4.4) The waiting space of the crossing adjacent to Sky Stadium - insufficient waiting space post-event.		3	3	H	This area of landscaping will be modified to hard landscaping as part of prelim design to allow for pedestrian storage.	1	3	M			Done			
2.011	Sheet 1	*Position / Location*	(RSA for Prelim Design - Finding 4.5) Visibility issue at left turn at Mulgrave Street	Proposal to signalise the bus terminal/left turn from Mulgrave Streeet.	3	3	H	The visibility could be improved with pruning some vegetation. Include signalisation of this intersection during the next phase of design.	1	3	M						
2.012	Sheet 1	*Position / Location*	Bus-stop Friendly - need to ensure these users have a safe crossing environment at Bus Station entry from Molesworth area	Crossing signals	1	3	M	Safe design crossing	1	1	L						
2.013	Sheet 1	*External safety interfaces*	Speed & Cycle user space - Concerns re high speed traffic (from Hutt Rd areas) coming into Thordon area - and cyclists not protected from vehicle movements due to cycle way width whilst cyclists making passing manoeuvres		3	3	H	Designed separated grade between Cycle and Vehicles; and cycles	1	3	M						
2.014	Sheet 1	*Egress / Access*	Car parking - lack of parking, unsafe parking exit movement	Designed to 250 parks (from approx 350) based on analysis of utilisation, and numbers will drop due to parallel park configuration and exit line of sight needs	2	3	M	To WCC standards	1	1	L						
2.015	Sheet 1	*Egress / Access*	Vehicle Crossings on Through Routes - safety risks	Lots of road markings for road users	2	3	M	To Standards	1	2	L						
2.016	Sheet 2	*Position / Location*	Right Turn Lanes - insufficient space for designed right turn	Separate lanes	2	3	M	Joint Lanes	1	2	L						

Sensitivity: General

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Approved By: Will Maguire | Date: 7 October 2021

Revision: 2 | Stage of Design / Project: Preliminary Design

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2.017	Sheet 3	*External safety interfaces*	Cycle Speed controls - accident and conflict of movement		2	3	M	Designed raised Zebra crossing to encourage reduced cycle and driver speed	1	2	L						
2.018	Sheet 4	*Position / Location*	Right Turn Lanes - insufficient space for designed right turn	Separate lanes	2	3	M	Joint Lanes	1	2	L						
2.019	Sheet 4	*External safety interfaces*	Raised Zebra Crossing Noise - Issues with noise on raised on crossings in other regions recorded.	Raised crossing for safety; road speed dropped from 50 to 40KM	1	1	L	Confirm height and texture , and impacts of heavies; assess noise effects (Carterton issues reported - get WK report - Mark Owen)	1	1	L						
2.020	Sheet 4	*External safety interfaces*	Bus Lane path areas on curves - safety issues with bus lane width a curve insufficient - riding footpaths		2	2	L	Model turning to confirm curves widths for bus movements	1	1	L						
2.021	Sheet 5		NIL raised														
2.022	Sheet 6	*Egress / Access*	Raised exits to Businesses - issues with varied widths, and line of sight in the immediate area is constrained	Parking set back to allow for improved visibility	3	3	H	WK request to re-check set-back lengths - looks minimal	2	2	L						
2.023	Sheet 7	*Egress / Access*	(RSA for Prelim Design - Finding 4.7) Te Puna Reo Childcare facility at 238 Thorndon Quay - the issue of providing safe vehicle stoppping space for this childcare facility		3	2	M	It has been confirmed that there is suitable space through this area to include a dedicated drop off zone similar to the design at CH3090m	1	1	L			Done			
2.024	Sheet 8	*Egress / Access*	(RSA for Prelim Design - Finding 4.8) Future bus parking area for electric buses under the motorway - the vehicle crossing will need to be modified to cater for safe bus entry and exit.		3	3	H	The vehicle crossing will be modified in the next phase of design.	2	2	L						
2.025	Sheet 9	*Egress / Access*	(RSA for Prelim Design - Finding 4.9) Access at former Target building - safety concerns due to the wide crossing.		3	3	H	To be investigated at the next stage including consultation with the new occupiers.	2	2	L						
2.026	Sheet 9	*External safety interfaces*	(RSA for Prelim Design - Finding 5.4) Intersection layout at Hutt Rd/Tinakori Rd: a. drivers have to stop far away from the intersection as the limit line on Tinakori Road is too far away from the intersection. Drivers may fail to stop at the limit line and make turns at Hutt Rd when pedestrians or other phases are running. b. no provision for pedestrians on the western side of Hutt Rd to enable pedestrians to cross Tinakori Rd safely. c. cyclists on Tinakori Rd to access the signalised crossing to the cycle path on the eastern side of Hutt Road.		5	1	M	a. Revise the layout so that the limit line on Tinakori Rd is closer to the intersection. b. Provide an informal crossing point on Tinakori Rd for pedestrians c. Provide access for cyclists on Tinakori Rd to access the signalised crossing to the cycle path on the eastern side of Hutt Road and *vice versa* .	2	1	L			Done			
2.027	Sheet 9	*Egress / Access*	(RSA for Prelim Design - Finding 5.5) Vehicle accesses at Hutt Rd/Tinakori Rd intersection: 1. The two vehicle crossings on the eastern side of Hutt Road will be difficult and unsafe for vehicles to exit from the signalisation of the intersection. 2. Restricted intervisibility with cyclists at the vehicle crossings		5	3	H	Rationalisation of these accesses should be considered and raised with the property owners. Explore the solutions of rationalising these accesses and signalise private driveway, e.g. at Johnsonville/Corlett and Johnsonvlle/Broderick. - to be included during the next phase of design.	1	1	L						
2.028	Sheet 9	*External safety interfaces*	Bus lane turning Jug handle - impacts ped crossing area - disconnected journey because bus needs area to sweep around curve		3	3	H										
2.029	Sheet 9	*Egress / Access*	Peds on western side - concerns re formal crossing areas v informal crossing safety. How do peds exit large commercial premises	Design constrained by area; ramp on sheet 8 design for peds to cross area	3	3	H										

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2.030	Various	*External safety interfaces*	(RSA for Prelim Design - Finding 4.1) 0.5m wide raised safety buffers between cyclists and pedestrians: 1. A trip hazard for people going to and from parked vehicles 2. Opening of vehicles doors can be a hazard for cyclists. 3. The risk of the island being struck is high at night when there are fewer parked vehicles. 4. Cyclist may not be able to safely manoeuvre around a stationary vehicle waiting to turn onto road from a driveway.	The raised safety buffers has been widened to 0.8m for the preliminary design to address the issue related to the insufficient safety buffer.	3	3	H	Include the detailed delineation between the traffic island between the carriagway and cycle path and solution to resolve the conflicts between cyclists and vehicles waiting to turn onto the carriageway at driveways in the next phase of design.	1	3	M						
2.031	Various	*External safety interfaces*	(RSA for Prelim Design - Finding 4.2) Pay and Display machines - drivers will need to access the machines by crossing the cycle path and they may not be aware of the presence of cyclists. In addition, the landscaping between the cyclepath and the footpath may be a hazard for drivers to cross or can be damaged by foot traffic.		3	2	M	The parking machines will likely to be located on the cycle path side of the footpath - to be included in the next phase of design. Regular breaks within the landscaping strip between the cycle path and the footpath can be included for motorists to walk to and from the footpath to their vehicles - to be included in the next phase of design.	1	1	L						
2.032	Various	*Egress / Access*	(RSA for Prelim Design - Finding 4.3) There are two drainage accesses on the eastern side of Thorndon Quay. Any work being undertaken will block the cycle path.		2	2	L	Suitable traffic management can be put in place to divert cyclists up and down ramps to the footpath with appropriate shared path signage - to be discussed with Wellington Water in next phase of design.	1	1	L						
2.033		*Egress / Access*	Cyclists collide with vehicles from accessways	On Hutt Road, the cycleway is in green colour and with cycle marking on the pavement to raise drivers' awareness.	3	4	H	Suitable signages and markings to remind drivers of cyclists and enhance the priority of cyclists on the cycleway over vehicles. Could provide LED warning lights to warn drivers for coming cyclists or the other way around. Rumble strips to slow cyclists at driveways.	2	3	M						
2.034	CH 1500m - CH 5040m	*External safety interfaces*	On Hutt Road corridor: Cyclists may use the space between on-street parallel parking and central carriageway and maybe crash into doors opening on them		3	3	H										
2.035	CH 1620m	*Egress / Access*	Business exits: conflict between motor vehicles and other road users result in collisions. higher use exit/access movements.		3	4	H	Consideration of rationalising exit entry points to reduce conflict areas	2	3	M						
2.036	CH 2560m	*Egress / Access*	Spotlight exit / Hutt Road: Collisions due to complex and conflict vehicle movements for right turn out vehicle drivers from the accessway - they need to take care of cyclists and pedestrians on the road, and have to cross multiple lanes in a short distance in order to make a U-turn.		3	4	H	Consideration was given to install another controlled arm however has been discounted due to complexity.	3	4	H						
2.037	CH 2560m - CH 5040m	*External safety interfaces*	Shared pedestrian and cyclists on the northern Hutt Road corridor cause accidents	Markings and signages on the shared path and also the footpath is concrete and cycle path is asphalt providing colour differentiation.	3	2	M	Existing separation between cycleway and footpath by line marking on Hutt Road will be adopted for the northern Hutt Road. The cycleway and footpath will be on the same level but with different colours and textures.	1	1	L						
2.038	CH 3220m	*External safety interfaces*	Illegal parking on the pedestrian side of the shared path along Hutt Road increases the conflicts between vehicles and vulnerable road users and the risk of collisions. It happens in front Storage One.		2	3	M	Talk to the business owner and let them understand that the space should not be used for parking. Provide enough signages to prevent parking.	1	1	L						

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2.039	CH 3580m - CH 3900m	*External safety interfaces*	Cyclists may crash into the fence, roll over to the railway line and hit a train or are hit by a train	There is existing fences along the property boundary	1	4	M	Possible extend the east for footpath. The separated cycleway would be the side away from the fence so that the risk for cyclists could be reduced. Consider to replace the existing fence with a higher fence so that the risk could be eliminated.	1	2	L						
2.040	CH 5040m	*External safety interfaces*	Jarden Mile/Cenntenial Highway/Hutt Rd intersection: Vehicles may take a U-turn at this intersection which increases the potential for crashes.		4	4	E	Provide suitable signages and markings in advance and at the intersection to ban the U-turn at the intersection and guide drivers who want to take a U-turn to Cennetinal Highway.	2	3	M						
2.041	CH 5040m	*External safety interfaces*	Jarden Mile/Cenntenial Highway/Hutt Rd intersection - Hutt Road: Pedestrians need to cross 7 lanes which increases the risk that pedestrians collide with vehicles.		3	4	H	Provide staged pedestrian crossing with an enough and safe standing area in the middle of the road.	2	3	M						
2.042	Various	*External safety interfaces*	Parked veicle users getting out of cars step into cyclelane	0.8m wide buffer	3	2	M	Continue 0.8m wide buffer for the rest of the Hutt Rd path	1	2	L						
2.043	Sheet 10 and Sheet 23	*Egress / Access*	(RSA for Prelim Design - Finding 3.7) The Sar Street Intersection and the Onslow Intersection: Cyclists cannot safely access the cycle path on the eastern side from the side road due to the lack of crossing facilities.		2	3	M	Cycle path access locations to be included in next phase of design.	1	2	L						
2.044	Sheet 10	*External safety interfaces*	Separation between cycle / peds - safety concerns	Designed to flush surface to allow for use of Ped footpath for cycle passing	3	2	M										
2.045	Sheet 10	*Timing*	Signals control does not working - during heavy traffic - queuing issues		3	2	M	Review this in next stage of design, with modelling	2	1	L						
2.046	Sheet 10	*External safety interfaces*	U Turn Control - safety risks	Design raised medians to impove safety, reduce U-Turns. Will be a mountable kerb to accommdate "break-down" or other traffic interruption issues	2	3	M										
2.047	Sheet 10	*Egress / Access*	(RSA for Prelim Design - Finding 5.6) Waitomo Fuel stop/Lighting Plus: some motorists drive along the footpath due to the contiguous surface between the footpath and the Lighting Plus car park.		3	3	H	Install a barrier at the property boundary between the Lighting Plus car park and the footpath. Modify the vehicle crossing to provide access to the Lighting Plus car park.	1	2	L		Done				
2.048	Sheet 11	*External safety interfaces*	Speed of Cyclists - safety concerns	Markings to slow at conflict areas	4	2	M	Additional markingas and signage to be included at next design stage	2	1	L						
2.049	Sheet 12	*Egress / Access*	Bollards - Different to maintenance, and high cost of upkeep; bollards would be a significant safety hazard and should be avoided (RSA for Prelim Design - Finding 5.7)	Replace the proposed bollards on the curve with the tactile alternative in the prelim design.	3	2	M	The removal of the existing bollards can be incorporated in the next phase of design after consultation with adjacent property owner regarding their purpose.	1	1	L						
2.050	Sheet 12	*External safety interfaces*	Lighting of area - visibility and safety conerns	Currnet Lighting	2	2	L	Investigate lighting requirements in next phase, to improve user utilitisation - well lit for safety	1	1	L						
2.051	Sheet 12	*External safety interfaces*	Bus Stop & Shelter Design - concerns re safety / design, blind spots from material use (not see-through from bus shelter)	Use of WK design guides for latest configurations	3	2	M	Update design in later phase to show more detail - to reflect latest WK design (As per Hutt Rd report); include bus shelter design on drawings Need to get location and shelter design right for safety	1	1	L						
2.052	Sheet 12	*Egress / Access*	Ped OverBridge from Ferry - Concerns re way-finding for Peds and cyclists - a conflict zone	Design of "step Up"	3	3	H	Include further detail on design	2	2	L						
2.053	Sheet 13		NIL Raised														
2.054	Sheet 14		NIL Raised														
2.055	Sheet 15		NIL Raised														
2.056	Sheet 16	*Size*	Cyclist volumes due to increase 3-fold in future modelling - concerns re impact of through light on cyclist "push button" zone. Many cyclists waiting on foot path to go up Kaiphoror		3	2	M	Review design to allow additional cyclist holder / waiting space at "push button" area in middle of intersection	1	1	L						

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2.057	Sheet 16	*Egress / Access*	(RSA for Prelim Design - Finding 5.6) Exit to Spotlight business area: Restricted visibility to the left for drivers exiting the Spotlight business area due to the solid panels on the handrail of the adjacent Kaiwharawhara Stream bridge and a tree.		4	3	H	Include the following in the next phase of design: 1. Move the solid panels on the eastern side of Kaiwharawhara Stream bridge handrail to the western side and replace with the 'see-through' panel from the western side; 2. Cut back the tree foliage on the stream bank at the Spotlight business area car park exit.	2	2	L						
2.058	Sheet 17		Not reviewed - similar to previous														
2.059	Sheet 18		Not reviewed - similar to previous														
2.060	Sheet 19	*Egress / Access*	Kindygarten area - footpath and parallel parking - conflict of users with Drop-offs and cycle / footpath - safety concerns	Safety audit improvements implemented	2	3	M	Look for further safety improvements to reduce conflict, or increase safety	1	1	L						
2.061	Sheet 20		Not reviewed - similar to previous														
2.062	Sheet 21	*External safety interfaces*	Ped Zebra Crossing - safety concerns - history of injury	Staggered crossings, and signalised	2	3	M	Further modelling progressing for wider area	2	2	L						
2.063	Sheet 21	*Egress / Access*	(RSA for Prelim Design - Finding 5.6) Exit from Placemakers car park - the signage on the 'see-through' fence and a shed restrict vsibility to cycle path and footpath users.		3	3	H	Work with Placemakers to eliminate the restriction to visibility (signs and shed) at the car park exit - to be included in the next phase of design.	2	2	L						
2.064	Sheet 22	*Egress / Access*	(RSA for Prelim Design - Finding 5.6) Caltex service station - At the exit to the service station, a solid fence and a fence cart within the Placemakers car park restrict visibility to cycle path and footpath users.		4	3	H	Work with Placemakers and Caltex to eliminate the restriction to visibility (fence and coffee cart) at the service station exit - to be included in the next phase of design.	2	2	L						
2.065	Sheet 23	*Size*	(RSA for Prelim Design - Finding 5.8) Hutt Road/Onslow Road Intersection: The proposed 0.95m wide median at the intersection is insufficient width for double aspect traffic signals with target boards - distance from vehicles constrained		3	2	M	Look at moving outter boundary - into Kiwirail or other options. Further design and discussions to take place during next phase of design.	1	1	L						
2.066	Sheet 23	*Egress / Access*	Footpath access - lack of linakge into wider area footpath		2	4	H	Look at connectivity in this area	1	2	L						
2.067	Sheet 23	*Timing*	Right Turn Vehicle stacking - concerns of high volumes at peak times (RSA for Prelim Design - Finding 5.8)		3	2	M	The modelling results have been provided to RCA. Further design and discussions to take place during next phase of design.	2	2	L						
2.068	Sheet 24		Not reviewed - similar to previous														
2.069	Sheet 25	*Environmental conditions*	Visibility concerns from road side into corridor - trees overhanging and many exits		3	3	H	Design progressing	2	2	L						
2.070	Sheet 26		Not reviewed - similar to previous														
2.071	Sheet 27		Not reviewed - similar to previous														
2.072	Sheet 28		Not reviewed - similar to previous														
2.073	Sheet 29		Not reviewed - similar to previous														
2.074	Sheet 30		Not reviewed - similar to previous														
2.075	Sheet 31	*External safety interfaces*	(RSA for Prelim Design - Finding 5.9) Lane changing on inbound approach to Jarden Mile - weaving across lanes	Design - Terminate the northbound SPV lane 200m in advance of the lane diverges - it has been done in the Prelim Design.	4	1	M	Include the following items in the next phase of design: 1. Erect overhead signage at the above SPV lane termination to direct drivers into the correct lane for Centennial Drive (SH1) or the SH2 on-ramp. 2. Reinforce the overhead signage with destination roadmarking in each traffic lane and additional advance destination signage.	2	1	L						
2.076	Sheet 32	*External safety interfaces*	Ped / Cycle movement at Intersection - concerns re connectivity with bus stops in area	Design - moved bus stop area, to free up space for red crossing areas - currently flush levels. (RSA for Prelim Design - Finding 5.10) The central island on the southern approach has been widened to 3m in Prelim Design.	3	2	M	Look at raised platforms to encourage speed reduce - maybe speak with James Hughes; look at north bound bus stop to enable 2 buses - design a double. Speak with Scott Coburn re cycle and footpath - share drawings for proposed new development Designer to look at prioritisation at intersection (RSA for Prelim Design - Finding 5.10) Make the two-stage crossings staggered - to be included in the next phase of design.	1	2	L						

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2.077	Sheet 32	*Position / Location*	(RSA for Prelim Design - Finding 5.11) Concerns regarding proposed raised safety platforms (RSP at Jarden Mile Intersection - a speed differential could lead to heavy braking and consequential rear-end or loss of control crashes. The RSP may not be visible to most drivers until they are at the intersections.	The speed limit on Centennial Highway is proposed to be reduced to 60km/h in advance of Jarden Mile intersection.	3	3	H	Further discussions and design to be undertaken during next phase. Information on SH2 installations to be provided to RCA by LGWM.	2	2	L						
2.078	Various	*External safety interfaces*	(RSA for Prelim Design - Finding 5.1) Pedestrians using the cycle path despite of different surfaces - conflicts between cyclists and pedestrians		3	2	M	The separator will be investigated and further considered and included at the next design stage.	2	2	L						
2.079	Various	*External safety interfaces*	(RSA for Prelim Design - Finding 5.2) The southbound SPV lane on Hutt Road is changing to a Bus lane along Thorndon Quay at the intersection with Tinakori Road - vehicles on the SPV lane have to move quickly to the general traffic lane at the intersection, resulting difficiult and unsafe manouvre.	The design changes have been made to the start of the 'BUS LANE' on southbound Hutt Road - changed from CH1500m to CH1740m	4	2	M	Signage to be included at the next phase of design to make it clear for motorists who can use which lane.	1	1	L						
2.080	Various	*External safety interfaces*	(RSA for Prelim Design - Finding 5.3) No provision for safe U-turns.		5	1	M	Further work to be included in the next phase of design regarding number, location and design of u-turn facilities.	2	1	L						
2.081	Aotea Quay Roundabout	*External safety interfaces*	Safety concerns re freight traffic exiting base into fast lanes; Ped crossing have to navigate high speed traffic	Mini roundabout, with low roundabout for heavies U-turns (not signalised)	3	2	M	Modelling tracking, and safety treatments Peds will cross at "freight area" crossing - look at a "step back area" for ped crossing in front of trucks	2	2	L						
2.082	Aotea Quay Roundabout	*External safety interfaces*	(RSA for Prelim Design - Finding 6.1) Safety concerns re proposed mini-roundabout: 1. truck drivers may seek for unsafe gaps; 2. the vehicle in the right-hand lane of northbound traffic lanes may be hidden from view by a truck in the left-hand lane; 3. the southbound acceleration lane is too short for slow moving trucks to merge to the faster left lane; 4. full signalisation of the intersection might provide a better option in terms of safety, and the pedestrian crossing across the freight yard could be controlled.	The size of the roundabout has been increased in the final Prelim Design. The southbound short acceleration lane has been removed, and truck drivers will not need to merge to the left lane.	3	2	M	Further discussion and design to be undertaken during the next design phase. Modelling is being undertaken by Wellington Analytics Unit considering requiremetns for TQHR, Single User and Multi User Ferry Terminal requirements.	2	2	L						
2.083	Aotea Quay Roundabout	*External safety interfaces*	(RSA for Prelim Design - Finding 6.2) The speed limit on Aotea Quay and on ramp from Hutt Road is still 70km/h while the speed limit on Hutt Road between Centennial Highway and Onslow Road is to be reduced from 80km/h to 60km/h. The speed limits will be inconsistent.		3	3	H	A speed reduction to 50km/h on Aotea Quay is proposed on Aotea Quay to align with the proposed 50km/h on Hutt Rd from the Tinakori Rd/Hutt Rd intersection to the Onslow Rd/Hutt Rd intersection.	2	2	L			Done			
2.084		*Position / Location*	Cyclists collide with street furniture		3	3	H	Make sure the street furniture are not in the middle of the cycleway. Relocate the street furniture or provide appropriate marks/protection surrounding the street furniture.	1	1	L						
2.085		*Position / Location*	Cycle path ponding resulting in falling off bike		2	3	M	Provide suitable cross fall from centre or one side depending on location and suitable numbers of catchpits to drain away and grooves within AC cycle path.	1	2	L						
2.086		*External safety interfaces*	Insufficient lighting resulting in collision	Currently lighting is available	3	3	H	Current lighting to be assessed and upgraded as required	1	3	M						
2.087		*Position / Location*	Existing inground pits covers and frames are not flush causing cyclists to fall off		3	3	H	Raise or lower pits cover and frames to be flush with new cycle path.	1	3	M						
2.088		*External safety interfaces*	Pedestrians crossing the road collide with cyclists on cycle paths		3	3	H	Pedestrian crossings goes across the cycle path and connects footpaths. Provide adequate signages at crossing.	1	2	L						
2.089		*External safety interfaces*	Cyclists access cycle path at random points resulting in collision with vehicles		3	4	H	Crossing installed where appropriate for main access points. Suitable signages and markings.	1	3	M						
2.090	CH 240m - CH 1500m	*Position / Location*	Trees planted on the landscape areas may impact on visibility lines and cause crashes.		3	4	H	Choose tree species to suit the location either low lying shrubs or lower canopy needs to be 2m plus. Make sure any plants planted on the landscape segregation will not obscure visibility lines for all road users.	1	3	M						

Safety in Design Risk Assessment Register

Author (Role): Blaise Cummins | Job No: 3821501
Approved By: Will Maguire | Date: 7 October 2021
Revision: 2 | Stage of Design / Project: Preliminary Design
Project Name: LGWM - Thorndon Quay & Hutt Road

Green = Thordon Quay; Orange = Hutt Rd; Purple = Aotea Quay; Blue = General

(Note: minimum of 2 reviews per project)

