Eastern Strategic Corridor Assessment

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Client: Auckland Transport

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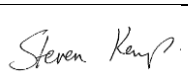
Final	4 August 2016	For Issue	Steve Kemp	

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1.0 Executive Summary

AECOM New Zealand Ltd (AECOM), in its role as the independent advisor to the Auckland Transport Alignment Project (ATAP), has been tasked by the ATAP Governance Group to undertake an assessment of the Eastern Highway alignment as proposed by the NZ Council for Infrastructure Development (NZCID) at a strategic level. The scope was to compare Eastern Highway alignment options against the "Providing Supply" network wide package from an operational and economic perspective using data provided by Joint Applications Modelling Centre (JMAC) sourced through the Auckland Regional Transport (ART) model.

The first option is an at grade expressway following the eastern corridor alignment connecting back to the local road network at Highbrook Drive and the second; a motorway following the same alignment and also extending further south to Murphys Road. Common to both options is the assumption of an eastern alignment of the Additional Waitematā Harbour Crossing (AWHC) with the southern portal connecting into State Highway 16 (SH16) in Grafton Gully.

The performance of the eastern alignment options have been evaluated against the defined ATAP objectives, including an indicative assessment of value for money.

When compared against the "Providing Supply" package, both options decrease travel time in the AM peak for trips in the south and south-east of Auckland. Freight travel times also decrease from the Ports of Auckland to the industrial hubs in the south. Furthermore, the Motorway option is more attractive than the Expressway and thereby draws traffic off State Highway 1 reducing congestion in the Manukau area. However, when compared against the whole network, congestion only decreases by 1% for the Motorway option.

The modelled options do not substantially reduce forecast congestion on the key section of State Highway 1 between Esmonde Road and Mt Wellington, but do provide additional traffic throughput and resilience to the regional strategic road network.

AECOM estimated the construction cost (excluding cost of property acquisition) of the Expressway option to be $10.89bn and the Motorway option $11.26bn, a difference of $370m. A 5.5km tunnel from Panmure to Highbrook Drive is the largest item of construction expenditure (excluding the new harbour crossing) and accounts for over 25% of both options cost.

Preliminary Benefit Cost Ratios (BCR)s for both options as modelled present poor value for money, with a BCR of 0.2 for the Expressway and a BCR of 0.4 for the Motorway, meaning that the Nett Present Value (NPV) benefits do not outweigh the investment costs.

When developing new highways a process of route optimisation and cost engineering processes are used to maximise benefits and minimise costs. Given the very limited development of the options considered ad time available to AECOM and the ATAP Working Group these optimisation processes have not been undertaken. However improvements to the economic performance of the options following such processes are unlikely because they would probably be counter balanced or cancelled out once the costs of property acquisition and operating and maintenance are factored in.

Based on the findings of this investigation and our understanding of the benefits evaluation of other measures being considered by ATAP, AECOM recommends no further consideration of an Eastern Alignment within the current ATAP project. However we also recommend that corridor protection for the eastern alignment should be maintained until such time as the ATAP Government agencies commit to both the additional western alignment of AWHC and the use of the smarter road charging approach being developed within ATAP.

2.0 Eastern Corridor, background and context

2.1 Purpose of assessment

AECOM New Zealand Ltd (AECOM), in its role as the independent advisor to the Auckland Transport Alignment Project (ATAP), has been tasked by the ATAP Governance Group to undertake an assessment of the Eastern Highway alignment as proposed by the NZ Council for Infrastructure Development (NZCID) at a strategic level. The purpose of the assessment is to determine if an Eastern highway represents a value proposition in terms of value for money and transport performance that merits further consideration by ATAP. To measure the relative merits of an Eastern corridor highway, two options were compared against the other road improvements being considered by ATAP through the "Providing Supply" network package. The assessment considered both operational and economic metrics.

The first option considered is an at grade expressway following the eastern corridor alignment connecting back to the local road network at Highbrook Drive. The second option considered is a motorway following the same alignment and also extending further south to Murphys Road. The performance of these Eastern corridor options has been evaluated against the defined ATAP objectives, including an indicative assessment of value for money.

2.2 Background

The NZ Council for Infrastructure Development (NZCID) presentation in December 2015 described their proposals for an alternate route for the Additional Waitematā Harbour crossing (AWHC) to the east of the City Centre linking to an Eastern Highway corridor is included in Appendix A. NZCID considers that this proposal:

- Will address existing congestion and planned land use intensification in the East of Auckland.
- Provide direct for freight between the Port of Auckland and the East Tamaki / Highbrook industrial areas.
- Addresses 'flaws' in the proposed western route for the AWHC.
- Reduces reliance on State Highway 1.

The NZCID proposal is in part a revised version of the former Auckland City Council Eastern Motorway proposal from the mid-2000's but with a significant difference being the inclusion of a tunnel section between Parnell and Orakei to avoid the need for a surface route across Hobson Bay.

The information presented below is based upon the data provided to AECOM from Auckland Transport and from NZCID including:

- ART model outputs based on 2046 one-off model runs to test the Eastern Highway alignment options and Eastern Harbour crossing.
- Report: Transport Solutions for a Growing City / Auckland Transport Report FINAL E-COPY: source NZCID Website.
- Presentation: "Transport Solutions for a Growing City": source NZCID Website.
- Presentation: "Eastern Corridor NZCID Presentation on Route and Rationale" : source [unknown].
- Video: Keeping Auckland Moving.

It should be noted that the NZCID material describing the form and connectivity of the Eastern alignment lacks detail, and certain assumptions have been made for the assessment and associated modelling.

In addition to the NZCID material outlined above, existing ATAP reports were also referred to including:

- Auckland Transport Alignment Project – Foundation Report.
- Auckland Transport Alignment Project – Interim Report: Findings and Conclusions – May 2016.

The key information obtained from these reports was:

- ATAP key performance indicators, and

- The high private vehicle access and public transport challenges currently facing the west and the south of Auckland will worsen with the expected increase in population growth in these areas. These areas may also miss out on Auckland's expanding employment base due to congestion in these areas.

2.3 Providing Supply

The "Providing Supply" package is a 30 year infrastructure plan for the Auckland network consisting of both roading and busway projects across the Auckland region and is considered the most compatible reference scenario against which to test the Eastern alignment options being themed around improvements to the strategic road network. This package is themed around providing significant motorway widening in the second and third decades and an Additional Waitematā Harbour Crossing. It also increases public transport services where public transport demand is expected to exceed current PT service capacity.

Figure 1 below illustrates the projects included in the "Providing Supply" package.

