Westhaven to Akoranga

Active Mode Demand and Economic Assessment: Report

August 2021

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TRANSPORTATION SPECIALISTS

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EXECUTIVE SUMMARY

Flow Transportation Specialists (Flow) has been commissioned by Waka Kotahi the NZ Transport Agency (Waka Kotahi) to assess the proposed Westhaven to Akoranga section of the Northern Pathway project, in terms of

- the predicted number of people who may use the project
- the economic effects of the project based on Waka Kotahi's procedures

This work follows earlier assessments carried out between 2014 and 2020. Since then, a number of changes have affected the project's potential use, and its benefit cost ratio (BCR). The most significant of those changes include

- a growing body of evidence that micro mobility (e-bikes, e-scooters and other motorised personal transport devices) will have a larger impact on the forecast demand for the project than previously thought
- a revised design for the bridge component of the project, with a new standalone active mode bridge now proposed that has significantly increased expected costs
- updated economic evaluation procedures introduced by Waka Kotahi in 2020, through the new Monetised Benefits and Costs Manual (MBCM), which has now replaced the former Economic Evaluation Manual (EEM).

Forecast trips of Westhaven to Akoranga

Table ES1 below summarises the future daily active mode trips we estimate will use the bridge component of Westhaven to Akoranga. We also compare these forecasts to those previously made in March 2020, as well as the main reasons for the change.

Table ES1: Annual average daily trips on bridge component of Westhaven to Akoranga

	Previous assessment (2020)	Current assessment (August 2021)	Main reasons for change
Trips by people walking, jogging, on e-scooters or other wheeled pedestrian devices			
2028	1,760	1,600	Lower population and employment growth forecasts, lower tourism expectations
2038	2,060	1,900	
Trips by people on bikes and e-bikes			
2028	2,690	3,400	As above, but conversely greater impact expected of e-bikes on travel behaviour
2038	3,190	5,200	

Benefit cost ratio (BCR) of Westhaven to Akoranga

Previous BCRs for the Westhaven to Akoranga project have included

- a BCR of 1.2 assessed in January 2020, based on discounted benefits of $326 million and discounted costs of $262 million ($302 million undiscounted, plus maintenance costs)
- an interim updated BCR range of 0.4 to 0.6 in June 2021, based on the above discounted benefits but the increased cost of a new, standalone bridge structure ($713 million undiscounted, plus maintenance costs).

We have revised the expected benefits of the project in light of our updated demands and Waka Kotahi's updated economic procedures. Both the discounted benefits and costs are summarised in Table ES2, comparing these to the figures from the January 2020 evaluation.

Table ES2: Updated economic evaluation, compared to January 2020 evaluation (discounted)

	Previous assessment (January 2020)	Current assessment (August 2021)	Main reasons for change
Discounted benefits	$326 million	$530 million	Set out in Table ES3
Discounted costs	$262 million	$588 million	New bridge structure now proposed
BCR	**1.2**	**0.90**	

Table ES3 provides further detail on the source of the changes to the project's expected benefits.

Table ES3: Summary of changes that have affected the updated economic benefits

	Approximate discounted economic impact	Main reasons for change
Discount rate	+ $195 million	Waka Kotahi's MBCM advises the use of a lower annual discount rate (4%, previously 6% under the EEM)
Cycle demands	+ $135 million	Revised demand estimates that account for growing trend in e-bikes
Evaluation period	+ $68 million	MBCM now allows a 60-year evaluation period for projects with a long lifespan (previously 40-years, according to the EEM)
Health benefits	- $112 million	Health benefits from increased physical activity now capped by MBCM, and a lower benefit rate now applies to micro mobility trips
Long term growth of benefits	- $36 million	Zero growth in both demand and benefits assumed from 2048 (ongoing linear growth previously assumed beyond 2048)
Other	- $46 million	Other minor changes and the cumulative effects of the above

We have reviewed the most significant assumptions behind the active mode demand estimates and the economic evaluation and tested the impact of these through a series of sensitivity tests. The resulting sensitivity test BCRs *generally* range from 0.8 to 1.0 (with the full range including one test as low as 0.71 and one at 1.06).

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APPENDICES

1 BACKGROUND TO THIS STUDY

Flow Transportation Specialists (Flow) has been commissioned by Waka Kotahi the NZ Transport Agency (Waka Kotahi) to assess the predicted walking and cycling demands on the proposed Westhaven to Akoranga section of the Northern Pathway project and to carry out an economic evaluation of the proposed facility. This work follows earlier assessments carried out between 2014 and 2020, and a now revised design that has significantly increased the project's construction costs.

Previous active mode demand and economic assessments of the Westhaven to Akoranga project (or sections of it) have included

- An October 2014 assessment of the likely use of the bridge component[1]
- An October 2018 assessment of the likely use and an economic assessment of the landward component[2]
- A January 2020 assessment of the likely use and an economic assessment of the bridge component[3]
- A more detailed assessment of the likely use of the bridge and landward components in March 2020[4]

The October 2018 and January 2020 studies were independently peer reviewed by Quality Transport Planning (QTP) and Ernst & Young, respectively. This included a peer review of the Auckland Cycle Model which we developed and have used to predict active mode use for several projects in Auckland.

Our evaluation has relied on the processes established by the October 2018 and January 2020 studies, and has updated each to reflect changes in cycle demand estimation processes and economic evaluation procedures.

2 CHANGES SINCE THE 2018 AND 2020 ASSESSMENTS

2.1 Changes that have affected the estimates of the number of people using the facility

2.1.1 Micro mobility

Forecast demands were previously developed in January 2020, with that assessment predicting 1,700 pedestrian trips per day across the proposed bridge in 2026, and 2,800 cycle trips per day (a total of

[1] Traffic Design Group. (August 2014). *SkyPath Resource Consent – Transportation Assessment Report.*
[2] Flow Transportation Specialists. (October 2018). *SeaPath Shared Path – Demand Assessment and Economic Benefit Evaluation*.
[3] Flow Transportation Specialists. (January 2020). *Cross Harbour Walking and Cycling Connection – Transport Modelling and Economic Evaluation.*
[4] Flow Transportation Specialists. (March 2020). *Northern Pathway Section 1, Westhaven to Akoranga – Walking and Cycling Forecasts and Level of Service Assessment*.

4,500 trips per day). These demand estimates were developed assuming there would be no significant changes in walking or cycling technologies.

Specifically, the cycle demand component was based on outputs from the Auckland Cycle Model (ACM), calibrated based on observed cycle data from 2016. In the period since, e-bikes have gained in popularity significantly. Evidence to support this includes

- Waka Kotahi's Research Report 674 "*Mode shift to micromobility"* (February 2021), which concluded that if appropriate infrastructure is provided, e-bike trips could account for up to 8% of all trips within a 5 km radius of Auckland's city centre, and 5% in more suburban areas of the city
- 2018 data collected by the University of Auckland[5], which observed that 31% of peak period trips on the Northwestern Cycleway were by e-bike (but only 15% on Tamaki Drive, which did not have safe cycle infrastructure at that time)
- Waka Kotahi's research[6] indicating that 11% of bikes sold in New Zealand in 2019 were e-bikes
- Data collected by Auckland Transport[7] indicating that in 2020, 25% of regular bike riders in Auckland used e-bikes
- Most micro-mobility hire companies that have launched in Auckland in recent years have e-bikes and e-scooters, rather than pedal bikes/scooters.

The evidence points to a rapidly increasing rate of e-bike ownership and use, from near-zero in 2016 when the ACM was calibrated, to the observed rates above. E-bikes are also particularly suited for longer distance trips on the strategic cycle network, such as on Westhaven to Akoranga. Reflecting this, we have made the following assumptions in updating our demand assessment

- 40% of cycle trips in Auckland will be by e-bike in 2028
- 60% of cycle trips in Auckland will be by e-bike in 2038

Waka Kotahi's Research Report 674 reviewed both New Zealand and international literature to consider the effect of e-bikes on trip lengths. Waka Kotahi's conclusion was that e-bikes enable trip lengths two to three times longer than traditional pedal bikes. We have taken the low end of this range, and assumed that e-bikes enable trips that are double (two times) the length of traditional pedal bike trips.

Similar trends have been observed for e-scooters and other 'wheeled pedestrian modes', however there is less data available to support this. Data collected by Flow on Tamaki Drive in 2018 found that approximately 20% of pedestrian trips on this route during the peak periods were by 'wheeled pedestrians'. Waka Kotahi's Research Report 674 concluded that given appropriate infrastructure, e-scooters could account for 1% to 3% of all trips outside of Auckland's city centre (and approximately double that within the city centre).

Research Report 674 also concluded that average e-scooter trip lengths were in the order of 1 to 2 km, based on data from dockless shared e-scooter providers. This is too short a distance to have an impact

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[5] Wild, K. & Woodward, A. (2018). *Electric city: E-bikes and the future of cycling in New Zealand*. University of Auckland Medical and Health Sciences

[6]

[7] TRA for Auckland Transport. (June 2021). *Measuring and growing active modes of transport in Auckland*

on Westhaven to Akoranga. This conclusion conflicts however with anecdotal evidence of commuters using privately owned e-scooters to commute significantly longer distances.

Given the uncertainty around e-scooters, we have not made any adjustments to our pedestrian demand estimates on the bridge component of Westhaven to Akoranga. However, we have assumed that an increasing proportion of pedestrian trips on the project would be by wheeled pedestrian devices, with the following assumptions being applied in the evaluation:

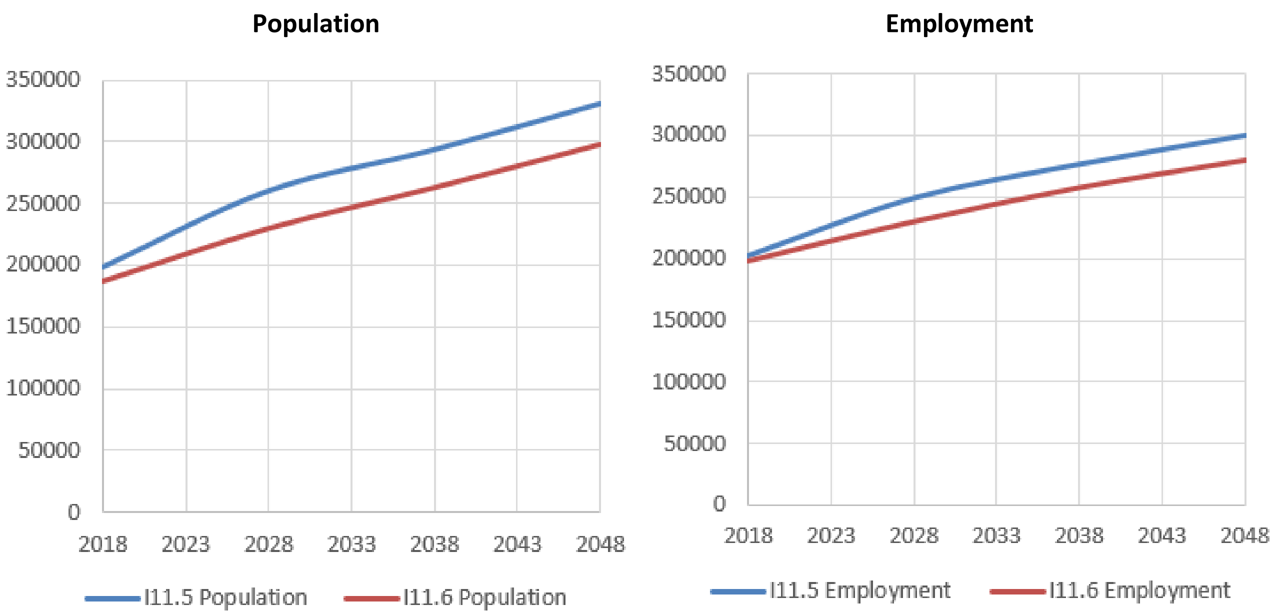
- 40% of pedestrian trips on the facility will be by e-scooter (or other wheeled pedestrian device) in 2028
- 60% of pedestrian trips on the facility will be by e-scooter (or other wheeled pedestrian device) in 2038

This assumption has affected the economic assessment of pedestrian health benefits (refer Section 2.2), and also affected the proportion of pedestrian trips across the proposed bridge assumed to continue northward on the landward section of the Westhaven to Akoranga.

2.1.2 Auckland Council's land use forecasts

The ACM was developed based on Auckland Council's I11.5 land use forecast scenario. In 2020 these forecasts were replaced by Scenario I11.6, and the updated land use forecasts have generally resulted in reductions in predicted population and employment within central Auckland. Figure 1 presents the population and employment forecasts for each of the two scenarios, for areas within a 5 km radius of the proposed bridge landings.

Figure 1: Comparison of Auckland Council I11.5 (old) and I11.6 (current) land use forecasts within 5km of proposed bridge landings



Within those 5 km radii, Scenario I11.6 population forecasts have reduced 11% relative to the old Scenario I11.5 forecast, and employment forecasts have reduced by 7%. These reductions are relatively consistent across the 2028, 2038 and 2048 forecasts. Regionally however, land use forecasts have reduced only by 5%, both in terms of population and employment.

The ACM remains based on the older Scenario I11.5 land use forecasts. While land use forecasts are not the only factor that affect potential walking and cycling trips, they play a significant part. To reflect the lower land use forecasts now predicted however, we have factored down forecast demands for the project by a blanket 5%.

2.1.3 Tourism estimates

The tourism potential of the Westhaven to Akoranga was estimated in the January 2020 assessment. Since that time, Covid 19 has disrupted international tourism dramatically. There are currently no post-Covid forecasts for tourism within New Zealand, and it remains unclear how the industry will respond long term.

Nonetheless, 82% of the tourist trips on Westhaven to Akoranga were estimated to be domestic tourists, and this market is expected to continue in the future, and might well be greater, if people are limited in their overseas tourist destinations.

However, we have updated the 2020 tourism estimates by assuming zero growth in tourism (previously estimated to grow at 1.2% per annum), rather than predict higher local tourism numbers.

2.2 Changes that have affected the economic evaluation

Previous economic assessments that we have carried out for Westhaven to Akoranga (or sections of the project) have included the following

October 2018

- a BCR of 1.2 for the landward section, based on discounted benefits of $72 million and discounted costs of $61 million ($72 million undiscounted construction costs, plus maintenance costs)

January 2020

- a BCR of 1.3 for the bridge component, based on discounted benefits of $254 million and discounted costs of $201 million ($230 million undiscounted construction costs, plus maintenance costs)
- a BCR of 1.2 for Westhaven to Akoranga overall, based on the sum of the above costs and benefits

June 2021

- an interim updated BCR range of 0.4 to 0.6, based on the above discounted benefits but applying the revised construction cost estimate ($713 million undiscounted construction costs, plus maintenance costs)

The interim updated BCR released in June 2021 was estimated based on the 2018/2020 benefit assessments, but applied the revised cost estimate for the new bridge. It did not update the evaluation to account for other changes that have affected the economic evaluation. These changes include

- new economic evaluation procedures, with Waka Kotahi's Monetised Benefits and Costs Manual replacing the now superseded Economic Evaluation Manual (EEM) in 2020
- new demand estimates, as documented in Section 2.1.