RISKS ASSOCIATED WITH DESIGN ELEMENTS					Risk Matrix			PROPOSED & APPROVED MITIGATION MEASURES	Mitigated Risk & Resolution							RESIDUAL RISK	
Ref	Chainage	Hazard (Guideword)	Cause & Outcome	Existing controls, if any	L	C	LR	Proposed Control (1 Eliminate, 2 Substitute, 3 Reduce, 4 Control)	L	C	LR	Risk Owner	Client Approved	Design Status	Date	Risk Owner	Action Required
2.091		*External safety interfaces*	Onslow and Tinakor Rd intersection: right turn filter and left turn filter increases the risk of crashes		3	4	H	Remove the right turn filter and left turn filter to allow full pedestrian protection and as well as remove the risk of right turn and left turn filtering crashes.	1	2	L						
2.092		Signals and telecommunications	Above ground assets on or near the route causes issues		2	3	M	Minimum clearance of 0.5m from any fixed asset.	2	2	L						
2.093		Network Services	Maintenance vehicles cannot access parts of the corridor.	No-stopping and no-parking control in front of the service stations.	1	1	L	The no-stopping and no-parking control will be maintained.	1	1	L						
2.094		Various	Drainage issues due to the new raised safety platforms		2	2	L	Identify the existing location of drains near the proposed raised safety platforms. Two options to address the drainage issue: 1. Relocate the sumps and build new ones if required or install slot drains.	1	1	L						
2.095		*Egress / Access*	Is their adequate / suitable fencing to prevent access to the adjacent Kiwirail land for the extents of the job. (who's responsibility is the fencing)	Existing Fencing	2	2	L	Review of existing fencing to confirm if modification required	1	1	L						
2.096		*External safety interfaces*	Catchpit cover grills catch skinny tyred wheels		1	3	M	Orientate at 90degrees to angle of movement. plus use of wave grills rather than straight ones.	1	1	L						
2.097		*External safety interfaces*	Skid resistance of existing covers and frames poor.		2	2	L	Replacement of cover and frame to be considered	1	1	L						
2.098		*Timing*	Pedestrian crossings throughout the project. As crossing multi lanes throughout the project. By it's nature takes time to cross.		4	3	H	Signalised crossings of the 4 lane highway at Thorndon Quay. Staggered signalised crossings through Hutt Rd. with central island of a suitable size for both Cyclists and Pedestrians.	2	2	L						
2.099		*Position / Location*	Safety Buffer for Disabled & others - transition between zones but result in trip/ fall risks on different levels		3	2	M	Investigate safety improvements on corridor re kerbs and transition between each modal zone	1	1	L						
2.100		*Egress / Access*	Emergency Vehicle Access on corridor - what is required re parking and bus lane use for emergency access		1	1	L	Look to design "multi-use" of lanes for emergencies - without undermining project objectives - "access" for normal traffic	1	1	L						
2.101		*External safety interfaces*	(RSA for Prelim Design - Finding 3.1) The potential cycle path users include but not limited to cyclists, e-bicycle users, e-scooters, skateboarders, etc. The high speed path users and the behaviour of failing to comply with 'Keep Left' rule will result in an increase in severity and likelihood of crashes with other road users.		2	4	H	Signs will be included at the next design stage to indicate modes of use. The directional arrows at regular intervals along the path will be included in next phase of design.	1	2	L						
2.102		*External safety interfaces*	(RSA for Prelim Design - Finding 3.2) Speed of Cyclists - safety concerns at pedestrian crossing areas, bus stops and majority of driveways	Design on TQ and existing control on HR - Green markings with cycle symbols across accessways.	2	4	H	Additional markings across the cycle path prior to driveways to highlight potential conflicts and cyclists to be included in next phase of design (e.g. zigzag, red markings).	1	2	L						
2.103		*Egress / Access*	(RSA for Prelim Design - Finding 3.3&3.4) Conflicts at vehicle crossings between cyclists and vehicles at driveways along the route: a. poor visibility to approaching cyclists due to parked vehicles. b. vehicles focusing on a gap in traffic rather than approaching cyclists c. vehicles existing a property where the driver is not forced to slow.		4	4	E	a. To ensure that drivers turning into accesses have visibility of cyclists using the cycle path, parking restriction will be put to ensure sight distance to approaching cyclists is sufficient, in accordance with Waka Kotahi Technical Note 2, as part of the next design stage. b. Speed humps to be included in next phase of design, location to be considered. c. Crossing ramps to be considered in next phase of design.	2	2	L						
2.104		*Position / Location*	(RSA for Prelim Design - Finding 3.5) Conflicts at bus stops between cyclists and passengers/pedestrians: - It is likely that passengers from buses are using the rear door and then crossing the cycle path but now the pedestrian crossing on the cycle path is leading to the front foor. - The buffer between the cycle path and footpath could be a trip hazard. - This is a high conflict area for pedestrians and cyclists.		3	3	H	To avoid any trip hazards and to minimise the conflicts between cyclists and pedestrians at bus stops, the design below is proposed. 	1	1	L						

Safety in Design Risk Assessment Register

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Approved By: Will Maguire | Date: 7 October 2021

Revision: 2 | Stage of Design / Project: Preliminary Design

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2.105		*Position / Location*	(RSA for Prelim Design - Finding 3.8) The rubbish bins and paper piles left out in the cycle path could be a hazard to cyclists.		3	3	H	The location and size of rubish collection areas will be considered in the next design phase which will involve consultation with property owners / tenants.	1	1	L						
2.106		*Size*	(RSA for Prelim Design - Finding 3.9) Signals infrastructures - insufficient space and may obstruct pedestrians and the public using facilities; accessibility of controllers for service vehicles		2	3	M	Detailed traffic signals infrastructure locations will be included in the next design stage	1	1	L						

Safety in Design Risk Assessment Register

Author (Role):	Blaise Cummins	Job No:	3821501
Approved By:	Will Maguire	Date	7 October 2021
Revision:	2	Stage of Design / Project:	Preliminary Design
Project Name:	LGWM - Thorndon Quay & Hutt Road		

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3	**Demolition Phase**																
3.01																	
3.02																	

Key;

No ledges to leave glasses on

C= Consequence 1) Low 2) Moderate 3) Significant 4) Major 5) Critical

L= Likelihood 1) Rare 2) Unlikely 3) Possible 4) Likely 5) Almost Certain

LR = Level o L) Low M) Moderate H) High E) Extreme

Notes: Hazards / risks considered are those that are project / site specific, non-standard / bespoke designs, special processes, high hazard risks (e.g. non 'business as usual' hazards) that have been identified at the time of the review(s). Other risks will continue to appear during the design life of the project and should be assessed and managed by appropriate parties.

Let's GET Wellington MOVING

WAKA KOTAHI NZ TRANSPORT AGENCY

greater WELLINGTON REGIONAL COUNCIL Te Pane Matua Taiao

Absolutely Positively Wellington City Council Me Heke Ki Pōneke

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Appendix K

Modelling and Analysis Report

Thorndon Quay and Hutt Road – Single Stage Business Case

Transport Modelling and Analysis

2 February 2022

Let's Get Wellington Moving
Waka Kotahi NZ Transport Agency
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Absolutely Positively Wellington City Council Me Heke Ki Pōneke

Contents

Introduction

Overview

This report has been prepared to outline the approach of the second phase of transport modelling for the Thorndon Quay and Hutt Road Single-Stage Business Case (SSBC). It details the methodology and provides outputs to assess the impact of the proposed scheme. This builds on the work carried out in Phase 1.

The Project

The Thorndon Quay and Hutt Road SSBC project is one of the LGWM's Early Delivery Interventions whose benefits could be delivered relatively quickly and are not constrained by the scope of the larger elements in the programme such as Mass Transit. The project has selected a preferred option which is tested within this report.

Thorndon Quay and Hutt Road are part of the critical northern route to and from Wellington City. Achievable benefits identified early include bus priority, reliability improvements and safety improvements for people cycling between the City and the planned Te Ara Tupua Ngauranga to Petone walking and cycling link.

The objectives of the Thorndon Quay and Hutt Road SSBC are to:

1. Improve reliability of bus services equivalent to current daytime speed and variability by 2026 and maintain to 2036;
2. Improve Level of Service (LoS) for non-car modes by 2026 and maintain to 2036 – Walking LoS (C), Cycling LoS (A/B). Public Transport – Sufficient capacity for growth;
3. Reduce the safety risk along Thorndon Quay and Hutt Road for all vulnerable road users and Hutt Road for vehicles by 2030;
4. Amenity aligns with Place and Movement Framework for Thorndon Quay by 2036; and
5. Freight – Maintain similar access for people and freight to the ferry terminal / CentrePort.
6. The analysis is intended to provide quantitative outputs to assess the benefits and impacts of the options against:
7. Investment Objective 1 – Reliability of bus services;
8. Investment Objective 2 – Active mode levels of service; and
9. Investment Objective 5 – Freight Reliability.

Summary of Phase 1

Phase 1

The Phase 1 modelling work was undertaken at high level using a first principles approach to the assessment of the network and four corridor options. These options are shown in Table 1.

Table 1 Concept Options

Concept	Elements			Common Elements
	Thorndon Quay Bus Lane	Thorndon Quay Cycle Lane	Hutt Road Special Vehicle Lanes	
1	Southbound	Bi-Directional	Southbound	• Speed limit changes • Intersection upgrades • Pedestrian crossing improvements • Bus stop balancing • Thorndon Quay Amenity • Hutt Road Safety Audit Recommendations
2	Both-Directions	Uni-Directional	Both Directions	
3	Southbound	Uni-Directional	Southbound	
4	Both-Directions	Bi-Directional	Both Directions	

The modelling assessment which was carried out for the above utilised the WTSM and AIMSUN models for public transport, route and mode choice and traffic forecasts. The AIMSUN model is developed for 2026, and a 10% uplift was applied to estimate for a 2036 scenario. This is based on a 1% growth rate per year over 10 years.

Assessment for active modes along the corridor was carried out using the Danish Level of Service method, and the crossing level of service was based on the crossing spacing and crossing delay times as per Austroads.

The Phase 1 analysis concluded as follows:

1. There is a very strong case for bus priority (southbound) in the morning peak (as per Concept 1 and Concept 3) as it is expected that there will be significant travel time benefits;
2. There is a case for bus priority (northbound) in the evening peak, however the expected benefit is lower than benefits in the southbound morning peak;
3. It is expected that with peak period bus priority, the bus journey times will be in the order of 10-11 minutes which is lower than currently observed, and in the case of the morning peak period, significantly lower than the do-minimum;

4. There does not appear to be a strong case for all-day bus priority along the corridor as the level of service (reliability) is expected to remain good in off-peak periods through to 2036. However, along Hutt Road there would likely be a lesser impact to other road users if the Special Vehicle Lane was implemented before congestion develops throughout the day;
5. The type of Special Vehicle Lane is a balancing act between improving reliability for buses, improving reliability for freight, managing the impact of converting a general traffic lane to a Special Vehicle Lane, and ensuring that the volume of traffic in the Special Vehicle Lane does not negate its benefits. As a result, the recommendation at this stage (excluding safety considerations is to exclude a T2 lane from further investigation);
6. The roundabout at Aotea Quay / Mainfreight entrance should be included under all options to provide an additional access to the Interisland Ferry Terminal, and / or to mitigate potential impacts of restricting right turn movements on Hutt Road if a raised median is implemented. The roundabout at Aotea Quay may negate the need to allow trucks in the Special Vehicle Lane to achieve the investment objective related to access to the Ferry Terminal;
7. Consider additional controlled pedestrian crossing points along Thorndon Quay to reduce the spacing between the current (which will be upgraded) and proposed crossing at Tinakori Road and the motorway overpass (where bus stops are proposed). More crossings will improve the level of service by reducing the distance to walk between formal crossing points. The provision of additional crossings is unlikely to have a significant impact on the reliability of public transport along the corridor;
8. Uni-directional cycle paths on Thorndon Quay (between the motorway overpass and Thorndon Quay) are expected to result in a poor level of service for cycling and walking due to the constrained width, hence extending the existing bi-directional cycle path is recommended;
9. The provision of a bi-directional path along Thorndon Quay provides a good level of service (B/C) and a higher level of service than the uni-directional cycle paths (D/E) using the Danish Cycling Level of Service method. This is primarily due to the path width and the buffer between the cycle path and the road. However, this assessment does not consider the safety implications of a bi-directional cycle path, which is being addressed through the Investment Objective related to safety;
10. The elasticities of the public transport response, the routing in AIMSUN, and the potential impacts outside the modelled periods in both the AIMUSN models and WTSM models are to be further investigated in Stage 2 of the project to confirm the assessment of the reliability for trucks.

Phase 2 Methodology

Introduction

Following on from the Phase 1 analysis, it was proposed to utilise the N2A AIMSUN model to determine the travel time benefits and network operation. This section of the report details the process undertaken to assess the impact of the proposed scheme and its key performance indicators against the investment objectives. As part of the assessment the roundabout intersection at the Aotea Quay / Mainfreight entrance has been removed due to a separate study being carried out on the new Interisland ferries which are to be operational soon. Therefore, this report has not included this assessment.

It should be noted that a review of the approach detailed below, along with the assessment has been checked by Flow Transportation Specialists (Peer Review) and the methodology has been robustly tested to confirm it is suitable for this project.

Model Development

The modelling of the network in AIMSUN was carried out by the Wellington Analytics Unit working closely with the consultant team. As part of the process a modelling specification report was produced and issued to the modelling team. This set out the proposed network changes including all traffic signal and pedestrian improvements as well as the dedicated Special Vehicle Lane. Initially it was decided to create a sub-area of the wider AIMSUN model to carry out the assessment at a Mesoscopic level and extract the economic information.

Whilst a more detailed Microsimulation model was considered due to the more detailed vehicle interaction outputs and would improve representation such as vehicle weaving however due to time frames and the fact that the mesoscopic model would reflect potential wider scale re-routing (i.e onto SH1) and trip re-timing that might result from the introduction of bus priority measures on Hutt Road this process was completed at a mesoscopic level of detail.

Following the 2026 model runs, a detailed review of the assessment was carried out. During this review it was identified that whilst the original aim to use the AIMSUN strategic model was to understand the wider network impacts, the wider outputs were too strategic and provided insufficient detail for the economics for a corridor-based assessment such as this project.

Therefore, the decision was taken to utilise the volume outputs from AIMSUN and input them into SIDRA Network software platform to enable a detailed assessment to be carried out across the corridor. It should be noted that following discussions between LGWM, Wellington Analytics Unit and the peer reviewers, only the 2026 assessment has been carried out. This is because the network would already be at capacity in 2026 and therefore limited growth can occur on the network.

The process undertaken for this is detailed below in Figure 1.

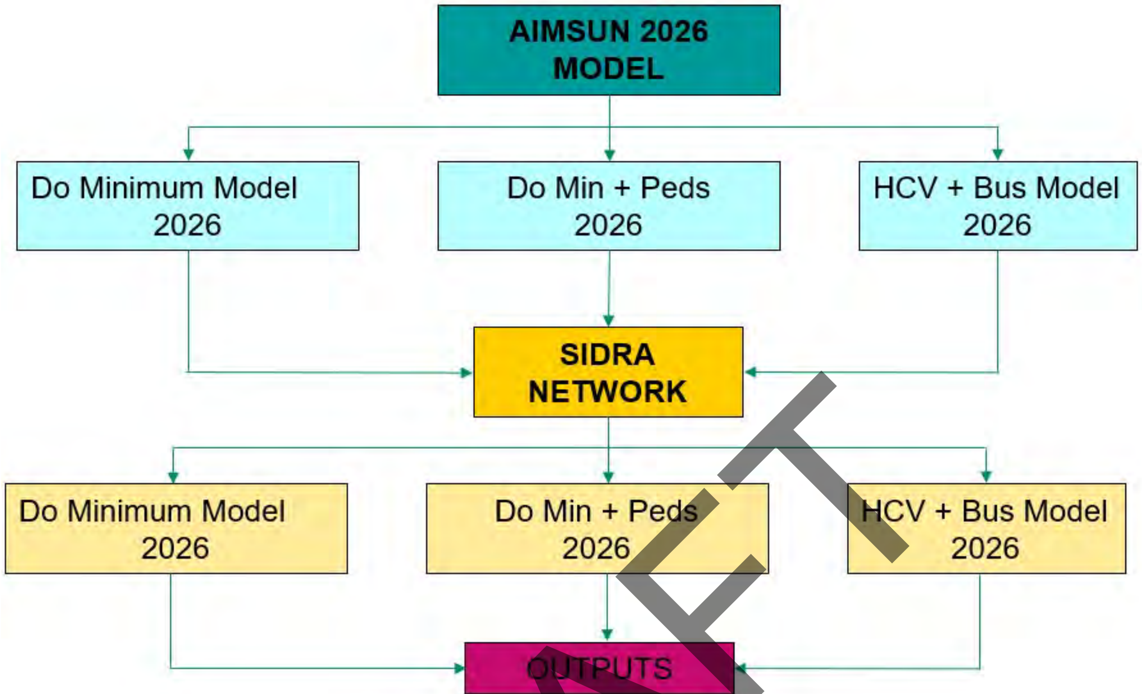


Figure 1 Modelling Process

Options developed

As part of the Aimsun level of assessment three options were developed. These were:

- Do minimum;
- Do minimum + pedestrian improvements; and
- HCV and Bus option.

The details of these options are provided below.

Do Minimum

The do minimum network is the current network layout to test the options against. During the development of the model and the subsequent data analysis, it became apparent that the bus travel time, and vehicle travel time benefits were not being identically compared to the HCV and Bus model. This was due to additional items being added to the scheme such as pedestrian safety improvements including signalised pedestrian crossings at mid-block points and new signalised pedestrian crossings at existing intersections. This resulted in an increase of the bus and vehicle travel times and therefore not a direct comparison of the options.

Therefore, a decision was taken to develop a do minimum + pedestrians' option which would expand the do minimum to only include those safety measures which would likely have been implemented in the future for pedestrians.

Do Minimum + Pedestrians

The model was developed to enable the pedestrian safety improvements detailed above to be included. This provides a more realistic do minimum for comparison.

Bus + HCV Option

This option includes a special vehicle lane on Hutt Road and Thorndon Quay. This is a tidal option with the lane re-allocated to buses and HCVs in the southbound for the AM peak and the northbound in the PM peak.

AIMSUN outputs

As set out above, the assessment of the network was carried out using outputs received from the Wellington Analytics Unit. The outputs were provided in four-hour, two-hour and 1-hour assessments. For the SIDRA assessments the one-hour counts were utilised to calculate the travel time along the network in each scenario. It should be noted that the following information is based arrival of vehicles into the network over a four-hour period and the information provided is specific screen line volumes from the model and therefore representing volumes passing set points and not total network traffic volumes.

The Aimsun results showed little difference in vehicle traffic using the corridor in the AM and PM peak in the do minimum and do minimum + pedestrians' options. However, a significant change was identified in the HCV and bus option. This would see traffic diverted across to State Highway 1 from the corridor which, given the reduction in capacity, would be appropriate. The extent of this is shown below in the figures below. Whilst a larger impact is shown in the AM peak, the impact is significantly less the PM peak.

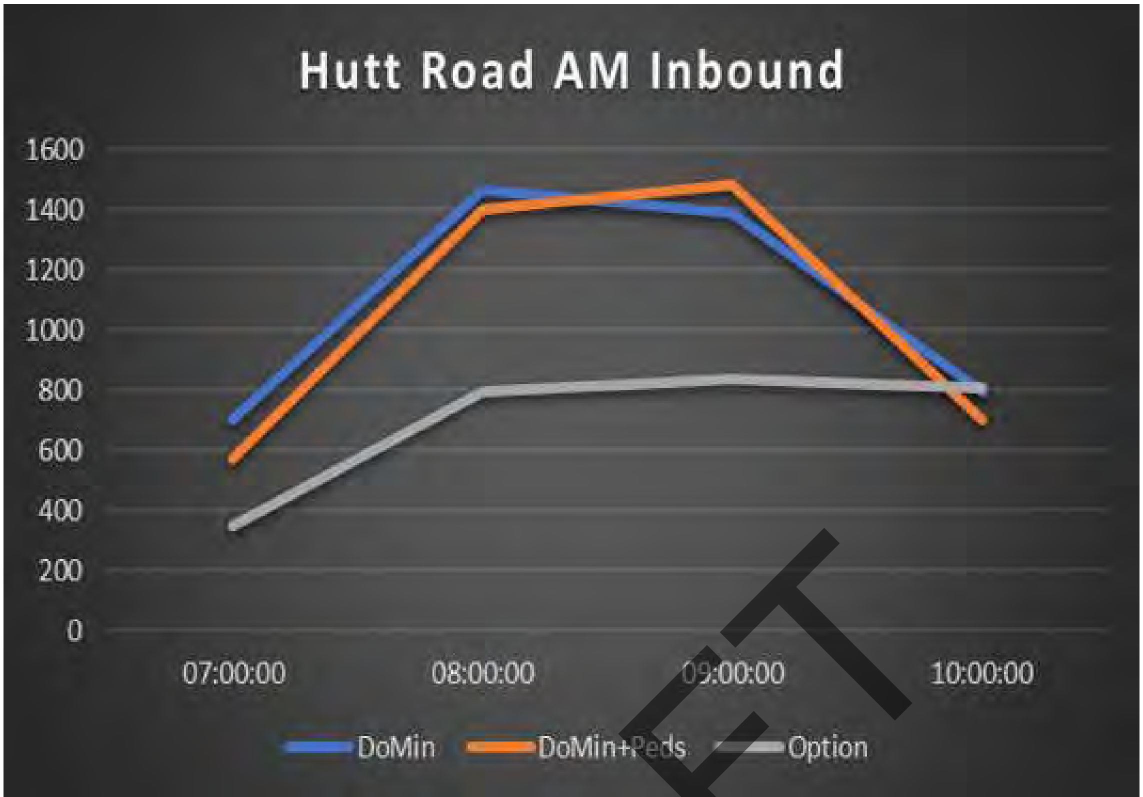


Figure 2 – Traffic Volumes on Hutt Road in the AM Peak Southbound from AIMSUN

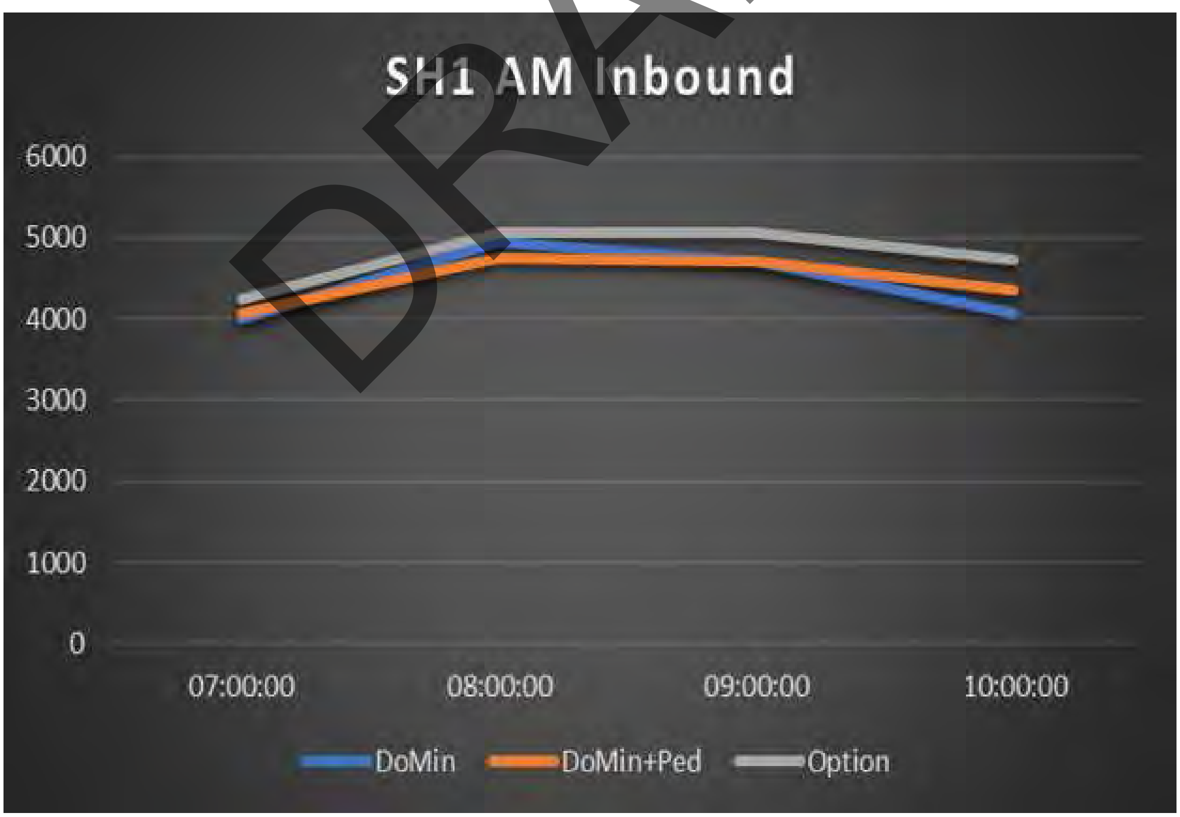


Figure 3 – Traffic Volumes on State Highway 1 in the AM Peak Southbound from AIMSUN

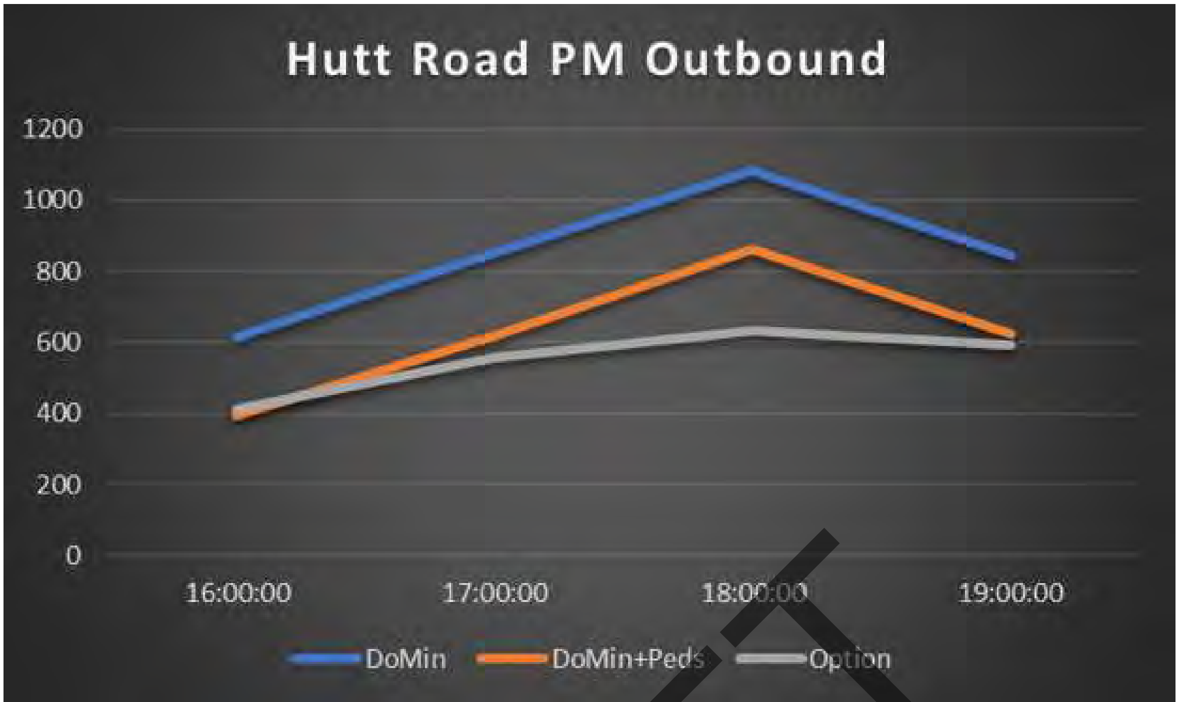


Figure 4 Traffic Volumes on Hutt Road in the PM Peak Northbound from AIMSUN

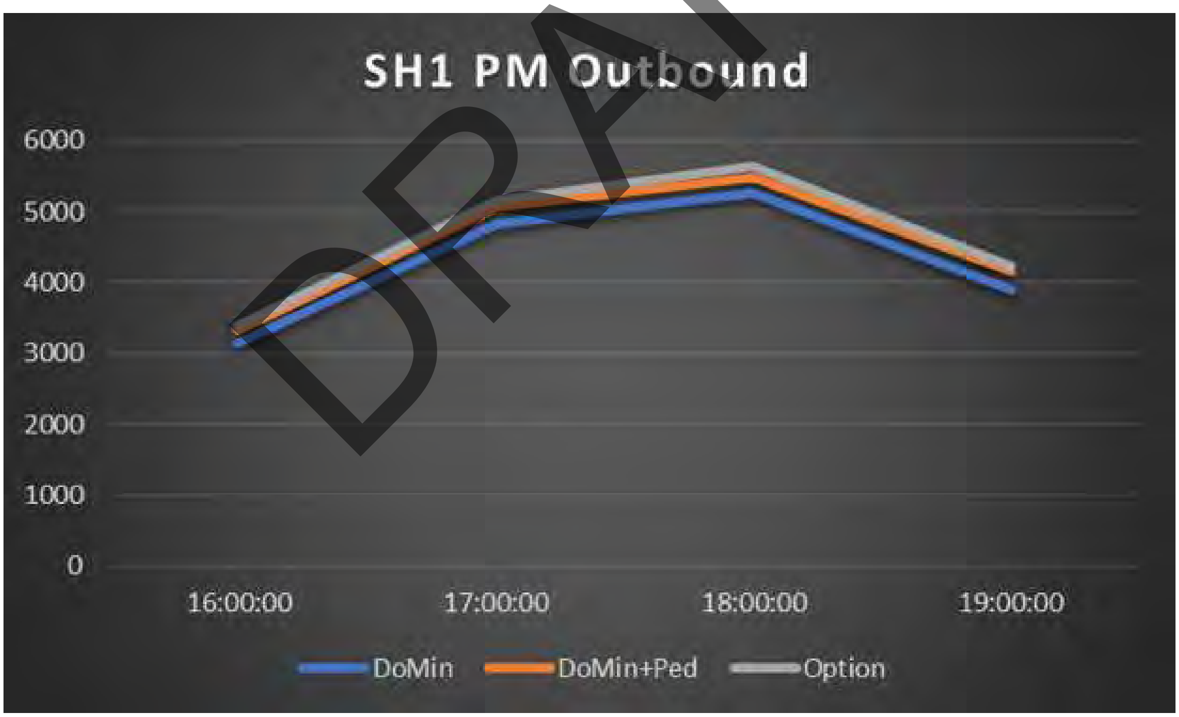


Figure 5 – Traffic Volumes on State Highway 1 in the PM Peak Northbound from AIMSUN

Upon receipt of the data, a review was carried out on the three options to ensure that the data was fit for purpose. The review identified a need for the vehicle volumes to be split out of the original data set into a set which could be used by SIDRA. This required extracting the total

HCV, cars and buses and allocating this data to the correct movement specification for SIDRA.