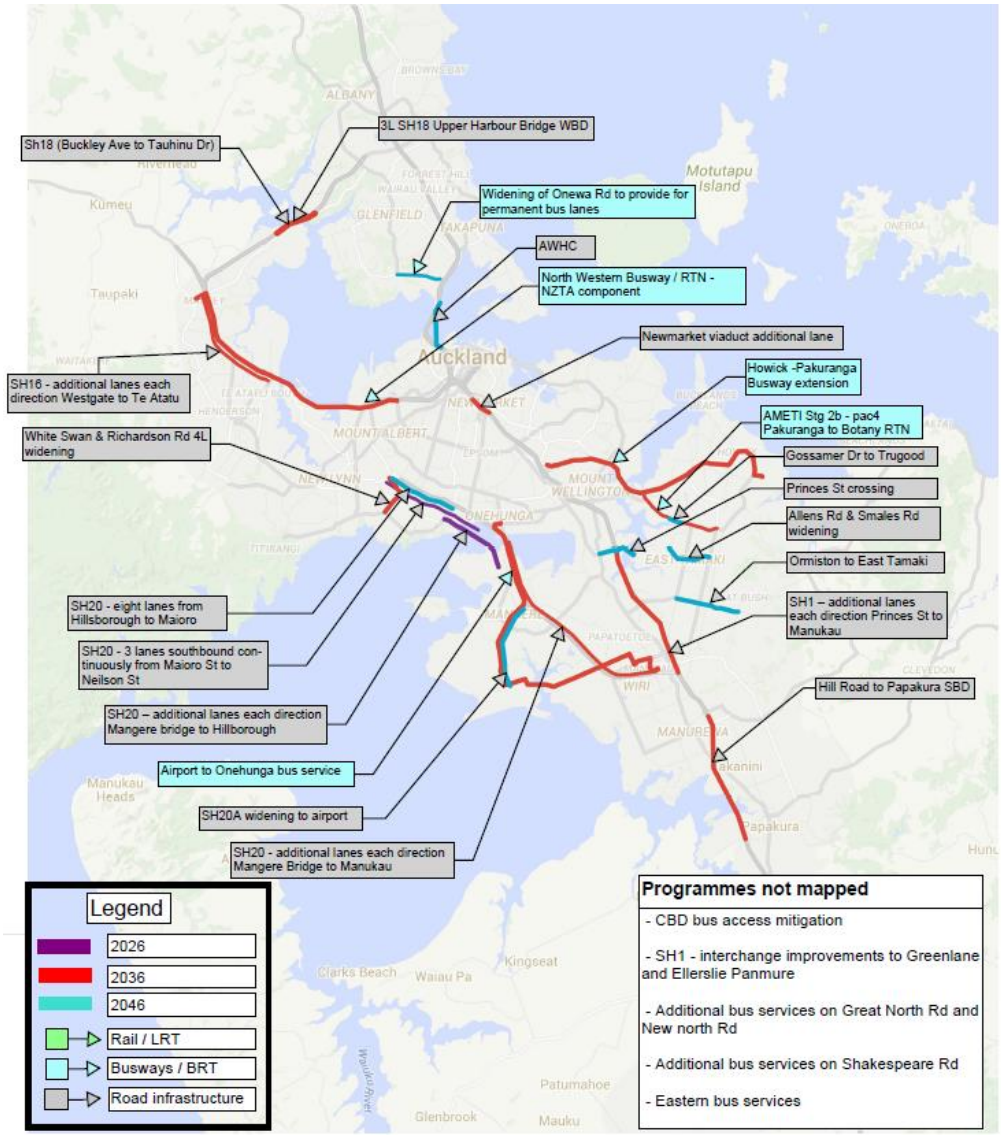


Figure 1: Providing Supply package

2.4 The Eastern Highway alignment: Expressway and Motorway options

NZCID have considered a range of eastern corridor designs but provide little detail on connectivity or capacity at this stage and certain assumptions have been made for this assessment.

As shown in Appendix A there has been a number of alignments presented by NZCID and it is unclear which the preferred option is for testing. Most of the alignments appear to have a high capacity connection with SH1 at Redoubt Road.

Figure 2 shows the alignments of the eastern expressway and motorway option tested by AECOM. Both options follow the same alignment through the eastern suburbs until Highbrook Drive where the expressway connects onto Allens Road. The motorway option continues past Highbrook Drive to the intersection of Murphys Road and Mill Road. It should be noted that these alignments are only indicative and no optimisation has been undertaken of the route or of the tested infrastructure.

Material relating to our interpretation of the NZCID Eastern Highway alignment is outlined in Appendix A while the Eastern Highway alignment option route descriptions are outlined in Appendix B.

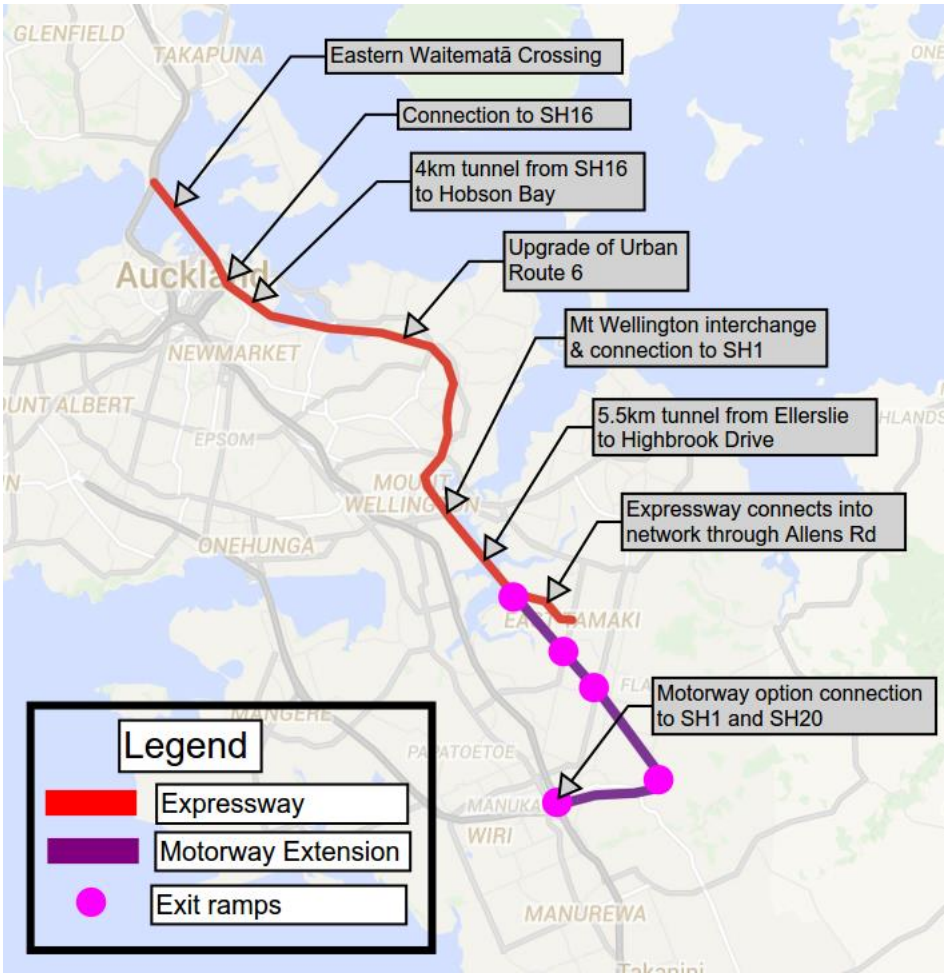


Figure 2 Expressway and Motorway option alignments

Note: the above alignments and network connections are indicative only. No optimisation of tested infrastructure design has been undertaken i.e. scaling of individual links or alignment for operational, cost, or constructability benefits realisation..

3.0 Evaluation frameworks

3.1 NZCID Eastern Highway alignment objectives

From the initial reports, NZCID developed a framework of objectives to be addressed by the Eastern Highway alignment options. The following sections will address these criteria in conjunction with the ATAP framework.

- Will address existing congestion and planned land use intensification in the East of Auckland.
- Provide direct link for freight between the Port of Auckland and the East Tamaki / Highbrook industrial areas.
- Addresses 'flaws' in the proposed western route for the AWHC.
- Reduces reliance on State Highway 1 (SH1).