The above changes, and their respective impacts on Westhaven to Akoranga's discounted benefits, are summarised in Table 1 below.

Table 1: Summary of changes that have affected the updated economic benefits

<table>
<tr><th>Item</th><th>Change since 2018/2020 assessment</th><th>Approximate impact on discounted benefits</th></tr>
<tr><td colspan="2">Discounted benefits from previous assessment</td><td>$326 million</td></tr>
<tr><td>Discount rate</td><td>MBCM applies a lower annual discount rate (4%, previously 6% according to the EEM)</td><td>+ $195 million</td></tr>
<tr><td>Cyclist demands</td><td>New demand estimates account for growing trend in e-bikes (refer Section 2.1)</td><td>+ $135 million</td></tr>
<tr><td>Evaluation period</td><td>MBCM allows a 60-year evaluation for projects with a long lifespan (previously 40-years, according to the EEM)</td><td>+ $68 million</td></tr>
<tr><td>Cycling health benefits</td><td>MBCM applies a higher health rate for cycling ($2.20 per cycle-km, previously $1.30 per cycle-km) but a lower rate for e-cycling ($1.00 per e-bike-km, also previously $1.30 per cycle-km).
MBCM also now requires health benefits to be capped.</td><td>- $94 million</td></tr>
<tr><td>Long term growth of benefits</td><td>Zero growth in benefits assumed from 2048 (linear growth previously assumed beyond 2048)</td><td>- $36 million</td></tr>
<tr><td>Pedestrian health benefits</td><td>MBCM applies a higher health rate for walking ($4.40 per ped-km, previously $2.60 per ped-km).
MBCM also now requires health benefits to be capped.</td><td rowspan="2">- $19 million</td></tr>
<tr><td>E-scooters</td><td>Increasing proportion of pedestrian trips assumed to be by e-scooter, or some other micro mobility device. Reduced health benefits are assumed to apply to this proportion ($1.00 per ped-km, previously $2.60 per ped-km).</td></tr>
<tr><td>Land use forecasts</td><td>Current Auckland Council I11.6 land use forecasts predict lower population and employment growth in central Auckland and the lower North Shore, relative to previous forecasts</td><td>- $16 million</td></tr>
<tr><td>Traffic effects</td><td>Zero growth in general traffic reduction benefits assumed from 2038. Linear growth previously assumed to 2048.</td><td>- $11 million</td></tr>
<tr><td colspan="2">Other minor changes, and cumulative effects of above changes</td><td>- $19 million</td></tr>
<tr><td colspan="2">Discounted benefit for current assessment</td><td>$530 million</td></tr>
</table>

3 REVISED DEMAND ASSESSMENT

3.1 Estimated active mode trips on the project

The following tables present the predicted annual average daily trips on each section of Westhaven to Akoranga. The trips include utility trips (ie people travelling to a destination, such as to work), recreational trips and tourist trips.

The methodology we have applied to develop these demand estimates is included in Appendices A to D.

Table 2: Predicted annual average daily trips on Westhaven to Akoranga, 2028

Section	Trips by people walking, jogging, on e-scooters or other wheeled pedestrian devices	Trips by people on bikes and e-bikes	Total daily trips
Akoranga Drive to Exmouth Road	350	1,450	1,800
Exmouth Road to Stafford Road	350	1,500	1,850
Stafford Road to Sulphur Beach Road	350	1,450	1,800
Sulphur Beach Road to Princes Street	400	1,450	1,850
Waitemata Harbour Bridge	1,600	3,400	5,000

Table 3: Predicted annual average daily trips on Westhaven to Akoranga, 2038

Section	Trips by people walking, jogging, on e-scooters or other wheeled pedestrian devices	Trips by people on bikes and e-bikes	Total daily trips
Akoranga Drive to Exmouth Road	400	2,900	3,300
Exmouth Road to Stafford Road	400	2,900	3,300
Stafford Road to Sulphur Beach Road	400	2,900	3,300
Sulphur Beach Road to Princes Street	450	2,900	3,350
Waitemata Harbour Bridge	1,900	5,200	7,100

Previous estimates for the bridge section of Westhaven to Akoranga, from the March 2020 assessment, were

- 1,750 daily pedestrians in 2028, increasing to 2,050 in 2038. The new forecasts are slightly lower due to reductions in forecast land use growth, and lower tourism expectations
- 2,700 daily cyclists in 2028, and 3,200 in 2038. The new forecasts are higher, due to the predicted impacts of e-bikes.

3.2 Estimated cycling mode shares

The following table presents estimated cycle to work mode shares for the Auckland region, as well as for the four Auckland Council Local Boards most affected by the proposed project. Forecast mode shares are compared to existing mode shares, for reference.

Table 4: Estimate commute to work mode shares by bike and e-bike

Area	Existing		2028 predicted		2038 predicted	
	2016 base model	2018 census[8]	Without project	With project	Without project	With project
Devonport-Takapuna Local Board	2.2%	1.8%	2.4%	2.9%	3.2%	3.9%
Kaipatiki Local Board	0.9%	0.5%	1.5%	2.7%	2.7%	4.3%
Waitemata Local Board	3.2%	2.7%	4.7%	5.0%	7.6%	8.0%
Albert-Eden Local Board	3.3%	2.9%	4.6%	4.7%	5.1%	5.2%
Auckland region	**1.3%**	**1.0%**	**2.2%**	**2.3%**	**3.7%**	**3.9%**

Increases in cycle mode shares between 2018 and 2028 are predicted for the above areas due to background investment in cycling, including completion of the Auckland Urban Cycleways programme, the Northcote Safe Routes, and cycling components of the Northern Corridor Improvements. Further increases are predicted to 2038 due to assumed ongoing investment in cycle infrastructure.

However, the forecast commute to work mode shares by bike fall below the targets set by Te Tāruke-ā-Tāwhiri: Auckland’s Climate Plan. Those regional targets are

- 7% bike and e-bike mode share by 2030
- 9% bike and e-bike mode share by 2050

Similarly, the forecast mode shares fall below the e-bike mode shares predicted by Waka Kotahi’s Research Report 674, of

- 8% e-bike mode share for urban areas within 5 km of the city centre
- 5% e-bike mode share for suburban Auckland locations

These comparisons provide some level of confidence that the model is not predicting unrealistically inflated cycle mode shares, relative to Te Tāruke-ā-Tāwhiri: Auckland’s Climate Plan, or to previous Waka Kotahi research. Conversely though, our estimates may be too low for Auckland to achieve the outcomes anticipated by the Council in the Climate Plan.

Considered from a different perspective, if Auckland was to meet its climate change goals and achieve the cycling mode share targets set out in Te Tāruke-ā-Tāwhiri: Auckland’s Climate Plan, the cycling estimates on the facility would be significantly higher.

[8] The 2018 census is thought to have underestimated actual bike mode shares, as the wording of the question excluded respondents who cycle to work less than 50% of the time

4 REVISED ECONOMIC EVALUATION

4.1 Economic benefits of Westhaven to Akoranga

The economic evaluation has been carried out in accordance to Waka Kotahi's Monetised Benefits and Costs Manual (MBCM).

The following benefit streams have been assessed for the project

- health benefits for cyclists – the public health benefits associated with increased physical activity
- health benefits for pedestrians – the public health benefits associated with increased physical activity
- emissions benefits – the economic impact of reduced emissions, when some users shift from driving to walking or cycling
- agglomeration benefits – the increased productivity and economic growth from improving connectivity between the city centre and the North Shore (Takapuna in particular)
- perceived travel time benefits for cyclists – travel time savings, weighted by the MBCM's Relative Attractiveness scale, which accounts for cyclist perceptions of comfort/time on cycle infrastructure
- general traffic reduction benefits – the travel time and vehicle operating cost benefits to general traffic that remains on the road network, when some users shift from driving to walking or cycling.

Our assessment of the project has not included safety benefits, as we haven't considered the alternate destinations, routes and modes of travel that the people using the facility would otherwise take. The facility itself will provide a safe route for pedestrians and cyclists, free from conflict with general traffic. For people using the facility, this portion of their trip will be safer than the route or mode of travel that they had used previously.

Our base assessment excludes tourism benefits, in accordance with MBCM guidance.

Table 5 presents a summary of the discounted benefits. Further detail of how these have been developed is included in Appendix E.

Table 5: Discounted economic benefits

Benefit stream		Discounted benefit
Cycling benefits	Health benefits for cyclists	$249 million
	Perceived travel time benefits for cyclists	$69 million
	Safety benefits	Not included
Pedestrian benefits	Health benefits for pedestrians	$16 million
	Safety benefits	Not included
General traffic benefits	General traffic benefits	$153 million
	Emissions reduction benefits	$2 million
Wider economic benefits	Agglomeration benefits	$41 million
	Tourism benefits	Not included
Total benefits		**$530 million**

4.2 Economic costs of Westhaven to Akoranga

Project costs have been supplied by Waka Kotahi and include

- an expected (P50) construction cost of $668 million – this forms the basis for the economic evaluation, and excludes sunk costs and escalation, as required by the MBCM
- 95th percentile costs of $783 million – this cost has been used for sensitivity testing only
- ongoing maintenance and operational costs of $1.2 million per year
- periodic maintenance of $19,000 to $59,000 at 10-year intervals and major periodic maintenance of $1.9 million at 25-year intervals.

Discounted over the 60-year evaluation period, the above costs sum to $588 million for the expected estimate (P50).

4.3 Benefit cost ratio

Based on the discounted benefits and costs presented above, the Westhaven to Akoranga project is estimated to have the following benefit cost ratio (BCR).

Table 6: Westhaven to Akoranga benefit cost ratio

Discounted benefits	$530 million
Discounted costs	$588 million
Benefit cost ratio	**0.90**

4.4 Sensitivity tests

The following table documents the main assumptions made in the demand assessment and economic evaluation. It presents a range of sensitivity tests, based on changes to these assumptions. The sensitivity test BCRs generally range from 0.8 to 1.0 (with the full range being from 0.71 to 1.06)

Table 7: Benefit cost ratio sensitivity testing

Input	Assumption	Sensitivity test	Sensitivity test BCR
Evaluation period	60-year evaluation period, permitted by MBCM for long-life infrastructure	Standard 40-year period	0.74
Demand growth	2028 & 2038 forecasts developed. Linear growth assumed up to 2048. All benefits (and therefore demands) assumed to be capped after 2048.	No cap	0.98
		2038 cap	0.83
Micro mobility	Increasing e-bike uptake assumed (40% of bike trips in 2028, 60% in 2038)	Fewer e-bikes (30% 2028, 40% 2038)	0.88
		More e-bikes (50% 2028, 80% 2038)	0.91
	Walking and cycling health benefits capped by factoring down by 50% (50% of NZ population already meets Ministry of Health exercise guidelines)	60% cap (40% of Auckland population meets MoH guidelines)	0.99
	E-scooters assumed to be 40% of pedestrian trips in 2028, 60% in 2038. However, pedestrian demands have not been adjusted to account for future wheeled pedestrian modes. E-scooter health benefits assumed to be same as e-bike benefits ($1 per km, no MBCM rate available). 50% capped as above.	Impacts of lower proportion of e-scooter trips (30% 2028, 40% 2038)	0.91
		Impacts of higher proportion of e-scooter trips (50% in 2028, 80% in 2038)	0.89
		Impact of higher pedestrian demands due to micro mobility (+20%)	0.91
Land use forecasts	Demand forecasts based on I11.5 forecasts. The latest I11.6 land use forecasts have been represented by factoring walking and cycling demands down (-5%)	Lower land use growth (-10% factor applied)	0.86
		Higher land use growth (-5% factor removed)	0.94
Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan	Forecast cycling travel to work mode shares are in the order of 2% to 4%, for the Auckland region. This is significantly lower than the targets set by Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan, of 7% by 2030 and 9% by 2050.	Consider impact on the BCR if Auckland was to meet the cycling mode share targets of Te Tāruke-ā-Tāwhiri: Auckland's Climate Plan.	Not assessed, but likely to result in a BCR well above 1

Table 7: Benefit cost ratio sensitivity testing

Input	Assumption	Sensitivity test	Sensitivity test BCR
Wind and weather effects	Demand forecasts are annual averages and account for typical seasonal and daily variation on Auckland cycleways	Effect of high winds closing bridge 20 days per year	0.85
CO2 emissions	Economic evaluation includes emissions benefits from car trips directly removed from the network (direct emissions benefits). Economic evaluation of traffic benefits includes travel time and operating costs only (excludes indirect emissions benefits due to reduced congestion)	Including CO2 benefits equal to 4% of vehicle operating costs, for vehicles that remain on the network	0.90
General traffic benefits	Economic evaluation applies $/km benefit rate for car trips removed, obtained from 2026 & 2036 Upper Harbour SATURN models	Apply MBCM default $/km rate (and zero interpeak benefits)	0.71
	Traffic benefits calculated for weekday commuter and interpeak periods only	Include weekend peak benefits	0.91
Bus benefits	No benefits calculated for trips diverted from public transport, or for deferring upgrades to the Northern Busway	Noted, but no sensitivity test	n/a
Additional Waitemata Harbour Crossing	Economic evaluation caps general traffic benefits after 2038, in response to potential Additional Waitemata Harbour Crossing	Cap general traffic benefits from 2048	0.96
		Cap general traffic benefits from 2028	0.80
Congestion charging and other changes in generalised costs	Cycle demand modelling assumes no future changes in generalised costs of travel by public transport or car. In practice, generalised costs may increase due to changes such as congestion charging, increased parking and public transport costs, or increased fuel costs. In these cases, cycle demands would be expected to increase. Conversely, generalised costs may decrease due to improvements in infrastructure such as future light rail to the North Shore. In this instance, cycle demands may reduce.	Sensitivity test higher demand (+20% by 2048), reflecting higher generalised cost of travel by car and public transport	1.06
		Sensitivity lower higher demand (-20% by 2048), reflecting higher generalised cost of travel by car and public transport	0.74

Table 7: Benefit cost ratio sensitivity testing

Input	Assumption	Sensitivity test	Sensitivity test BCR
Cycle infrastructure	2028 forecasts assume completion of currently committed projects (Auckland Urban Cycleways programme) 2038 forecasts assume ongoing background investment in cycle infrastructure (Akoranga to Constellation, Lake Rd/Esmonde Rd cycleways, Glenfield Rd, Queen St and Victoria St)	Cap demands from 2038	Refer to Demand Growth sensitivity test
Agglomeration benefits	Agglomeration benefits provided by MRC in 2018 report, and factored up to account for new discount rate and evaluation period	Low agglomeration benefit estimate from MRC	0.88
		High agglomeration benefit estimate from MRC	0.92
Tourism benefits	Evaluation excludes tourism benefits, in accordance with the MBCM	Include tourism benefits	0.91
Construction costs	Costs supplied by Waka Kotahi. Evaluation based on expected (P50) cost estimate	Apply P95 costs	0.82
	Sunk costs excluded, including $4 million in design fees and $21 million in property	Include sunk costs	0.87
	Escalation excluded (estimated by Waka Kotahi to be 2% per annum)	Include cost escalation	0.88

4.5 Economic evaluation peer review

The economic update (August 2021) to the Westhaven to Akoranga project has been independently peer reviewed. The elements of the evaluation that have specifically been reviewed include

- Overview of the previous economic evaluations and peer review documents, specifically that of the ACM and the demand predictions of the previous assessments
- The updated assumptions applied to the August 2021 economic update
- The economic worksheets used to translate demand predictions into benefits, according to the procedures set out in the MBCM
- The sensitivity tests completed and the assumptions behind these

We note that the peer review concluded that

- *"the economic assessment presented to WSP is considered robust*
- *most peer review comments are minor in nature and any points raised are unlikely to change the benefit cost ratio (BCR) significantly, or pertain to sensitivity testing rather than the base BCR*
- *the economics author, Flow Transportation Specialists, have provided adequate responses to all peer review comments"*

A copy of the peer review document issued by WSP is included at Appendix F.