A review of the traffic changes from AIMSUN was carried out and the table below summaries the changes in traffic volumes on SH1 and Hutt Road between 7:30am and 8:30am which is the peak hour within the AM peak period. The table demonstrates the differences between the Do Minimum, Do Minimum + Pedestrian and the Options (Bus + HCV)

Table 2 – Total Diversion of Traffic AM Peak

Route	Section	Direction	Flow	Flow Difference	
			Do Min AM	Do Min + Ped AM	Bus and HCV
South Ngauranga	SH1	Northbound	3,280	20	-40
		Southbound	4,960	20	100
	Hutt Road	Northbound	400	-40	0
		Southbound	1,840	-80	-880
	Total	Northbound	**3,680**	**-20**	**-40**
		Southbound	**6,800**	**-60**	**-780**

The table shows the following:

- Minimal change in traffic volumes between the Do Minimum and Do Minimum + Pedestrian option.
- A reduction of 880 vehicles (compared to the Do Minimum) on Hutt Road and a corresponding increase of 100 vehicles on State Highway 1.

A review of the traffic volumes by 15-minute time slice between 6am and 10am on Hutt Road has been carried out. This is shown in Figure 6

DRAFT

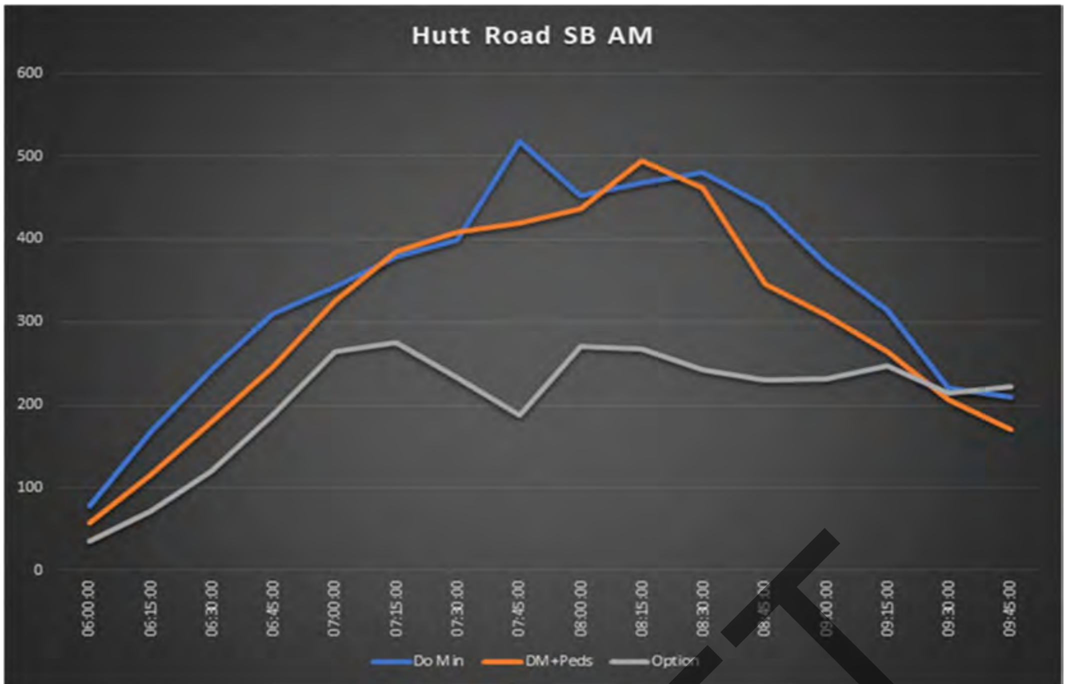


Figure 6 Hutt Road Traffic Volumes

Figure 6 shows the following key information:

- Traffic volumes are around 30% higher during the peak of the peak (7:30am to 8:30am) compared to 7am and 9am.
- The flow profile is broadly similar between Do Minimum and the Do Minimum + Pedestrians.
- Under the option scenario, traffic volumes remain broadly consistent between 7am and 8am due to the reduced capacity, with the difference in volume between the Do Minimum and Option by 15-minute time slice ranging from around 50 to 100 vehicles at 7:15am / 8:15am to nearer 300 at 7:45am.

The reduced capacity on Hutt Road results in the following:

- People diverting to State Highway 1 and travelling at the same time.
- People diverting to State Highway 1 and travelling earlier or later to avoid congestion.
- People travelling later but continuing to use Hutt Road.
- People using alternative diversionary routes such as Burma Road and Ngiao Gorge.

Figure 7 below shows changes in traffic volumes on State Highway 1 between the Do Minimum, Do Minimum + Pedestrian and the Option (bus + HCV).

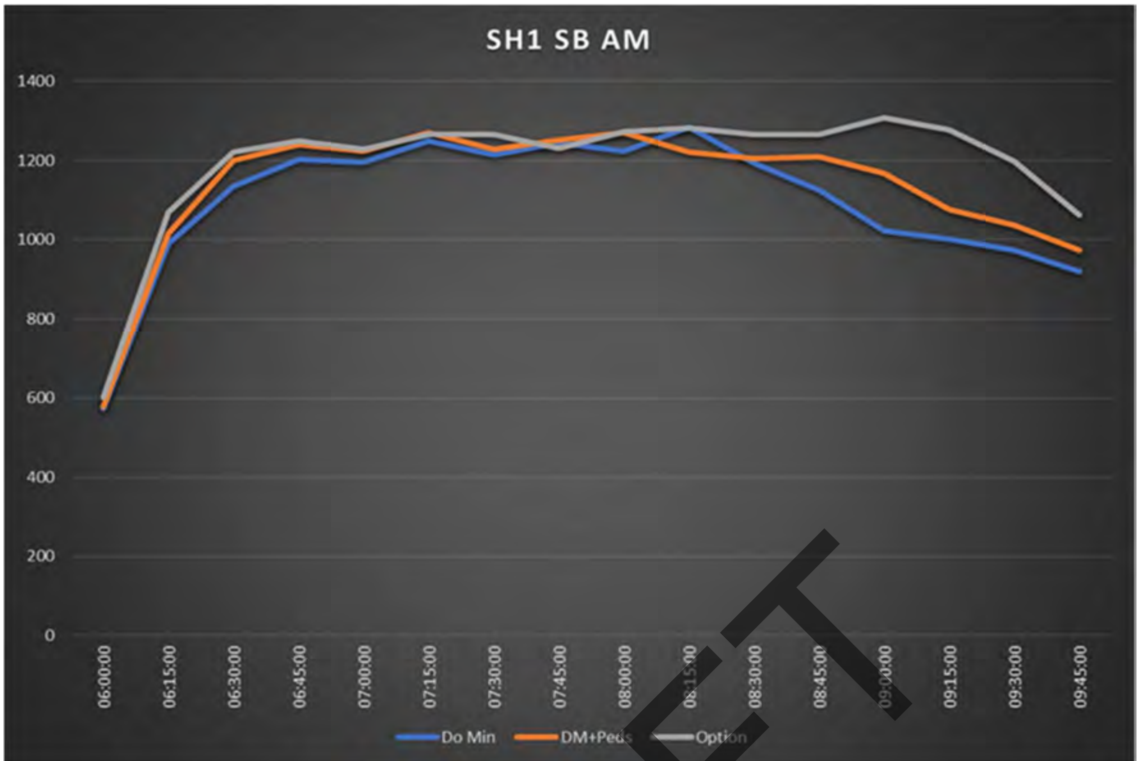


Figure 7 – SH1 Southbound Traffic Volumes

Figure 7 shows the following:

- A very broad peak, starting at 6:30am and continuing to 9am.
- The option results in peak spreading beyond 9am, with the 8:30am peak extending beyond 9am because of traffic diverting from Hutt Road.

Through the process of extraction, some minor side streets such as Rangiora Avenue, Westminster Street, School Road and Sar Street were not included in the model due to the limited access nature of these streets. Given no current data existed for these streets we carried the same assumptions from Phase 1 through to Phase 2 which was a total of 100 vehicles split evenly across each movement entering and exiting these side streets to the main corridor.

Summary of the AIMSUN results

The Aimsun model has shown that whilst it does react to the changes, in the option of a dedicated special vehicle lane, it has reacted by creating a significant re-diversion of vehicles to SH1 and the wider road network. The images shown above for SH1 show that the peak is extended to approximately 09:15 in the option from 08:15 in the do minimum. This could be either due to peak spreading (people leaving earlier or later) or more vehicles joining the back of the queue on SH1 and therefore taking longer to reach their destination.

Whilst this is an issue for SH1 and the economics, in relation of reporting disbenefits, the project corridor would benefit from the significant diversion and whilst diversion is expected a further test was needed to determine what would the worst-case impact be should no diversion occur. This sensitivity test is detailed after the SIDRA model results section further within this document.

Further information and more detail of the AIMSUN assessment is included within Appendix A of this report.

SIDRA model development

SIDRA Network models were developed within SIDRA Intersection 9.0 for each of the three options detailed above.

Do Minimum

The do minimum SIDRA model was previously used in Phase 1 and replicates the current arrangement along the Thorndon Quay and Hutt Road. Each intersection has been reviewed against site observations and the single phasing and timing has been taken from the SCATS data provided. It has been cross checked against the modelling in AIMSUN to ensure that both the AIMSUN model network and the SIDRA model network are the same in terms of lanes, location of signals and intersection layouts.

Do Minimum + Pedestrians

Building from the Do Minimum model and utilising the preliminary design provided by BECA, this SIDRA network model has been developed to include safety improvements such as providing signalised crossings at intersections and signalised mid-block crossings. It has not included changes such as Onslow Road where the proposed scheme signalises the southbound approach to the signal. This enables the safety benefits of these interventions to be isolated.

Signal phasing for this option was determined using practical cycle times. A maximum cycle time of 150 seconds was used with a rounding time of one second. The default time for amber and all-red times of two and four seconds respectively were used. At the Jarden Mill / Hutt Road intersection a dummy movement of 20 seconds was included to allow pedestrians sufficient time to cross on the eastern approach.

Peak Hour Factors (PHF) and Flow Constant was set to 100% for all options modelled. To support the economics, tests were completed based on incremental reduction of the Flow Factors to represent the four-hour spread.

Like the Do Minimum, a review of the AIMSUN layout and the SIDRA layout, has been carried out to confirm that the layouts tested are the same.

Bus + HCV

The HCV Bus Network is a direct reflection of the preliminary design and accounts for the changes to the network to implement the full scheme. This includes:

- Provision of a Special Vehicle Lane in the AM peak in the southbound direction.
- Provision of a Special Vehicle Lane in the PM peak in the northbound direction.
- All changes to lane configurations required by the design.
- All new traffic signal intersections and pedestrian crossings throughout the corridor.

Like the Do Minimum + Pedestrian assessment signal phasing has been determined using practical cycle times. Maximum cycle time of 150 seconds was used with a one second rounding time. Default for amber and all-red times of two and four seconds were used respectively. As requested by the peer reviewers we have ensured that the phasing matched both the do minimum and the do minimum + peds match throughout the scheme. There may be an opportunity in the detailed design phase to improve the final option network by implementing specific phasing and timing at specific intersections.

As completed in the Do Minimum and Do Minimum + Pedestrian assessments, a review of the layout compared to the AIMSUN layout has been carried out to ensure consistency across both model platforms.

Travel time extraction

SIDRA Intersection 9.0 software does not provide travel time outputs for specific vehicle types. Therefore, the travel times were calculated manually. A macro was built to extract specific results from the SIDRA model into an excel sheet.

The macro developed uses the lane length, posted speed limit and average delay from SIDRA to calculate travel time by adding the average delay to the free flow travel time between each intersection. In addition to the above, the macro displays other parameters such as Level of Service (LoS), degree of saturation, queue lengths and the number of vehicles at the approach to each intersection.

Using the travel time calculated for each lane, bus travel times were obtained by considering which lanes buses are likely to utilise along the network. Figure 8 shows the network outputs for a single lane at an intersection. These were summed for all intersections used in the bus route between the Mulgrave Street / Lambton Quay intersection and the Hutt Road / Jarden Mile Intersection.

Scenario	Average Delay (sec)	Lane Length (m)	Posted speed km/hr (across leg)	Time (sec)
1PMJardenMile	67.21	90.0	80.0	125.7
1PMJardenMile	66.75	150.0	80.0	73.5
1PMJardenMile	80.46	1300.0	80.0	139.0
1PMJardenMile	91.39	1300.0	80.0	149.9
1PMJardenMile	32.25	220.0	100.0	40.2
1PMJardenMile	83.69	370.0	100.0	97.0
1PMJardenMile	83.79	235.0	100.0	92.3
1PMJardenMile	26.62	80.0	100.0	29.5
1PMJardenMile	52.20	40.0	100.0	53.6
1PMJardenMile	51.56	500.0	100.0	69.6
1PMJardenMile	51.56	500.0	100.0	69.6
1PMJardenMile	78.32	25.0	100.0	79.2
1PMJardenMile	30.21	350.0	50.0	55.4
1PMJardenMile	67.41	20.0	50.0	68.9
2PMOnslowRd	56.74	1300.0	80.0	115.2
2PMOnslowRd	60.66	1300.0	80.0	119.2
2PMOnslowRd	65.18	500.0	50.0	101.2
2PMOnslowRd	12.77	60.0	80.0	15.5
2PMOnslowRd	21.51	330.0	80.0	=([illegible] * 1000 / 3600)+
2PMOnslowRd	26.07	330.0	80.0	40.9
2aPMRangioracrossing	7.70	330.0	60.0	27.5
2aPMRangioracrossing	5.40	330.0	60.0	25.2

Figure 8 Example of extracted data.

It should be noted that the same process has been used to calculate vehicle travel times and HCV travel time (between Hutt Road / Jarden Mile Intersection and Aotea Quay). The full outputs for the spreadsheets are including in Appendix B of this report.

Corridor Assessments

Journey time summaries

AM peak period

Table 3 below summarises the journey times along the corridor with the three different options.

Table 3 2026 AM Peak Period Southbound Journey Times

Option	Bus (corridor length)	HCV (Jarden Mile to Aotea Quay)	Car (corridor length)
Do minimum	8.7 minutes	5.7 minutes	8.6 minutes
Do minimum + pedestrian	13.5 minutes	6.5 minutes	13.30 minutes
HCV + Bus	7.4 minutes	4.0 minutes	9.1 minutes
SH1 Do Minimum[1]	NA	NA	10 minutes
SH1 HCV + Bus Option[2]	N/A	N/A	10min 30 seconds (average over time-period)

The results show that in the AM peak buses current take approximately 8.7 minutes to complete the journey from the intersection of Jarden Mile / Hutt Road to the intersection of Thorndon Quay / Mulgrave Street intersection. It should be noted that SIDRA does not include dwell times for buses along the corridor and therefore for comparison these have not been included within the assessment.

With the addition of the pedestrian safety improvement along the corridor this increases to 13.5 minutes a 4.8-minute increase. This demonstrates that the additional safety measures will have a general impact on the travel time in a southbound direction.

The implementation of a dedicated Special Vehicle Lane improves this travel time from 13.5 minutes to 7.4 minutes - a total reduction of 6.1 minutes for buses. It should be noted that this does not include dwell times as detailed previously.

For HCVs the travel time is taken from the intersection of Jarden Mile / Hutt Road to Aotea Quay where HCVs would typically leave the route to access the Interisland Ferry terminal. Currently the journey is modelled at approximately 5.7 minutes in the do minimum option.

[1] Taken from the N2A AIMSUN Model.

[2] Taken from the N2A AIMSUN Model.

This increases to 6.5 minutes in the do minimum + pedestrian assessment which would be expected given the additional network changes. With the implementation of the special vehicle lane this decreases to 4.0 minutes, which is a 1.7-minute travel time saving.

Whilst car travel time increases by 4.7 minutes between the do minimum and the do minimum + pedestrian network, we do see a reduction between the do minimum + pedestrian and HCV + Bus option of approximately 4.2 minutes. This is attributed to the reduction of vehicle volume on the corridor with the traffic diverting to State Highway 1 as directed from the AIMSUN model which results in approximately 30 seconds additional travel time for vehicles on SH1. This is due to upstream constraints and potentially a longer travel time will occur either side of the peak however most journeys from Kapiti, Porirua, Johnsonville to Wellington CBD and beyond.

In this context, an 'average' commute from Porirua or North Wellington taking 30 to 35 minutes would experience a negligible increase in travel time along SH1.

Further information on this is included within Appendix A.

PM peak period

Table 4 below summarises the journey times along the corridor with the three different options.

Table 4 2026 PM Peak Period Northbound Journey Times

Option	Bus	HCV	Car
Do minimum	8.80 minutes	5.20 minutes	8.20 minutes
Do minimum + pedestrian	8.50 minutes	4.50 minutes	8.80 minutes
HCV + Bus	8.70 minutes	4.80 minutes	9.00 minutes

The results of the PM assessment show that currently buses take approximately 8.8 minutes to travel from the southern extent of the scheme to the Jarden Mile / Hutt Road intersection. This is a similar travel time with the do minimum + pedestrians. With the HCV + Bus option in place, the travel time decreases slightly to 8.7 minutes - a 0.1-minute saving. It should be noted that the Phase 1 report also set out a minimal benefit in the northbound approach.

A review of the results shows that where the buses join Thorndon Quay at Lambton Street intersection, the low number of vehicles from the bus station to the main road is resulting little green time to buses. SIDRA does not allow a pre-emption for buses and it is understood that should this be carried out further travel time benefits would be achieved. This can be tested and confirmed in the detail design element of the project in accordance with traffic signal designers.

For cars, an increase in travel time is observed between the do minimum and do minimum + peds of approximately 0.6 minute. The HCV+Bus option has a 0.2-minute increase on car travel time over the do minimum + pedestrians.

However, with the improved AM peak bus travel time introduced with the project, it is envisaged that more people will move from car trip to bus trips (given the journey time saving) and this will lead to an increased PT patronage in the PM peak that supports the justification for bus lanes. Whilst travel time is a key demographic, it is also the reliability and perception of level of service which will lead to mode shift.

Level of Service for the corridor and options are included in Appendix B.

Sensitivity tests

A review of the data above has shown that the option to remove a traffic lane in the AM peak results in similar light vehicle travel times as the current base scenario. This is due to the AIMSUN model rediverting a significant volume of traffic around the network and mainly into State Highway 1 where potentially traffic will be joining the back of the existing queue and not being counted within the screenline data. To test the potential worst-case scenario a sensitivity test was carried out, following discussions and agreement with both the peer reviewer and the client advisors, to assume limited redistribution on the network within the HCV and Bus option.

Given the safety schemes could potentially be implemented without the bus lane, it was deemed that the Do Minimum + Pedestrian volumes should be tested. Whilst this included some minor redistribution to SH1 and further areas it was discussed that this data would be the most relevant to test.

The results of this assessment are shown below:

Table 5 2026 AM Sensitivity Test

Option	Bus	HCV	Car
HCV + Bus Option with Do Min + Pedestrian Volumes	7.5 minutes	4.1 minutes	21.5 minutes
HCV + Bus Option (Original)	7.4 minutes	4 minutes	9.1 minutes

Table 5 above shows the impact on the design option with limited diversion. It shows that with the limited diversion of traffic from the corridor to SH1 that the travel time for light vehicles will increased by 12.4 minutes in the AM peak and will effectively be over capacity in the AM peak hour for light vehicles. However, for the HCV and Bus option, the travel time remains consistent with a 0.1-minute difference and therefore meets the investment objectives of the project.

Based on this, the economic elements have been carried out on the two above scenarios.

Investment objectives

The investment objectives of the scheme, in relation to the corridor assessments are:

- Investment Objective 1 – Reliability of bus services;
- Investment Objective 5 – Freight Reliability.

For the AM assessment both objectives have been met with the provision of the HCV + Bus Lane. For the PM assessment, whilst the bus travel time is similar - there is an improvement in the freight reliability and therefore it can be concluded that the scheme meets the investment objectives.

Active Modes Assessment

Introduction

Phase 1 of the assessment utilised the Danish Level of Service method (spreadsheet supplied by Waka Kotahi). For the preferred option the route has been split into the various segments in line with the changing road layouts, types of facilities and corridor widths. This route sees a footway and a bi-directional cycle path on the eastern side of Hutt Road and Thorndon Quay.

It should be noted that this section relates to Investment Objective 2 of Improving the level of service for people walking and cycling along and across Thorndon Quay and Hutt Road.

Danish Level of Service

The Danish Level of Service method utilises various elements of data to estimate the level of service along sections of carriageway. This includes:

- AADT volumes;
- Average Speeds;
- Land Use
- Cross Sections of the Sidewalk, buffer between sidewalk and bicycle paths, bicycle track and buffers between bicycle facility and drive lane.

By entering the relevant information into the spreadsheet, it calculates the level of service for that section based on that data provided.

Given that along the corridor the cycle path and footpath change within the CBD for the preferred option, each section was disaggregated to provide a robust assessment of the scheme. The results of the assessment are shown in the section below.

Results of the Assessment

The LoS estimated using the Danish Cycling Method are provided in Table 8.

Table 6 Active Modes Level of Service

Segment	Walk LoS	Cycle LoS
Existing Corridor (taken from Phase 1 Report)	D	F
Jarden Mile to Motorway Overpass	D	C
Motorway Overpass to Sar Street	C	B
Sar Street to Tinakori Road	C	B
Tinakori Road to Celebration Church	C	A
Celebration Church to Canape Company	C	A
Canape Company to Davis Street	C	A
Davis Street to Moore Street	C	A
Moore Street to Mulgrave Street	C	B

As the above table shows, the existing walking LoS is D with the cycle LoS being F. The proposed scheme will provide a dedicated footway and bi-directional cycle path the entire length of the corridor and therefore the improvements in the Level of Service can be seen with most of the sections resulting in a LoS C for walking and between LoS A and B for cycling. This is a significant improvement over the current situation and meets the Investment Objective of improving the Level of Service for people walking and cycling along the project corridor.

Conclusion

This report has been prepared to detail the results of the assessment work carried out for the second phase of the Thorndon Quay and Hutt Road project. It has detailed the modelling approach undertaken. This included a combination of software from the strategic model in AIMSUN to the completion of a SIDRA network to provide a detailed assessment of the options. The assessment has focused on three options, do minimum, do minimum + pedestrian and HCV and bus lane option.

Corridor Assessment

The assessment has demonstrated that in the AM peak, travel time benefits can be realised with the provision of a dedicated special vehicle lane travelling southbound which meets the investment objectives set out at the start of the project. A travel time benefit of approximately five minutes is observed on the corridor for buses in 2026.

For HCVs the investment objective is to maintain similar travel times on the corridor, and this appears to be represented within the assessments completed. With an approximate two-minute travel time saving between Jarden Mile / Hutt Road and the Aotea Quay intersection. It should be noted that further studies are being carried out by a third-party for the access to the port which includes higher HVC volumes due to the new interisland ferries.

General vehicle traffic shows a decrease in travel time compared to the do min + pedestrian option when compared to the HCV and Bus option. However, this is due in part to a high percentage of traffic redistribution on the network which would be expected given the reduction of through traffic lanes proposed in this option.

For the PM Peak similar travel times are identified for buses in the peak hour. However, for buses this could be due to a lack of pre-emption for buses at the Lambton intersection. With SIDRA unable to allow for this option, it will be tested in detail in the detailed design stage with traffic signal designers.

The sensitivity testing carried out has focused on reviewing the vehicle travel time in the AM peak. It has demonstrated that, in the event of no diversion or mode shift and with the option in place, that vehicle traffic will have significant delay increasing travel time from nine minutes to 22 minutes. It has also shown that with the event of change of traffic volumes the travel time will be reduced along the corridor with tests at 10% reduction and 25% reductions demonstrating this.