3.2 ATAP framework

A framework has been established by ATAP to test how different intervention packages perform against the key performance indicators outlined in Table 1 below. The following sections use these KPIs to compare the two Eastern Highway alignment options against the Providing Supply package.

Table 1 ATAP evaluation framework KPI's

Objective	Measure	Headline KPI
Improve access to employment and labour	Access to employment and labour within a reasonable travel time	- Jobs accessible by car within a 30 minute trip in the AM peak. - Jobs accessible by public transport within a 45 minute trip in AM peak. - Proportion of jobs accessible to other jobs by car within a 30 minute trip in the inter-peak.
Improve congestion results	Impact on general traffic congestion	- Per capita annual delay (compared to maximum throughput). - Proportion of travel time in severe congestion in the AM peak and inter-peak.
	Impact on freight and goods (commercial traffic) congestion	- Proportion of business and freight travel time spent in severe congestion (in the AM peak and inter-peak).
	Travel time reliability	- Proportion of total travel subject to volume to capacity ratio of greater than 0.9 during AM peak, PM peak and inter-peak.
	Increase vehicle occupancy	- Average vehicle occupancy.
Increase public transport mode share	Public transport mode share	- Proportion of vehicular trips in the AM peak made by public transport.
	Increase public transport where it impacts on congestion.	- Proportion of vehicular trips over 10km in the AM peak made by public transport.
Increased financial costs deliver net user benefits	Net benefits to users from additional transport expenditure.	- Increase in financial cost per trip compared to savings in travel time and vehicle operating cost.
Ensure value for money	Value for money	- Package benefits and costs.

4.0 Option assessment

4.1 Modelling results

ART modelling of the Eastern Highway alignment packages has currently only been undertaken by JMAC for the 2046. The model run for the Providing Supply package was compared against the Expressway and Motorway options to determine how they perform at a network level for the KPI measures outlined in Table 1 above. The following sections will present the results of the options performance.

The ART model's suitability to be used to test alternative transport projects is dependent upon what purpose its outputs are to be used for. Given the number of agreed ATAP performance metrics that are based upon journey time data, the ART model can only be used to produce comparative data between one project/intervention with another. If such comparative differences are small, ART model outputs should not be used as a point of differentiation. The ART model is not suitable to inform detailed design decisions or to develop individual / detailed project business cases. It can be used to develop and test concept designs.

4.1.1 Traffic Volumes

The traffic volume plots shown below represent the traffic volumes for the Expressway and Motorway options for the AM peak (Figure 3 & Figure 4). The Motorway option provides shorter journey times and therefore attracts increased traffic volumes along the Urban Route 6 due to its uninterrupted flow from south Auckland to the CBD. Traffic south of Manurewa is attracted to the Eastern Highway alignment rather than State Highway (SH) 1. The likely explanation for this is the upgrade of Mill Road connects directly to the Motorway alignment at the Murphys Road exit ramps, increasing accessibility. The Expressway option, provides little incentive for road users from south of Manurewa to use the Eastern Highway alignment because they still have to use the local road network to reach Highbrook Drive.

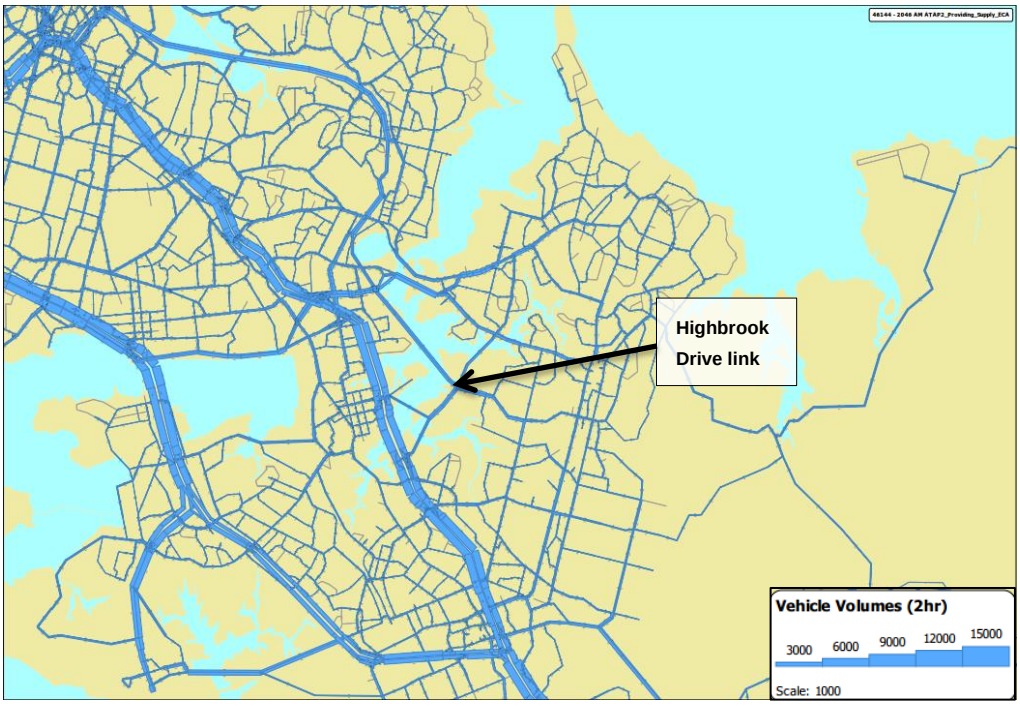


Figure 3 Expressway option - 2046 2hr AM peak Botany traffic volume plot

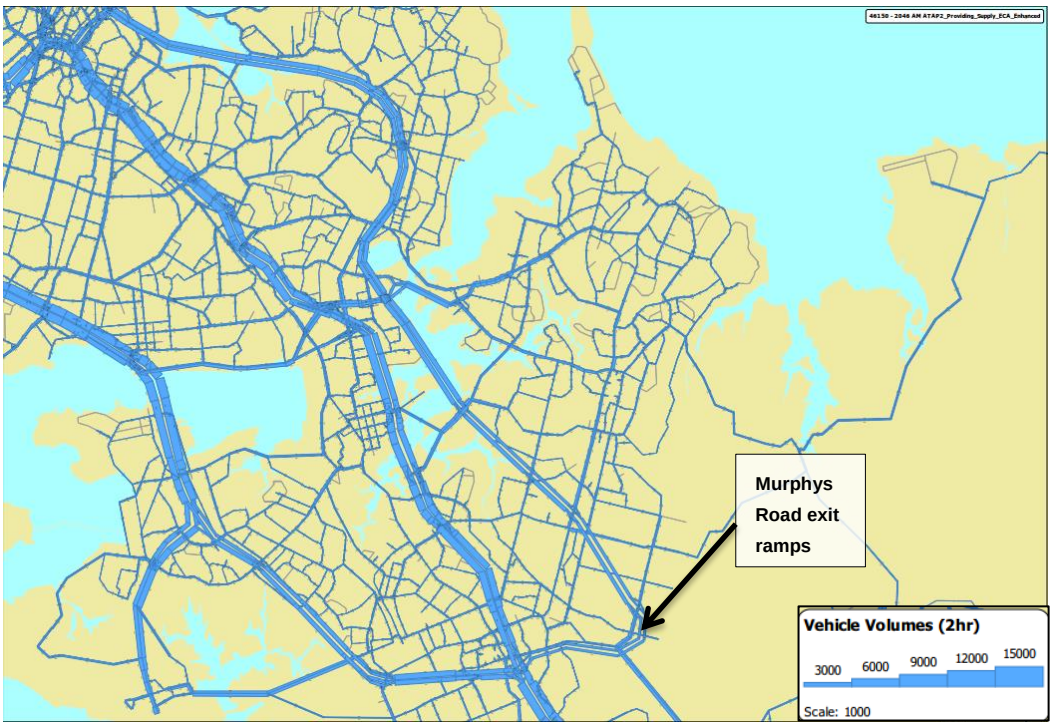


Figure 4 Motorway option – 2046 2hr AM peak Botany traffic volume plot

4.1.2 Assessment of traffic volumes

The vehicle volume differences between the Expressway option and the Motorway option for the 2046 AM Peak, for the Isthmus and Botany areas are shown below (Figure 5 & Figure 6).