APPENDIX A pedestrian demand estimates

The following text has been copied from the January 2020 demand assessment. We note that the methodology refers to land use forecasts that have now been superseded. The high level comparisons however remain valid, as do the conclusions drawn from them.

Comparisons with Tamaki Drive

The evaluation draws significantly on the comparisons between the proposed cross harbour facility, and the existing causeway section of Tamaki Drive. These comparisons are presented below.

Table 8: Auckland Harbour Bridge and Tamaki Drive Comparisons

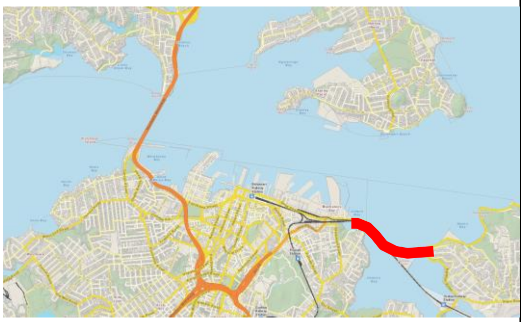
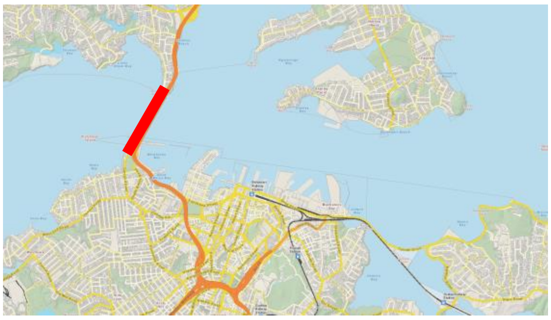
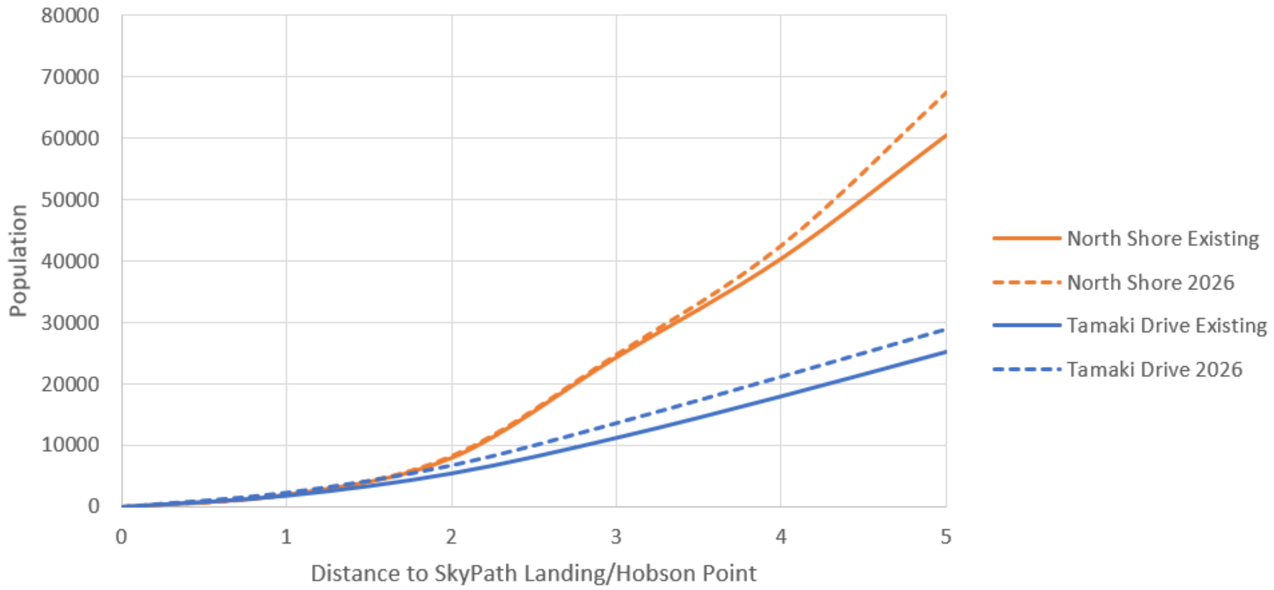
	Tamaki Drive Causeway (Hobson Point to Judges Bay)	**Auckland Harbour Bridge**
Location		
General description	1.6 km coastal route across Hobson Bay	1.3 km coastal route across Waitemata Harbour
Use	Popular with utility and recreational cyclists and pedestrians.	Expected to be popular with utility and recreational cyclists and pedestrians, as well as tourists.
Connections	City connections: ◆ Harbour side route to city centre, via Quay Street cycleway ◆ Steep uphill routes to Parnell, via St Stephens Avenue (pedestrians only) or via St Georges Bay Road	City connections: ◆ Harbour side route to city centre, via Westhaven Boardwalk shared use path ◆ Steep uphill route to Ponsonby, via Curran Street
	Eastern connections: ◆ Inland local road route to Orakei, via Ngapipi Road (and in future via Glen Innes to Tamaki Drive shared use path) ◆ Coastal route to Eastern Bays, via Tamaki Drive	Northern connection: ◆ Inland local road route to Northcote, via Northcote Safe Routes ◆ Coastal route to Takapuna, via proposed SeaPath shared use path
Key Distances	From Hobson Point: ◆ 1.4 km to Parnell Baths ◆ 2.9 km walk to Parnell via St Stephens Avenue	From Northern Landing: ◆ 1.3 km to southern landing ◆ 2.9 km to Wynyard Quarter ◆ 3.1 km to Ponsonby (Three Lamps)

Table 8: Auckland Harbour Bridge and Tamaki Drive Comparisons

	Tamaki Drive Causeway (Hobson Point to Judges Bay)	Auckland Harbour Bridge
	◆ 3.5 km cycle to Parnell via St Georges Bay Road ◆ 3.7 km to City Centre (Queen Street/ Customs Street)	◆ 4.4 km to City Centre (Queen Street/ Customs Street)
Adjacent Land Uses	Very few – Auckland Outboard Boat Club, minigolf course and pedestrian footbridge to St Stephens Avenue on southern side	None (harbour both sides)
Residential catchment	Refer Figure 2	
Active Mode Infrastructure	Two existing shared use paths, both approximately 2.5 m wide. Generally poor standard with uneven surface due to tree roots, low branches, street furniture and pinch points. Future two-way separated cycleway proposed by Auckland Transport.	Proposed shared use path, minimum 4 m width.

Figure 2 illustrates the existing and forecast 2026 residential populations within 5 km radii of the Hobson Point landing of Tamaki Drive, and of the northern landing of the Auckland Harbour Bridge. It can be seen that both the Tamaki Drive causeway and the Auckland Harbour Bridge have very comparable residential catchments for pedestrian trips (ie within 1 to 2 km). In terms of cycling catchments however (ie within 5 km), the proposed cross harbour walking and cycling connection would have a residential catchment approximately double that of the Tamaki Drive causeway.

Figure 2: Tamaki Drive and Northern Auckland Harbour Bridge Residential Catchments



Overall, we consider the existing Tamaki Drive causeway provides a very useful comparison to the proposed cross harbour walking and cycling connection, with the only significant differentiator being the residential catchments and gradients.

Estimating pedestrian demands

Given the similarities between the proposed cross harbour walking and cycling connection and the existing Tamaki Drive causeway, the two facilities are anticipated to operate with comparable pedestrian demands. Flow carried out manual surveys of pedestrians on Tamaki Drive on Wednesday 14th November 2018 and on Saturday 17th November 2018. The surveys were carried out immediately east of the pedestrian footbridge connecting Tamaki Drive to Parnell Baths. The weather was fine on both occasions, and the following pedestrian volumes were recorded:

- 245 pedestrians in the weekday morning period (6 to 9 am)
- 253 pedestrians in the weekday interpeak period (12 to 2 pm)
- 294 pedestrians in the weekday evening period (4 to 7 pm)
- 1,210 pedestrians throughout a Saturday (6 am to 7 pm).

Notably, approximately 20% of the surveyed pedestrians were wheeled pedestrians, including electric scooters.

Automated pedestrian count data from four shared path sites across Auckland[9] has been used to factor the above counts into annual average daily pedestrians, correcting for weather and season. The resulting estimated 2018 annual average daily pedestrian volume on Tamaki Drive is 1,190 daily pedestrian trips. The same "existing" pedestrian demand of 1,190 daily pedestrians has been assumed

[9] Orewa shared path, Twin Streams shared path Henderson, Mangere Harbour bridge and Waterview Unitec shared path

to apply to a walking and cycling facility across the Auckland Harbour Bridge, if it were available today, given both facilities have comparable population catchments within 2 km of their northern/eastern landings, and have comparable connections to the city centre.

The above figure relates to 2018 pedestrians, and this would be expected to grow over time. There are multiple drivers behind future growth in pedestrian trips across the harbour, including land use changes and the future cost of travel by other modes. Land use growth has been used as a proxy for pedestrian demand growth as documented below.

From the land use data presented in Figure 2 previously, very little land use growth is anticipated within a 2 km radius of the proposed northern landing of the Auckland Harbour Bridge. Significant growth is forecast however near the southern landing, and Table 9 presents the existing and forecast 2026 land uses within a 2 km radius of the bridge's southern landing.

Table 9: Auckland Harbour Bridge Southern Landing Land Use Catchments

Area	Population			Employment		
	2016	2026	Annual growth	2016	2026	Annual growth
1 km radius of landing	1,035	1,203	+2%	1,584	1,582	-
2 km radius of landing	7,073	8,851	+2%	26,106	34,598	+3%

A 2% annual growth in pedestrian demands has been assumed to apply, that is:

- 1,350 daily pedestrian trips are predicted in 2028 (1,190 in 2018 plus 2% annual growth for 10 years, less 5% to account for reduced land use forecasts from Section 2.1.2)
- 1,600 daily pedestrian trips in 2038 (as above, plus a further 2% annual growth)

APPENDIX B cycling demand estimates

Utility and Recreational Cyclists

Methodology

The Auckland Cycle Model (ACM) has been used to develop estimates of average weekday peak period cyclist trips on Westhaven to Akoranga (both utility and recreational trips). The ACM estimates future cycling demand and

- reflects predicted land use (according to Auckland Council's scenario I11.5 land use forecasts)
- reflects cyclists' route choice – with cyclists generally opting to travel via a slightly longer route if it provides a higher standard of infrastructure, or less adverse gradients
- reflects realistic cycling trip lengths – with longer trips less likely to be undertaken by bicycle than shorter trips, with a probability distribution applied that is based on the existing Auckland cycle trip length distribution
- reflects realistic cycle trip types – with trip types such as home-to-work and home-to-education more likely to be undertaken by bicycle than trip types such as trips for employer's business
- reflects anticipated future growth in e-bikes
- is responsive to changes in cycle infrastructure (in terms of both demands and trip assignment), in that high quality cycle infrastructure between any two nodes will result in more trips between those nodes being undertaken by bicycle, than a scenario with poorer quality cycle infrastructure
- reflects both utility and recreational cyclist components, but not tourist trips.

The ACM is informed by the Auckland Macro Strategic Model (MSM), and its development is documented more fully in a Model Development Report. The model was independently peer reviewed by QTP for the purpose of forecasting cross-harbour cycle trips in 2018.

For the economic evaluation of the project, 2028 and 2038 forecast models have been used.