The modelling has demonstrated that the project will see travel time benefits for bus and HCV vehicles whilst impacting vehicle travel time. This would be expected given the significant improvement for buses and hcv with dedicated peak time facilities. It therefore meets the investment objective of improved bus reliability and improved bus travel times.

Active modes

Similar to phase one, the danish method to calculate Level of Service for walking and cycling has been completed. A breakdown of the main corridor into various segments was carried out to test the Level of Service where changes in width for pedestrians or cyclists was identified. The result of this is a significant improvement over the existing Level of Service which is currently D for walking and F for cyclists. The improvements see Level of Service results of largely Level of Service C for pedestrians and between A and B for cyclists.

The Investment objective related to active modes was to improve the Level of Service for people walking and cycling along the corridor which has been proven in the assessment.

Appendix A – AIMSUN Model Report

Thorndon Quay Hutt Rd AIMSUN Modelling

1. Context

This brief note summarises the modelling work undertaken in AIMSUN to support the Thorndon Quay Hutt Rd Single Stage Business Case. The options have all been modelled using the Ngauranga to Airport (N2AM) Model.

It should be noted that the purpose of the AIMSUN modelling was to feed into more detailed SIDRA modelling.

Both models use different input assumptions, and outputs from both models should not be compared against each other.

2. Methodology and scope

The modelling work has focussed on a 2026 model year in the AM peak, with the following model scenarios undertaken:

- Do Minimum – essentially the current network in 2026
- Do Minimum + Pedestrian Crossings – the future baseline, a Do Minimum plus 5 signalised crossings and a range of safety improvements proposed for the corridor
- Option – the TQHR preferred option, with one lane along Hutt Rd allocated as an SPV lane for buses / trucks and one lane on Thorndon Quay for buses only

The AIMSUN meso-scopic model has been used for this analysis. Whilst consideration was given to using a micro-simulation model of the corridor, it was decided that a meso-scopic DUE model was more appropriate for the following reason:

- the primary purpose of the modelling was to inform economics and assessment, not detailed operational design
- the meso model will account for wider route choice as a result of the options and identify traffic diversion and changes in travel times on alternative corridors as a result of the option

The following should also be noted:

- peak spreading functionality is turned on in the model, whereby one of the response to changes in travel times (costs) is for people to change their time of travel, travelling later / earlier in order to avoid congestion
- the Hutt Rd project is at the periphery of the modelled area, which from previous analysis create challenges in terms of route choice sensitivity between SH1 / SH2 and Hutt Rd as on partial travel costs are represents (i.e. a trip from Kapiti to the CBD taking 50+ minutes would be 'modelled' as from the edge of the model extent in Johnsonville to the CBD); therefore the costs that the model uses to inform route choice are not the true costs that the user would experience
- merges are complex and most models struggle to accurately replicate observed behaviour

3. AIMSUN model baseline performance

Figure 1 summarises AM peak 2016 observed traffic volumes vs 2026 future demand at key locations in the AM peak, southbound, between 7am and 9am.

Figure 1 Comparison of 2016 observed and 2026 modelled traffic volumes

Intersection	Movements	2016 Observed			2026 Modelled			% Diff
		Car	Truck	Total	Car	Truck	Total	
Jarden Mile / Hutt Road	Centennial Highway to Hutt Rd S	1,463	64	1,527	1,795	146	1,941	27%
	SH2 off-ramp to Hutt Rd	692	55	747	778	81	859	15%
Onslow Road / Hutt Road	Hutt Rd N to Hutt Rd S	2,133	120	2,253	2,494	213	2,707	20%
	Hutt Rd N to Onslow Rd	93	10	103	98	19	117	14%
Kaiwharawhara Road / Hutt Road	Hutt Rd N to Aotea Quay	2,718	100	2,818	3,035	185	3,220	14%
	Hutt Rd N to Kaiwharawhara	222	19	241	172	34	206	-15%
	SH1 SB (N to AQ)	9,639	718	10,357	9,095	558	9,653	-7%

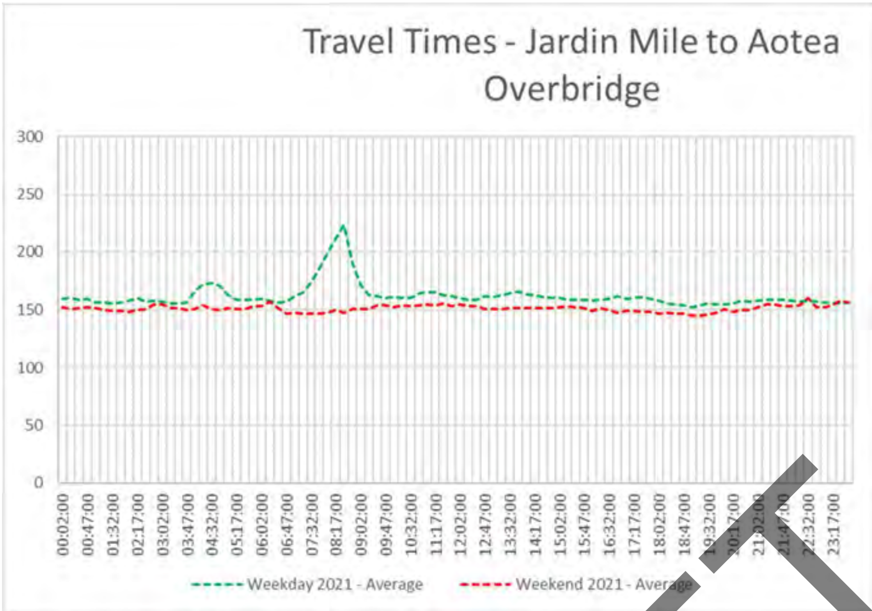
It shows that forecast traffic volumes in 2026 are around 15% to 20% higher than 2016 observed volumes on Hutt Rd but around 5% lower on SH1 in the AM peak between 7am and 9am.

Background growth in traffic volumes on this corridor has been around 5% (during peak periods) during the period 2016 to 2021. If this trend were to continue, and also taking into account the upstream constraints on the corridor, it suggests that the AIMSUN model might be slightly over-representing the attractiveness of Hutt Rd and slightly under-representing the attractiveness of SH1.

The figure below shows weekday (green) and weekend (red) average Hutt Rd travel times between Jardin Mile (south of intersection) and Aotea over-bridge for March 2021.

Accepting that Covid-19 will have had an impact on traffic volumes and travel times (Wellington was at alert level 1 in March), it shows that peak period highway travel times appear to be 60s to 90s slower than during the off-peak.

Figure 2 Highway travel times, jardin Mile to Aotea Overbridge (via Hutt Rd)



4. Model outputs

The sections below present the following key model outputs:

- observed data
- changes in PT travel times and highway travel times along Hutt Rd
- change in traffic volumes by user class
- changes in highway travel times, traffic volumes and flow profile along Hutt Rd
- diversion between Hutt Rd and SH1

Observed PT travel time data

Analysis of PT travel times during the AM peak (7am to 9am) inbound and PM peak (4pm to 6pm) outbound has been undertaken.

It shows the following in relation to corridor travel times:

- AM peak inbound – between **2min and 6 min** increases in bus travel time compared to off-peak (median)
- PM peak outbound – between **~1min and 2 min** increase in bus travel time compared to off-peak (median)

Figure 3 Observed bus travel times along Hutt Rd, March 2020

Note that the data is unable to differentiate between stop dwell time and drive time; it is likely that some of the difference between off-peak and peak is due to lower boardings and alighting along the corridor in peak periods compared to the off-peak and shorter SCATS phase times in the off-peak

Median travel times for the route from Jarden Mile to Capital gateway are shown below. These travel times are sourced from Metlink March 2021 travel times (note these are for the period March 8th onwards when Wellington was at Alert Level 1)

Table 1 Observed PT travel times by section and time period, inbound

	Inbound - TQ	Inbound- HR	Total
AM (7am to 9am)	00:04:38	00:05:53	00:10:31
IP (11am to 3pm)	00:03:49	00:04:47	00:08:36
PM (4pm to 6pm)	00:04:14	00:05:09	00:09:24
Off-peak (8pm to 10pm)	00:03:03	00:04:10	00:07:12

The analysis above shows a **3 min to 3min 30s** difference between the AM peak and off-peak travel times that could be indicative of the travel time benefits that a peak period bus lane could deliver.

Looking at Hutt Rd specifically, the analysis shows that median **bus travel times are 90s slower on Hutt Rd in the AM peak compared to the off-peak**. Given that bus travel times are a function of general traffic travel times as there are no bus priority measures currently in place on the corridor, the data supports the highway travel times (Figure 2) that suggests a 90s differential between AM peak and off-peak travel times between Jardin Mile and Aotea overbridge.

Summary of modelled travel times

The table below shows car and bus travel times for the Do Min + peds and Option in the 7.30am to 8.30am period.

Analysis of bus travel times using distance vs time graphs showed a significant delay at the new Thorndon Quay / Mulgrave St signalised intersection (it is presently a priority intersection)

The bus (adjusted) travel times show what bus travel times could be if there was signal pre-emption at Mulgrave St (buses currently incur 40s of delay here) and at Kaiwharawhara / Hutt Rd (buses currently incur 30s delay here); it is accepted that should pre-emption be assumed, there could be corresponding adverse impacts for general traffic

Overall, the modelling show the following:

- a 15sec improvement in bus travel times under the Option
- up to a minute and a half in bus travel time savings in the option if signal pre-emption at Mulgrave St (40s max delay, 20s average) and Hutt Rd / Kaiwharawhara Rd (40s max delay, 20s average) were assumed
- a 3 min 30s increase in car travel times on the corridor under the option in the AM peak

Table 2 Comparison of car and PT travel times for Do Min + Peds and Option

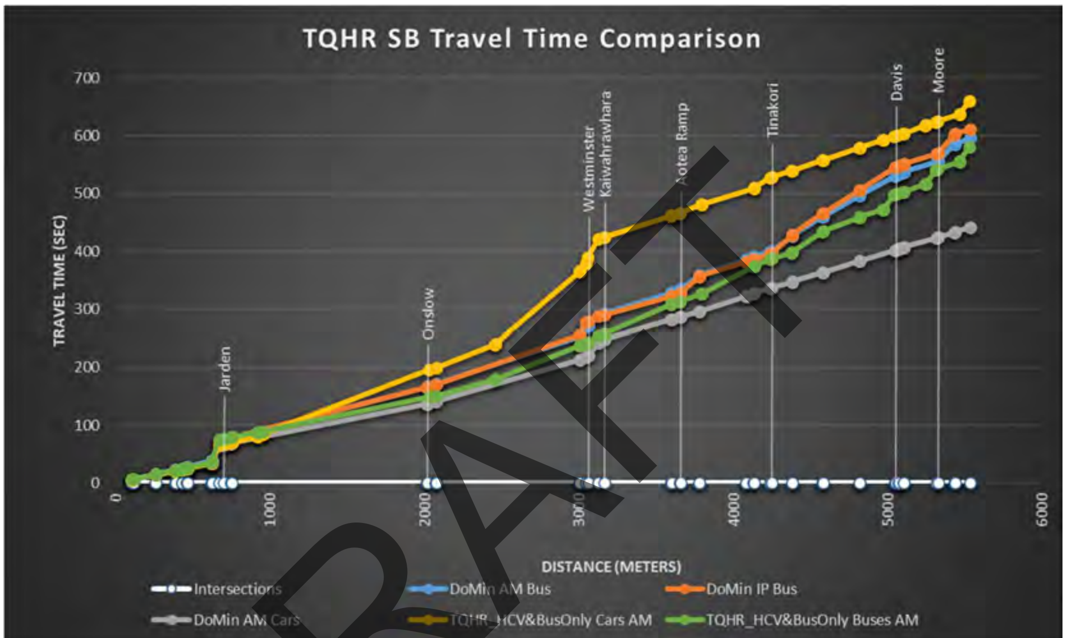
Period/Direction	Mode	Do Min inc peds	Option	Diff	% Diff
AM peak (IB)	Car	442	661	219	50%
	Bus	596	581	-15	3%
	Bus – adjusted (low)	596	536	-60	16%
	Bus – adjusted (low)	596	506	-90	25%

Increases in car travel time between the Do Min and Option generally occurs between Onslow Rd and Kaiwharawhara as shown in the southbound travel time graph below.

This shows that delays for cars as a result of the option exceed 2 minutes for each time slice from 7.45 to 9.00, with a maximum of 3m 30s (8am) and 4 min 30s (8.45am). These delays mainly occur on the section approaching Hutt Rd / Kaiwharawhara intersection (see below, yellow line on the chart) – this is plausible as Hutt Rd goes from 2 lanes to 1 lane in the Option.

There is no noticeable change in car travel time on Thorndon Quay.

Figure 4 Thorndon Quay Hutt Rd Southbound AM Peak car travels times, 2026



Delays along Hutt Rd might be expected to be ‘capped’ as it is a constrained corridor at both ends (Ngauranga Gorge / Jardin Mile is the AM peak constraint, exiting the CBD is the constraint in the PM peak)

The model show a relatively plausible outcome (reported in subsequent sections of the note) whereby when delays get to a certain level, people would re-assign to SH1 and other alternative routes and / or travel earlier or later in order to travel when less congested.

Traffic volumes

The tables below show changes in traffic volumes between the Do Min, Do Min + Peds and Option between 7.30am to 8.30am for the following sections and screenlines

- North of Ngauranga
- South of Ngauranga
- South of Aotea Interchange
- CBD screenline

The model outputs show the following:

	Section	Direction	Flow			Flow Difference	
			Do Min	Do Min + Peds	Option	Do Min + Peds	Option
North Ngauranga	SH1	NB	2,040	2,080	2,020	40	-20
		SB	4,780	4,600	4,140	-180	-640
	SH2	NB	3,180	3,200	3,080	20	-100
		SB	3,340	3,700	3,360	360	20
	Burma Road	NB	480	480	480	0	0
		SB	980	1,000	1,000	20	20
	Total	**NB**	**5,700**	**5,760**	**5,580**	**60**	**-120**
		SB	**9,100**	**9,300**	**8,500**	**200**	**-600**

North Ngauranga

- A shift in demand between SH2 (increase) and SH1 (decrease) between Do Min and Do Min + Peds:
  - this is a function of the sensitivity of the model around the periphery of the model, with demand shifting between 15 minute time slices from one scenario to the next
  - when analysed over a broader 2hr or 4hr time period, this differences are less
- A reduction in traffic volumes on SH1 between 7.30am and 8.30am of 640, a result of the sensitivity of the model in this area coupled with peak spreading whereby people travel earlier / later to avoid the additional congestion on Hutt Rd in the peak of the peak

	Section	Direction	Flow			Flow Difference	
			Do Min	Do Min + Peds	Option	Do Min + Peds	Option
South Ngauranga	SH1	NB	3,280	3,300	3,240	20	-40
		SB	4,960	4,980	5,060	20	100
	Hutt Road	NB	400	360	400	-40	0
		SB	1,840	1,760	960	-80	-880
	Total	**NB**	**3,680**	**3,660**	**3,640**	**-20**	**-40**
		SB	**6,800**	**6,740**	**6,020**	**-60**	**-780**

South Ngauranga

- Minimal change between Do Min and Do Min + peds
- A decrease of 800 vehicles on Hutt Rd as a result of the capacity reduction on Hutt Rd in the Option
- A smaller corresponding increase of 100 on SH1, reflective of the fact that SH1 is at capacity and displaced traffic from Hutt Rd travels earlier / later in order to avoid congestion

	Section	Direction	Flow			Flow Difference	
			Do Min	Do Min + Peds	Option	Do Min + Peds	Option
South Aotea Interchange	Aotea Quay	NB	660	740	780	80	120
		SB	2,400	2,260	2,160	-140	-240
	SH1	NB	2,800	2,720	2,740	-80	-60
		SB	3,720	3,980	3,820	260	100
	Thorndon Quay	NB	480	480	400	0	-80
		SB	1,500	1,340	740	-160	-760
	Grant Road	NB	160	180	180	20	20
		SB	680	680	700	0	20
	Total	**NB**	**4,100**	**4,120**	**4,100**	**20**	**0**
		SB	**8,300**	**8,260**	**7,420**	**-40**	**-880**

South Aotea Interchange

- A decrease on Thorndon Quay as a result of upstream decreases on Hutt Rd
- A small decrease on Waterloo Quay and small increase on Mulgrave St

	Section	Direction	Flow			Flow Difference	
			Do Min	Do Min + Peds	Option	Do Min + Peds	Option
Mid CBD	Waterloo Quay	NB	1,000	1,020	1,040	20	40
		SB	2,080	1,940	1,840	-140	-240
	Thorndon Quay	NB	400	400	320	0	-80
		SB	800	700	360	-100	-440
	Mulgrave Street	SB	1,040	1,260	1,280	220	240
	Molesworth Street	NB	600	580	540	-20	-60
	SH1 SB On Ramp	SB	700	700	580	0	-120
	SH1 NB On Ramp	NB	420	460	420	40	0
	SH1	NB	2,060	1,960	1,980	-100	-80
		SB	2,600	2,680	2,420	80	-180
	Tinakori	NB	460	480	540	20	80
		SB	600	600	540	0	-60
	Total	**NB**	**4,940**	**4,900**	**4,840**	**-40**	**-100**
		SB	**7,820**	**7,880**	**7,020**	**60**	**-800**

Mid CBD

- A reduction in traffic on Thorndon Quay, driven by decrease on Hutt Rd
- A small increase on Mulgrave as a result of increased traffic on SH1

Hutt Rd

The table below summarises cars and trucks on Hutt Rd and SH1 during the AM peak between 7am and 9am.

Table 3 Changes in traffic volumes on Hutt Rd – 2026 AM southbound, DO Min + peds and option

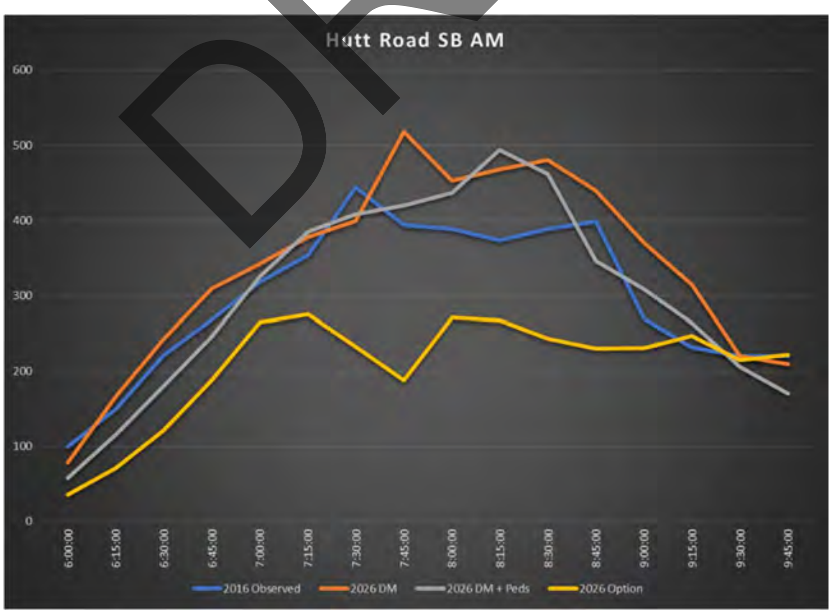
Period/Direction	Mode	Do Min inc peds	Option	Diff	% Diff
SH1	Car	8,900	9,550	650	7%
	Truck	550	550	0	
	Total	9,450	10,100	650	7%
Hutt Rd	Car	3,200	1,750	-1,450	-45%
	Truck	200	200	0	
	Total	3,400	1,950	-1,450	-40%

It shows the following:

- A 50% reduction in cars on Hutt Rd between the Do Min + Peds and Option due to the reduction in traffic capacity for general traffic from 2 lanes to 1 lane
- Around 200 trucks on Hutt Rd in the AM peak between 7am and 9am

The figure below summaries traffic volumes for the 2026 Do Min + peds and 2026 Option by 15 minute time slice between 6am and 10am (with the 2016 observed for Reference).

Figure 5 Hutt Rd southbound traffic volumes, AM peak 2026



It shows that whilst between 6am and 7am the option traffic volumes are only marginally lower than those in the Do Min + peds, Hutt Rd reaches capacity for general traffic around

7am in the option, with between 200 and 300 fewer vehicles during the 'peak of the peak' (7.30am to 8.30am) compared to the DO Min + peds.

In terms of trucks, 200 trucks per hour in the option on Hutt Rd equates to just below 2 trucks a minute. It should be noted that the model potentially over-estimates the number of trucks on Hutt Rd by around 50% (based on the 2016 observed data), meaning that 200 trucks is probably at the upper end of what we might expect to observe in reality. By comparison, around 80 buses use the corridor in the AM peak.

The relatively low number of trucks provides assurance that trucks will not negatively impact upon bus operations.

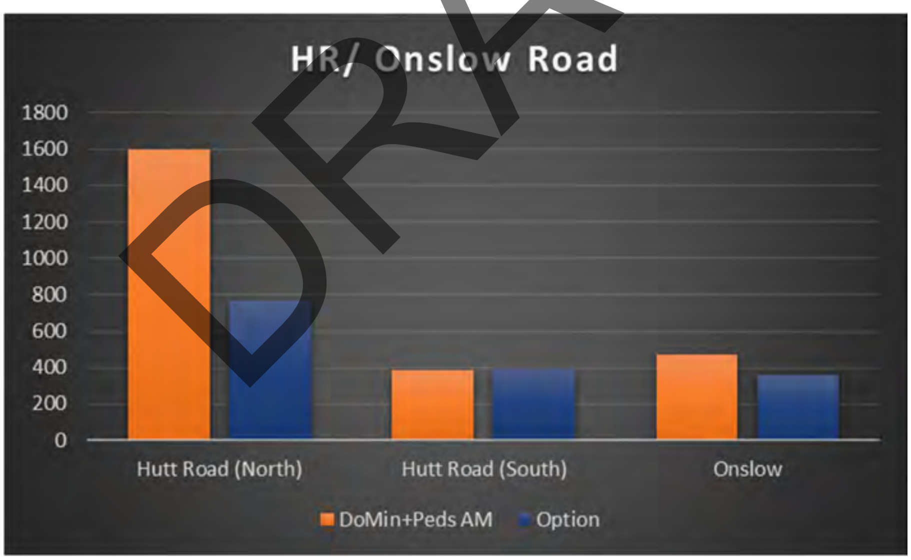
DM + Ped vs Option

The figures below show changes in traffic volumes between the Do Min, Do Min + Peds and Option between 7.30am to 8.30am for key intersections on Hutt Rd.

It shows for Onslow Road:

- A halving of traffic coming from the north from 1600 to 800 vehicles in the peak hour, the result of general traffic capacity being effectively reduced from 2 to 1 lane
- A small decrease (100) in vehicles heading onto Hutt Rd southbound from Onslow Rd, a result of increased travel times on Hutt Rd resulting in some rerouting via Kaiwharawhara and Grant Road

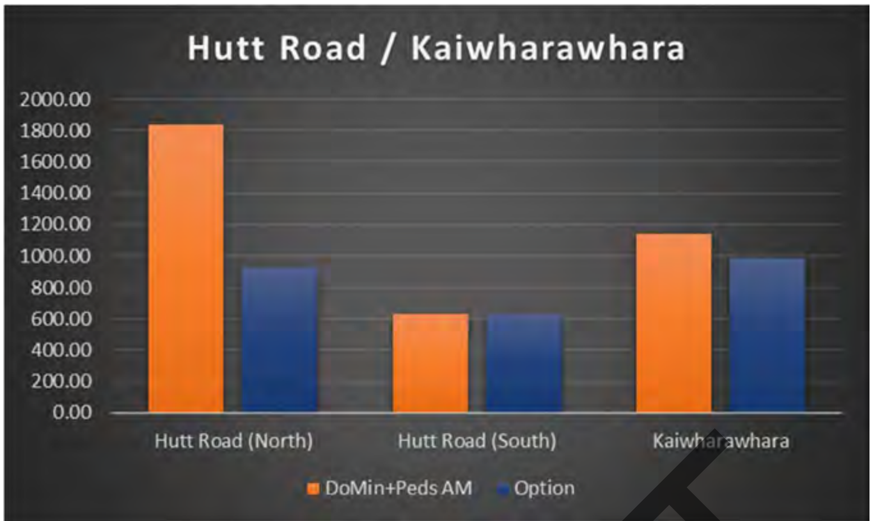
Figure 6 Hutt Rd / onslow Road traffic volumes, AM peak 2026



It shows for Hutt Rd / Kaiwharawhara:

- A halving of traffic coming from the north from 1600 to 800 vehicles in the peak hour, the result of general traffic capacity being effectively reduced from 2 to 1 lane
- A small decrease (100) in vehicles heading onto Hutt Rd southbound from Onslow Rd, a result of increased travel times on Hutt Rd resulting in some rerouting via Kaiwharawhara and Grant Road

Figure 7 Hutt Rd / Kaiwharawhara Road traffic volumes, AM peak 2026

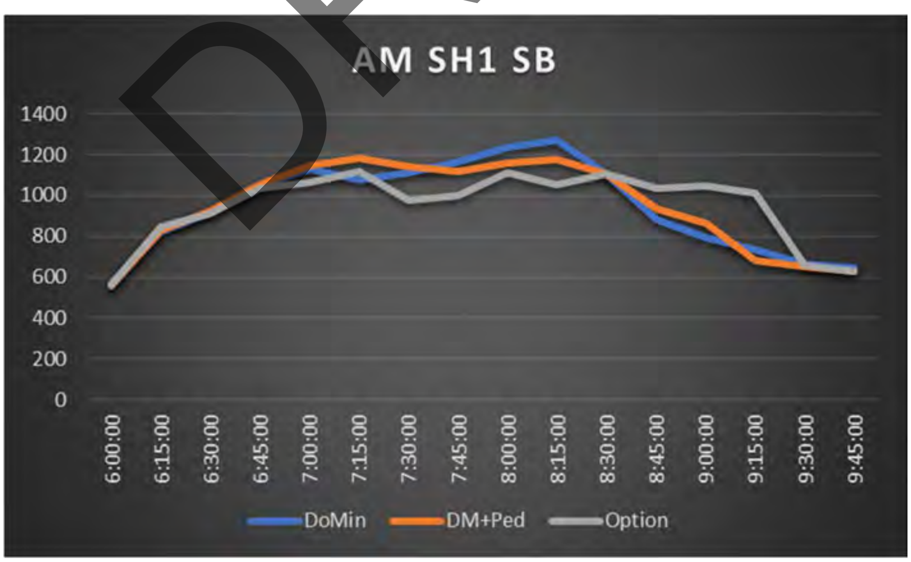


SH1 – Flow profiles and Travel Times

The tables below show changes in traffic volumes between the Do Min, Do Min + Peds and Option between 7.30am to 8.30am for the following sections and screenlines.