Key points:

- The Eastern Highway alignment is more attractive in the Motorway option as illustrated by the large positive red volume difference. The combined flow across both Waitematā Harbour crossings is approximately 800 veh/2hr more for the Motorway option.
- The Expressway option connects back to the existing road network at Highbrook Drive and Allens Road, these sections see increased patronage indicated in green.
- State Highway 1 from Otahuhu to Clover Park also experiences an increase in patronage for the Expressway option, illustrated in green. Road users further south of Manurewa will still prefer to use State Highway 1 as they would have to use the local road network to access the Expressway.
- The Western Ring route experiences approximately 300 veh/2hr more in the Expressway option.

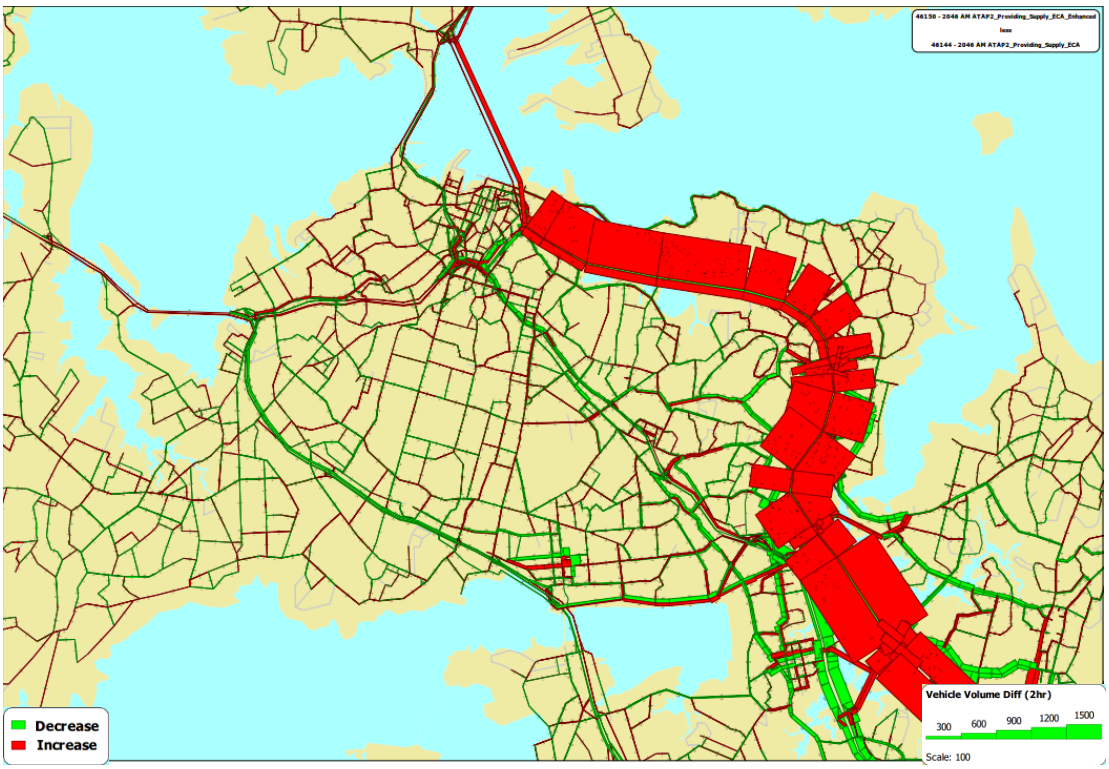


Figure 5 Vehicle volume difference: Motorway option vs Expressway option 2046 AM peak - Isthmus

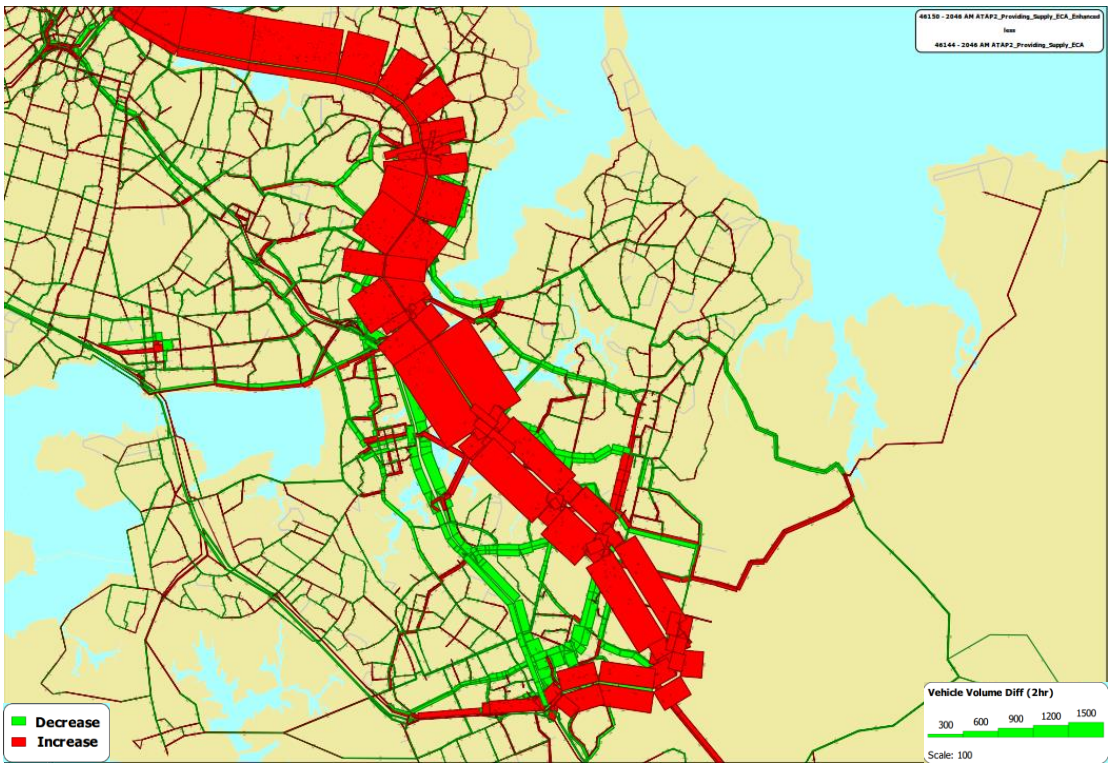


Figure 6 Vehicle volume difference: Motorway option vs Expressway option 2046 AM peak - Botany

In order to assess the vehicle volumes of the Eastern Highway alignment options against the Providing Supply package, screenlines were drawn at key locations throughout the whole network as shown in Figure 7.