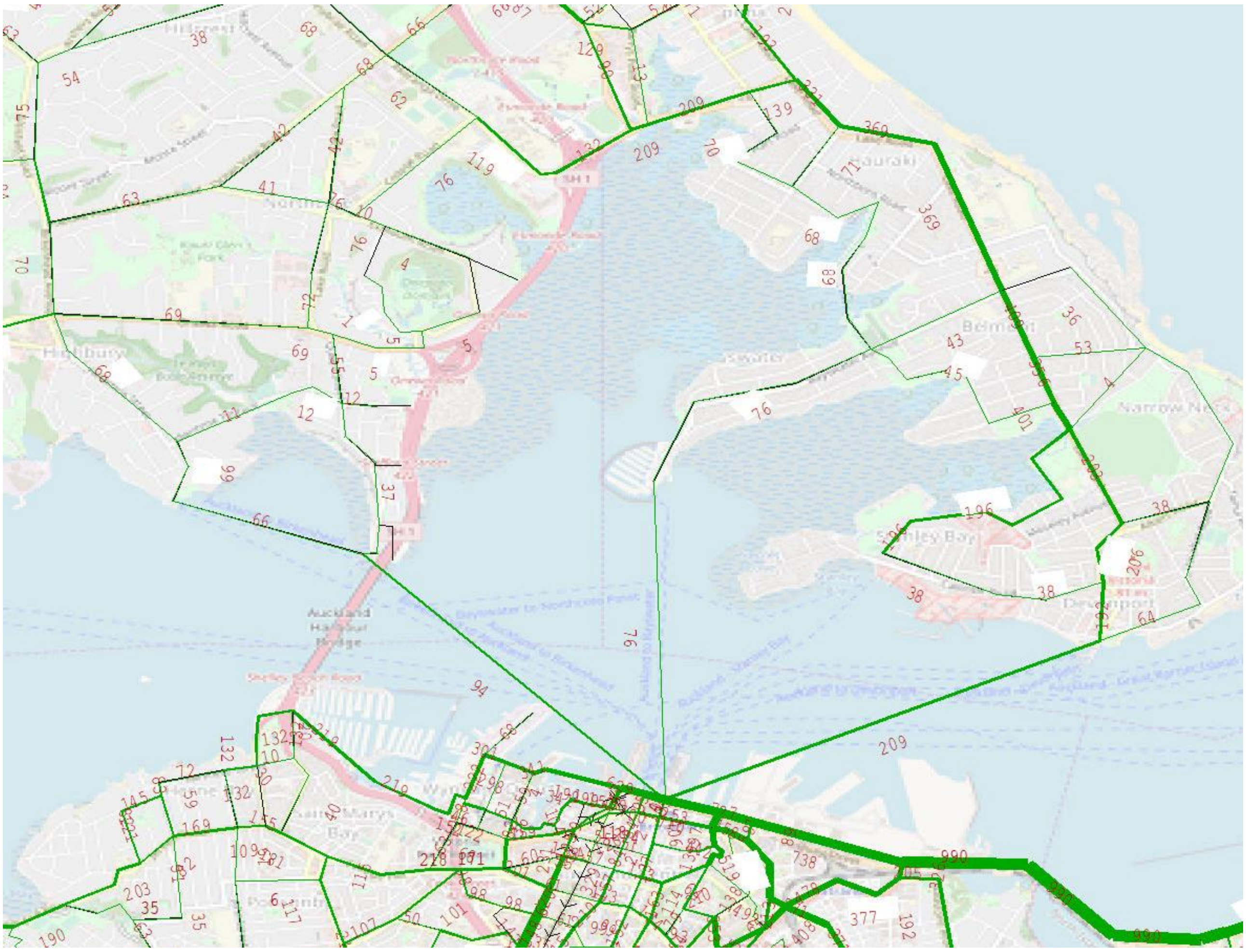
The model represents morning and evening peak period (two hour) cyclist demands for each forecast year. Estimates of daily cyclist demands have been derived by factoring the morning and evening peak period forecasts. A factor of 2.3 has been used in this process in order to replicate the off-peak and weekend profiles currently observed on Tamaki Drive and anticipated to similarly apply to a future cross harbour walking and cycling connection. We note that lower factors tend to apply to cycle routes that have a lower proportion of recreational trips, such as the Northwestern Cycleway.

2016 Base Model

A 2016 ACM base has been developed, based on 2016 scenario I9 land use forecasts[10]. Figure 2 presents a plot of forecast daily cyclists from the 2016 model.

[10] Scenario I9 was the last land use forecast scenario that was modelled by a 2016 regional transport model (ART or the MSM).

Figure 3: 2016 Modelled Daily Cyclist Plot



The ACM is relatively coarse grained, in that it does not include local street links nor the detailed land uses and accesses that result in cyclist volumes varying along a given section of road. A factor of 2.3 has been used to calibrate the estimated daily cyclist demands against the 2016 observations. It should be recognised that applying a network-wide factor as such will result in some demands being under-estimated on routes that attract a high proportion of off peak and recreational users, such as Tamaki Drive and Te Wero Bridge. Conversely, demands will be over-estimated on routes with a commuter focus, such as the Northwestern Cycleway. It is also important to recognise that this approach has produced differing estimated daily demands relative to those in the Model Development Report, where route-specific factors were applied to each cycleway.

A comparison of the 2016 model's outputs was undertaken using historic cycle count data. Counts in Northcote were manual surveys carried out by Auckland Transport in November 2016 and March 2017, and average counts are presented where there were multiple count sites and dates. The remaining counts are annual average counts for 2016 obtained from Auckland Transport's automatic counters.

Table 10: Comparison of 2016 Model and Count Data

Road	Section	2016 Daily Count	2016 Model	
			Daily Cyclists	Difference
North Shore Count Data				
Northcote Road	SH1 to Akoranga Road	75	66	-9
	Akoranga Road to Lake Road	51	68	+17
Lake Road (Northcote)	Northcote Road to Exmouth Road	36	42	+6
	Exmouth Road to Onewa Road	24	72	+48
Queen Street	North of Belle Vue Avenue	25	55	+30
	South of King Street	107	37	-70
Lake Road (Takapuna)	South of Eversleigh Road	281	369	+87
City Centre Count Data				
Curran Street	North of Sarsfield Street	252	132	-120
Te Wero Bridge	Te Wero Bridge	550	342	-208
Quay Street	Spark Arena	738	755	+17
Tamaki Drive	East of Solent Street	1,176	1,032	-144
Lightpath	South of Union Street	529	524	-5
Northwestern Cycleway	Kingsland	657	774	+117

The 2016 forecast model generally predicts an appropriate quantum of cyclists on each route, given the following considerations:

- the morning and evening commuter peak cycle model outputs were factored to develop the daily estimates above, as documented previously. The blanket factoring of all routes by the same factor will have over-estimated daily demands on commuter-oriented routes such as the Northwestern Cycleway, and under-estimated demands on routes with significant sports/recreational use such as Tamaki Drive and Te Wero Bridge.
- the model underestimates the number of cyclists using Queen Street to access the Northcote Ferry, and predicts that more cyclists will instead join this ferry service at Birkenhead. The total number of cyclists estimated to use the Birkenhead/Northcote ferry is 94 per day, and this agrees with Auckland Transport data from 2013 which provided a figure of 83 daily cyclists. As a result, the quantum of cyclists predicted to cross the Waitemata Harbour via the Birkenhead/Northcote ferry is considered appropriate.

Future Scenarios Assessed

The Project has been benchmarked against a future Reference Case that includes all existing cycle infrastructure, in addition to future infrastructure either currently proposed, or expected to be implemented in the future. The projects assumed within the future Reference Case for 2028 and 2038 are identified below.

2028 Future Reference Case:

The 2028 future Reference Case includes all existing cycle infrastructure, as well as all future projects either currently under construction or with committed funding. These include:

- completion of the Northcote Safe Routes (a combination of shared use paths and on street cycle facilities on Northcote Road, Lake Road and Queen Street),
- completion of the Auckland Urban Cycleways programme
- the Waka Kotahi's proposed cycle infrastructure included in the Northern Corridor Improvements project, which include shared paths parallel to SH1 (Oteha Valley Road to Constellation Drive) and SH18 (SH1 to Albany Highway).

2038 Future Reference Case:

The 2038 future Reference Case includes all infrastructure included in the 2028 Reference Case. It also includes limited future cycle infrastructure that, while not committed, is considered the 'bare minimum' level of ongoing cycle investment over the next 20-year period. This is consistent with the Auckland Cycling Programme Business Case which proposes significant future investment in cycle infrastructure across Auckland, but does not yet identify where that investment will be. If no further background investment was assumed, this would unrealistically limit the long-term connectivity of the proposed Project. Infrastructure included is:

- the Akoranga to Constellation section of the Northern Pathway project
- cycling improvements to Lake Road and Esmonde Road, as proposed by Auckland Transport in 2020 but subsequently put on hold
- assumed future cycle infrastructure on lower North Shore arterials, including on Glenfield Road, Birkenhead Avenue and Albany Highway
- future cycle infrastructure on Queen Street, Victoria Street, Ponsonby Road, Jervois Road, College Hill, West End Road and Richmond Road, the latter where not already provided by the Waitemata Safe Routes project.

Demand Estimates

Approximately 3,200 daily cyclist trips are forecast on the proposed cross harbour walking and cycling connection in 2028, and 5,000 in 2038. The following figures illustrates the 2028 and 2038 average annual daily cyclist trips (utility and recreational trips) predicted by the ACM.

Figure 4: 2028 forecast daily cycle trips (utility and recreational trips)

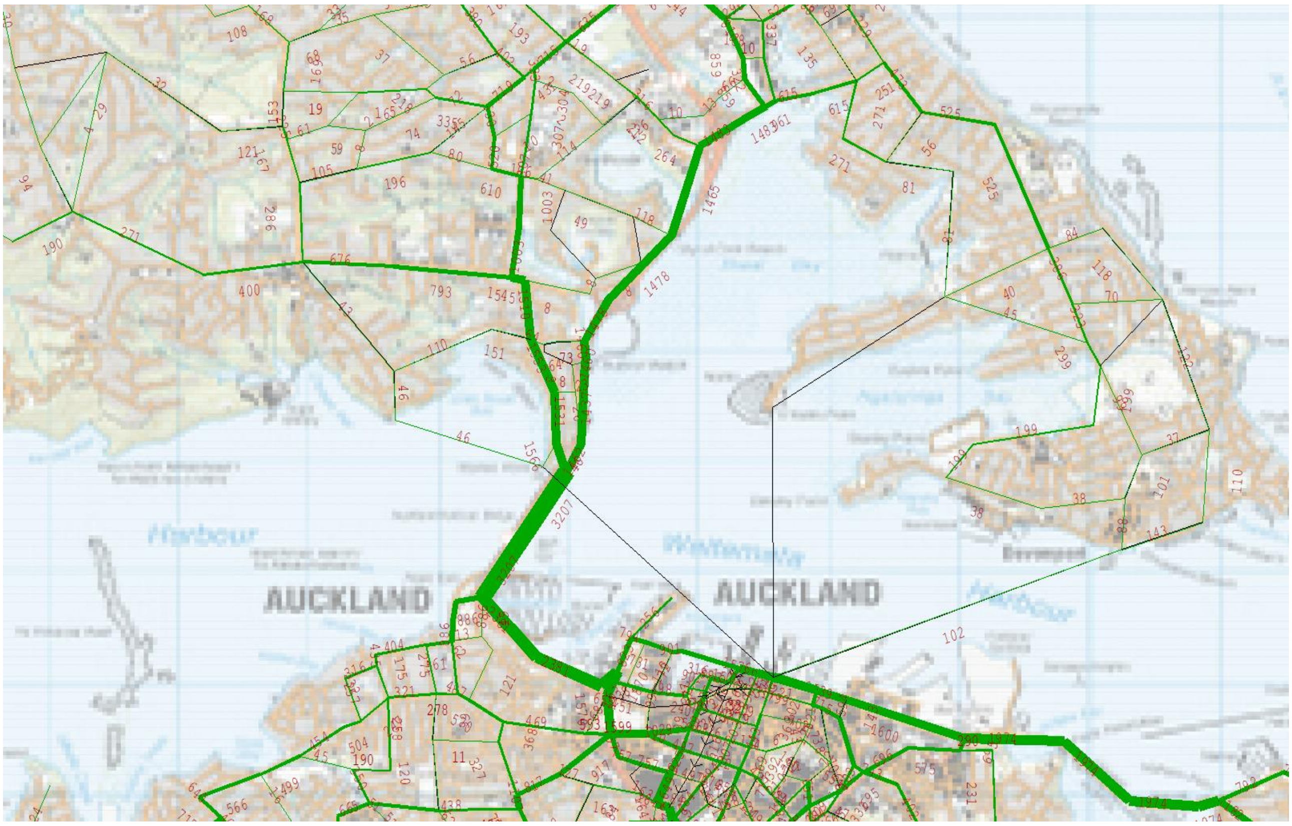
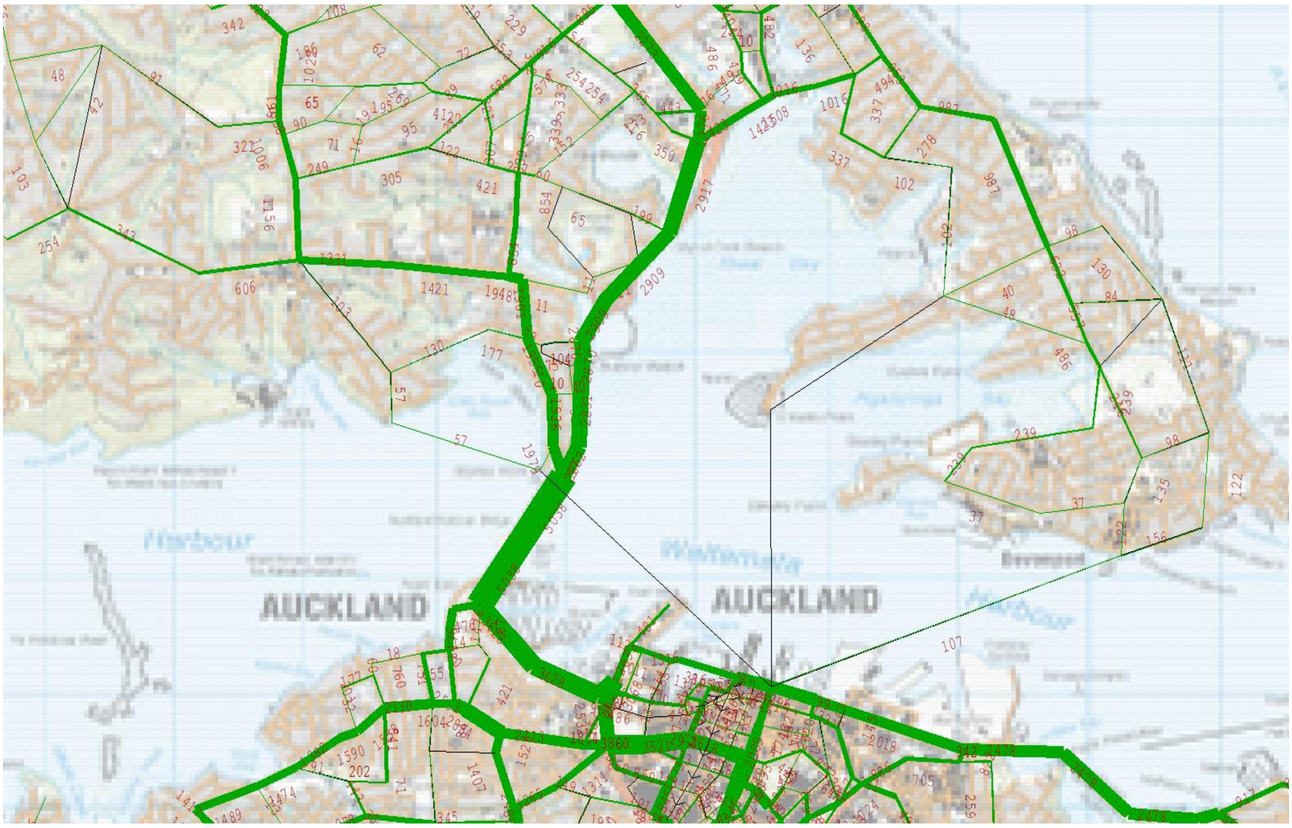


Figure 5: 2038 forecast daily cycle trips (utility and recreational trips)



Appendix D includes plots showing the origins of forecast morning peak trips on the project.