It shows that for SH1 southbound, traffic volumes fluctuate across all options by 15 min time slice between 7am and 8.30am, with around 200 vehicles more per 15 minute between 8.45am and 9.15am, the result of peak spreading caused by traffic displaced from SH1.

Figure 8 AM Peak SH1 Southbound traffic volumes, 2026



SH2 shows a similar profile across all time periods.

Figure 9 AM Peak SH2 Southbound traffic volumes, 2026

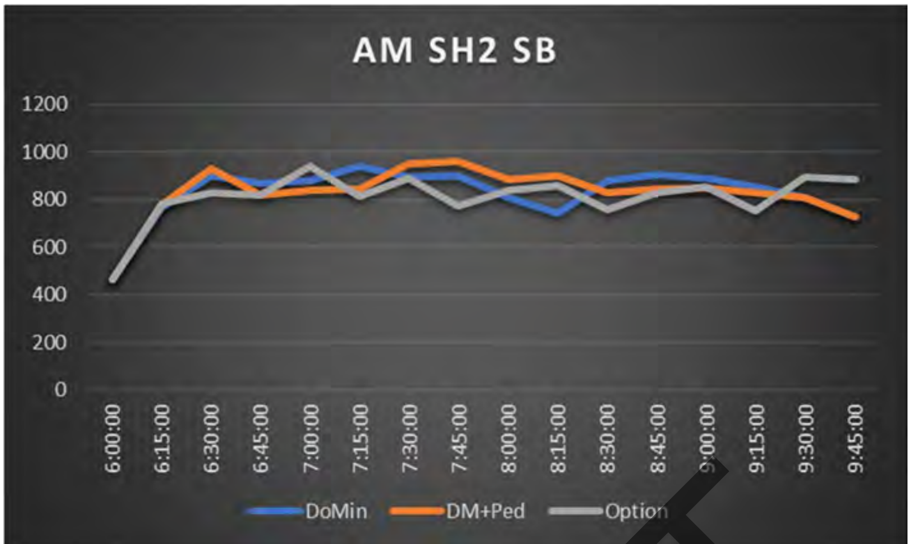
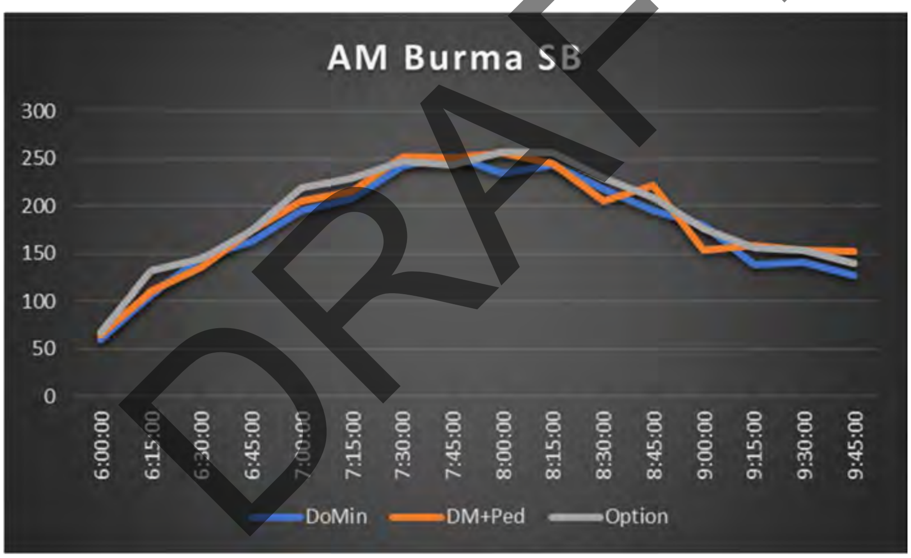


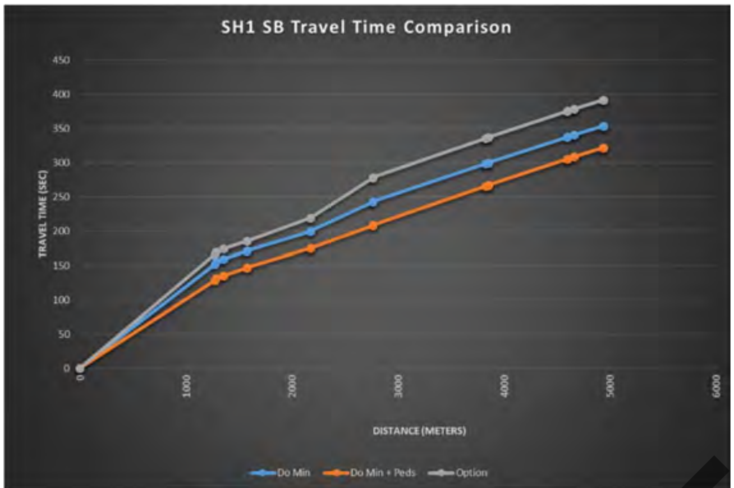
Figure 10 AM Burma Rd Southbound traffic volumes, 2026



There is no significant change in traffic volumes on Burma Rd between the three scenarios, showing that no wider re-routing (i.e. Burma Rd instead of Sh1) is occurring as a result of the option.

The figure below summarises travel times on SH1 between north of the Ngauranga merge and Aotea off-ramp for the AM peak, 2026, southbound

Figure 11 SH1 Travel time comparison, AM peak 2026



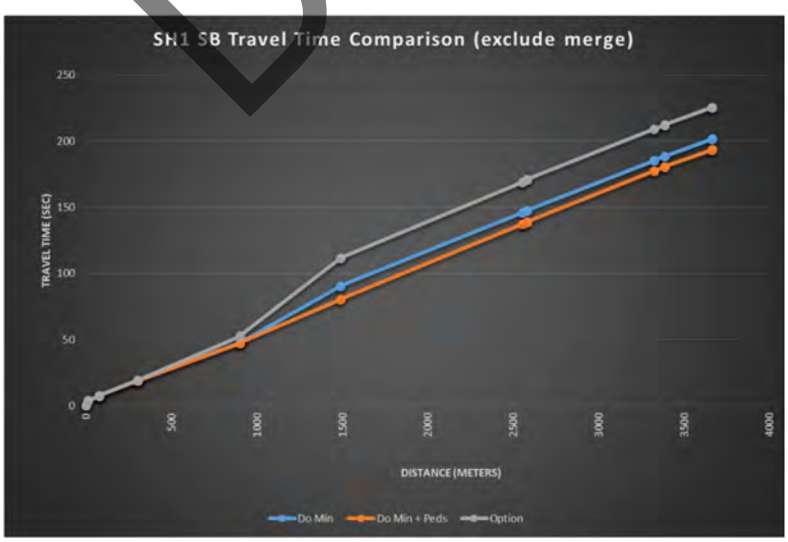
The data shows the following:

- Around a 6-minute travel time in the Do Min, decreasing to 5 min 30s in the Do Min + peds and increasing back to 6 min 30s in the Option
- The greatest divergence in travel times between options occurs in the first 1km of the route

Further analysis in AIMSUN has shown that the merge is the main driver of the change in travel times between options. The AIMSUN model is highly sensitive in this area to small changes in traffic volumes, and this results in changes in travel times along the short section that in reality would not be expected.

If travel times are calculated excluding the merge, as shown below, there is no difference in travel times between the Do Min and Do Min + peds and a 30s increase in travel time between the Do Min + Peds and the Option.

Figure 12 SH1 Travel time comparison, AM peak 2026 (exc merge)



When considered in the context of a journey from Porirua or Kapiti to the CBD, a 30s increase in travel time can be considered negligible.

5. Summary

This section summarises the key metrics, outputs and limitations from the analysis presented in this note.

- Corridor summary
    - 3,000 people travel down the corridor by bus in the AM peak between 7am and 9am
    - 9,600 vehicle (12,500 people) travel down Sh1 the corridor by car
    - 2,000 (2,500 people) travel down Hutt Rd by car
- Trucks
    - Comprise ~5% of traffic on Hutt Rd between 7am and 9am (100 over 2hr)
    - Comprise up to 10% of traffic on SH1 (700 over 2hr)
- Hutt Rd & Thorndon Quay current travel times (noting impact of Covid 19)
    - Bus travel times in the AM peak are between 2 min and 6 min (median 3m 30s) slower than in the off-peak
    - Highway travel times on Hutt Rd are around 90s slower in the AM peak compared to the off-peak
- Hutt Rd & Thorndon Quay forecast PT and car travel times
    - Modelling suggests option will result in a 3 to 4 min for car travel times along the corridor, mainly driven by increases between Onslow Rd and hutt Rd
    - Bus travel times are forecast to improve by between 60s and 90s
- Traffic volumes
    - Hutt Rd traffic volumes forecast to decrease from 1800 to 900 under the option between 7.30am and 8.30am
    - SH1 Traffic volumes are not forecast to change between 7.30am to 8.30am as SH1 is at capacity, however the peak period lengthens with displaced traffic from Hutt Rd travelling earlier / later to avoid congestion
- Sh1 Travel times
    - The option is forecast to increase travel times on SH1 by 30s
    - In the context of most trips using SH1 in the Am peak being longer distance commuter trips, this is considered to be a negligible difference that would not be perceived by most users
- Diversion and change in behaviour
    - The model is generally showing an intuitive change in behaviour
    - On Sh1, peak spreading and displacement from TQHR results in peak extending past 8.30am
    - Burma Rd shows increase and no wider re-routing as a result of the option
    - Onslow Road shows a reduction in traffic volumes under the option, with a corresponding increase on Kaiwharawhara and Churchill / Grant Rd and some peak spreading

6. Limitations

The key limitation is that whilst AIMSUN traffic volumes in 2026 are intuitive compared to 2016 observed, the model is not replicating the slow-moving queue on Hutt Rd that is apparent in the AM peak.

This could be a function of under-assignment on SH1 and not enough demand entering the corridor (either held back upstream or because counts measure actual volumes not demand) or a function of the model not representing the weaving and complex interaction between traffic changing lanes on Hutt Rd that might occur, leading to flow breakdown

Consequently, the model is not capturing the decongestion benefits that bus lanes might be expected to deliver along Hutt Rd and that the observed bus travel times suggest could be realised if travel times comparable to those in the off-peak could be delivered.

Two further minor limitations that won't fundamentally affect conclusions that can be drawn from this work

- there is a slight under-assignment on SH1 (compared to observed traffic volumes)
- the model slightly over-represents trucks on Hutt Rd and under-estimates on SH1

It is suggested that these limitations be accounted for when using model outputs for SIDRA analysis and be addressed during subsequent stages of modelling

Appendix B – Spreadsheet outputs

Do Min - AM Peak

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr (across leg)	Time (sec)	Level of Service
1AMJardenMile	Hutt Rd	South	Lane 1	147	12%	8.81	1300.0	80.0	67.3	LOS A
1AMJardenMile	Hutt Rd	South	Lane 2	93	12%	19.52	1300.0	80.0	78.0	LOS B
1AMJardenMile	Hutt Rd	South	Lane 3	251	54%	46.92	220.0	80.0	56.8	LOS D
1AMJardenMile	SH2 Off Ramp	East	Lane 1	433	87%	63.53	220.0	100.0	71.4	LOS E
1AMJardenMile	SH2 Off Ramp	East	Lane 2	316	81%	58.25	370.0	100.0	71.6	LOS E
1AMJardenMile	SH2 Off Ramp	East	Lane 3	313	81%	58.45	235.0	100.0	66.9	LOS E
1AMJardenMile	Centennial Hwy	North	Lane 1	1122	72%	10.67	80.0	100.0	13.6	LOS B
1AMJardenMile	Centennial Hwy	North	Lane 2	515	102%	105.77	500.0	100.0	123.8	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 3	487	102%	106.71	500.0	100.0	124.7	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 4	35	28%	65.22	25.0	100.0	66.1	LOS E
1AMJardenMile	Jarden Mile	West	Lane 1	4	4%	61.96	350.0	50.0	87.2	LOS E
1AMJardenMile	Jarden Mile	West	Lane 2	40	44%	65.27	20.0	50.0	66.7	LOS E
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 1	712	38%	0.23	1300.0	80.0	58.7	LOS A
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 2	701	38%	0.23	1300.0	80.0	58.7	LOS A
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 3	53	33%	62.92	95.0	80.0	67.2	LOS E
2AMOnslowRd	Onslow Rd	North	Lane 1	605	115%	209.57	500.0	50.0	245.6	LOS F
2AMOnslowRd	Hutt Road South	SouthWest	Lane 1	79	6%	9.76	60.0	80.0	12.5	LOS A
2AMOnslowRd	Hutt Road South	SouthWest	Lane 2	156	20%	22.57	370.0	80.0	39.2	LOS C
2AMOnslowRd	Hutt Road South	SouthWest	Lane 3	156	20%	22.57	370.0	80.0	39.2	LOS C
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 1	921	47%	4.32	370.0	60.0	26.5	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 2	906	47%	4.32	370.0	60.0	26.5	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	2%	6.97	30.0	60.0	8.8	LOS A
3AMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	28%	24.07	300.0	50.0	45.7	LOS C
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 1	275	14%	0.53	620.0	60.0	37.7	LOS A
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 2	270	14%	0.05	620.0	60.0	37.2	LOS A
4AMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	20%	12.93	100.0	60.0	18.9	LOS B
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	933	48%	0.39	620.0	60.0	37.6	LOS A
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	919	48%	0.24	620.0	60.0	37.4	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	262	14%	3.33	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	258	14%	3.33	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	6%	10.06	20.0	60.0	11.3	LOS B
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	896	96%	57.49	70.0	60.0	61.7	LOS E
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	802	96%	57.91	70.0	60.0	62.1	LOS E
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	100	68%	53.58	46.0	60.0	56.3	LOS D
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	555	123%	266.29	2000.0	50.0	410.3	LOS F
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	593	123%	265.68	2000.0	50.0	409.7	LOS F
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	264	18%	4.97	43.0	60.0	7.6	LOS A
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	217	37%	26.20	45.0	60.0	28.9	LOS C
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	213	37%	26.21	45.0	60.0	28.9	LOS C
6AMSchoolRd	Hutt Rd	NorthEast	Lane 1	1364	65%	2.48	45.0	60.0	5.2	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 2	1342	65%	2.48	45.0	60.0	5.2	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	3%	5.28	12.0	60.0	6.0	LOS A
6AMSchoolRd	School Rd	NorthWest	Lane 1	50	33%	23.84	150.0	50.0	34.6	LOS C
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 1	355	26%	4.40	430.0	60.0	30.2	LOS A
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 2	348	26%	4.31	430.0	60.0	30.1	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 1	1352	67%	5.64	430.0	60.0	31.4	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 2	1393	67%	1.95	430.0	60.0	27.7	LOS A
7AMAoteaQuay	Aotea Quay	West	Lane 1	220	12%	5.66	500.0	70.0	31.4	LOS A
7AMAoteaQuay	Hutt Road	SouthWest	Lane 1	483	26%	0.08	430.0	45.0	34.5	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 1	247	12%	2.73	430.0	45.0	37.1	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 2	1272	61%	2.98	430.0	45.0	37.4	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 3	25	4%	7.16	21.0	45.0	8.8	LOS A
8AMSarSt	Sar Street	NorthWest	Lane 1	50	53%	61.82	85.0	40.0	69.5	LOS F
8AMSarSt	Hutt Rd West	SouthWest	Lane 1	25	1%	4.01	18.0	45.0	5.5	LOS A
8AMSarSt	Hutt Rd West	SouthWest	Lane 2	428	23%	2.68	100.0	45.0	10.7	LOS A
9AMTinakoriRd	Thorndon Quay	South	Lane 1	167	10%	0.25	770.0	45.0	61.8	LOS A
9AMTinakoriRd	Hutt Road	North	Lane 1	753	46%	3.21	100.0	45.0	11.2	LOS A
9AMTinakoriRd	Hutt Road	North	Lane 2	739	77%	9.99	45.0	45.0	13.6	LOS A
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	316	23%	4.31	10.0	45.0	5.1	LOS A
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	15	3%	10.76	500.0	45.0	50.8	LOS B
10AMDavisStreet	Thorndon Quay	South	Lane 1	261	16%	3.85	235.0	45.0	22.7	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 1	743	38%	3.08	770.0	45.0	64.7	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 2	31	3%	5.62	15.0	45.0	6.8	LOS A
10AMDavisStreet	Davis Street	SouthWest	Lane 1	89	17%	7.87	500.0	30.0	67.9	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 1	745	38%	2.74	235.0	45.0	21.5	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 2	57	7%	6.79	15.0	45.0	8.0	LOS A
11AMMooreStreet	Moore Street	NorthWest	Lane 1	119	20%	6.77	50.0	30.0	12.8	LOS A
11AMMooreStreet	Thorndon Quay	SouthWest	Lane 1	391	22%	2.10	200.0	45.0	18.1	LOS A
12aAMThorndon/Bus Terminal	Bus Terminal	South	Lane 1	110	9%	3.02	20.0	60.0	4.2	LOS A
12aAMThorndon/Bus Terminal	Thorndon South	SouthEast	Lane 1	278	15%	0.00	33.0	60.0	2.0	LOS A
12aAMThorndon/Bus Terminal	Thorndon North	NorthWest	Lane 1	388	19%	4.20	210.0	60.0	16.8	LOS A
12aAMThorndon/Bus Terminal	Thorndon North	NorthWest	Lane 2	391	19%	4.18	210.0	60.0	16.8	LOS A
12aAMThorndon/Bus Terminal	Thorndon North	NorthWest	Lane 3	11	2%	8.27	210.0	60.0	20.9	LOS A
12bAMMulgrave/Thorndon	Thorndon Quay	SouthEast	Lane 1	276	39%	10.25	500.0	45.0	50.2	LOS B
12bAMMulgrave/Thorndon	Throndon Quay	NorthWest	Lane 1	388	82%	20.07	33.0	45.0	22.7	LOS C
12bAMMulgrave/Thorndon	Throndon Quay	NorthWest	Lane 2	391	82%	20.29	33.0	45.0	22.9	LOS C
12bAMMulgrave/Thorndon	Mulgrave Street	SouthWest	Lane 1	480	82%	13.46	13.0	45.0	14.5	LOS B
12bAMMulgrave/Thorndon	Mulgrave Street	SouthWest	Lane 2	480	82%	13.21	13.0	45.0	14.3	LOS B
12cAMMulgrave/Bus Terminal	Mulgrave North	NorthWest	Lane 1	557	97%	52.23	500.0	45.0	92.2	LOS D
12cAMMulgrave/Bus Terminal	Mulgrave North	NorthWest	Lane 2	503	97%	51.84	500.0	45.0	91.8	LOS D
12cAMMulgrave/Bus Terminal	Mulgrave North	NorthWest	Lane 3	9	2%	9.60	20.0	45.0	11.2	LOS A
12cAMMulgrave/Bus Terminal	Lambton Quay South	SouthWest	Lane 1	19	11%	17.46	500.0	45.0	57.5	LOS B
12cAMMulgrave/Bus Terminal	Lambton Quay North	NorthEast	Lane 1	11		17.20	20.0	45.0	18.8	LOS B

									Bus Travel Time	
							Distance		Seconds	Minutes
							5100.0	Bus	519.1	8.7
							5113.0	Vehicle	516.7	8.6
							3335.0	HCV	344.9	5.7

Do Min - PM Peak

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr	Time (sec)	Level of Service
1PMJardenMile	Hutt Rd	South	Lane 1	405	89%	54.67	1300.0	80.0	113.2	LOS D
1PMJardenMile	Hutt Rd	South	Lane 2	365	89%	56.09	1300.0	80.0	114.6	LOS E
1PMJardenMile	Hutt Rd	South	Lane 3	230	26%	11.56	220.0	80.0	21.5	LOS B
1PMJardenMile	SH2 Off Ramp	East	Lane 1	198	22%	21.89	220.0	100.0	29.8	LOS C
1PMJardenMile	SH2 Off Ramp	East	Lane 2	626	90%	52.97	370.0	100.0	66.3	LOS D
1PMJardenMile	SH2 Off Ramp	East	Lane 3	623	90%	53.05	235.0	100.0	61.5	LOS D
1PMJardenMile	Centennial Hwy	North	Lane 1	772	50%	10.61	80.0	100.0	13.5	LOS B
1PMJardenMile	Centennial Hwy	North	Lane 2	159	59%	46.23	500.0	100.0	64.2	LOS D
1PMJardenMile	Centennial Hwy	North	Lane 3	159	59%	46.22	500.0	100.0	64.2	LOS D
1PMJardenMile	Centennial Hwy	North	Lane 4	1	1%	56.95	25.0	100.0	57.8	LOS E
1PMJardenMile	Jarden Mile	West	Lane 1	56	33%	52.77	350.0	50.0	78.0	LOS D
1PMJardenMile	Jarden Mile	West	Lane 2	131	87%	62.48	20.0	50.0	63.9	LOS E
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 1	245	13%	0.06	1300.0	80.0	58.6	LOS A
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 2	245	13%	0.06	1300.0	80.0	58.6	LOS A
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 3	138	55%	42.02	95.0	80.0	46.3	LOS D
2PMOnslowRd	Onslow Rd	North	Lane 1	179	56%	42.86	500.0	50.0	78.9	LOS D
2PMOnslowRd	Hutt Road South	SouthWest	Lane 1	338	26%	11.88	60.0	80.0	14.6	LOS B
2PMOnslowRd	Hutt Road South	SouthWest	Lane 2	495	58%	21.31	370.0	80.0	38.0	LOS C
2PMOnslowRd	Hutt Road South	SouthWest	Lane 3	453	58%	20.47	370.0	80.0	37.1	LOS C
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 1	295	16%	4.28	370.0	60.0	26.5	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 2	291	16%	4.28	370.0	60.0	26.5	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	4%	9.25	30.0	60.0	11.0	LOS A
3PMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	18%	16.35	300.0	50.0	38.0	LOS C
3PMRangioraAvenue	Hutt Road	SouthWest	Lane 1	696	37%	0.34	620.0	60.0	37.5	LOS A
3PMRangioraAvenue	Hutt Road	SouthWest	Lane 2	685	37%	0.15	620.0	60.0	37.4	LOS A
4PMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	15%	10.50	100.0	60.0	16.5	LOS B
4PMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	569	30%	0.35	620.0	60.0	37.6	LOS A
4PMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	560	30%	0.11	620.0	60.0	37.3	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	683	36%	3.35	70.0	60.0	7.5	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	673	36%	3.35	70.0	60.0	7.6	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	3%	6.81	20.0	60.0	8.0	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	314	29%	7.64	70.0	60.0	11.8	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	310	29%	7.64	70.0	60.0	11.8	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	189	110%	141.59	46.0	60.0	144.4	LOS F
5PMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	318	77%	35.52	45.0	50.0	38.8	LOS D
5PMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	330	77%	35.32	500.0	50.0	71.3	LOS D
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	827	56%	5.92	43.0	60.0	8.5	LOS A
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	513	96%	53.80	45.0	60.0	56.5	LOS D
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	734	96%	52.16	45.0	60.0	54.9	LOS D
6PMSchoolRd	Hutt Rd	NorthEast	Lane 1	561	30%	2.45	45.0	60.0	5.2	LOS A
6PMSchoolRd	Hutt Rd	NorthEast	Lane 2	552	30%	2.45	45.0	60.0	5.2	LOS A
6PMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	14%	18.54	12.0	60.0	19.3	LOS C
6PMSchoolRd	School Rd	NorthWest	Lane 1	50	81%	82.03	150.0	50.0	92.8	LOS F
6PMSchoolRd	Hutt Rd West	SouthWest	Lane 1	1046	55%	4.38	430.0	60.0	30.2	LOS A
6PMSchoolRd	Hutt Rd West	SouthWest	Lane 2	1031	55%	4.35	430.0	60.0	30.2	LOS A
7PMAoteaQuay	Hutt Road East	NorthEast	Lane 1	619	34%	5.67	430.0	60.0	31.5	LOS A
7PMAoteaQuay	Hutt Road East	NorthEast	Lane 2	510	27%	1.72	430.0	60.0	27.5	LOS A
7PMAoteaQuay	Aotea Quay	West	Lane 1	1040	55%	5.72	500.0	70.0	31.4	LOS A
7PMAoteaQuay	Hutt Road	SouthWest	Lane 1	1037	55%	0.28	430.0	45.0	34.7	LOS A
8PMSarSt	Hutt Rd East	NorthEast	Lane 1	515	29%	2.78	430.0	45.0	37.2	LOS A
8PMSarSt	Hutt Rd East	NorthEast	Lane 2	25	10%	17.12	21.0	45.0	18.8	LOS C
8PMSarSt	Sar Street	NorthWest	Lane 1	50	30%	26.95	85.0	40.0	34.6	LOS D
8PMSarSt	Hutt Rd West	SouthWest	Lane 1	25	1%	4.01	18.0	45.0	5.5	LOS A
8PMSarSt	Hutt Rd West	SouthWest	Lane 2	963	52%	2.70	100.0	45.0	10.7	LOS A
9PMTinakoriRd	Thorndon Quay	South	Lane 1	601	33%	0.71	770.0	45.0	62.3	LOS A
9PMTinakoriRd	Hutt Road	North	Lane 1	199	11%	2.73	100.0	45.0	10.7	LOS A
9PMTinakoriRd	Hutt Road	North	Lane 2	286	65%	15.53	45.0	45.0	19.1	LOS C
9PMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	455	51%	8.25	10.0	45.0	9.1	LOS A
9PMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	21	4%	9.68	500.0	45.0	49.7	LOS A
10PMDavisStreet	Thorndon Quay	South	Lane 1	794	47%	4.07	235.0	45.0	22.9	LOS A
10PMDavisStreet	Thorndon Quay	NorthWest	Lane 1	244	14%	3.02	770.0	45.0	64.6	LOS A
10PMDavisStreet	Thorndon Quay	NorthWest	Lane 2	106	27%	12.63	15.0	45.0	13.8	LOS B
10PMDavisStreet	Davis Street	SouthWest	Lane 1	149	24%	7.02	500.0	30.0	67.0	LOS A
11PMMooreStreet	Thorndon Quay	NorthEast	Lane 1	311	17%	2.71	235.0	45.0	21.5	LOS A
11PMMooreStreet	Thorndon Quay	NorthEast	Lane 2	9	3%	13.98	15.0	45.0	15.2	LOS B
11PMMooreStreet	Moore Street	NorthWest	Lane 1	602	79%	12.67	50.0	30.0	18.7	LOS B
11PMMooreStreet	Thorndon Quay	SouthWest	Lane 1	567	31%	1.26	210.0	45.0	18.1	LOS A
12aPMThorndon/Bus Terminal	Bus Terminal	South	Lane 1	111	12%	4.23	20.0	60.0	5.4	LOS A
12aPMThorndon/Bus Terminal	Thorndon South	SouthEast	Lane 1	463	24%	0.01	33.0	60.0	2.0	LOS A
12aPMThorndon/Bus Terminal	Thorndon North	NorthWest	Lane 1	248	13%	4.17	120.0	60.0	11.4	LOS A
12aPMThorndon/Bus Terminal	Thorndon North	NorthWest	Lane 2	248	13%	4.17	210.0	60.0	16.8	LOS A
12aPMThorndon/Bus Terminal	Thorndon North	NorthWest	Lane 3	25	6%	11.03	210.0	60.0	23.6	LOS B
12bPMMulgrave/Thorndon	Thorndon Quay	SouthEast	Lane 1	463	52%	20.57	500.0	45.0	60.6	LOS C
12bPMMulgrave/Thorndon	Throndon Quay	NorthWest	Lane 1	253	32%	20.81	33.0	45.0	23.4	LOS C
12bPMMulgrave/Thorndon	Throndon Quay	NorthWest	Lane 2	253	32%	20.81	33.0	45.0	23.4	LOS C
12bPMMulgrave/Thorndon	Mulgrave Street	SouthWest	Lane 1	408	54%	25.55	13.0	45.0	26.6	LOS C
12bPMMulgrave/Thorndon	Mulgrave Street	SouthWest	Lane 2	408	54%	25.55	13.0	45.0	26.6	LOS C
12cPMMulgrave/Bus Terminal	Mulgrave North	NorthWest	Lane 1	461	56%	5.00	500.0	45.0	45.0	LOS A
12cPMMulgrave/Bus Terminal	Mulgrave North	NorthWest	Lane 2	418	56%	4.25	500.0	45.0	44.2	LOS A
12cPMMulgrave/Bus Terminal	Mulgrave North	NorthWest	Lane 3	8	1%	7.45	20.0	45.0	9.1	LOS A
12cPMMulgrave/Bus Terminal	Lampton Quay South	SouthWest	Lane 1	29	27%	49.26	500.0	45.0	89.3	LOS D
12cPMMulgrave/Bus Terminal	Lampton Quay North	NorthEast	Lane 2	25		49.00	20.0	45.0	50.6	LOS D