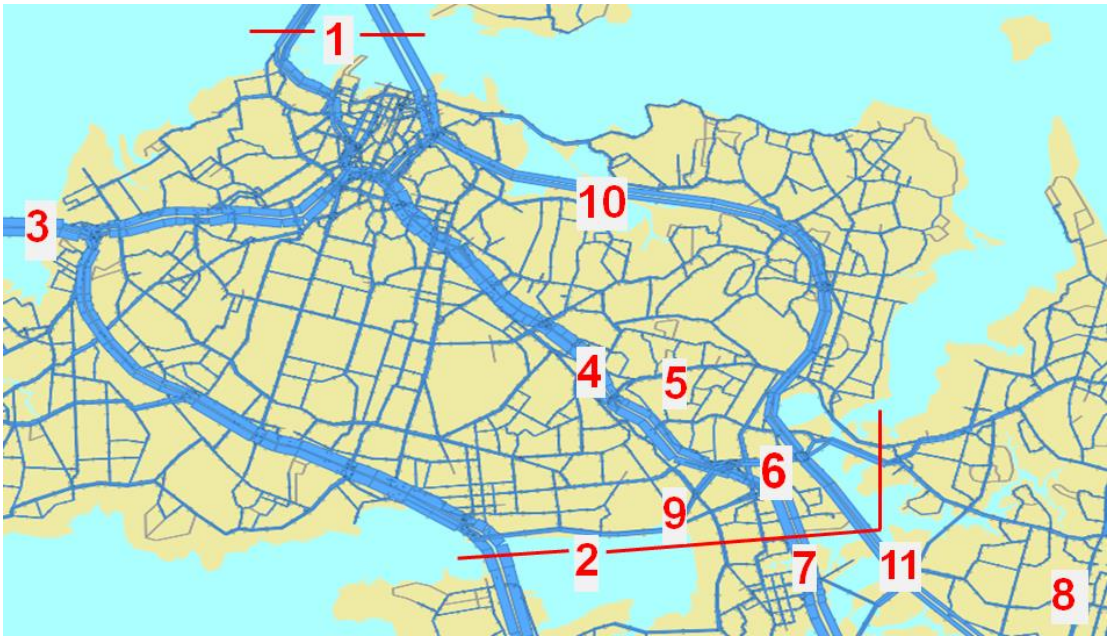


Figure 7 Network Screenlines

The data for the screenlines is for the 2046 AM peak for both directions shown in Table 2 below. It was manually extracted from the vehicle volume plot diagrams as shown in Figure 3 and Figure 4 in the preceding section.

Table 2 AM 2hr peak package volume comparisons

ID	Location	Providing Supply (PS)	Expressway		Motorway	
		Volume	Volume	% Change against PS	Volume	% Change against PS
1	Waitematā Crossing	39,622	38,817	-2.0	39,614	0.0
2	Isthmus	81,982	85,581	4.4	90,520	10.4
3	SH 16 Causeway	25,612	26,044	1.7	26,162	2.1
4	SH 1 Nth of EPH	24,577	24,624	0.2	24,543	-0.1
5	Ellerslie Panmure Highway	4,992	4,537	-9.1	4,720	-5.4
6	SEART (Sylvia Park Flyover)	10,516	11,570	10.0	11,323	7.7
7	SH 1 Nth of Highbrook Drive	25,457	24,974	-1.9	22,657	-11.0
8	Te Irirangi Drive Sth of Smales Road	3,881	3,539	-8.8	5,424	39.8
9	East West connection	5,504	7,501	36.28	7,281	32.29
10	Orakei Tunnel	N/A	9,338	N/A	13,941	N/A
11	Tamaki Tunnel	N/A	6,618	N/A	14,555	N/A

Key points:

- Isthmus Screenline;
  - An additional 3.600 in the Expressway option and 8,500 vehicles in the Motorway option cross the Isthmus screen line, the majority of these northbound.
- SH1 north of Highbrook Drive:
  - 1.9% decrease for the Expressway option vs an 11% decrease for the Motorway option can be attributed to the Expressway option connecting and ending at Highbrook Drive.
- East West connection:
  - Roading upgrade results in a 36.28% and 32.29% increase in volume for the two options. Connection now part of the strategic road network and provides traffic from the south east an alternative route to travel west.
- Te Irirangi Drive south of Smales Road:
  - 39.8% increase for the Motorway option can be attributed to the exit ramps located at Te Irirangi Drive increasing the attractiveness for this option.

4.2 Other Modelling KPIs

4.2.1 Access to employment

For road users, the Expressway and Motorway options result in an increased labour availability pool of 16,500 and 37,300 persons within 30 minutes respectively during the AM peak. This results in a 4.2% and 9.5% respective increase. Furthermore, the labour pool within 45 minutes of employment increases 2.2% and 5.3% for each respective option. Both options result in less than one percent increases in jobs available by PT 30 minutes away and 45 minutes away. As any PT will not be using the eastern alignment, the small increase could be attributed to the reduction in congestion due to general traffic.

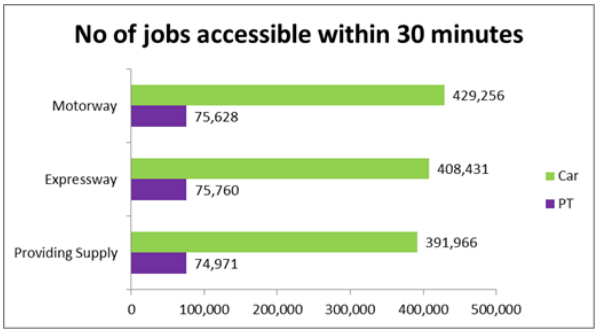


Figure 8 Accessible jobs – 30 mins

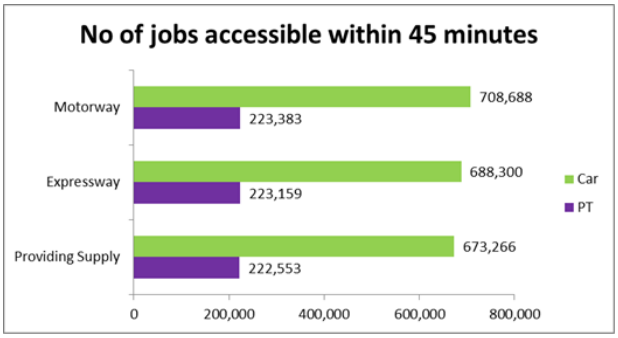


Figure 9 Accessible jobs – 45 mins

4.2.2 Congestion

The ratio of the volume of traffic carried by a road compared with its capacity is a key metric of a roads performance. A V/C ratio of greater than 0.8 indicates that delay and queuing will increase significantly. Volume Capacity ratios (V/C) in the range 0.9 to 1.0 indicate severe congestion and correspond to a level of service of E and F respectively.

Figure 10 to Figure 12 below; outline the V/C plots for the three options in the AM peak.

Key points of Eastern Alignment v's Providing Supply:

- Expressway:
  - Decrease in V/C from 1 to 0.8 in Onehunga along State Highway 1.
  - Urban Route 6 increases V/C from less than 0.8 to 0.9.
  - V/C for the Tamaki Tunnel is less than 0.8.

- Motorway:
  - Decrease in V/C from 1 to less than 0.8 along State Highway 1 from Manukau to Onehunga.
  - V/C for Orakei and Tamaki tunnel increased to 0.9.
  - Entire Eastern Motorway alignment experiences a V/C of at least 0.8.