The following table summarises the forecast 2028 daily demand on the proposed facility, as well as on related infrastructure, both with and without the facility:

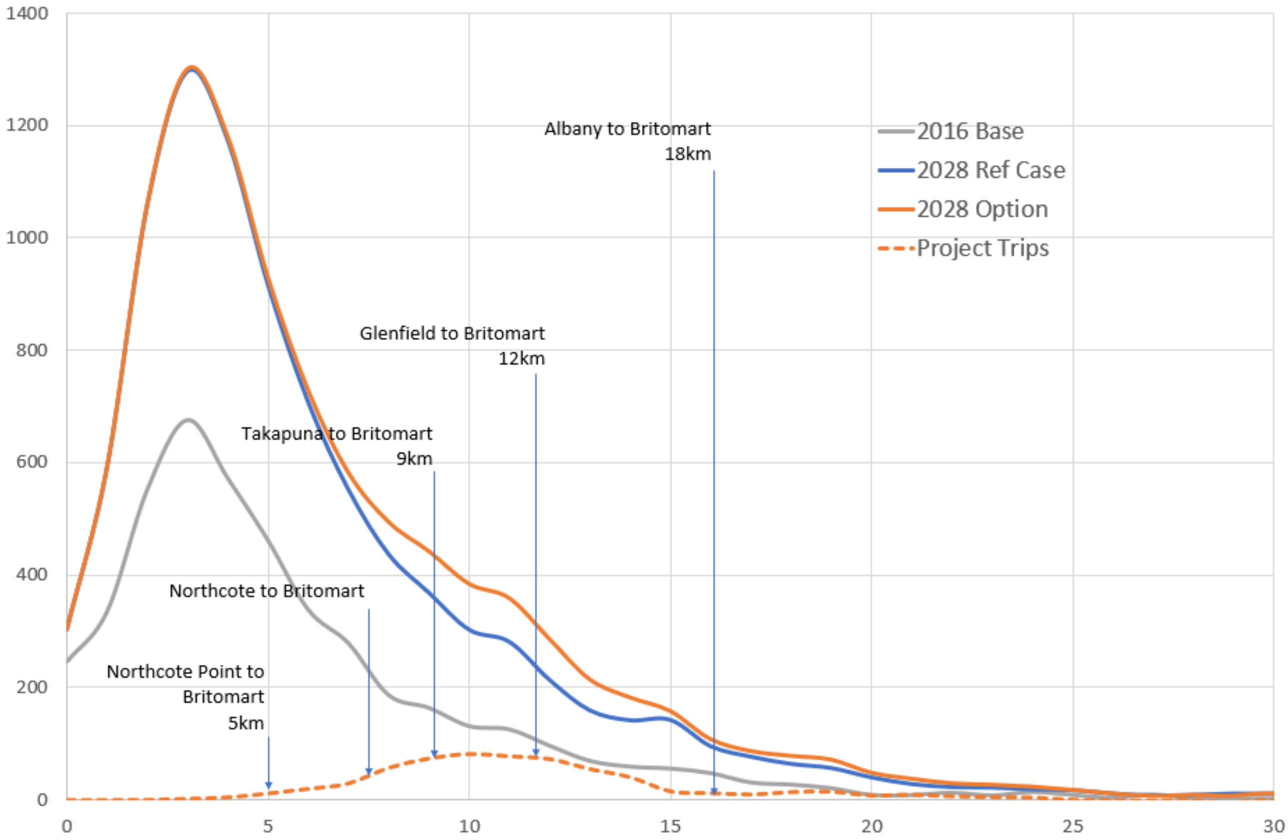
Table 11: Summary of forecast 2028 average annual daily cyclists (utility and recreational)

	2028 Without Project	2028 With Project
Waitemata Harbour Bridge	n/a	3,200
Bridge to Sulphur Beach Road	n/a	1,450
Sulphur Beach Road to Stafford Road	n/a	1,450
Stafford Road to Exmouth Road	n/a	1,500
Exmouth Road to Akoranga Drive	n/a	1,450
Queen Street, Northcote	170	1,550
Curran Street, Ponsonby	150	900
Westhaven Drive/Boardwalk	240	2,400
Northcote Ferry	170	0
Bayswater Ferry	80	0
Devonport Ferry	250	100
Upper Harbour Bridge	250	220

Cycling trip lengths

The following section presents the forecast cycling trip lengths from the 2016 base model and 2028 forecast models.

Figure 6: Modelled 2016 and 2028 bike (and e-bike) trip length distributions



The predicted average trip bike lengths include

- 2016 base model: 5.6 km
- 2028 without project: 6.1 km
- 2028 with project: 6.4 km

The average trip length on the project itself in 2028 is predicted to be 11.1 km (and median trip length 10.3 km).

Auckland Comparisons

The 3,200 daily cyclist trips forecast across the proposed cross harbour walking and cycling connection in 2028 can be benchmarked against existing, historic and forecast daily cyclist volumes on other significant Auckland cycleways. This comparison is presented below. The historic and existing data is from Auckland Transport's automated cycle counters unless otherwise stated, and the forecasts are from the same ACM scenario that produced the estimated 3,200 trips across the harbour connection.

Table 12: Comparison of demand estimates with other major Auckland cycle routes

Cycleway	2019 [11]	2028 ACM Forecasts	
	Average Daily Cyclists	Forecast Average Daily Cyclists	Forecast Annual Growth 2019-2028
Cross Harbour Connection	n/a	3,200	n/a
Tamaki Drive	1,250 [12]	2,000	9%
Quay Street totem	1,270	1,700	4%
Northwestern Cycleway, Kingsland	1,080	1,950	7%

The above comparisons show that while the forecast 3,200 daily cyclist trips on the proposed cross harbour walking and cycling connection is high relative to existing counts on Auckland's major cycle routes, it is a sensible estimate relative to the future forecasts for these other routes. Understandably the forecast for Westhaven to Akoranga is higher than the forecasts for Tamaki Drive and the Northwestern Cycleway, as the proposed facility will be the only cycling connection to the North Shore other than the Upper Harbour Bridge. By contrast, the Northwestern Cycleway has multiple alternative parallel corridors, while Tamaki Drive serves a smaller catchment.

The existing Upper Harbour Bridge has not been used as a comparator facility however, as this bridge serves a significantly smaller catchment than any of the four routes compared above. The Upper Harbour Bridge is also not considered a realistic alternative to the proposed cross harbour facility, due to the significant distances involved in routing via the former.

International Comparisons

The 3,200 daily cyclist trips and the 1,350 daily pedestrian trips forecast on the proposed cross harbour walking and cycling facility in 2028 can also be benchmarked against existing volumes on significant international bridges. This comparison is presented below.

[11] The last complete year of data prior to Covid 19 disruptions to travel patterns
[12] 2018 data, prior to construction of Tamaki Drive cycleway

Table 13: International Comparisons to Proposed Cross Harbour Walking and Cycling Facility

International Example	Similarities	Differences
Golden Gate Bridge, San Francisco 5,500 daily pedestrians 4,000 daily cyclists[13]	Broadly similar urban population to Auckland. Popular tourist and recreational activity. Similar climate. No alternative active mode routes available, except ferry.	2.7 km long, approximately twice the length of the Auckland Harbour Bridge. Greater distance to CBD than Auckland Harbour Bridge. Better connecting cycling facilities than Auckland. No significant population on northern landing, and little within 2 km of southern landing. Little use by utility cyclists. Greater international tourist status.
Story Bridge, Brisbane 2,280 people daily[14]	Similar urban population to Auckland. Comparable densities to Auckland. Popular tourist activity. Comparable in length. Comparable waterfront cycleway network.	Closer to CBD than Auckland Harbour Bridge. Smaller catchment area Multiple parallel bridges to the west (Go Between Bridge, William Jolly Bridge, Victoria Bridge, Kurilpa Bridge).
Sydney Harbour Bridge 3,500 daily pedestrians[15] 1,750 daily cyclists[16]	Popular tourist activity. Comparable length. Similarly connects CBD to North Shore. No alternative routes available, except ferry. Comparable cycle network to Auckland.	Higher density than Auckland. Greater international tourist status. Business districts situated on both landings.
ANZAC Bridge, Sydney 1,200 daily cyclists[17]	Popular tourist activity. Comparable spiral approach ramps to those proposed for Auckland Harbour Bridge. Similar proximity to CBD.	Higher density than Auckland, although relatively little land use close to western landing. Shorter span – approximately 800 m. Much smaller catchment – bridge spans small inlet, with multiple inland routes available approximately 1 km to the south.

[13] August to October 2015 data, supplied by Golden Gate Bridge Highway & Transportation District
[14] 1st January 2016 to 31st December 2016 data, supplied by Brisbane City Council, Infrastructure Division
[15] 1.3 million annual pedestrians quoted by email by New South Wales Roads and Maritime Services
[16] Cycling statistics; Roads and Maritime Services, Government of New South Wales; March 2016.
[17] Cycling statistics; Roads and Maritime Services, Government of New South Wales; March 2016.

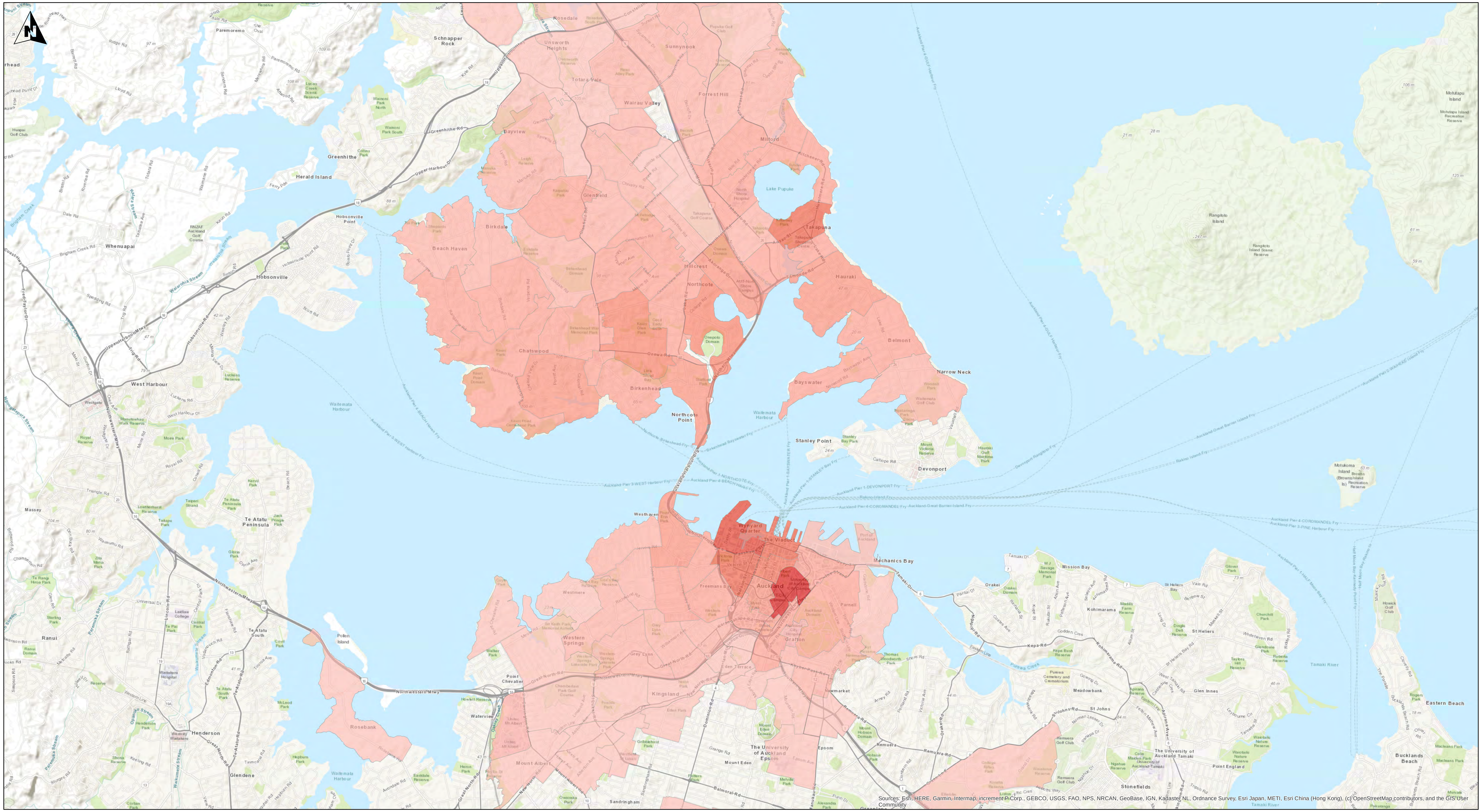
Table 13: International Comparisons to Proposed Cross Harbour Walking and Cycling Facility

International Example	Similarities	Differences
Brooklyn Bridge, New York 2,300 daily cyclists[18]	Popular tourist activity. Comparable length.	Higher density than Auckland, but much smaller catchment area. More developed connecting cycling infrastructure. Colder winter climate. Multiple parallel bridges (Manhattan Bridge is approximately 400 m to the east; see below).
Manhattan Bridge, New York 4,600 daily cyclists18	Comparable length.	Higher density than Auckland. More developed connecting cycling infrastructure. Colder winter climate. Multiple parallel bridges (see Brooklyn Bridge above).
Forth Road Bridge, Scotland 600 people daily (July – November 2018)[19]	No alternative active mode routes available, except ferry.	2.5km long, approximately twice the length of the Auckland Harbour Bridge. Lower population density on both landings. No Business District within proximity of bridge. Not identified as a popular tourist activity. Colder climate.

It is important to recognise the many differences between the above international examples and any proposed cross harbour walking and cycling facility in Auckland, and that the daily volumes on the above examples are historic numbers from 2015 to 2018, while the forecasts for the proposed facility are 2028 predictions. As such, it is difficult to draw conclusions from direct comparisons of the above international examples and the proposed facility. Nonetheless, the proposed cross harbour walking and cycling facility's forecasts of 3,200 daily cycle trips and 1,350 daily pedestrian trips in 2028 sit relatively well within the above range, being significantly fewer travellers than the Golden Gate Bridge, Sydney Harbour Bridge and Manhattan Bridge, and more travellers than Sydney's ANZAC Bridge and the Scotland's Forth Road Bridge.