		Bus Travel Time	
Distance		Seconds	Minutes
5100.0	Bus	526.2	8.8
5113.0	Vehicle	492.8	8.2
3335.0	HCV	314.7	5.2

Do Min + Peds - AM Peak

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr (across leg)	Time (sec)	Level of Service
1AMJardenMile	Hutt Rd	South	Lane 1	111	11%	13.57	1300.0	80.0	72.1	LOS B
1AMJardenMile	Hutt Rd	South	Lane 2	87	11%	12.60	1300.0	80.0	71.1	LOS B
1AMJardenMile	Hutt Rd	South	Lane 3	223	93%	96.85	125.0	80.0	102.5	LOS F
1AMJardenMile	SH2 Off Ramp	East	Lane 1	285	64%	50.39	220.0	100.0	58.3	LOS D
1AMJardenMile	SH2 Off Ramp	East	Lane 2	354	182%	799.21	370.0	100.0	812.5	LOS F
1AMJardenMile	SH2 Off Ramp	East	Lane 3	350	182%	799.44	235.0	100.0	807.9	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 1	1093	194%	921.62	80.0	100.0	924.5	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 2	581	65%	30.26	500.0	100.0	48.3	LOS C
1AMJardenMile	Centennial Hwy	North	Lane 3	556	65%	29.47	500.0	100.0	47.5	LOS C
1AMJardenMile	Centennial Hwy	North	Lane 4	29	12%	70.11	25.0	100.0	71.0	LOS E
1AMJardenMile	Jarden Mile	West	Lane 1	5	1%	33.10	350.0	50.0	58.3	LOS C
1AMJardenMile	Jarden Mile	West	Lane 2	46	37%	78.81	20.0	50.0	80.2	LOS E
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 1	717	39%	0.24	1300.0	80.0	58.7	LOS A
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 2	705	39%	0.24	1300.0	80.0	58.7	LOS A
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 3	43	26%	31.67	95.0	80.0	35.9	LOS C
2AMOnslowRd	Onslow Rd	North	Lane 1	469	68%	19.53	500.0	50.0	55.5	LOS B
2AMOnslowRd	Hutt Road South	SouthWest	Lane 1	70	6%	10.36	60.0	80.0	13.1	LOS B
2AMOnslowRd	Hutt Road South	SouthWest	Lane 2	142	66%	25.63	330.0	80.0	40.5	LOS C
2AMOnslowRd	Hutt Road South	SouthWest	Lane 3	142	66%	25.63	330.0	80.0	40.5	LOS C
2aAMRangioracrossing	Hutt Road (north)	NorthEast	Lane 1	887		6.30	330.0	60.0	26.1	LOS A
2aAMRangioracrossing	Hutt Road (north)	NorthEast	Lane 2	873		6.40	330.0	60.0	26.2	LOS A
2aAMRangioracrossing	Hutt Road South	SouthWest	Lane 1	267	22%	2.60	40.0	60.0	5.0	LOS A
2aAMRangioracrossing	Hutt Road South	SouthWest	Lane 2	262	22%	2.60	40.0	60.0	5.0	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 1	812	50%	2.29	40.0	60.0	4.7	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 2	923	50%	2.28	40.0	60.0	4.7	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	2%	4.83	30.0	60.0	6.6	LOS A
3AMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	18%	14.94	300.0	50.0	36.5	LOS B
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 1	267	14%	0.54	620.0	60.0	37.7	LOS A
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 2	262	14%	0.05	620.0	60.0	37.2	LOS A
4AMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	19%	12.67	100.0	60.0	18.7	LOS B
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	887	47%	0.40	620.0	60.0	37.6	LOS A
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	873	47%	0.24	620.0	60.0	37.4	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	254	13%	3.33	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	250	13%	3.33	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	6%	10.00	20.0	60.0	11.2	LOS A
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	873	112%	175.19	70.0	60.0	179.4	LOS F
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	776	112%	177.23	70.0	60.0	181.4	LOS F
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	104	31%	49.34	46.0	60.0	52.1	LOS D
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	564	112%	187.13	2000.0	50.0	331.1	LOS F
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	588	112%	186.23	2000.0	50.0	330.2	LOS F
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	244	16%	4.84	43.0	60.0	7.4	LOS A
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	189	64%	51.05	45.0	60.0	53.7	LOS D
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	196	64%	51.34	45.0	60.0	54.0	LOS D
6AMSchoolRd	Hutt Rd	NorthEast	Lane 1	1326	63%	2.48	45.0	60.0	5.2	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 2	1306	63%	2.48	45.0	60.0	5.2	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	3%	5.04	12.0	60.0	5.8	LOS A
6AMSchoolRd	School Rd	NorthWest	Lane 1	50	34%	20.28	150.0	50.0	31.1	LOS C
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 1	317	17%	4.36	430.0	60.0	30.2	LOS A
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 2	312	17%	4.25	430.0	60.0	30.1	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 1	1319	65%	6.02	430.0	60.0	31.8	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 2	1334	64%	1.91	430.0	60.0	27.7	LOS A
7AMAoteaQuay	Aotea Quay	West	Lane 1	186	10%	5.63	500.0	70.0	31.3	LOS A
7AMAoteaQuay	Hutt Road	SouthWest	Lane 1	443	24%	0.03	150.0	45.0	12.0	LOS A
7aAMAQcrossing	Hutt Rd East	NorthEast	Lane 1	731		5.00	150.0	60.0	14.0	LOS A
7aAMAQcrossing	Hutt Rd East	NorthEast	Lane 2	624		5.20	150.0	60.0	14.2	LOS A
7aAMAQcrossing	Hutt Road West	SouthWest	Lane 1	478	41%	3.02	280.0	60.0	19.8	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 1	214	11%	2.73	280.0	45.0	25.1	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 2	1116	53%	2.81	280.0	45.0	25.2	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 3	25	3%	7.04	21.0	45.0	8.7	LOS A
8AMSarSt	Sar Street	NorthWest	Lane 1	50	31%	20.38	85.0	40.0	28.0	LOS C
8AMSarSt	Hutt Rd West	SouthWest	Lane 1	25	1%	4.01	18.0	45.0	5.5	LOS A
8AMSarSt	Hutt Rd West	SouthWest	Lane 2	453	25%	2.70	100.0	45.0	10.7	LOS A
9AMTinakoriRd	Thorndon Quay	South	Lane 1	182	28%	21.63	260.0	45.0	42.4	LOS C
9AMTinakoriRd	Hutt Road	North	Lane 1	687	118%	219.71	100.0	45.0	227.7	LOS F
9AMTinakoriRd	Hutt Road	North	Lane 2	646	118%	222.09	65.0	45.0	227.3	LOS F
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	303	34%	18.08	10.0	45.0	18.9	LOS B
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	5	3%	46.53	500.0	45.0	86.5	LOS D
9aAMChurchCrossing	Thorndon Quay	SouthEast	Lane 1	195	22%	3.20	170.0	60.0	13.4	LOS A
9aAMChurchCrossing	Thorndon Quay	NorthWest	Lane 1	340	28%	3.33	260.0	60.0	18.9	LOS A
9aAMChurchCrossing	Thorndon Quay	NorthWest	Lane 2	352	28%	3.32	260.0	60.0	18.9	LOS A
9bAMThorndonCrossing	Thorndon Quay	SouthEast	Lane 1	195	22%	3.20	300.0	60.0	21.2	LOS A
9bAMThorndonCrossing	Thorndon Quay	NorthWest	Lane 1	340	28%	3.33	170.0	60.0	13.5	LOS A
9bAMThorndonCrossing	Thorndon Quay	NorthWest	Lane 2	352	28%	3.32	170.0	60.0	13.5	LOS A
9cAMCafeCrossing	Thorndon Quay	SouthEast	Lane 1	195	22%	3.20	40.0	60.0	5.6	LOS A
9cAMCafeCrossing	Thorndon Quay	NorthWest	Lane 1	130	11%	3.86	300.0	60.0	21.9	LOS A
9cAMCafeCrossing	Thorndon Quay	NorthWest	Lane 2	562	45%	3.70	300.0	60.0	21.7	LOS A
10AMDavisStreet	Thorndon Quay	South	Lane 1	301	18%	3.85	185.0	45.0	18.6	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 1	674	28%	2.21	40.0	45.0	5.4	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 2	32	3%	4.90	15.0	45.0	6.1	LOS A
10AMDavisStreet	Davis Street	SouthWest	Lane 1	60	9%	5.87	500.0	30.0	65.9	LOS A
10aAMMooreCrossing	Thorndon Quay (south)	South	Lane 1	298	32%	3.42	50.0	60.0	6.4	LOS A
10aAMMooreCrossing	Thorndon Quay (north)	North	Lane 1	153	13%	3.95	185.0	60.0	15.0	LOS A
10aAMMooreCrossing	Thorndon Quay (north)	North	Lane 2	566	46%	3.73	185.0	60.0	14.8	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 1	651	27%	2.41	50.0	45.0	6.4	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 2	65	6%	6.26	15.0	45.0	7.5	LOS A
11AMMooreStreet	Moore Street	NorthWest	Lane 1	126	14%	4.43	50.0	30.0	10.4	LOS A
11AMMooreStreet	Thorndon Quay	SouthWest	Lane 1	396	22%	1.86	200.0	45.0	17.9	LOS A
12AMMulgrave/Thondon/Lambton	Lambton Quay	South	Lane 1	18	25%	53.88	500.0	45.0	93.9	LOS D
12AMMulgrave/Thondon/Lambton	Thorndon Quay	SouthEast	Lane 1	293	42%	24.89	500.0	45.0	64.9	LOS C
12AMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 1	14	15%	52.64	200.0	45.0	68.6	LOS D
12AMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 2	654	89%	46.11	200.0	45.0	62.1	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 1	84	12%	23.68	18.0	45.0	25.1	LOS C
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 2	568	90%	47.68	500.0	45.0	87.7	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 3	622	90%	47.80	500.0	45.0	87.8	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 4	10	3%	24.70	30.0	45.0	27.1	LOS C

Distance	Bus Travel Time	
	Seconds	Minutes
5070.0	808.4	13.5

Distance	Vehicle Travel Time	
	Seconds	Minutes
5070.0	798.9	13.3

Distance	Travel time - Jarden to Aotea	
	Seconds	Minutes
3335.0	391.8	6.5

Do Min + Peds - PM Peak

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr	Time (sec)	Level of Service
1PMJardenMile	Hutt Rd	South	Lane 1	270	37%	25.93	1300.0	80.0	84.4	LOS C
1PMJardenMile	Hutt Rd	South	Lane 2	262	37%	26.17	1300.0	80.0	84.7	LOS C
1PMJardenMile	Hutt Rd	South	Lane 3	224	94%	97.33	125.0	80.0	103.0	LOS F
1PMJardenMile	SH2 Off Ramp	East	Lane 1	230	35%	35.54	220.0	100.0	43.5	LOS D
1PMJardenMile	SH2 Off Ramp	East	Lane 2	622	163%	635.67	370.0	100.0	649.0	LOS F
1PMJardenMile	SH2 Off Ramp	East	Lane 3	619	163%	635.72	235.0	100.0	644.2	LOS F
1PMJardenMile	Centennial Hwy	North	Lane 1	770	164%	648.78	80.0	100.0	651.7	LOS F
1PMJardenMile	Centennial Hwy	North	Lane 2	189	27%	22.36	500.0	100.0	40.4	LOS C
1PMJardenMile	Centennial Hwy	North	Lane 3	188	27%	22.35	500.0	100.0	40.4	LOS C
1PMJardenMile	Centennial Hwy	North	Lane 4	3	2%	70.84	25.0	100.0	71.7	LOS E
1PMJardenMile	Jarden Mile	West	Lane 1	53	13%	31.32	350.0	50.0	56.5	LOS C
1PMJardenMile	Jarden Mile	West	Lane 2	123	106%	154.49	20.0	50.0	155.9	LOS F
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 1	86	5%	0.02	1300.0	80.0	58.5	LOS A
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 2	86	5%	0.02	1300.0	80.0	58.5	LOS A
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 3	543	90%	44.34	95.0	80.0	48.6	LOS D
2PMOnslowRd	Onslow Rd	North	Lane 1	184	84%	43.95	500.0	50.0	79.9	LOS D
2PMOnslowRd	Hutt Road South	SouthWest	Lane 1	300	37%	20.86	60.0	80.0	35.7	LOS C
2PMOnslowRd	Hutt Road South	SouthWest	Lane 2	362	85%	36.04	330.0	80.0	50.9	LOS D
2PMOnslowRd	Hutt Road South	SouthWest	Lane 3	376	85%	35.81	330.0	80.0	50.7	LOS D
2aPMRangioracrossing	Hutt Road (north)	NorthEast	Lane 1	355		3.50	330.0	60.0	23.3	LOS A
2aPMRangioracrossing	Hutt Road (north)	NorthEast	Lane 2	349		3.60	330.0	60.0	23.4	LOS A
2aPMRangioracrossing	Hutt Road South	SouthWest	Lane 1	719	75%	6.72	40.0	60.0	9.1	LOS A
2aPMRangioracrossing	Hutt Road South	SouthWest	Lane 2	707	75%	6.76	40.0	60.0	9.2	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 1	346	19%	2.27	40.0	60.0	4.7	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 2	340	19%	2.27	40.0	60.0	4.7	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	4%	7.16	30.0	60.0	9.0	LOS A
3PMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	22%	16.67	300.0	50.0	38.3	LOS C
3PMRangioraAvenue	Hutt Road	SouthWest	Lane 1	704	52%	0.58	620.0	60.0	37.8	LOS A
3PMRangioraAvenue	Hutt Road	SouthWest	Lane 2	697	52%	0.39	620.0	60.0	37.6	LOS A
4PMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	9%	8.85	100.0	60.0	14.8	LOS A
4PMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	351	29%	0.67	620.0	60.0	37.9	LOS A
4PMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	416	29%	0.14	620.0	60.0	37.3	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	706	37%	3.35	70.0	60.0	7.6	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	695	37%	3.35	70.0	60.0	7.6	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	3%	5.92	20.0	60.0	7.1	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	518	68%	17.46	70.0	60.0	21.7	LOS B
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	455	68%	17.06	70.0	60.0	21.3	LOS B
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	163	84%	41.54	46.0	60.0	44.3	LOS D
5PMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	316	87%	40.27	45.0	50.0	43.5	LOS D
5PMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	320	87%	40.16	2000.0	50.0	184.2	LOS D
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	836	60%	7.09	43.0	60.0	9.7	LOS A
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	489	89%	30.96	45.0	60.0	33.7	LOS C
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	665	89%	30.78	45.0	60.0	33.5	LOS C
6PMSchoolRd	Hutt Rd	NorthEast	Lane 1	689	36%	2.45	45.0	60.0	5.2	LOS A
6PMSchoolRd	Hutt Rd	NorthEast	Lane 2	678	36%	2.45	45.0	60.0	5.2	LOS A
6PMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	12%	16.71	12.0	60.0	17.4	LOS C
6PMSchoolRd	School Rd	NorthWest	Lane 1	50	82%	84.85	150.0	50.0	95.7	LOS F
6PMSchoolRd	Hutt Rd West	SouthWest	Lane 1	1013	53%	4.36	430.0	60.0	30.2	LOS A
6PMSchoolRd	Hutt Rd West	SouthWest	Lane 2	997	53%	4.33	430.0	60.0	30.1	LOS A
7PMAoteaQuay	Hutt Road East	NorthEast	Lane 1	758	40%	5.81	430.0	60.0	31.6	LOS A
7PMAoteaQuay	Hutt Road East	NorthEast	Lane 2	629	35%	1.76	430.0	60.0	27.6	LOS A
7PMAoteaQuay	Aotea Quay	West	Lane 1	863	46%	5.66	500.0	70.0	31.4	LOS A
7PMAoteaQuay	Hutt Road	SouthWest	Lane 1	1147	61%	0.13	150.0	45.0	12.1	LOS A
7aPMAQcrossing	Hutt Rd East	NorthEast	Lane 1	105		2.40	150.0	60.0	11.4	LOS A
7aPMAQcrossing	Hutt Rd East	NorthEast	Lane 2	524		3.30	150.0	60.0	12.3	LOS A
7aPMAQcrossing	Hutt Road West	SouthWest	Lane 1	1167	88%	15.73	280.0	60.0	32.5	LOS B
8PMSarSt	Hutt Rd East	NorthEast	Lane 1	629	45%	2.83	280.0	45.0	25.2	LOS A
8PMSarSt	Hutt Rd East	NorthEast	Lane 2	25	10%	17.53	21.0	45.0	19.2	LOS C
8PMSarSt	Sar Street	NorthWest	Lane 1	50	35%	31.11	85.0	40.0	38.8	LOS D
8PMSarSt	Hutt Rd West	SouthWest	Lane 1	25	1%	4.01	18.0	45.0	5.5	LOS A
8PMSarSt	Hutt Rd West	SouthWest	Lane 2	1142	61%	2.71	100.0	45.0	10.7	LOS A
9PMTinakoriRd	Thorndon Quay	South	Lane 1	679	89%	32.76	260.0	45.0	53.6	LOS C
9PMTinakoriRd	Hutt Road	North	Lane 1	235	33%	15.70	100.0	45.0	23.7	LOS B
9PMTinakoriRd	Hutt Road	North	Lane 2	394	88%	43.26	65.0	45.0	48.5	LOS D
9PMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	511	69%	22.62	10.0	45.0	23.4	LOS C
9PMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	14	9%	39.51	500.0	45.0	79.5	LOS D
9aPMChurchCrossing	Thorndon Quay	SouthEast	Lane 1	524	56%	4.04	170.0	60.0	14.2	LOS A
9aPMChurchCrossing	Thorndon Quay	NorthWest	Lane 1	249	28%	3.35	260.0	60.0	18.9	LOS A
9bPMThorndonCrossing	Thorndon Quay	SouthEast	Lane 1	524	55%	3.99	300.0	60.0	22.0	LOS A
9bPMThorndonCrossing	Thorndon Quay	NorthWest	Lane 1	249	28%	3.35	170.0	60.0	13.5	LOS A
9cPMCafeCrossing	Thorndon Quay	SouthEast	Lane 1	524	55%	3.98	40.0	60.0	6.4	LOS A
9cPMCafeCrossing	Thorndon Quay	NorthWest	Lane 1	249	28%	3.35	300.0	60.0	21.3	LOS A
10PMDavisStreet	Thorndon Quay	South	Lane 1	856	49%	3.97	185.0	45.0	18.8	LOS A
10PMDavisStreet	Thorndon Quay	NorthWest	Lane 1	262	15%	2.30	40.0	45.0	5.5	LOS A
10PMDavisStreet	Thorndon Quay	NorthWest	Lane 2	93	5%	3.35	15.0	45.0	4.6	LOS A
10PMDavisStreet	Davis Street	SouthWest	Lane 1	141	23%	7.53	500.0	30.0	67.5	LOS A
10aPMMooreCrossing	Thorndon Quay	South	Lane 1	854	87%	11.91	50.0	60.0	14.9	LOS B
10aPMMooreCrossing	Thorndon Quay	North	Lane 1	348	38%	3.56	185.0	60.0	14.7	LOS A
11PMMooreStreet	Thorndon Quay	NorthEast	Lane 1	336	19%	2.41	50.0	45.0	6.4	LOS A
11PMMooreStreet	Thorndon Quay	NorthEast	Lane 2	15	3%	10.43	15.0	45.0	11.6	LOS B
11PMMooreStreet	Moore Street	NorthWest	Lane 1	598	124%	233.07	50.0	30.0	239.1	LOS F
11PMMooreStreet	Thorndon Quay	SouthWest	Lane 1	609	34%	1.02	200.0	45.0	17.0	LOS A
12PMMulgrave/Thondon/Lambton	Lambton Quay	South	Lane 1	32	27%	31.00	500.0	45.0	71.0	LOS C
12PMMulgrave/Thondon/Lambton	Thorndon Quay	SouthEast	Lane 1	515	88%	30.03	500.0	45.0	70.0	LOS C
12PMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 1	29	24%	30.40	20.0	45.0	32.0	LOS C
12PMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 2	497	88%	29.93	200.0	45.0	45.9	LOS C
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 1	64	13%	21.09	18.0	45.0	22.5	LOS C
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 2	399	90%	37.89	500.0	45.0	77.9	LOS D
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 3	431	90%	37.89	500.0	45.0	77.9	LOS D
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 4	8	3%	22.37	30.0	45.0	24.8	LOS C