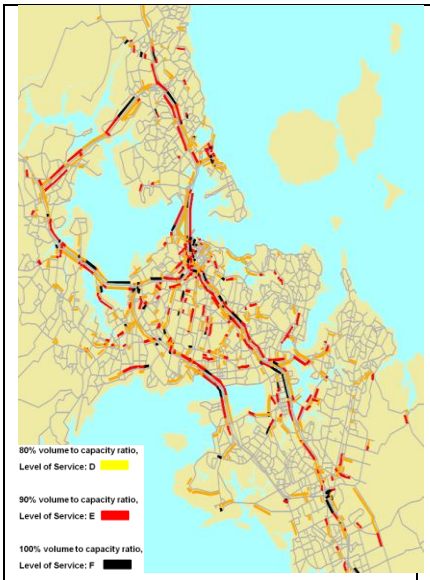


Figure 10 Providing Supply V/C plot AM Peak

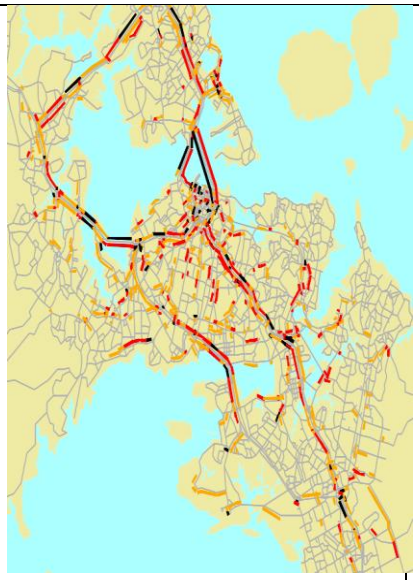


Figure 11 Expressway option V/C plot AM Peak

Figure 12 Motorway option V/C plot AM Peak

Figure 13 to Figure 15 below; outline the V/C plots for the three options in the interpeak.

Key points of Eastern Alignment v's Providing Supply:

- Expressway:
  - Increase in V/C from less than 0.8 to 1 northbound and 0.8 southbound along the Waitematā Harbour crossing.
  - Decrease in V/C from 0.8 to less than 0.8 along Highbrook Drive.

- Motorway:
  - Increase in V/C from less than 0.8 to 1 northbound along the Waitemata Harbour.
  - Decrease in V/C from 0.8 to less than 0.8 along Highbrook Drive.
  - V/C of 0.9 until the end of the Orakei tunnel.

Figure 13 Providing Supply V/C plot Inter Peak

Figure 14 Expressway option V/C plot Inter Peak

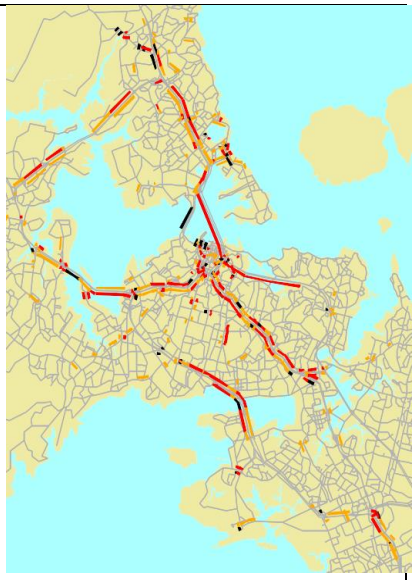


Figure 15 Motorway option V/C plot Inter Peak

Congestion across the network exhibits only minor changes as illustrated by Figure 16 and Figure 17 below. Apart from the Motorway option in the AM peak, which shows a decrease of 1.3%; there is less than a one percent decrease in hours spent in severe congestion which is defined as LOS E or worse for all other scenarios. However as noted above both options are experiencing congestion from the opening year suggesting the modelled assumption of two lanes in each direction is constraining demand. To provide capacity for future growth any further investigation needs to optimise the lane arrangements.

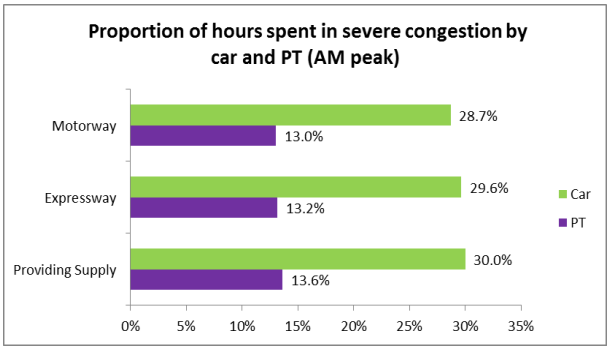


Figure 16 Hours in severe congestion – 2046 2hr AM peak

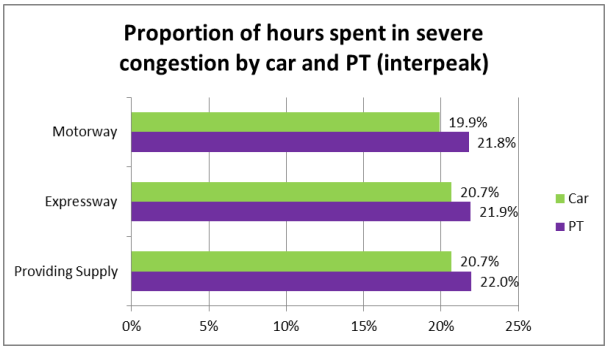


Figure 17 Hours in severe congestion – 2046 2hr interpeak

4.2.3 Travel times

An assessment of comparative travel times on key routes are shown below in Figure 18. The nature of the ART model is such that absolute journey time values should not be relied upon, however relative differences can be taken as representative of differences in the performance of options.

The first three figures clearly show that there is a decrease in travel time for both Eastern Highway alignment options in comparison to the Providing Supply package. However, it must be noted that these routes are directly affected by the options and it is logical that they exhibit lower travel times.

The Westgate route is directly affected by the Providing Supply package but neither of the Eastern Highway alignment options. In comparison to the first three figures, there is not a decrease in travel time for either the Expressway or the Motorway. Therefore, the implementation of either of the Eastern Highway alignment options will reduce the travel time for the south and south-east of Auckland but will not have as large an impact throughout the rest of the network. This is supported by the vehicle speeds in the network having minor changes (Figure 19).

The final two figures, illustrate there is a large decrease in travel time for key freight routes, with the Motorway option cutting 35% off the travel time in the AM peak from the Ports of Auckland to East Tamaki.