[18] Daily average across April and May 2018, New York City Department of Transport
[19] 16th July 2018 to 6th November 2018 data, supplied by Forth Estuary Transport Authority

APPENDIX C cycle trip distribution plots



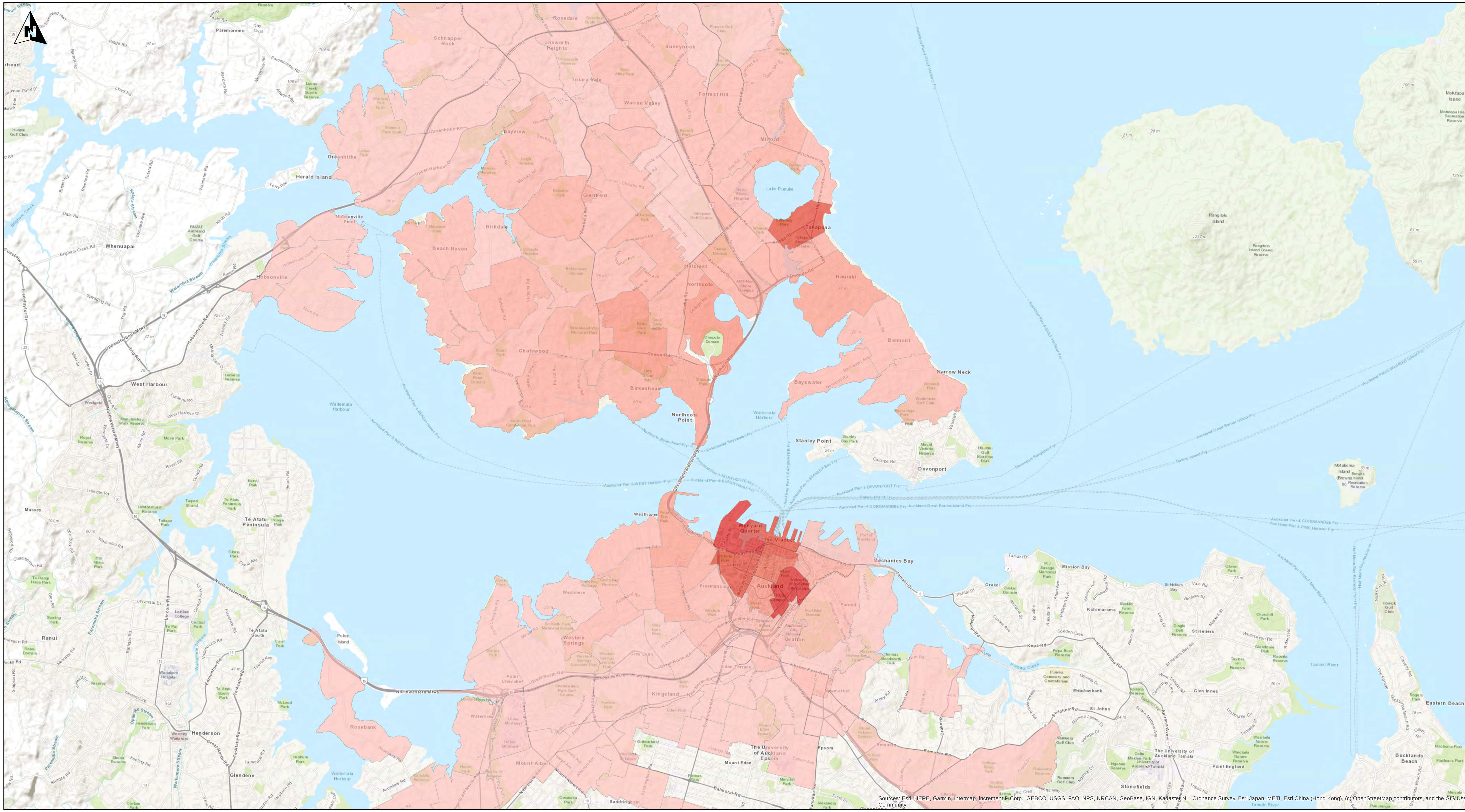
0 1.5 3
Kilometers

Westhaven to Akoranga Cycle Trip Distribution
2028 AM Cycle Trips

Total Trips
- 2 - 5
- 5 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- >80

flow
TRANSPORTATION SPECIALISTS

Drawn By:	ST
Checked by:	MJ
Date:	05/08/2021



0 1.5 3 Kilometers

Westhaven to Akoranga Cycle Trip Distribution

2038 AM Cycle Trips

Total Trips

- 2 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- >100

flow TRANSPORTATION SPECIALISTS

Drawn By:	ST
Checked by:	MJ
Date:	05/08/2021

APPENDIX D tourism estimates

The following text has been copied from the January 2020 demand assessment. In the period since, the Covid 19 pandemic has significantly disrupted international tourism. Post Covid tourism forecasts are not yet available however, and in lieu of this, we consider the below assessment to remain valid. We have however revised our annual growth forecasts (refer post Covid section below).

Demand Estimates

San Francisco's Golden Gate Bridge provides a useful comparison for a walking and cycling tourist facility across the Waitemata Harbour. The Golden Gate Bridge connects San Francisco to the small village of Sausalito. On the southern (San Francisco) side the bridge lands at the base of an extensive public park (Presidio of San Francisco) and as a result there is very little urban land use within 2 km of the bridge's southern landing. Beyond this, the CBD is an approximately 10 km cycle from the southern bridge landing. To the north, Sausalito has a population of approximately 7,000, and is a 3 to 6 km cycle from the bridge's northern abutment.

As a result of this geography, the Golden Gate Bridge connects very few urban land uses within a walkable or cycle-able distance. Relatively few walking and cycling trips across the bridge are considered to be utility trips (ie commute to work or education trips), and the bridge is instead used primarily as a recreational and tourist connection. In August to October 2015, the bridge carried on average 4,000 daily cyclist trips and 5,500 daily pedestrian trips.

Key factors when comparing the tourism potential of a future walking and cycling connection on Auckland Harbour Bridge and the Golden Gate Bridge include:

- Golden Gate Bridge has a significantly higher international profile than the Auckland Harbour Bridge
- San Francisco received 25.1 million tourists[20] in 2016, while Auckland received 2.72 million visitor arrivals[21] in the year to March 2018, a ratio of approximately ten-to-one[22]
- San Francisco has a broadly comparable climate and topography to Auckland, similarly amenable to walking and cycling
- San Francisco has a more developed cycle network and bicycle culture than Auckland generally, but Auckland will have a comparable network within the city centre on completion of the Urban Cycleways Programme

[20] https://www.sftravel.com/article/san-francisco-travel-reports-record-breaking-tourism-2016; retrieved 20 October 2018

[21] https://www.stats.govt.nz/news/annual-visitor-arrivals-up-more-than-1-2-million-in-five-years; retrieved 20 October 2018

[22] The San Francisco figure includes both domestic and international arrivals, while the Auckland figure includes only international. The latter however also includes international arrivals transiting through Auckland en route to other destinations in New Zealand. As a result, the use of the two figures to form a broad comparison is considered appropriate

- The Auckland Harbour Bridge is significantly closer to Auckland's city centre than the Golden Gate Bridge is to San Francisco's city centre, and will be connected by an appealing harbourside route (the Westhaven Boardwalk)
- A proposed cross harbour walking and cycling connection would form part of a cohesive and continuous waterfront walking and cycling route consisting of SeaPath, the Auckland Harbour Bridge, the Westhaven Boardwalk, the Wynyard Quarter, Te Wero Bridge, Quay Street and Tamaki Drive. This presents greater leveraging opportunities for walking and cycling tourism along the waterfront, relative to the Golden Gate Bridge, which is a more isolated tourist attraction.

An estimate of annual average daily tourist trips on the proposed facility has been developed by the following process:

- Assuming that half of those using the Golden Gate Bridge are tourists, either domestic or international, with the remainder being local recreational trips
- Acknowledging the Auckland Harbour Bridge's lesser international reputation than the Golden Gate Bridge, but assuming that this will be offset by:
  - The Auckland Harbour Bridge's better proximity to hotels, international cruise terminal and tourist facilities in the city centre
  - Opportunities presented by Auckland's more cohesive and continuous waterfront walking and cycling route
- Assuming that tourists visiting the facility are proportional to overall city visitor numbers, with Auckland broadly receiving 10% of San Francisco's visitors.

On the basis of the above, the proposed facility is estimated to receive approximately 200 tourist cycle trips and 275 tourist pedestrian trips per day, averaged across a year. Assuming 50% of those would make a return trips across the facility, and the remaining 50% would complete only a one-way trip and return by ferry, this is broadly equivalent to 130 daily tourists on bicycles plus 180 pedestrians, or approximately 115,000 visitors annually. This estimate can be compared to other Auckland tourist attractions that include 931,000 visitors to Auckland Museum[23], 698,000 visitors to Auckland Zoo[24], and 155,000 visitors to the New Zealand Maritime Museum[25].

The above estimates are based on existing tourist data however, and must be inflated to account for growth in tourism to 2026.

This growth has been estimated based on the following:

- An estimated 18%/82% split between international and domestic tourists, based on research carried out by MRCagney[26]

[23] Auckland Museum Annual Review 2017/2018
[24] Auckland Council Summary Annual Report 2017/2018
[25] NZ Maritime Museum Annual Report; 2015/2016
[26] Wider Economic Benefits of a New Walking and Cycling Link Across the Waitemata Harbour; MRCagney; December 2018

- Forecast annual growth in international tourists from Auckland Tourism, Events and Economic Development (ATEED), who estimate that international tourist visitors to Auckland will increase 39% between 2017 and 2023 – a 6.5% annual increase[27]
- Annual growth in domestic tourists based on the forecast New Zealand population of growth of 1.2%[28] per annum.

The above growth rates have been applied to the estimated daily trips to arrive at an estimated 230 daily tourist cyclist trips and 320 daily tourist pedestrian trips on the proposed facility in 2026 (550 daily tourist trips in total). This is broadly equivalent to 150 individual daily tourists by bicycle, plus 210 pedestrian tourists, or 130,000 annual visitors.

Local Comparison

The peer reviewer of this study has recommended investigating other local walking and cycling trails that may be able to benchmark the estimated tourist trip forecasts for the proposed cross harbour walking and cycling facility. A useful New Zealand comparison to the proposed cross-harbour walking and cycling facility is the Queenstown trail. This trail network received an estimated 332,400 annual users in 2017, with 58% being visitors to Queenstown[29]. This corresponds to approximately 530 daily tourist users, averaged across the calendar year. On the surface, this presents a useful comparison to the 550 daily tourist users estimated to use the proposed cross-harbour walking and cycling facility in 2026.

These tourist daily numbers must be considered against the similarities and differences between the two facilities and their context:

- Visitor numbers: Auckland receives a significantly higher number of tourists than Queenstown, with 2.72 million recorded at Auckland airport in the year to March 2018 and 272,000 at Queenstown airport over the same period[30]. Auckland received a further 211,000 cruise ship visitors[31], although there will be some overlap between Auckland's airport and cruise ship visitors
- Visitor type: Queenstown is generally known as an adventure tourism destination, which differs from Auckland's more general tourist visitors. This suggests that visitors to Queenstown may be more amenable to cycle tourism. The Queenstown Trail however attracts a relatively older profile of tourists, with 70% of users being over 40 years old[32], and 50-60 being the most popular ten-year age bracket
- Facility type: The Queenstown Trail is a network with approximately 120 km of off-road mountain bike trails. As a result, 75% of the Queenstown Trail's users are cyclists, with 23% on foot[33].

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[27] Destination Auckland 2025: Supplementary Report; Auckland Tourism, Events and Economic Development
[28] Stats NZ median projection to 2028
[29] Review of Queenstown Trails – Economic Impacts and User Satisfaction; Queenstown Trails Trust; July 2017
[30] https://www.stats.govt.nz/news/annual-visitor-arrivals-up-more-than-1-2-million-in-five-years; retrieved 20 October 2018
[31] Cruise ship traveller and expenditure statistics: Year ended June 2018; Statistics New Zealand
[32] Review of Queenstown Trails – Economic Impacts and User Satisfaction; Queenstown Trails Trust; July 2017
[33] ibid

Auckland's cross harbour facility would be 2 km long, and part of an approximately 17 km long waterfront route of paved and sealed cycleways and shared use paths

- Climate: Queenstown's climate features more extreme winter weather events, with snow and frost likely to reduce tourist use of the Queenstown Trail over winter. Cycle tourist numbers in Auckland's winter climate, while warmer and snow free, will be affected by higher rainfall.

It is not practicable to develop estimates of daily tourist users on the proposed cross-harbour walking and cycling facility based on the 530 average daily tourist users of the Queenstown Trail, given the differences between these two facilities and their context. However, the latter provides some confidence that the separately estimated 550 daily tourist users of the proposed cross-harbour walking and cycling facility is sensible.

Other New Zealand cycle trails, such as the Hauraki Rail Trail and the Central Otago Rail Trail, tend to be in less accessible locations and provide a less useful comparison to the proposed cross harbour walking and cycling facility.

Post Covid considerations

In the time since the above, January 2020 assessment, Covid 19 has disrupted international tourism dramatically. There are currently however no post-Covid forecasts for tourism within New Zealand, and it remains unclear how the industry will respond long term.

We note that 82% of the tourist trips on Westhaven to Akoranga were estimated to be domestic tourists, and this market is expected to continue into the future. However, the international tourism market remains unclear.

We have updated the January 2020 tourism estimates by assuming zero growth in tourism (previously estimated to grow at 1.2% per annum). Our revised tourism estimates, and the previous estimates, are:

Table 14: Westhaven to Akoranga tourist trips forecast

	Previous assessment (January 2020)		Current assessment (August 2021)	
	2026	2046	2028	2038
Trips by people walking, jogging, on e-scooters or other wheeled pedestrian devices	320	440	275	275
Trips by people on bikes and e-bikes	230	320	200	200

APPENDIX E economic evaluation methodology

General methodology

This section quantifies the transportation economic benefits of the proposed cross harbour walking and cycling connection; a separate assessment by MR Cagney considers non-transportation benefits of the project.

The economic evaluation has been based on procedures from Waka Kotahi's Monetised Benefits and Costs Manual (MBCM). It has used forecast 2028 and 2038 cycle demands from the Auckland Cycle Model (ACM), in addition to estimated pedestrian demands. ACM outputs from both the future Reference Case scenario (ie without project) and Project scenario have been used. Benefits for intermediate years have been interpolated and extrapolated from the two forecast years.

The project has been assessed with a 60-year evaluation period. While standard economic evaluations apply a 40-year evaluation period, the MBCM permits a 60-year evaluation in the case of infrastructure with a long lifespan, "to ensure that the whole-of-life costs and benefits of long-lived infrastructure activities are captured". The project's proposed new Waitemata Harbour Bridge is expected to have a lifespan far in excess of 60 years, and the longer evaluation period is considered appropriate in this instance.

The evaluation applies a 5-year construction period beginning in January 2022. During this period, no benefits accrue. This may be a conservative approach, if the landward section of Westhaven to Akoranga can be delivered earlier, releasing early benefits.