Bus Travel Time

Distance	Seconds	Minutes
5070.0	511.7	8.5

Vehicle Travel Time

Distance	Seconds	Minutes
5070.0	525.8	8.8

Travel time - Jarden to Aotea

Distance	Seconds	Minutes
3335.0	269.8	4.5

Bus + HCV - AM Peak

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr (across leg)	Time (sec)	Level of Service
1AMJardenMile	Hutt Rd	South	Lane 1	109	10%	11.27	90.0	80.0	15.3	LOS B
1AMJardenMile	Hutt Rd	South	Lane 2	76	10%	26.72	150.0	80.0	33.5	LOS C
1AMJardenMile	Hutt Rd	South	Lane 3	123	172%	708.16	1350.0	80.0	768.9	LOS F
1AMJardenMile	Hutt Rd	South	Lane 4	123	172%	707.14	1300.0	80.0	765.6	LOS F
1AMJardenMile	SH2 Off Ramp	East	Lane 1	127	42%	55.18	220.0	100.0	63.1	LOS E
1AMJardenMile	SH2 Off Ramp	East	Lane 2	335	128%	334.06	370.0	100.0	347.4	LOS F
1AMJardenMile	SH2 Off Ramp	East	Lane 3	332	128%	334.32	235.0	100.0	342.8	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 1	993	172%	721.77	80.0	100.0	724.6	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 2	81	15%	22.00	40.0	100.0	23.4	LOS C
1AMJardenMile	Centennial Hwy	North	Lane 3	256	28%	24.16	500.0	100.0	42.2	LOS C
1AMJardenMile	Centennial Hwy	North	Lane 4	290	32%	24.75	500.0	100.0	42.8	LOS C
1AMJardenMile	Centennial Hwy	North	Lane 5	26	35%	88.49	25.0	100.0	89.4	LOS F
1AMJardenMile	Jarden Mile	West	Lane 1	3	1%	32.54	350.0	50.0	57.7	LOS C
1AMJardenMile	Jarden Mile	West	Lane 2	27	10%	64.00	20.0	50.0	65.4	LOS E
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 1	94	17%	31.59	1300.0	80.0	90.1	LOS C
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 2	676	76%	42.83	1300.0	80.0	101.3	LOS D
2AMOnslowRd	Onslow Rd	North	Lane 1	356	75%	56.90	500.0	50.0	92.9	LOS E
2AMOnslowRd	Hutt Road South	SouthWest	Lane 1	57	7%	30.31	60.0	80.0	33.0	LOS C
2AMOnslowRd	Hutt Road South	SouthWest	Lane 2	163	74%	62.76	330.0	80.0	77.6	LOS E
2AMOnslowRd	Hutt Road South	SouthWest	Lane 3	172	74%	62.44	330.0	80.0	77.3	LOS E
2aAMRangioracrossing	Hutt Road (north)	NorthEast	Lane 1	97		1.00	330.0	60.0	20.8	LOS A
2aAMRangioracrossing	Hutt Road (north)	NorthEast	Lane 2	866		4.30	330.0	60.0	24.1	LOS A
2aAMRangioracrossing	Hutt Road South	SouthWest	Lane 1	267	17%	1.79	40.0	60.0	4.2	LOS A
2aAMRangioracrossing	Hutt Road South	SouthWest	Lane 2	270	17%	1.79	40.0	60.0	4.2	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 1	97	8%	2.25	40.0	60.0	4.6	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 2	841	43%	2.28	40.0	60.0	4.7	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	3%	4.86	30.0	60.0	6.7	LOS A
3AMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	10%	9.31	300.0	50.0	30.9	LOS A
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 1	267	15%	0.54	620.0	60.0	37.7	LOS A
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 2	270	15%	0.05	620.0	60.0	37.2	LOS A
4AMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	9%	7.41	100.0	60.0	13.4	LOS A
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	122	9%	1.17	620.0	60.0	38.4	LOS A
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	841	43%	0.20	620.0	60.0	37.4	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	254	14%	3.33	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	258	14%	3.34	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	3%	6.55	20.0	60.0	7.8	LOS A
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	86	17%	22.30	70.0	60.0	26.5	LOS C
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	779	99%	81.58	70.0	60.0	85.8	LOS F
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	62	14%	39.96	46.0	60.0	42.7	LOS D
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	485	98%	84.99	2000.0	50.0	229.0	LOS F
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	502	98%	84.04	2000.0	50.0	228.0	LOS F
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	286	19%	4.51	43.0	60.0	7.1	LOS A
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	168	89%	69.76	45.0	60.0	72.5	LOS E
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	181	89%	69.50	45.0	60.0	72.2	LOS E
6AMSchoolRd	Hutt Rd	NorthEast	Lane 1	114	10%	2.42	45.0	60.0	5.1	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 2	1525	79%	2.52	45.0	60.0	5.2	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	3%	5.08	12.0	60.0	5.8	LOS A
6AMSchoolRd	School Rd	NorthWest	Lane 1	50	26%	15.20	150.0	50.0	26.0	LOS C
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 1	315	17%	4.39	430.0	60.0	30.2	LOS A
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 2	320	17%	4.24	430.0	60.0	30.0	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 1	813	46%	5.53	430.0	60.0	31.3	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 2	850	44%	1.75	430.0	60.0	27.6	LOS A
7AMAoteaQuay	Aotea Quay	West	Lane 1	256	14%	5.65	500.0	70.0	31.4	LOS A
7AMAoteaQuay	Hutt Road	SouthWest	Lane 1	379	21%	0.02	150.0	45.0	12.0	LOS A
7aAMAQcrossing	Hutt Rd East	NorthEast	Lane 1	21		1.40	150.0	60.0	10.4	LOS A
7aAMAQcrossing	Hutt Rd East	NorthEast	Lane 2	907		2.70	150.0	60.0	11.7	LOS A
7aAMAQcrossing	Hutt Road West	SouthWest	Lane 1	412	25%	1.30	280.0	60.0	18.1	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 1	21	2%	3.32	280.0	45.0	25.7	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 2	882	95%	6.24	280.0	45.0	28.6	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 3	25	3%	6.41	21.0	45.0	8.1	LOS A
8AMSarSt	Sar Street	NorthWest	Lane 1	25	2%	3.53	85.0	40.0	11.2	LOS A
8AMSarSt	Sar Street	NorthWest	Lane 2	25	28%	24.83	40.0	40.0	28.4	LOS C
8AMSarSt	Hutt Rd West	SouthWest	Lane 1	61	4%	3.86	100.0	45.0	11.9	LOS A
8AMSarSt	Hutt Rd West	SouthWest	Lane 2	351	19%	2.85	100.0	45.0	10.8	LOS A
9AMTinakoriRd	Thorndon Quay	South	Lane 1	102	19%	42.24	260.0	45.0	63.0	LOS D
9AMTinakoriRd	Hutt Road	North	Lane 1	21	6%	37.69	100.0	45.0	45.7	LOS D
9AMTinakoriRd	Hutt Road	North	Lane 2	296	68%	43.97	100.0	45.0	52.0	LOS D
9AMTinakoriRd	Hutt Road	North	Lane 3	432	67%	33.73	65.0	45.0	38.9	LOS C
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	321	31%	18.41	10.0	45.0	19.2	LOS B
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	15	9%	70.66	500.0	45.0	110.7	LOS E
9aAMChurchCrossing	Thorndon Quay	SouthEast	Lane 1	126	8%	1.18	170.0	60.0	11.4	LOS A
9aAMChurchCrossing	Thorndon Quay	NorthWest	Lane 1	21	2%	0.28	260.0	60.0	15.9	LOS A
9aAMChurchCrossing	Thorndon Quay	NorthWest	Lane 2	311	19%	0.74	260.0	60.0	16.3	LOS A
9bAMThorndonCrossing	Thorndon Quay	SouthEast	Lane 1	126	8%	1.72	300.0	60.0	19.7	LOS A
9bAMThorndonCrossing	Thorndon Quay	NorthWest	Lane 1	21	2%	0.28	170.0	60.0	10.5	LOS A
9bAMThorndonCrossing	Thorndon Quay	NorthWest	Lane 2	311	19%	0.33	170.0	60.0	10.5	LOS A
9cAMCafeCrossing	Thorndon Quay	SouthEast	Lane 1	126	8%	1.83	40.0	60.0	4.2	LOS A
9cAMCafeCrossing	Thorndon Quay	NorthWest	Lane 1	21	2%	0.28	300.0	60.0	18.3	LOS A
9cAMCafeCrossing	Thorndon Quay	NorthWest	Lane 2	311	19%	0.33	300.0	60.0	18.3	LOS A
10AMDavisStreet	Thorndon Quay	South	Lane 1	116	7%	4.82	12.0	45.0	5.8	LOS A
10AMDavisStreet	Thorndon Quay	South	Lane 2	104	6%	3.22	185.0	45.0	18.0	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 1	21	2%	2.20	40.0	45.0	5.4	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 2	345	31%	2.96	40.0	45.0	6.2	LOS A
10AMDavisStreet	Davis Street	SouthWest	Lane 1	80	7%	3.11	500.0	30.0	63.1	LOS A
10aAMMooreCrossing	Thorndon Quay (south)	South	Lane 1	267	17%	2.15	50.0	60.0	5.2	LOS A
10aAMMooreCrossing	Thorndon Quay (north)	North	Lane 1	21	2%	1.87	185.0	60.0	13.0	LOS A
10aAMMooreCrossing	Thorndon Quay (north)	North	Lane 2	346	22%	2.24	185.0	60.0	13.3	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 1	21	2%	0.00	50.0	45.0	4.0	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 2	340	20%	1.17	50.0	45.0	5.2	LOS A
11AMMooreStreet	Moore Street	NorthWest	Lane 1	118	16%	4.83	50.0	30.0	10.8	LOS A
11AMMooreStreet	Thorndon Quay	SouthWest	Lane 1	124	7%	4.03	20.0	45.0	5.6	LOS A
11AMMooreStreet	Thorndon Quay	SouthWest	Lane 2	192	11%	0.01	200.0	45.0	16.0	LOS A
12AMMulgrave/Thondon/Lambton	Lambton Quay	South	Lane 1	18	20%	41.21	500.0	45.0	81.2	LOS D
12AMMulgrave/Thondon/Lambton	Thorndon Quay	SouthEast	Lane 1	213	41%	24.34	500.0	45.0	64.3	LOS C
12AMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 1	7	8%	39.81	200.0	45.0	55.8	LOS D
12AMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 2	339	88%	40.88	200.0	45.0	56.9	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 1	81	11%	18.64	18.0	45.0	20.1	LOS B
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 2	590	89%	39.69	500.0	45.0	79.7	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 3	636	89%	39.74	500.0	45.0	79.7	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 4	14	4%	19.87	30.0	45.0	22.3	LOS B

Bus Travel Time

Seconds	444.9
Minutes	7.4

Vehicle travel Time

Seconds	547.3
Minutes	9.1

Travel time - Aotea to Jarden

Seconds	240.3
Minutes	4.0

Bus + HCV - PM Peak

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr	Time (sec)	Level of Service
1PMJardenMile	Hutt Rd	South	Lane 1	226	49%	67.21	90.0	80.0	125.7	LOS E
1PMJardenMile	Hutt Rd	South	Lane 2	209	49%	66.75	150.0	80.0	125.3	LOS E
1PMJardenMile	Hutt Rd	South	Lane 3	29	30%	80.46	1300.0	80.0	139.0	LOS F
1PMJardenMile	Hutt Rd	South	Lane 4	148	90%	91.39	1300.0	80.0	149.9	LOS F
1PMJardenMile	SH2 Off Ramp	East	Lane 1	171	19%	32.25	220.0	100.0	40.2	LOS C
1PMJardenMile	SH2 Off Ramp	East	Lane 2	634	95%	83.69	370.0	100.0	97.0	LOS F
1PMJardenMile	SH2 Off Ramp	East	Lane 3	631	95%	83.79	235.0	100.0	92.3	LOS F
1PMJardenMile	Centennial Hwy	North	Lane 1	776	86%	26.62	80.0	100.0	29.5	LOS C
1PMJardenMile	Centennial Hwy	North	Lane 2	43	15%	52.20	40.0	100.0	53.6	LOS D
1PMJardenMile	Centennial Hwy	North	Lane 3	99	22%	51.56	500.0	100.0	69.6	LOS D
1PMJardenMile	Centennial Hwy	North	Lane 4	99	22%	51.56	500.0	100.0	69.6	LOS D
1PMJardenMile	Centennial Hwy	North	Lane 5	4	3%	78.32	25.0	100.0	79.2	LOS E
1PMJardenMile	Jarden Mile	West	Lane 1	50	11%	30.21	350.0	50.0	55.4	LOS C
1PMJardenMile	Jarden Mile	West	Lane 2	106	45%	67.41	20.0	50.0	68.9	LOS E
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 1	260	64%	56.74	1300.0	80.0	115.2	LOS E
2PMOnslowRd	Hutt Rd North	NorthEast	Lane 2	245	64%	60.66	1300.0	80.0	119.2	LOS E
2PMOnslowRd	Onslow Rd	North	Lane 1	190	64%	65.18	500.0	50.0	101.2	LOS E
2PMOnslowRd	Hutt Road South	SouthWest	Lane 1	241	19%	12.77	60.0	80.0	15.5	LOS B
2PMOnslowRd	Hutt Road South	SouthWest	Lane 2	53	9%	21.51	330.0	80.0	36.4	LOS C
2PMOnslowRd	Hutt Road South	SouthWest	Lane 3	495	65%	26.07	330.0	80.0	40.9	LOS C
2aPMRangioracrossing	Hutt Road (north)	NorthEast	Lane 1	244		7.70	330.0	60.0	27.5	LOS A
2aPMRangioracrossing	Hutt Road (north)	NorthEast	Lane 2	255		5.40	330.0	60.0	25.2	LOS A
2aPMRangioracrossing	Hutt Road South	SouthWest	Lane 1	66	6%	1.63	40.0	60.0	4.0	LOS A
2aPMRangioracrossing	Hutt Road South	SouthWest	Lane 2	764	46%	2.53	40.0	60.0	4.9	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 1	231	13%	2.26	40.0	60.0	4.7	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 2	243	13%	2.27	40.0	60.0	4.7	LOS A
3PMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	3%	5.53	30.0	60.0	7.3	LOS A
3PMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	12%	7.81	300.0	50.0	29.4	LOS A
3PMRangioraAvenue	Hutt Road	SouthWest	Lane 1	91	7%	1.49	620.0	60.0	38.7	LOS A
3PMRangioraAvenue	Hutt Road	SouthWest	Lane 2	739	38%	0.16	620.0	60.0	37.4	LOS A
4PMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	6%	7.13	100.0	60.0	13.1	LOS A
4PMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	244	14%	0.61	620.0	60.0	37.8	LOS A
4PMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	255	14%	0.04	620.0	60.0	37.2	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	66	6%	3.30	70.0	60.0	7.5	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	739	38%	3.35	70.0	60.0	7.6	LOS A
4PMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	2%	5.42	20.0	60.0	6.6	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	241	22%	6.17	70.0	60.0	10.4	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	254	22%	6.16	70.0	60.0	10.4	LOS A
5PMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	146	75%	38.37	46.0	60.0	41.1	LOS D
5PMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	253	80%	35.81	45.0	50.0	39.0	LOS D
5PMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	295	80%	35.05	2000.0	50.0	179.1	LOS D
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	796	56%	6.60	43.0	60.0	9.2	LOS A
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	54	11%	13.23	45.0	60.0	15.9	LOS B
5PMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	682	89%	30.16	45.0	60.0	32.9	LOS C
6PMSchoolRd	Hutt Rd	NorthEast	Lane 1	455	25%	2.45	45.0	60.0	5.1	LOS A
6PMSchoolRd	Hutt Rd	NorthEast	Lane 2	469	25%	2.45	45.0	60.0	5.1	LOS A
6PMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	10%	13.22	12.0	60.0	13.9	LOS B
6PMSchoolRd	School Rd	NorthWest	Lane 1	50	38%	22.44	150.0	50.0	33.2	LOS C
6PMSchoolRd	Hutt Rd West	SouthWest	Lane 1	97	8%	5.24	430.0	60.0	31.0	LOS A
6PMSchoolRd	Hutt Rd West	SouthWest	Lane 2	1460	75%	4.57	430.0	60.0	30.4	LOS A
7PMAoteaQuay	Hutt Road East	NorthEast	Lane 1	464	26%	5.51	430.0	60.0	31.3	LOS A
7PMAoteaQuay	Hutt Road East	NorthEast	Lane 2	490	26%	1.70	430.0	60.0	27.5	LOS A
7PMAoteaQuay	Aotea Quay	West	Lane 1	776	41%	5.62	500.0	70.0	31.3	LOS A
7PMAoteaQuay	Hutt Road	SouthWest	Lane 1	781	42%	0.06	150.0	45.0	12.1	LOS A
7aPMAQcrossing	Hutt Rd East	NorthEast	Lane 1	87		1.30	150.0	60.0	10.3	LOS A
7aPMAQcrossing	Hutt Rd East	NorthEast	Lane 2	438		1.70	150.0	60.0	10.7	LOS A
7aPMAQcrossing	Hutt Road West	SouthWest	Lane 1	32	3%	2.41	280.0	60.0	19.2	LOS A
7aPMAQcrossing	Hutt Road West	SouthWest	Lane 2	756	46%	1.82	280.0	60.0	18.6	LOS A
8PMSarSt	Hutt Rd East	NorthEast	Lane 1	500	28%	2.91	280.0	45.0	25.3	LOS A
8PMSarSt	Hutt Rd East	NorthEast	Lane 2	25	6%	10.31	21.0	45.0	12.0	LOS B
8PMSarSt	Sar Street	NorthWest	Lane 1	25	2%	3.54	85.0	40.0	11.2	LOS A
8PMSarSt	Sar Street	NorthWest	Lane 2	25	11%	18.22	40.0	40.0	21.8	LOS C
8PMSarSt	Hutt Rd West	SouthWest	Lane 1	57	4%	3.62	100.0	45.0	11.6	LOS A
8PMSarSt	Hutt Rd West	SouthWest	Lane 2	731	39%	2.85	100.0	45.0	10.9	LOS A
9PMTinakoriRd	Thorndon Quay	South	Lane 1	52	15%	47.18	260.0	45.0	68.0	LOS D
9PMTinakoriRd	Thorndon Quay	South	Lane 2	221	46%	50.64	260.0	45.0	71.4	LOS D
9PMTinakoriRd	Hutt Road	North	Lane 1	177	40%	49.26	100.0	45.0	57.3	LOS D
9PMTinakoriRd	Hutt Road	North	Lane 2	285	30%	23.29	65.0	45.0	28.5	LOS C
9PMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	535	45%	16.15	10.0	45.0	16.9	LOS B
9PMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	9	6%	73.76	500.0	45.0	113.8	LOS E
9aPMChurchCrossing	Thorndon Quay	SouthEast	Lane 1	33	3%	1.14	170.0	60.0	11.3	LOS A
9aPMChurchCrossing	Thorndon Quay	SouthEast	Lane 2	305	19%	1.31	170.0	60.0	11.5	LOS A
9aPMChurchCrossing	Thorndon Quay	NorthWest	Lane 1	186	13%	0.69	260.0	60.0	16.3	LOS A
9bPMThorndonCrossing	Thorndon Quay	SouthEast	Lane 1	33	3%	1.40	300.0	60.0	19.4	LOS A
9bPMThorndonCrossing	Thorndon Quay	SouthEast	Lane 2	305	19%	1.61	300.0	60.0	19.6	LOS A
9bPMThorndonCrossing	Thorndon Quay	NorthWest	Lane 1	186	13%	0.31	170.0	60.0	10.5	LOS A
9cPMCafeCrossing	Thorndon Quay	SouthEast	Lane 1	33	3%	2.27	40.0	60.0	4.7	LOS A
9cPMCafeCrossing	Thorndon Quay	SouthEast	Lane 2	305	19%	2.66	40.0	60.0	5.1	LOS A
9cPMCafeCrossing	Thorndon Quay	NorthWest	Lane 1	36	4%	0.32	55.0	60.0	3.6	LOS A
9cPMCafeCrossing	Thorndon Quay	NorthWest	Lane 2	150	9%	0.34	300.0	60.0	18.3	LOS A
10PMDavisStreet	Thorndon Quay	South	Lane 1	523	33%	4.76	185.0	45.0	19.6	LOS A
10PMDavisStreet	Thorndon Quay	South	Lane 2	239	13%	3.05	185.0	45.0	17.9	LOS A
10PMDavisStreet	Thorndon Quay	NorthWest	Lane 1	59	4%	2.27	40.0	45.0	5.5	LOS A
10PMDavisStreet	Thorndon Quay	NorthWest	Lane 2	399	22%	2.92	40.0	45.0	6.1	LOS A
10PMDavisStreet	Davis Street	SouthWest	Lane 1	87	9%	3.93	500.0	30.0	63.9	LOS A
10aPMMooreCrossing	Thorndon Quay	South	Lane 1	33	3%	1.89	50.0	60.0	4.9	LOS A
10aPMMooreCrossing	Thorndon Quay	South	Lane 2	570	35%	2.61	50.0	60.0	5.6	LOS A
10aPMMooreCrossing	Thorndon Quay	North	Lane 1	238	16%	1.43	185.0	60.0	12.5	LOS A
11PMMooreStreet	Thorndon Quay	NorthEast	Lane 1	236	14%	0.59	50.0	45.0	4.6	LOS A
11PMMooreStreet	Moore Street	NorthWest	Lane 1	577	66%	7.08	50.0	30.0	13.1	LOS A
11PMMooreStreet	Thorndon Quay	SouthWest	Lane 1	377	22%	3.70	200.0	45.0	19.7	LOS A
11PMMooreStreet	Thorndon Quay	SouthWest	Lane 2	162	11%	0.02	200.0	45.0	16.0	LOS A
12PMMulgrave/Thondon/Lambton	Lambton Quay	South	Lane 1	31	26%	31.51	500.0	45.0	71.5	LOS C
12PMMulgrave/Thondon/Lambton	Thorndon Quay	SouthEast	Lane 1	415	88%	32.36	500.0	45.0	72.4	LOS C
12PMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 1	29	24%	31.01	20.0	45.0	32.6	LOS C
12PMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 2	344	79%	25.78	200.0	45.0	41.8	LOS C
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 1	96	16%	18.57	18.0	45.0	20.0	LOS B
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 2	472	89%	35.62	500.0	45.0	75.6	LOS D
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 3	526	89%	35.64	500.0	45.0	75.6	LOS D
12PMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 4	9	3%	19.58	30.0	45.0	22.0	LOS B

Distance	Travel Time	
5070.0	Seconds	521.2
	Minutes	8.7

Distance	Vehicle Travel Time	
5070.0	Seconds	538.5
	Minutes	9.0

Distance	Travel time - Aotea to Jarden	
3335.0	Seconds	290.6
	Minutes	4.8

Appendix C – Sensitivity Test Outputs

Scenario	Approach Name	Approach Direction	Lane #	Demand Volumes	Deg. Satn	Average Delay (sec)	Lane Length (m)	Posted speed km/hr (across leg)	Time (sec)	Level of Service
1AMJardenMile	Hutt Rd	South	Lane 1	111	9%	5.53	90.0	80.0	9.6	LOS A
1AMJardenMile	Hutt Rd	South	Lane 2	87	9%	21.11	150.0	80.0	27.9	LOS C
1AMJardenMile	Hutt Rd	South	Lane 3	112	127%	322.03	1350.0	80.0	382.8	LOS F
1AMJardenMile	Hutt Rd	South	Lane 4	112	127%	322.03	1300.0	80.0	380.5	LOS F
1AMJardenMile	SH2 Off Ramp	East	Lane 1	285	91%	78.74	220.0	100.0	86.7	LOS E
1AMJardenMile	SH2 Off Ramp	East	Lane 2	354	134%	387.33	370.0	100.0	400.7	LOS F
1AMJardenMile	SH2 Off Ramp	East	Lane 3	350	134%	387.60	235.0	100.0	396.1	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 1	1093	205%	1018.36	80.0	100.0	1021.2	LOS F
1AMJardenMile	Centennial Hwy	North	Lane 2	110	20%	26.93	40.0	100.0	28.4	LOS C
1AMJardenMile	Centennial Hwy	North	Lane 3	592	65%	37.87	500.0	100.0	55.9	LOS D
1AMJardenMile	Centennial Hwy	North	Lane 4	435	74%	37.36	500.0	100.0	55.4	LOS D
1AMJardenMile	Centennial Hwy	North	Lane 5	29	40%	89.01	25.0	100.0	89.9	LOS F
1AMJardenMile	Jarden Mile	West	Lane 1	5	2%	33.04	350.0	50.0	58.2	LOS C
1AMJardenMile	Jarden Mile	West	Lane 2	46	27%	67.46	20.0	50.0	68.9	LOS E
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 1	143	24%	31.36	1300.0	80.0	89.9	LOS C
2AMOnslowRd	Hutt Rd North	NorthEast	Lane 2	1322	140%	418.91	1300.0	80.0	477.4	LOS F
2AMOnslowRd	Onslow Rd	North	Lane 1	469	141%	446.12	500.0	50.0	482.1	LOS F
2AMOnslowRd	Hutt Road South	SouthWest	Lane 1	70	9%	32.34	60.0	80.0	35.0	LOS C
2AMOnslowRd	Hutt Road South	SouthWest	Lane 2	138	136%	378.01	330.0	80.0	392.9	LOS F
2AMOnslowRd	Hutt Road South	SouthWest	Lane 3	146	136%	377.74	330.0	80.0	392.6	LOS F
2aAMRangioracrossing	Hutt Rd North	NorthEast	Lane 1	146		1.10	330.0	60.0	20.9	LOS A
2aAMRangioracrossing	Hutt Rd North	NorthEast	Lane 2	1614		4.10	330.0	60.0	23.9	LOS A
2aAMRangioracrossing	Hutt Road South	SouthWest	Lane 1	263	17%	1.79	40.0	60.0	4.2	LOS A
2aAMRangioracrossing	Hutt Road South	SouthWest	Lane 2	266	17%	1.79	40.0	60.0	4.2	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 1	146	12%	2.25	40.0	60.0	4.6	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 2	1589	62%	2.29	40.0	60.0	4.7	LOS A
3AMRangioraAvenue	Hutt Road	NorthEast	Lane 3	25	2%	4.85	30.0	60.0	6.6	LOS A
3AMRangioraAvenue	Rangiora Avenue	North	Lane 1	50	27%	16.29	300.0	50.0	37.9	LOS C
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 1	263	15%	0.55	620.0	60.0	37.8	LOS A
3AMRangioraAvenue	Hutt Road	SouthWest	Lane 2	266	15%	0.05	620.0	60.0	37.2	LOS A
4AMWestminsterSt	Westminster Street	SouthEast	Lane 1	50	14%	9.54	100.0	60.0	15.5	LOS A
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 1	171	13%	0.71	620.0	60.0	37.9	LOS A
4AMWestminsterSt	Hutt Road (north)	NorthEast	Lane 2	1589	64%	0.45	620.0	60.0	37.6	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 1	250	14%	3.33	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 2	254	14%	3.34	70.0	60.0	7.5	LOS A
4AMWestminsterSt	Hutt Road (south)	SouthWest	Lane 3	25	5%	8.69	20.0	60.0	9.9	LOS A
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 1	143	26%	20.83	70.0	60.0	25.0	LOS C
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 2	1506	141%	422.23	70.0	60.0	426.4	LOS F
5AMKaiwharawharaRd	Hutt Road East	NorthEast	Lane 3	104	37%	56.30	46.0	60.0	59.1	LOS E
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 1	176	25%	24.86	2000.0	50.0	168.9	LOS C
5AMKaiwharawharaRd	Kaiwharawhara Rd- NW	NorthWest	Lane 2	976	143%	449.10	2000.0	50.0	593.1	LOS F
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 1	244	16%	4.72	43.0	60.0	7.3	LOS A
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 2	190	38%	37.95	45.0	60.0	40.6	LOS D
5AMKaiwharawharaRd	Hutt Road West	SouthWest	Lane 3	195	38%	37.91	45.0	60.0	40.6	LOS D
6AMSchoolRd	Hutt Rd	NorthEast	Lane 1	175	15%	2.43	45.0	60.0	5.1	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 2	2457	78%	2.51	45.0	60.0	5.2	LOS A
6AMSchoolRd	Hutt Rd	NorthEast	Lane 3	25	2%	5.02	12.0	60.0	5.7	LOS A
6AMSchoolRd	School Rd	NorthWest	Lane 1	50	24%	15.61	150.0	50.0	26.4	LOS C
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 1	310	30%	4.46	430.0	60.0	30.3	LOS A
6AMSchoolRd	Hutt Rd West	SouthWest	Lane 2	319	30%	4.31	430.0	60.0	30.1	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 1	1374	54%	5.71	430.0	60.0	31.5	LOS A
7AMAoteaQuay	Hutt Road East	NorthEast	Lane 2	1279	41%	1.74	430.0	60.0	27.5	LOS A
7AMAoteaQuay	Aotea Quay	West	Lane 1	186	10%	5.63	500.0	70.0	31.3	LOS A
7AMAoteaQuay	Hutt Road	SouthWest	Lane 1	443	24%	0.03	150.0	45.0	12.0	LOS A
7aAMAQcrossing	Hutt Road East	NorthEast	Lane 1	21		1.40	150.0	60.0	10.4	LOS A
7aAMAQcrossing	Hutt Road East	NorthEast	Lane 2	1334		2.60	150.0	60.0	11.6	LOS A
7aAMAQcrossing	Hutt Road West	SouthWest	Lane 1	478	29%	1.11	280.0	60.0	17.9	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 1	21	2%	3.32	280.0	45.0	25.7	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 2	1309	45%	2.96	280.0	45.0	25.4	LOS A
8AMSarSt	Hutt Rd East	NorthEast	Lane 3	25	2%	6.80	21.0	45.0	8.5	LOS A
8AMSarSt	Sar Street	NorthWest	Lane 1	25	2%	3.56	85.0	40.0	11.2	LOS A
8AMSarSt	Sar Street	NorthWest	Lane 2	25	27%	23.85	40.0	40.0	27.5	LOS C
8AMSarSt	Hutt Rd West	SouthWest	Lane 1	72	4%	3.90	100.0	45.0	11.9	LOS A
8AMSarSt	Hutt Rd West	SouthWest	Lane 2	406	22%	2.85	100.0	45.0	10.8	LOS A
9AMTinakoriRd	Thorndon Quay	South	Lane 1	182	27%	33.13	260.0	45.0	53.9	LOS C
9AMTinakoriRd	Hutt Road	North	Lane 1	21	5%	30.48	100.0	45.0	38.5	LOS C
9AMTinakoriRd	Hutt Road	North	Lane 2	666	88%	53.21	100.0	45.0	61.2	LOS D
9AMTinakoriRd	Hutt Road	North	Lane 3	646	88%	57.27	65.0	45.0	62.5	LOS E
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 1	303	32%	23.75	10.0	45.0	24.6	LOS C
9AMTinakoriRd	Tinakori Rd	SouthWest	Lane 2	5	3%	69.68	500.0	45.0	109.7	LOS E
9aAMChurchCrossing	Thorndon Quay	SouthEast	Lane 1	195	13%	1.23	170.0	60.0	11.4	LOS A
9aAMChurchCrossing	Thorndon Quay	NorthWest	Lane 1	21	2%	0.28	260.0	60.0	15.9	LOS A
9aAMChurchCrossing	Thorndon Quay	NorthWest	Lane 2	671	27%	0.36	260.0	60.0	16.0	LOS A
9bAMThorndonCrossing	Thorndon Quay	SouthEast	Lane 1	195	13%	1.79	300.0	60.0	19.8	LOS A
9bAMThorndonCrossing	Thorndon Quay	NorthWest	Lane 1	21	2%	0.28	170.0	60.0	10.5	LOS A
9bAMThorndonCrossing	Thorndon Quay	NorthWest	Lane 2	671	27%	0.36	170.0	60.0	10.6	LOS A
9cAMCafeCrossing	Thorndon Quay	SouthEast	Lane 1	195	13%	1.89	40.0	60.0	4.3	LOS A
9cAMCafeCrossing	Thorndon Quay	NorthWest	Lane 1	21	2%	0.28	300.0	60.0	18.3	LOS A
9cAMCafeCrossing	Thorndon Quay	NorthWest	Lane 2	671	27%	0.36	300.0	60.0	18.4	LOS A
10AMDavisStreet	Thorndon Quay	South	Lane 1	121	7%	4.80	12.0	45.0	5.8	LOS A
10AMDavisStreet	Thorndon Quay	South	Lane 2	180	10%	3.19	185.0	45.0	18.0	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 1	20	2%	2.20	40.0	45.0	5.4	LOS A
10AMDavisStreet	Thorndon Quay	NorthWest	Lane 2	686	40%	2.66	40.0	45.0	5.9	LOS A
10AMDavisStreet	Davis Street	SouthWest	Lane 1	60	6%	3.46	500.0	30.0	63.5	LOS A
10aAMMooreCrossing	Thorndon Quay (south)	South	Lane 1	298	19%	2.19	50.0	60.0	5.2	LOS A
10aAMMooreCrossing	Thorndon Quay (north)	North	Lane 1	20	2%	1.87	185.0	60.0	13.0	LOS A
10aAMMooreCrossing	Thorndon Quay (north)	North	Lane 2	699	30%	2.45	185.0	60.0	13.6	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 1	20	2%	0.00	50.0	45.0	4.0	LOS A
11AMMooreStreet	Thorndon Quay	NorthEast	Lane 2	696	30%	1.07	50.0	45.0	5.1	LOS A
11AMMooreStreet	Moore Street	NorthWest	Lane 1	126	21%	6.45	50.0	30.0	12.5	LOS A
11AMMooreStreet	Thorndon Quay	SouthWest	Lane 1	181	10%	4.02	20.0	45.0	5.6	LOS A
11AMMooreStreet	Thorndon Quay	SouthWest	Lane 2	215	12%	0.02	200.0	45.0	16.0	LOS A
12AMMulgrave/Thondon/Lambton	Lambton Quay	South	Lane 1	18	24%	51.46	500.0	45.0	91.5	LOS D
12AMMulgrave/Thondon/Lambton	Thorndon Quay	SouthEast	Lane 1	293	45%	25.22	500.0	45.0	65.2	LOS C
12AMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 1	14	19%	50.62	200.0	45.0	66.6	LOS D
12AMMulgrave/Thondon/Lambton	Throndon Quay	NorthWest	Lane 2	654	90%	48.08	200.0	45.0	64.1	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 1	84	12%	22.48	18.0	45.0	23.9	LOS C
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 2	568	89%	43.34	500.0	45.0	83.3	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 3	622	89%	43.52	500.0	45.0	83.5	LOS D
12AMMulgrave/Thondon/Lambton	Mulgrave Street	SouthWest	Lane 4	10	3%	23.53	30.0	45.0	25.9	LOS C