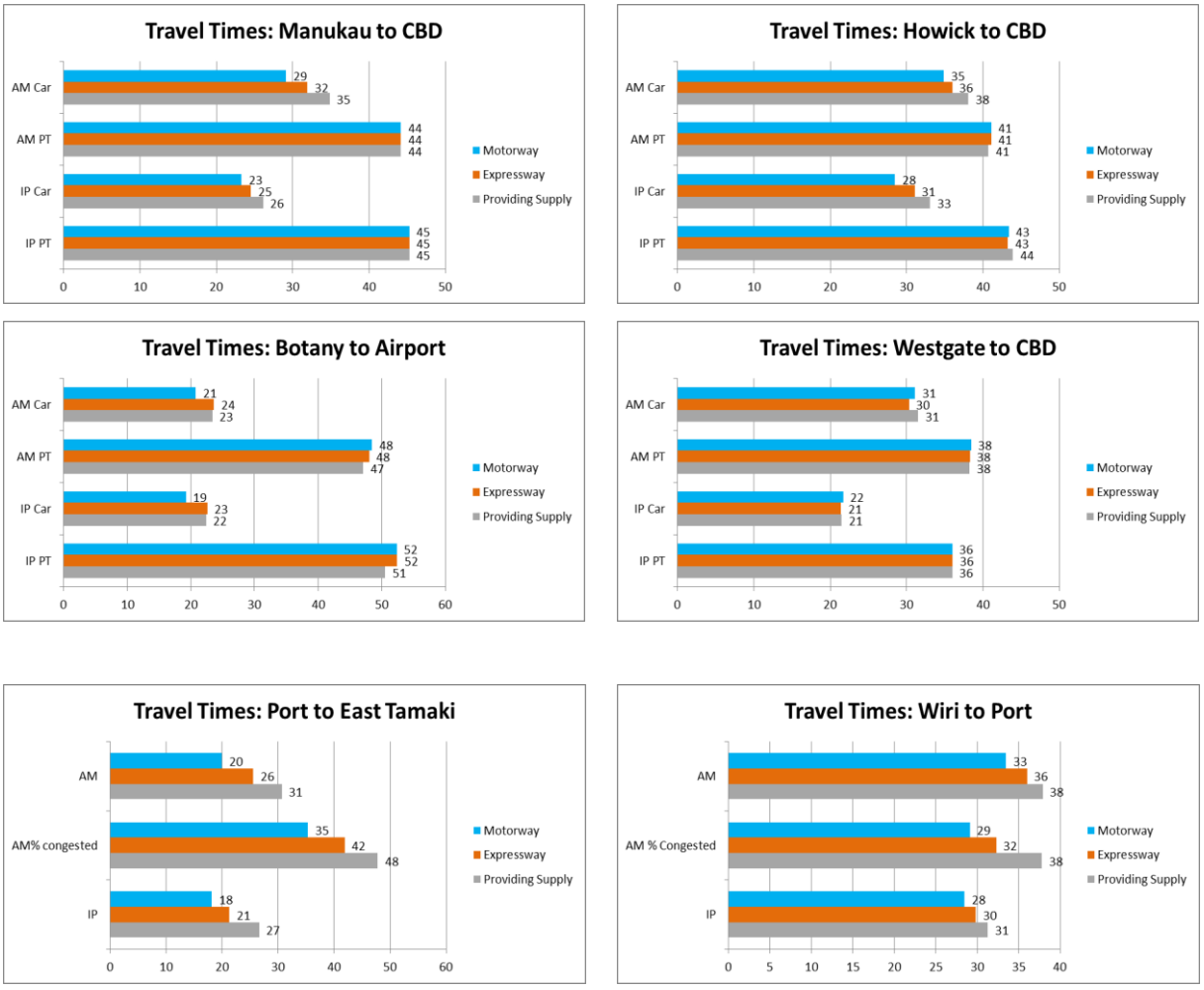


Figure 18 Comparative travel time difference – 2046

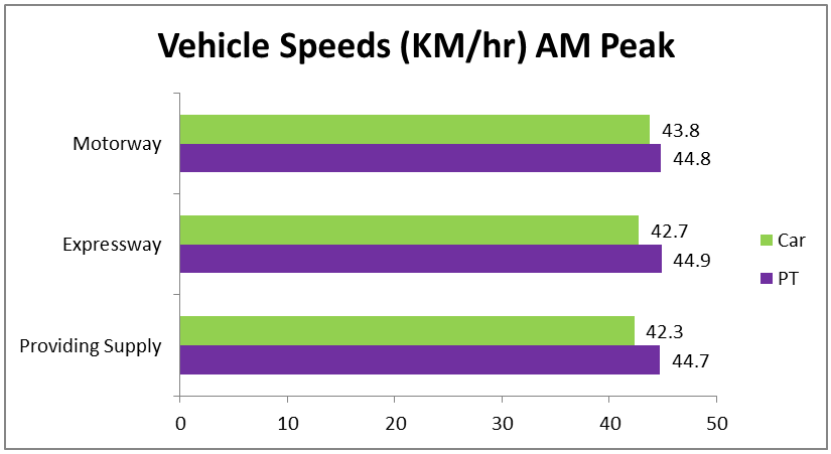


Figure 19 Comparative vehicle speeds across the network - 2046

4.3 Network resilience

The implementation of an Eastern Highway option would improve the resilience of Auckland's transport network by reducing dependence on State Highway 1, particularly on the central isthmus, and provide an alternative route in the event of an incident on the network. Additional high capacity links between the southern Isthmus and east and south Auckland would enhance the ability of Auckland's transport network to respond to disruption, degradation or loss of function as the consequence of a range of planned and unplanned events.

While acknowledging the above, this investigation has not attempted to assess or quantity the significance or value of improved network resilience.

4.3.1 Preliminary capital cost estimates – Harbour crossing

The tunnel component of the Waitematā Harbour crossing eastern alignment is nearly twice as long as that of the western alignment. A similar alignment was one of the shortlisted options in the 2008 Waitematā Harbour Crossing Study as depicted in Figure 20 below. From the Onewa Road interchange, the crossing would descend into a driven tunnel continuing to the Beach Road / Tangihua Street intersection. The study also indicated that the route would continue along Beach Road and join north of the Grafton Road overbridge to the State Highway 1.

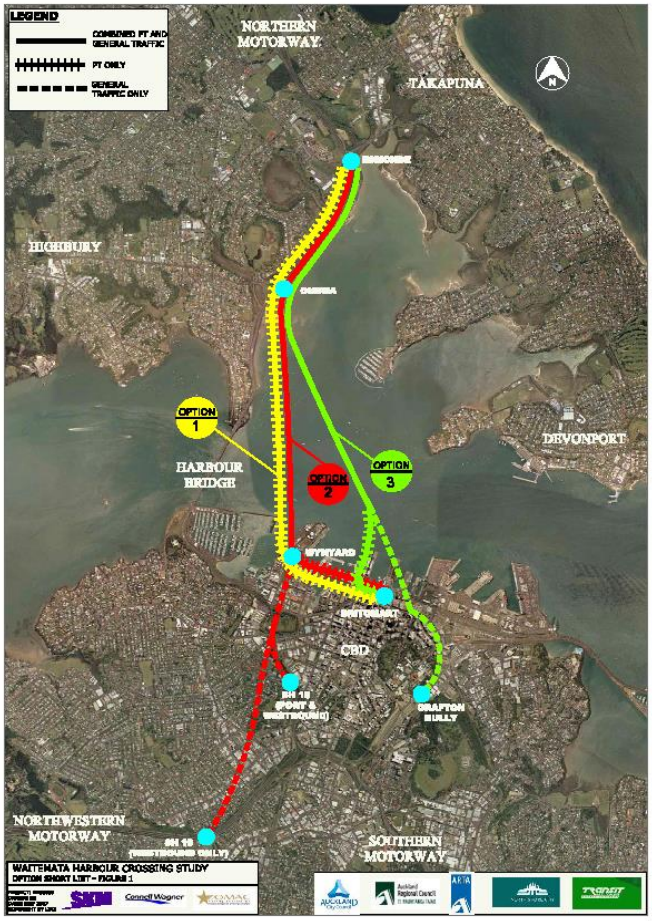


Figure 20 AWHC Options assessed in SKM 2008 Waitematā Harbour Study

Option 2C (cost range $3.7 - $4.1bn in 2008 dollars) was the recommended option in the 2008 study and their Option 3A/3B ($4.7bn- $5.1bn) appears closest to the current NZCID proposals for the Eastern alignment AWHC option. It is understood that the 2008 indicative estimates included separate rail tunnels beside the highway tunnels but it is noted that the current ATAP capital cost assumption for the Western alignment of the AWHC is also $3.7 B (Source AT Test D5) so it is unclear what assumption is currently being assumed for the Western alignment.