The economic evaluation has been carried out using the MBCM's most recent update factors (1 December 2018), including:

- 1.57 for travel time benefits
- 1.04 for walking and cycling benefits

Benefit streams

The following benefit streams have been assessed for the project:

- perceived travel time benefits for cyclists – calculated using ACM outputs and applying MBCM travel time cost rates
- health benefits for cyclists – calculated using outputs from the ACM, and applying MBCM health benefit rates
- health benefits for pedestrians – calculated using estimated pedestrian demands, and applying MBCM health benefit rates
- general traffic reduction benefits – calculated using standard economic evaluation procedures to quantify vehicle travel time, congestion and operating cost benefits, informed by the Northern Corridor Improvements SATURN models
- emissions benefits – the economic impact of reduced emissions, when some users shift from driving to walking or cycling
- agglomeration benefits – provided by MRCagney

Further detail on each of the above benefit streams is provided in the following sections.

Cyclist perceived travel time cost savings

Perceived cyclist travel time cost savings associated with the project have been evaluated, based on outputs from the ACM. The evaluation has applied the MBCM's Relative Attractiveness rating to weight travel time by the perceived cost on each route according to that route's infrastructure standard. The travel time costs on each modelled link included in the ACM have been aggregated across the Reference Case and Project networks, using fixed trip matrices, and compared to determine user cost savings for existing users. These have then been applied to predicted new users of the facility, using the rule of half.

We have applied average cycle speeds of 17 km/hr across the network, based on the existing average cycle speed recorded in the NZ Household Travel Survey. An average speed of 25 km/h has been applied to the project, which will be free of intersection delay.

In 2028 for example:

- The ACM predicts cyclists will travel 246,775 daily cyclist-km across the 2028 Reference Case network. When adjusting this for Relative Attractiveness on each link and the average speed above, the daily perceived travel time is 9,178 cyclist-hr
- With the project, and with fixed Do Minimum cycle demands, the perceived travel time reduces to 9,081 cyclist-hr, a saving of 97 daily cyclist-hr, shared by the 485 existing daily users that are predicted to use the project (ie cyclists that divert from ferries or the Upper Harbour Bridge)
- A further 3,126 new daily users are predicted to use the facility. To these users, half of the above perceived travel time cost savings, per user, have been applied. Ie: 97 / 485 x 3,126 x 0.5 = 313 cyclist-hr per day
- The total perceived travel time saving is 97 + 313 = 410 cyclist-hr per day
- The above 410 daily cyclist-hr has been monetised, by applying a weighted travel time cost of $7.35/hour[34], the relevant MBCM update factor of 1.57, and multiplying by 365 days per year: 410 x $7.35 x 1.57 x 365 = $1,639,645 per year in 2028.

When also applied to the 2038 model outputs and discounted, the net discounted travel time cost savings are $69 million, or approximately 13% of the overall project benefits.

Health benefits for people on bikes and e-bikes

This benefit stream calculates the health benefits gained from additional cycling activity. Cyclist health benefits have been calculated for the full length of each new cyclist's trip. This quantity has been obtained directly from the model, with the total length of cyclist-km travelled under the Reference Case and Project scenarios compared, and the difference being the total distance of new cyclist-km trips.

The MBCM applies cycling health rates of

[34] $7.80/hr for cycle commuting purposes and $6.90 for other cycling purposes, applying a 50%/50% utility/recreational split

- $2.20 per cycle-km, for traditional pedal bicycles
- $1.00 per e-bike-km

The economic evaluation has applied a composite value of the above, based on the following estimated e-bike proportions

- 40% of bike trips estimated to be by e-bike (or similar device) by 2028
- 60% of bike trips estimated to be by e-bike (or similar device) by 2038

This benefit stream has been calculated for utility and recreational cyclists using the proposed facility forecast by the ACM, and also for the estimated domestic cycle tourists. Health benefits have not been calculated for the international tourist trips.

For domestic cycle tourists, the calculation of health benefits has assumed that these users will cycle on average 3 km – the distance from the Wynyard Quarter to Northcote Point. This is considered conservative in that while some tourists will only cross the bridge itself and no further (ie 1.3 km), others will cycle across the proposed facility as part of a much longer waterfront trip (Northcote Point to Mission Bay for example being 13 km).

The MBCM requires cycling health benefits to be capped, with maximum annual benefits of $2,500 per year for pedal bike riders. This cap was developed on the basis that 50% of New Zealanders already achieve Ministry of Health physical exercise guidelines, so this 50% would not gain additional health benefits from cycling more. The cap is accordingly equal to 50% of the estimated $5,000 benefit of making an inactive person active. A lower cap of $2,000 per e-bike riders is given by the MBCM.

The above caps are not practical to apply however, as they apply to *people*, from a public health perspective. Transport planning generally however deals with *trips*, and the two (people versus trips) do necessarily align. In the case of a street with on average 100 daily cycle trips, these may be undertaken by several hundred individual people, some cycling twice a day and others only very occasionally. Instead, we have capped the cycling health benefits by simply factoring these down by 50%, reflecting the 50% of New Zealanders who already meet daily exercise guidelines. We note that this is a potentially conservative approach, as we understand only 40% of Aucklanders meet these physical activity guideline (so a higher, 60% cap could be justified).

Discounted over the 60-year evaluation period of the project, this benefit stream equates to $249 million, or approximately 47% of the overall benefits.

Health benefits for pedestrians and wheeled pedestrians

The MBCM also allows health benefits to be calculated for new pedestrian trips, at a rate of $4.40 per new pedestrian-km travelled. As with the cycling health benefits above, this benefit stream reflects the health benefit gained by increased walking activity. The MBCM does not however provide a health benefit rate for wheeled pedestrian trips, such as e-scooter trips. In lieu of this, we have applied the e-bike health benefit rate of $1.00 per km. We have weighted the two benefit rates assuming 40% of pedestrian trips will be via wheeled modes in 2028, and 60% in 2038. This assumption is on the basis of 20% of pedestrian trips on Tamaki Drive being via wheeled modes when surveyed in 2018, and the expectation that access and availability of e-scooters and other wheeled pedestrian devices will increase over the coming years.

The MBCM also applies a cap to pedestrian benefits, of $1,250 per person per year. We have again applied this by capping pedestrian health benefits by 50%.

Pedestrian health benefits have been calculated for utility, recreational and domestic tourists, but excluded for international tourists. The average domestic tourist trip has been assumed to be 1.4 km, which is the length of the proposed Waitemata Harbour Bridge (ie one one-way trip, or a return trip to the summit and back).

Not all predicted pedestrian trips on the project are expected to be new trips. Some will be existing recreational trips that shift from some other route to the new facility. To account for this, we have assumed that only 50% of utility and recreational pedestrian trips are new. All domestic tourist trips are assumed to be new trips, that contribute toward health benefits.

In total, discounted pedestrian health benefits (utility, recreational and tourist) are estimated to be $16 million, or approximately 3% of the overall project benefits.

Safety benefits

Walking and cycling safety benefits typically accrue where new or improved infrastructure reduces the crash risk for pedestrians or cyclists on a given route, or at a specific location. In the case of the proposed facility, the existing crash risk for active modes crossing the Waitemata is low, as those people either travel on ferries, travel via other modes, or don't travel at all. As a result, safety benefits for the proposed facility have been assumed to be zero.

In reality, there will likely be some safety gains, and some losses, as:

- people transferring from private car travel will reduce the risk and therefore incidence of vehicle crashes
- people transferring to active modes will result in increased walking and cycling on the routes leading to the proposed facility, resulting in an increased risk of active mode crashes on these unimproved routes
- there could be crashes between active mode users on the proposed facility itself that wouldn't otherwise have occurred
- depending on their origin, some existing cycle trips across the Waitemata Harbour via the Bayswater and Devonport ferry services will transfer to the project, which may be a safer route for cyclists than those connecting to the Bayswater or Devonport ferry terminals (or equally may be a less safe option, if the new route requires them to cycle on a greater length of Lake Road without safe cycle infrastructure).

We note that the MBCM places a very modest value on the safety benefits of cycle infrastructure – at $0.05 per new and existing cyclist-km travelled on the facility. As a result, safety benefits typically account for only 1% to 2% of the overall project benefits, for new cycle infrastructure.

When considering the above, the net effect of the above safety gains and losses are considered negligible, within the context of the other, much larger benefit streams. We have omitted safety benefits accordingly.

General traffic reduction benefits

Decongestion benefits are expected to be a significant portion of the overall project benefits, as the proposed facility would provide an alternative to private car travel on currently congested road corridors, including the Northern Motorway, Onewa Road and Esmonde Road. As a result, any mode shift in favour of active modes will reduce existing (or forecast future) congestion on the road network.

The MBCM decongestion value for Auckland is $1.97 per vehicle-km removed from the network (Table 42, updated to current values). This region-wide value was developed in 2008 and does not however recognise the high levels of congestion currently experienced on the Northern Motorway and its approaches during the commuter peak periods, nor does it reflect how this congestion is expected to change over time.

The evaluation has instead used the Upper Harbour SATURN models to quantify the benefits of each cross-harbour car trip removed from the road network. To quantify these benefits per vehicle-km, a small number of cross-harbour vehicle trips[35] have been removed from the morning peak, evening peak and interpeak period Upper Harbour SATURN models. The Upper Harbour model runs with and without these trips have then been compared, and standard economic evaluation methodologies have been used to quantify the vehicle travel time, congestion and operating cost benefits per peak period, with cross-harbour vehicle trips removed from the network. The assessment conservatively omits CO_2 emission benefits, which are typically a very small component of general traffic benefits.

This process has resulted in the following decongestion values:

2026 Decongestion Rates

- $5.03 per vehicle-km removed from the road network during the commuter peaks
- $1.43 per vehicle-km during the weekday interpeak period

2036 Decongestion Rates

- $7.38 per vehicle-km removed from the road network during the commuter peaks
- $1.53 per vehicle-km during the weekday interpeak period

The above outputs from the 2026 and 2036 Upper Harbour SATURN models have been applied to the 2028 and 2038 general traffic benefit assessments, respectively.

The peak period values derived above are higher than the MBCM's default rate of $1.97 per vehicle-km removed from the road network, and reflect that the proposed facility would remove vehicle trips from an area of the network that is significantly more congested than the Auckland average. Conversely, the interpeak values are lower than the MBCM default rate.

[35] Cross harbour trips between Northcote/Takapuna and the CBD/Inner west have been removed only.

Weekend and off-peak decongestion values have conservatively been assumed to be zero, and general traffic reduction benefits have been capped beyond 2038. This reflects the conflicting factors of increasing land use and traffic volumes, but the decongestion expected following construction of the Additional Waitemata Harbour Crossing.

The above assessment was carried out in 2018 for the assessment of the landward component of the Westhaven to Akoranga (at that time known as SeaPath). It used the Upper Harbour SATURN models available at that time. We have not updated this assessment to reflect current land use forecasts, expected traffic conditions, or current MBCM update factors.

Forecasts of new commuter peak cycle trips have been obtained directly from the ACM, with daily cyclist count profiles obtained from Tamaki Drive used to develop estimates of new interpeak cycle trips. Estimates of new pedestrian trips have been developed based on the earlier assumption that 50% of the proposed facility's forecast daily pedestrian trips will be new trips, with commuter peak and interpeak proportions based on pedestrian profiles obtained from Tamaki Drive.

It is important to recognise that not every new cross-harbour active mode trip on the proposed facility would otherwise take place by private car. Recognising this, the number of new active mode trips has been factored down to reflect:

- the forecast car mode share between the model zones where new cycle trips are predicted, from the regional transport model (Macro Strategic Model, MSM)
- the forecast average car occupancy among car trips between the model zones where new cycle trips are predicted, again from the MSM
- non-utility cycling trips – some new cross-harbour trips will be recreational trips and therefore not replace a trip by any other mode. 80% of new cycle trips are estimated to be utility trips during the commuter peaks, based on survey data collected on Tamaki Drive

The above process has resulted in 'diversion rates' from car to active modes of 0.30 and 0.24 in the 2028 and 2038 commuter peaks, respectively. The MBCM does not provide diversion rates for walking or cycling trips, but provides a rate of 0.725 for public transport trips in Auckland. The rates developed are appropriately lower than the MBCM's public transport diversion rate, and reflect that new walking and cycling trips are more likely to come from an existing public transport trip, than from a car trip.

We have assumed 50% lower car diversion rates apply in the interpeak, recognising that a higher proportion of new active mode trips are expected to be recreational trips during this period, and therefore not replace a car trip. This is a conservative assumption, as conversely, car mode shares are higher during this period.

The resulting general traffic reduction benefits have been estimated to be $152 million, discounted over the 60-year evaluation period. This accounts for approximately 29% of the overall project benefits.

Emissions reduction benefits

Emissions reductions associated with the project can from two sources:

- Direct emission reductions, where a private car driver chooses not to drive, but to walk or cycle instead
- Indirect emission reductions accrued by general traffic that continues to drive, but who experience reduced congestion due to the reduction in traffic from the above

We have calculated benefits associated with the first source only.

The second emission reduction source will be negligible, as they tend to make up a very small component of general traffic travel time and vehicle operating cost savings (ie general traffic reduction benefits). We consider the benefit rate associated with this small emissions component to be within the margin of error for the main general traffic decongestion benefits, already derived.

Direct emission benefits have been calculated based on the forecast reduction in daily general traffic km travelled, as already described in the general traffic reduction benefit section above. Off-peak and weekend traffic reductions have been estimated assuming a 50% lower car diversion rate than during the commuter peak period.

Emissions reduction benefits have been calculated for CO_2, PM10, NO_x, CO and HC emissions. Economic rates for each emission have been obtained from the MBCM, while emissions rates per car-km have been obtained from Waka Kotahi's Vehicle Emissions Prediction Model. Our assessment has assumed that CO_2, NO_x and CO emissions per veh-km will fall over time, due to the electrification of New Zealand's private car fleet over time.

Other Benefit Streams

In a separate 2018 study[36], MRCagney have estimated the agglomeration and tourism benefits of the proposed cross harbour walking and cycling connection. These discounted benefits have been determined to be $23 million and $2 million, respectively, over the 40-year evaluation period.

We have factored these benefit streams up to account for the extended 60-year evaluation period and MBCM update factors to bring these 2018 costs up to current dollar terms. We have also factored the tourism benefits down by 50%, to reflect revised international tourism expectations post Covid 19.

The resulting updated discounted agglomeration benefits have been determined to be $41 million, or approximately 8% of the overall project benefits.

The tourism benefits have been omitted from the default economic analysis, and included only in a sensitivity test, as per MBCM procedures.

[36] Wider Economic Benefits of a New Walking and Cycling Link Across the Waitemata Harbour; MRCagney; December 2018

APPENDIX F economic evaluation peer review

Project Number: 1-C2214.00

Northern Pathway Economics Peer Review

16 July 2021

CONFIDENTIAL

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Revision Details

Revision	Details
1	Final version after receiving economics author comments to review

Contents

Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for Waka Kotahi ('**Client**') in relation to the Northern Pathway Economics Peer Review ('**Purpose**') and in accordance with the Short form agreement for consultant engagement signed and dated with the client on 23rd June 2021. The findings in this Report are based on and are subject to the assumptions specified in the Report and our Offer of Service dated 22nd June 2021. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Waka Kotahi has commissioned WSP to undertake a peer review for the economic assessment of the proposed option for the Northern Pathway in Auckland between Westhaven and Akoranga.