Distance	Bus Travel Time	
5070.0	Seconds	451.6
	Minutes	7.5

Distance	Vehicle travel Time	
5070.0	Seconds	1290.3
	Minutes	21.5

Distance	Travel time - Aotea to Jarden	
3335.0	Seconds	243.4
	Minutes	4.1

Appendix L

Economic Evaluation Approach and Assumptions

General Assumptions

General assumptions for the economic evaluation of the scheme are as follows:

- 40-year evaluation period from the start of construction
- Base Date for the evaluation is 1 July 2021
- Time Zero is 1 July 2022
- Discount rate is 4%. Construction takes place over a 30-month period (all from Time Zero)
- No benefits are assumed to arise until after the completion of all works i.e. benefits have been assumed to commence in Year 3
- Traffic flows in 2036 are assumed to be as 2026 traffic flows, but with a 1% per annum daily traffic growth assumed between 2026 and 2036 based on current land use assumptions
- Peak spreading has been applied to distribute additional traffic growth outside the peak periods i.e. peak hour demand does not increase, but peak period demand does
- Travel time, congestion relief and VOC disbenefits for existing users of SH1 included. External delays for SH1 southbound traffic assessed based on a bottleneck analysis of apportioned trips rerouted onto SH1 based on SH1 and SH2 screen line traffic volumes
- Benefits are assumed to taper off linearly from 2036 to 2045, with no growth in benefits assumed after 2045, as the constrained nature of the Hutt Road/SH1 corridor will not allow for unlimited traffic growth in the future
- Taking into account planned investment in public transport, travel demand growth and the anticipated peak spreading of trips by all modes, bus patronage growth between 2026 and 2036 is assumed to be 3% with a 2% growth applied thereafter (with tapering to zero growth from 2045) - this assumption is based on the latest advice provided to the TQHR project team by the WAU in November 2021.
- Bus passenger travel time benefits have only been calculated for the morning and evening peak periods (i.e. 2 hours each)
- Approximately 450 new cyclist trips per day are assumed to be use the cycle facilities. This is due to the increased attractiveness of the route, increased use of e-mobility modes and the likely effect of the opening of the Te Ara Tupua shared path (which is forecast to attract around 620 extra trips per day by 2026). These will be users from Wellington’s northern suburbs
- 50% of the cyclists accessing the corridor via the Te Ara Tupua shared path have been assumed to not cycle without an off-road cycle path being available all the way to the CBD. Hence, these cyclists are reliant on the Thorndon Quay section of this project being completed.
- Most of the new riders on Te Ara Tupua will be heading to the CBD, so will use the improved facilities on TQHR - the economic evaluation of Te Ara Tupua did not include these additional benefits for the TQHR section. The scheme consists of approximately half of the journey from Petone to the CBD, therefore, only 50% of the increase in cycle distance has been attributed to the scheme.
- Disbenefit to general traffic during construction have not been considered in economic analysis as they are not anticipated to be significant
- The reference case for the economic comparison includes the infrastructure upgrades along the corridor (excluding the bus lane/SVL) as these elements are primarily aimed at improving the safety of cyclists and pedestrians.

- No benefits have been assessed for the inter-peak and off-peak periods, as it is assumed that the bus lane/SVL will not be operating during these periods
- HCVs have not been assumed to use the proposed SPV lane on Hutt Road, and therefore the benefit of the SPV are likely to be under-estimated.

Modelling Input

Details of the transport modelling undertaken to provide inputs to the economic evaluation are contained in the TQHR SSBC (Stage 2) Transport Modelling Report dated February 2022 (Appendix K). This report includes an explanation of the inputs obtained from the WAU Aimsun model and a corridor Sidra model developed for the project in Stage 1 of the SSBC process and refined in Stage 2.

In summary, the following inputs to the economic evaluation were derived from WAU's WTSM model:

- Public transport demand (bus and rail) provided by WAU in November 2021.
- Demand forecasts for the SH1 corridor, including screenline traffic volume data.

The following inputs were derived from the Sidra model.

- Vehicle travel times (separately for bus and general traffic (including trucks)) on Thorndon Quay and Hutt Road
- Vehicle operating cost skims.

Capital Costs

Expected cost estimates (i.e. 50th percentile) have been used to assess the proposed scheme. The basis of these is explained in the financial case chapter of the SSBC.

Due to the high safety risk related to pedestrians along this corridor, the Do-Minimum (reference case) scenario includes costs related to the pedestrian safety improvements. This includes the raised pedestrian tables and pedestrian crossing signals from the scheme. The cost estimate of the Do-Minimum scenario is shown in Table 1. It is not possible to determine the cost of the other items required to provide the Raised Pedestrian Tables and Pedestrian Crossing as these items are not specified individually within the cost estimate relative to the Raised Pedestrian Tables and Pedestrian Crossing.

Table 1: Do-Minimum (reference case) scenario capital cost estimate

Item	Base Cost (extracted from Cost Estimate elements)
Raised Pedestrian Table	$85,000
Pedestrian Crossing Traffic Signals	$485,000
Uplift for Non-Specific Costs	$500,000
Physical Costs Estimate	**$1,055,000**
Pre-implementation and Implementation Fees	$422,000
Project Base Estimate	**$1,492,000**
Contingency (30%)	$448,000

Project Expected Estimate	**$1,940,000**
Funding Risk Contingency (20%)	$388,000
95th Percentile Project Estimate	**$2,328,000**

This cost estimate for the Do-Minimum scenario (reference case) is based on an analysis of the scheme cost estimate items with the following assumptions:

- An uplift of 85% on the on the physical works estimate for the raised pedestrian table and pedestrian crossing signal has been included to account for non-specific costs within the scheme cost estimate (i.e. earthworks/demolition, drainage, line marking, temporary traffic management, preliminary and general costs)
- Pre-implementation fees and implementation fees are 40% over and above total physical cost estimate.

Maintenance and Operational Costs

Implementation of the project will also result in existing and additional assets requiring ongoing maintenance and operational expenditure. This was assumed to be 1% of the capital cost. In addition, every 20 years over the evaluation period, a further 0.5% renewal cost was assumed.

Benefits Calculated

The following benefit streams have been assessed for the recommended option:

- Cyclist crash cost savings
- Health benefits for cyclists
- Vehicle operating cost (VOC), travel time and bottleneck delay savings for all motorised vehicles on the corridor, as well as those diverting onto alternative routes
- External delays for southbound traffic in the AM peak associated with increased traffic on the re-routing onto SH1 which is currently at capacity
- Travel time savings for existing and additional bus users using bus lanes/ SVLs and from the improved bus stop designs and reduction in the number of bus stops
- Bus travel time benefits
- Bus service reliability benefits
- Pedestrian amenity benefits.

External Delays for SH1 Traffic

Screen line data was extracted from AIMSUN modelling for SH1 and SH2 for the Do-min+Peds scenario. This indicated that there are likely to be additional delays prior to vehicles entering to model area experienced by southbound traffic during the AM peak due with few viable alternatives available for diverted traffic.

Diverted trips were apportioned to SH1 and SH2 based on the relative traffic volume for each 15-minute time slice as part of the Do-min+Peds scenario. A bottleneck analysis was undertaken on these traffic volumes with the capacity of SH1 and SH2 based on the average traffic flows from the Do-min+Peds scenario within 90% of the peak traffic volume respectively. The resulting average vehicle delay was applied to the SH1 travel time. It is assumed that external delays associated with TQHR traffic is assessed as part of the SIDRA modelling of the corridor.

Cyclist Crash Cost Savings

For the purposes of crash analysis, the crashes along the corridor have been grouped based on the current speed limit to match the resulting changes in crash costs. Crashes affected by proposed linear treatments (e.g. changing angled parking to parallel parking, raised median, etc.) have been grouped based on the affected crash type with the crash savings scaled based on the coverage of each segment.

Crashes affected by proposed point treatments (e.g. raised safety platforms) have been grouped based on the affected crashes that occur within a 50m radius from the proposed treatment.

The features proposed in each section that affect cycle crashes along this route are as follows:

- Mulgrave Street to Aotea Quay (50km/h area)
  - Separated cycleway – Crash reductions associated with this are limited to cycle crashes only. The net effect of the separated cycleway is the removal of conflict with parked vehicles with provision of an off-road cycleway. Currently cyclists only interact with parked vehicles on Thorndon Quay between Mulgrave Street and Tinakori Road.
- Aotea Quay to Onslow Street (60km/h area)
  - Raised Median – The effect of the raised median is to eliminate right turning movements in and out of accesses. This results in a reduction in higher risk movements crossing the cycleway.
- Onslow Street to Jarden Mile (80km/h area)
  - Raised Safety Platforms – Crash reductions associated with these are limited to crashes within the vicinity of the proposed treatment. This treatment results a reduction in traffic speed and increased awareness where the treatments are provided. This applies to the Jarden Mile intersection only.

Health Benefits for Cyclists

Based on the existing cycle counts along the TQHR section, the new cyclists on this section were estimated based on the proportion of new cyclists estimated using the population catchment method in the MBCM. It assumed that there are approximately 450 new cycle trips generated within the catchment.

As this project also has the potential to further encourage cyclists to/from Petone and further north, it has been assumed that this project will result in a further 50% increase of new cyclists estimated from the Ngā Ūranga ki Pito-One Shared Path Project. The scheme consists of approximately half of the journey from Petone to the CBD, therefore, only 50% of the increase in cycle distance has been attributed to the project, which is a conservative assumption.

The total new cyclists travelled distance was then applied to the unit rate of new cyclist health benefit of $2.20/km.

It is noted that that a significant portion of the benefits can be attributed to cyclist benefits, in particular cyclist health benefits.

It also acknowledged that there are interdependencies in relation to cycle benefits, in particular with Te Ara Tupua, to realise the full benefits calculated. That said, the benefits calculated were not included in the benefits for this project. Whilst the BCR may be at the higher end of what some would predict could be expected, the approach has been agreed with Waka Kotahi.

It is also acknowledged that the connection to Te Ara Tupia is currently unfunded and is not provided for within the funded Ngā Ūranga to Pito-one project. This lack of connection could therefore potentially reduce the growth in the number of cyclists which have been assumed to use the TQHR project.

Bus Stop Time Savings

The project will remove two bus stops in each direction on the TQHR corridor.

A 30 second time saving per stop has been assumed at peak times/in the peak direction, and no saving has been assumed in the off-peak/counter peak direction.

This means a saving of one minute inbound in the morning peak period and one minute outbound in the evening peak period.

The fact that most of the retained or relocated bus stops will be easier for buses to access and/or egress (largely because buses will be exiting stops into a bus lane rather than a general traffic lane), has been assumed to result in a further 20 seconds saving per stop at half of the stops in the peak period/direction.

On the basis that there are approximately nine stops where this saving will materialise, a further saving of one and a half minutes is estimated.

The total time saving in the morning peak inbound/evening peak outbound is therefore estimated to be around about two and a half minutes.

By way of comparison, Figure 5 in the Strategic Case report indicated that the total dwell time in the southbound direction, in the morning peak, is around 80 seconds, with an 85th percentile dwell times of around 180 seconds. This period/direction has the longest dwell times for the corridor.

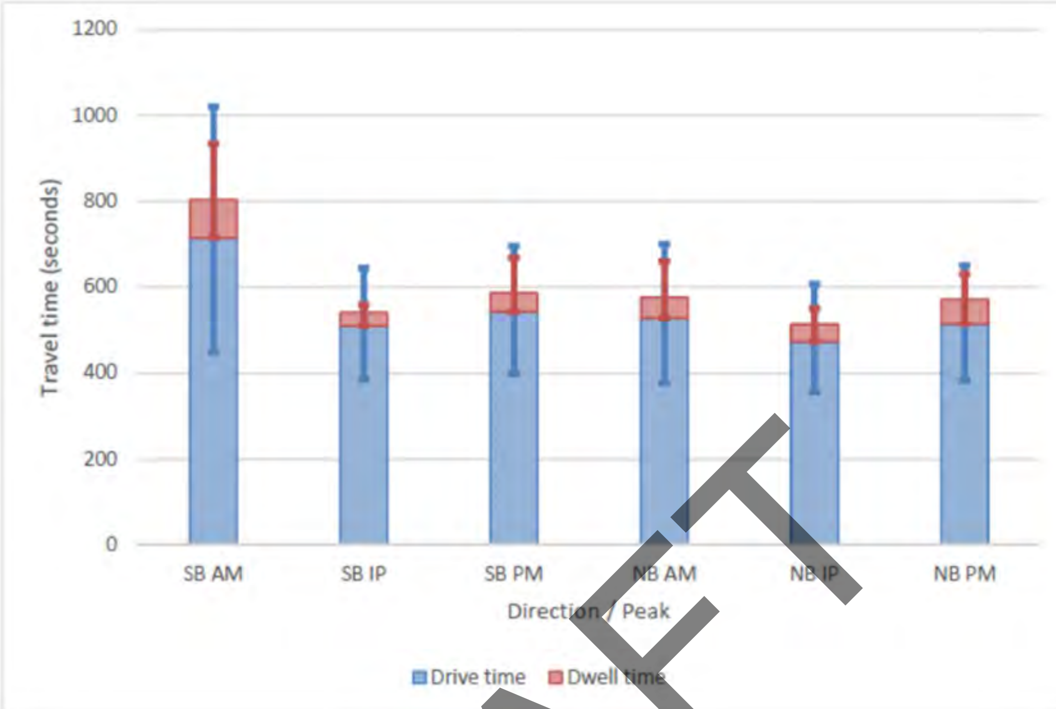
A notional one-minute saving in the off peak and counter peak time periods has been assumed.

Bus Reliability Benefits

The scheme is expected to improve bus reliability when the bus lanes/SVLs are operational (i.e. southbound during the morning peak period and Northbound the during the evening peak period). The existing bus travel times and travel time variability is shown in Figure 1.

This information was extracted from the Strategic Case Report (Figure 5) and shows that the variability in bus travel time during morning peak period is approximately twice as much as the those experienced during the evening peak period. The scheme is not expected to significantly the variability of the dwell times at the bus stops, outside of what has been considered as part of bus stop removal analysis.

Figure 1 - Bus Travel Times by Time of Day (average with 15th/85th percentile error bars)



For the purposes of the economic analysis, the following assumptions have been made:

- There will be a 30 second reduction in average late time for southbound buses in the morning peak period
- There will be a 15 second reduction in average late time for northbound buses during the evening peak period
- No improvement to bus reliability will arise whilst the bus lanes are not operational
- The improvements to bus reliability will affect 50% of bus passengers in 2026, increasing to 60% in 2036 due to peak spreading.

Pedestrian Amenity Benefits

The daily pedestrian volumes along the scheme are based on the those identified in Table 4 of the Strategic Case, as shown in Table 2. These pedestrian volumes are related to 2019 strategic case identified that over the past 20 years there has been a 3% per annum growth in pedestrian volumes. This growth rate has been applied between 2019 and 2036 with growth rates tapering off linearly to 2046.

Table 2: 2019 Assumed Current Pedestrian Data (values over 50 rounded to nearest 10)

Location	Peak Hour Flow	Daily Flow
Thorndon Quay	200-300	2,000-3,000
Hutt Road (Thorndon Quay to Kaiwharawhara Road)	50-100	500-1,000
Hutt Road (Kaiwharawhara Road to Onslow Road)	20-40	200-400
Hutt Road (north of Onslow Road)	5-15	50-150

For the purposes of the economic evaluation, it is assumed that the pedestrian volumes are consistent along the length of the sections identified. It has been assumed that the average pedestrian trip length on the facility will be 1km and pedestrians have a walking speed of 1.2m/s. The pedestrian amenity benefits are based on the methodology and values stated in '*Impact on Urban Amenity in Pedestrian Environments, Waka Kotahi, 2020*'.

A 3km/h reduction in average speed along the corridor has been assumed in the calculation of pedestrian amenity benefits.

Whilst the applicability of other pedestrian amenity benefits has been considered, there is not expected to be significant improvement in pedestrian amenity relating to the features considered in '*Impact on Urban Amenity in Pedestrian Environments, Waka Kotahi, 2020*'.

Sensitivity Testing

Sensitivity testing has been undertaken on the following scenarios:

- High-cost scenario based on the 95th percentile capital costs
- High cycle growth scenario where the number of new cyclists generated by the scheme is doubled to approximately 900 new cycle trip from within the direct catchment and a 100% increase in new cyclists generated from Ngā Ūranga ki Pito-One Shared Path Project
- Low cycle growth scenario where the number of new cyclists generated by the scheme is halved to approximately 260 new cycle trip from within the direct catchment and a 10% increase in new cyclists generated from Ngā Ūranga ki Pito-One Shared Path Project
- High and low bus patronage as a result of the scheme with a +/-20% bus patronage numbers
- 25% reduction in through traffic on Thordon Quay Hutt Road being diverted to the SH1 corridor. This sensitivity test was based on a separate modelling results undertaken on the Thorndon Quay Hutt Road corridor
- Increasing the evaluation period to a 60-year evaluation period
- Changes in discount rate to 6% and 3%
- Removal of external delays associated with southbound traffic in the AM peak re-routing onto SH1. This sensitivity test represents where these trips are delayed later in the peak such that there is no additional cost associate with peak spreading.
- Change in SH1 travel time during the AM peak period to achieve a BCR of 1.0 assuming a net change in vehicle operating costs of zero to partially account for changes in travel time.

Appendix M
Cost Estimates

Project Estimate

Project Name: Thorndon Quay and Hutt Road & Aotea Roundabout
Client: Let's Get Wellington Moving (LGWM)

DBE

Detailed Business Case Estimate

DRAFT

Item	Description	Base Estimate	Contingency	Funding Risk Contingency
A	**Nett Project Property Cost**	1,260,000	378,000	327,600
	Project Development Phase			
	- Consultancy Fees	Nil	Nil	Nil
	- LGWM Managed Costs	Nil	Nil	Nil
B	**Total Project Development**	Nil	Nil	Nil
	Pre-implementation Phase			
	- Consultancy Fees	4,300,000	1,290,000	1,118,000
	- LGWM Managed Costs	2,500,000	750,000	650,000
C	**Total Pre-implementation**	6,800,000	2,040,000	1,768,000
	Implementation Phase			
	Implementation Fees			
	- Consultancy Fees	2,500,000	750,000	650,000
	- LGWM Managed Costs	1,920,000	576,000	499,200
	- Construction/ Consent Monitoring Fees	300,000	90,000	78,000
	Sub Total Base Implementation Fees	4,720,000	1,416,000	1,227,200
	Physical Works			
1	Environmental Compliance	72,000	21,600	18,720
2	Earthworks Demolition and Site Clearance	1,148,000	344,400	298,480
3	Ground Improvements	0	0	0
4	Drainage	1,710,000	513,000	444,600
5	Pavement and Surfacing	5,988,000	1,796,400	1,556,880
6	Bridges	0	0	0
7	Retaining Walls	0	0	0
8	Traffic Services	5,371,000	1,611,300	1,396,460
9	Service Relocations	1,260,000	378,000	327,600
10	Landscaping and Urban Design	4,930,000	1,479,000	1,281,800
11	Traffic Management and Temporary Works	2,333,000	699,900	606,580
12	Preliminary and General	6,740,000	2,022,000	1,752,400
13	Extraordinary Construction Costs	170,000	51,000	44,200
	Allowance of $500k for price fluctuation			500,000
	Sub Total Base Physical works	29,730,000	8,919,000	8,227,720
D	**Total for Implementation Phase**	34,450,000	10,335,000	9,454,920
E	**Project Base Estimate** (A+C+D)	42,510,000		

F	**Contingency** (Assessed/Analysed)	(A+C+D)	12,753,000
G	**Project Expected Estimate**	(E+F)	55,263,000
Nett Project Property Cost Expected Estimate			1,638,000
Project Development Phase Expected Estimate			Nil
Pre-implementation Phase Expected Estimate			8,840,000
Implementation Phase Expected Estimate			44,785,000

H	**Funding Risk Contingency** (Assessed/Analysed)	(A+C+D)	11,550,520
I	**95th percentile Project Estimate**	(G+H)	66,820,000
Nett Project Property Cost 95th percentile Estimate			1,965,600
Project Development Phase 95th percentile Estimate			Nil
Pre-implementation Phase 95th percentile Estimate			10,608,000
Implementation Phase 95th percentile Estimate			54,239,920

Date of Estimate Update 26/10/21	**Cost Index 4th Quarter 2021**
Estimate prepared by Racheal Spragg and Shirley Mendoza Cruz	**Signed**
Estimate internal peer review by Jason Luo	**Signed**
Estimate external peer review by	**Signed**
Estimate accepted by LGWM	**Signed**

Note:
(1) These estimates are exclusive of escalation and GST.
(2) Project Development Phase Estimates are set to Nil as these are now sunk costs.
(3) Contingency is allowed at 30%.
(4) Funding Risk Contingency is allowed at 20%.

Single Stage Business Case Estimate 1/1 Printed Date: 26/10/2021