The peer review checked that the economics for the preferred option met the requirements of the Waka Kotahi prescribed business case approach process, particularly the Waka Kotahi Monetised Benefits and Costs Manual (MBCM) procedures.

2 General Comments

The economic assessment presented to WSP is considered robust. Most peer review comments are minor in nature and any points raised are unlikely to change the benefit cost ratio (BCR)) significantly,. or pertain to sensitivity testing rather than the base BCR. The economics author, Flow Transportation Specialists, have provided adequate responses to all peer review comments. The full list of peer review comments is included in Appendix A.

3 Specific Comments

3.1 Conformity

Conformity was not specifically assessed, and we understand the activity, as a separate walking and cycling bridge, complies with the requirements for the activity class it seeks funding from.

3.2 Credibility

Table 1summarises the credibility criteria, pertaining to economics that Waka Kotahi require, to be met by the business case:

Table 1: Credibility criteria summary

Criteria	Met/Not Met	WSP Review Comment
Critically assess the results of each stage for economic efficiency evaluation of the project.	Met (for preferred option only)	The economics are for a single option only, which is understood to be the preferred option - a separate walking and cycling bridge. We understand that assessment of other options has taken place in previous stages of the project, and these are not part of the scope for this peer review. The economics have been reviewed and all review comment have adequate responses from the economics author.
Identify the key benefits and determine whether they are realistic (e.g. are the travel time savings realistic or are excessive delays forecast under the congested conditions in the do-minimum option?).	Met	The monetised benefits claimed are generally conservative.
Identify the factors or assumptions, particularly	Met	Cycle, micromobility, and pedestrian demand forecasts were provided. The

Criteria	Met/Not Met	WSP Review Comment
forecasted estimates that have a major influence on the evaluation. Describe each of these factors/ assumptions and include commentary on the sensitivity of the evaluation to each factor or assumption.		method used to determine the demands is considered reasonable and adequate sensitivity testing has been undertaken.
Highlight any significant areas of risk for costs and benefits.	Met	Robust sensitivity testing has been undertaken and addressed areas of higher risk to benefits and costs.

3.3 Choice of do-minimum option[1]

The choice of a do-minimum option is appropriate economically.

3.4 Identification and selection of alternatives and options

No alternatives or options have been assessed in the economics provided, and we understand alternatives and options were assessed in previous stages of the project. Peer review of these alternatives and options was not part of the scope for this peer review.

3.5 Cost estimate

This peer review has not undertaken a parallel cost estimate (i.e. is excluded from the scope of the peer review).co

3.6 Cost-benefit appraisal

The cost-benefit appraisal generally conforms with the MBCM. We have noted some points of clarification and suggestions in the attached review register, and they are mostly minor in nature (i.e. unlikely to affect the BCR). The economics author has provided acceptable reposes to the peer review comments.

3.6.1 Sensitivity analysis

The cost-benefit appraisal has undertaken enough sensitivity testing. We have provided commentary in the review register and the economics author has undertaken additional sensitivity tests in response..

4 Summary

This peer review has identified several issues and points for clarification, most of which were minor in nature, and unlikely to affect the economics result. The issues identified by our peer review are noted in detail within the review register (Appendix A) and responses from the authors are recorded.

Based on the responses to the issues identified, we confirm that the economics are credible and conform to the Waka Kotahi Business Case Approach requirements.

[1] https://www.nzta.govt.nz/planning-and-investment/learning-and-resources/business-case-approach-guidance/supporting-material/glossary/#D

Appendix A - Review Register

#	Reference	Description	WSP Comment/ Feedback	Flow Response
1	Assumptions	Cost sensitivity testing (P95 cost)	Carry out sensitivity test of upper bound cost using P95 (95th percentile) cost estimate rather than +25% cost.	Accept
2	Assumptions	Analysis period of 60 years	An analysis period of 60 years is permitted by the MBCM. The MBCM recommends that the business case includes emphasis on comprehensive optioneering and sensitivity testing on demand forecasts.	No change needed
3	Assumptions	Demand forecast maps (SATURN)	WSP requested cycle demand catchment maps in the form of SATURN model outputs. WSP agree with the general methodology and note that the review does not cover review of the SATURN modelling. Extrapolation of demands beyond modelled years need careful consideration and it may be appropriate to cap them. WSP agree with sense checking the demand forecast.	Accept - demand select link supplied for review
4	Assumptions	Micro-mobility	WSP agree with the general approach and sensitivity tests for e-bikes and e-scooters.	No change needed
5	Assumptions	Land use forecasts (I11.5 and I11.6)	WSP agree that changes between the I11.5 and I11.6 models need to be checked. WSP suggest considering development that is not included in the I11.6 model, such as the brownfield development in Northcote.	Accept – demand sensitivity testing is undertaken
6	Sensitivity	Congestion charging	No need to sensitivity test for congestion charging needed and could test increased cycling –	Agree to sensitivity test with +/- cycle demand

#	Reference	Description	WSP Comment/ Feedback	Flow Response
			Elasticity of walking and cycling with congestion charging is low because congestion charge is looking to only be about the cost of a PT fare and the trips within the walkable and cyclable catchment that choose to use car with the northern pathway open would be more likely to switch to PT with congestion charging than walking and cycling. Internationally where congestion charging has resulted in uptake of walking and cycling it seems to have been paired with investment in walking and cycling infrastructure (i.e. it is likely the infrastructure invests had a part to play in the uptake). There is an OECD report that looked at congestion charging impact on bike mode share that found it increased bike mode share by 5%, so that could be an upper sensitivity test (OECD report link – add reference elsewhere?) I'm just not convinced its directly applicable to the Northern Pathway example.	(and not rerun cycle model)
7	Sensitivity	Additional Waitemata Harbour Crossing	Sensitivity test using simple +/- cycle demand and comment on AWHC in reporting. If AWHC was rail / light rail from Takapuna - then this option would take away walking and cycling from that zoning. (i.e. sensitivity test by removing walking and cycling demand from Takapuna catchment, which leaves you with Northcote and other catchments only for walking and cycling) If AWHC was a road link: The road crossing would make very little difference to walking and cycling demand compared with test above, so better to sensitivity test above as the worst-case scenario.	Agree to sensitivity test with +/- cycle demand (and not rerun cycle model)
8	Assumptions	Bridge closure due to inclement weather conditions	WSP suggest carrying out sensitivity tests for bridge closures during high wind and significant weather events.	Sensitivity test added considering effects should

#	Reference	Description	WSP Comment/ Feedback	Flow Response
				the bridge be closed 20 days per year
9	Assumptions	Greenhouse gas emissions calculation basis	Consider using Ministry of Transport fleet composition predictions for greenhouse gas emissions. WSP agree with sensitivity testing for different greenhouse gas emission scenarios. Sensitivity testing on demand forecasts can reflect different legislative environments relating to this (ETS, ICE vehicle bans, etc.).	GHG benefits make up $2m of the total $516m benefits, and these have been calculated applying falling emissions rates in line with the VEPM. Sensitivity testing the GHG benefits is unlikely to affect the BCR.
10	Assumptions	Traffic benefits	WSP agree with the method and sensitivity tests proposed for traffic benefits, with the understanding that this is based on the SP9 decongestion benefits method.	No change needed.
11	Assumptions	Bus benefits	WSP agree with carrying out a sensitivity test with fewer bus services to determine the impact on the economics.	No change needed.
12	Assumptions	Congestion charging and other changes in generalised costs	WSP agree with the approach of changing generalised costs. WSP suggest consideration of effects from the Emissions Trading Scheme (ETS) in this sensitivity test.	Agree to sensitivity test with +/- cycle demand (and not rerun cycle model)
13	Assumptions	Agglomeration benefits data	Check that 2018 agglomeration benefits data is not out of date and that there is not a more recent version available (e.g. from MR Cagney).	Agree to check
14	Assumptions	Cycle demand catchment (SATURN)	The SATURN catchment does not appear to show cycle trips on the Northern Pathway between the Northern Corridor improvements and the Seapath/ Skypath links.	The 2028 scenario modelled excludes the Akoranga to Constellation section of Northern

#	Reference	Description	WSP Comment/ Feedback	Flow Response
			WSP suggest testing the demand/ catchment with the Northern Pathway link in the model, if the link is not part of the do-minimum model scenario.	Pathway, as this project is currently unfunded. The 2038 scenario includes this project. A plot showing cycle demand on this project is now included in the report (Figure 5). Cycle trip origin distribution maps are also included in Appendix C.
15	Economics (multiple sheets)	Multiple references to Economic Evaluation Manual (EEM)	The EEM references need to be updated to the corresponding MBCM references and checked that they are still valid.	Agree
16	Economics (Model Summary)	Assumed pedestrian growth	This is not in the EEM or the MBCM and is considered reasonable in the absence of any other information. AHB demands appears to forecast increasing volumes out to 2078 - consider using those?	Local population catchments are considered a more appropriate measure to benchmark pedestrian trips by. Traffic forecasts on the AHB are likely to be affected by very distant land use, such as in Silverdale.
17	Economics (Model Summary,	Average cycle speed	Confirm basis of 25km/h assumed speed.	The speed applied is based on an average of 7 on-road cycle tube counts made in Northcote in

#	Reference	Description	WSP Comment/ Feedback	Flow Response
	Cyclist Travel Time)			2018. Mean speeds in those locations ranged from 17 to 33 km/h, with an average of 24 km/h.
18	Economics (Model Summary, Health)	Different annual growth rate for pedestrians – utility and recreational	WSP suggest using a consistent rate for pedestrian growth, for utility and recreational purposes, or provide justification for using different rates.	2% growth rate has been applied to both utility and recreational pedestrian trips, based on local land use growth. Zero growth has conservatively been applied to tourist trips, due to the post-Covid uncertainty in the future of tourism.
19	Economics (Health)	Tourist pedestrian and cycle volumes	Confirm the source or basis for tourist pedestrian and cyclist volumes.	Refer Appendix D of report
20	Economics (Health)	Higher e-scooter uptake reduces health benefits for pedestrians	Confirm that the modelled pedestrian volumes are based on faster speeds (because 40% of pedestrians are assumed to be on e-scooters). If they are not, consider using full pedestrian health benefits.	The MBCM does not provide a benefit rate for e-scooters, so the evaluation has applied the $1/km rate for e-bikes and applied this to a portion of the new pedestrian trips. The sensitivity test assumes a higher proportion of e-scooters and hence, a lower average benefit rate.

#	Reference	Description	WSP Comment/ Feedback	Flow Response
				A separate sensitivity test now considers the effect of increased pedestrian demands, due to increased access to e-scooters.
21	Economics (Model Summary and Decongestion)	Effective diversion rate from veh-km to cycle-km	'Confirm basis of diversion rates used and document that they are lower than Waka Kotahi have accepted on other cycling infrastructure projects (e.g. Christchurch Major Cycleways), and therefore potentially conservative. Consider using less conservative diversion rate.	Diversion rates are documented in Appendix E (road traffic reduction benefits). They are lower than those applied in Christchurch as cross harbour trips in Auckland have a much higher PT mode share than Christchurch does (and therefore, a higher portion of new cycle trips are expected to have switched from PT)
22	Economics (Decongestion)	Average pedestrian trip length	1km is recommended by the MBCM for typical projects, however in this case a higher value would be expected given that the bridge is longer than 1km. The modelled average cycle trip length is significantly longer than the MBCM recommendation (10km versus 3km). Consider using a similar ratio for the pedestrian average distance.	The project in its entirety is ~4.5 km long, from Akoranga to Westhaven. Not all pedestrian trips will be across the 1.3 km bridge component, and some will be shorter local trips. 1 km is considered a reasonable average.

#	Reference	Description	WSP Comment/ Feedback	Flow Response
23	Economics (Decongestion)	Decongestion benefits in weekday peak periods only	Given the nature of this project in relation to the Auckland city centre and harbour bridge, traffic reductions would be expected to result in benefits outside peak periods. Consider including traffic reduction benefits for the busier interpeak and weekend periods.	Traffic decongestion benefits have been included for the weekday interpeak. The weekend peak has been sensitivity tested.
24	Economics (Discounting)	Time zero is inconsistent	Consider setting time zero as 1 July 2021 ("the financial year in which the analysis is submitted") and ending the analysis period in 2081 (60 years from Time Zero).	Time Zero has been set to 2021. This is not the same as the Base Date, which has been set to 2020 (refer MBCM section 1.6). The 60-year evaluation period has been set to start at the first major cost (Jan 2022), taking the evaluation period to Dec 2081.
25	General comments	Safety benefits excluded	Safety benefits would be difficult to estimate and likely relatively small. This conservatism is therefore considered appropriate and should be noted when interpreting results.	No response required.
26	General comments	Carbon emission reduction benefits not explicitly calculated	Consider calculating carbon reduction benefits separately to ensure benefits are fully included.	GHG emissions benefits now included for all car trips that change mode to walking or cycling.
27	General comments	Air quality improvement benefits not explicitly calculated	Consider calculating air quality improvement benefits separately to ensure benefits are fully included.	As above

#	Reference	Description	WSP Comment/ Feedback	Flow Response
28	General comments	Capping of benefits at 2038 or 2048.	Confirm basis for capping benefits beyond 2038/48. Consider not capping these.	Cycle demand forecasts for the AHB include 3,700 in 2028 and 5,300 in 2038. Extrapolating these linearly gets us to 11,800 cycle trips in 2078 and regional modes shares of around 10%, which seems a stretch. When we test a "complete cycle network" using the 2038 cycle model, AHB cycle demands are 7,600, if we assume a very high e-bike adoption rate. That's roughly where the above linear extrapolation would get us by 2048.
29	General comments	Single option assessed only	Consider incremental analysis on a range of options so make it clear why only one option considered	Refer comment back to business case, as only one options was considered for economic evaluation.
30	GHG Emissions	Number of days for GHG emissions inconsistent with decongestion benefits	Change to only weekdays when the GHG emission benefits are considered.	While there would be car users that transfer to walking/cycling every day of the year, those car trips removed from the network will

#	Reference	Description	WSP Comment/ Feedback	Flow Response
				- reduce GHG emissions all 365 days/year - reduce congestion only on weekday commuter peaks Hence the different number of days/years applied.
31	Report (Table ES3)	Not explicitly clear that net present values are annual	I assume the values are NPV, and this should be stated so it is clear.	Correct. Clarified in report
32	Report (Section 2.1.1)	Assume e-scooters will not increase pedestrian uptake.	Sensitivity test uptake of pedestrian demand based on increased e-scooter use	New sensitivity test added

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