Table 3 AWHC options Indicative costs from SKM 2008 Additional Waitematā Harbour crossing report

Option	Cost range ($Millions – 2008 values)
1A	1,000 – 1,200
1B	1,200 – 1,500
1C	1,000 – 1,200
2A	3,700 – 4,100
2B	3,100 – 3,500
2C	3,700 – 4,100
3A	4,700 – 5,100
3B	4,700 – 5,100

4.3.2 Preliminary capital cost estimates – Eastern corridor alignment

AECOM has also undertaken preliminary investigative costings for both the Expressway and Motorway options as outlined below. As the tunnel is linear, it was assumed that the geometry of it would be the same for both options and thus they would have the same cost. The major cost difference between the two options is the additional 10.5km from Highbrook Drive to Murphys Road in the Motorway option.

The cost breakdown is shown below with the Expressway option costing $10.89bn and the Motorway option, $11.26bn.

Table 4 Expressway CAPEX cost

Item	Distance / No.	Assumptions	Cost ($Millions)
Harbour Crossing		New harbour crossing. Upper limit of price range.	$5,100
Road Tunnel	4 km	SH16>Hobson Bay	$1,200
New Road	4km	New Road - 4 lanes	$80
Intersection	3 No.	Signalled intersections	$15
Upgrade Road	2km	Upgrade SH6 to 4 lanes 80kph	$32
Road Tunnel	5.5km	Tunnel Ellerslie / Panmure to Highbrook	$3,000
Local Road	1km	Hollyford Drive upgrade	$20
Interchange	1	Diamond	$20
Sub total			**$9,467**
Professional Services		15%	**$1,420**
Total			**$10,887**

Table 5 Motorway CAPEX cost

Item	Distance / No.	Assumptions	Cost ($Millions)
Harbour Crossing		New harbour crossing. Upper limit of price range.	$5,100
Road Tunnel	4 km	SH16>Hobson Bay	$1,200
New Road	4km	New Road - 4 lanes	$80
Intersection	3 No.	Signalled intersections	$15
Upgrade Road	2km	Upgrade Route 6 to 4 lanes 100kph	$64
Road Tunnel	5.5km	Tunnel Ellerslie / Panmure to Highbrook	$3,000

Item	Distance / No.	Assumptions	Cost ($Millions)
New Road	10.5km	New link	$210
Interchanges	5 No	Interchanges (diamond)	$100
Local Road	1km	Hollyford Drive upgrade	$20
Sub total			**$9,789**
Professional Services		15%	**$1,468.35**
Total			**$11,257.35**

4.3.3 Cost exclusions & assumptions

No operational expenditure estimates have been sighted for the AWHC noting that the Eastern Highway Corridor had an estimated opex of $679M over 10 years (Source AT Test D5). As such a comparison of operational and maintenance expenditure have been excluded from this preliminary assessment.

Consistent with all ATAP cost estimates, the property and land acquisition cost have not been included due to inadequate information to provide realistic costs. By providing a cost to construct, this does not imply that a scheme is considered feasible to consent, construct or operate.

When considering the costings provided, it should be noted that a 'maximum scheme' design has been provided without attempts at value engineering. In many cases there are likely to be opportunities to adjust the schemes to deliver the core benefits with reduced costs, but these would require a greater level of detail to be applied to the design and assessment.

4.3.4 Benefit Cost Ratio

A high level benefit cost ratio has been calculated for each of the options based on the 2046 Auckland Regional Transport model (ART3) outputs. This is based on the following assumptions:

- Investigation / design period of 5 years 2036 to 2040.
- Construction Period of 5 years, 2041 to 2045.
- 2046 Opening Year.
- 0.5% per annum benefit growth rate after 2046.
- Discount Rate of 6%.
- A60 year evaluation period, including 55 year benefit period to better reflect the long term nature of this scale of major infrastructure investment.

The full EEM worksheet is provided at Appendix C.

Table 6 Benefit Cost analysis summary

Benefits	PV of net benefits compared to Providing Supply	
	Expressway	**Motorway**
Travel Time savings	224,461,463	550,267,500
Vehicle operating cost savings	12,919,213	-35,339,083
Crash cost savings (Estimated at 5% of all benefits excluding WEBs)	14,251,245	31,443,892
Vehicle emission reductions (5% of VOCs)	645,961	-1,766,954
Public Transport benefits	422,509	1,535,871
Congestion relief (15% of Travel Time savings)	33,669,219	82,540,125
Trip reliability (Estimated at 5% of TT and CRVs)	12,906,534	31,640,381
Wider economic benefits (Estimated at 30% of all benefits above)	89,782,843	198,096,520
PV total net benefits	**389,058,988**	**858,418,252**
Costs	**PV of net costs compared to Providing Supply**	
Construction / implementation (incl. preconstruction)	2,365,220,692	2,445,585,614
BCR	**0.2**	**0.4**

As can be seen from table 6 above, preliminary BCR's both options as modelled present poor value for money coming in well below 1.0, meaning that the NPV benefits do not outweigh the investment costs. The Motorway option has substantially higher benefits than the expressway, particularly as would be expected in travel time savings. However it must be noted that the tunnel components for the Motorway option has been modelled as a 100kph posted speed limit. To date, road tunnels in New Zealand have only been posted at 80kph generally as a compromise between safety requirements and cost. As such a modelled posted speed limit of 100kph may not be achievable in practice and the travel time savings, and attraction of the route may be overstated in this test.

The negative vehicle operating costs savings (VOCs) for the Motorway option results is due to the attractiveness of the higher speed and minimal constraints of this corridor. Traffic is travelling further to access the travel time savings with a resultant increase in total vehicle kilometres travelled. The Vehicle emissions reductions is a ratio of the VOCs hence is also negative for this option.

No sensitivity or scenario tests have been undertaken to understand if the options assessed here can be improved upon. Elements such as the potential for optimising the options to refine the costs and maximise benefits or to confirm feasibility of tunnels and surface infrastructure have not been investigated at this time. Table 7 overleaf provides a qualitative indication of the how the BCRs would be expected to change subject to further investigation and revised assumptions.

Table 7 Qualitative assessment of changes to BCR assumptions & inputs

Assumption / Limitation	Expected Impact on BCR
Further project optimisation	Increase
Value engineering	Increase
Inclusion of land costs	Decrease
Application of High Growth Scenario	Increase
Complex construction issues require mitigation (e.g. unforeseen geological issues, contaminated land)	Decrease
Application of Demand Management Strategies	Likely decrease

It is expected that the addition of costs associated with property acquisition and operating and maintenance, which have been excluded from the BCR presented above would be substantial, and will likely outweigh any construction cost savings or additional benefits.

5.0 Key Findings

- Both Eastern Highway Alignment options provide benefits in accordance to the ATAP KPIs for the south and south-east of Auckland. However, when these additional benefits and additional capital expenditure is compared to the Providing Supply package, the viability of this project in context of the whole Auckland region becomes less certain.
- Initial cost estimation suggests the Expressway option has a cost of $10.89bn and the Motorway a cost of $11.26bn; a difference of $370m. It was expected that the Motorway option would have a higher CAPEX than that Expressway option; however, this change is reasonable as the tunnel attributes to over 25% of the cost for both projects.
- When the modelled benefits of Eastern Highway Alignment options are considered within a localised corridor they both provide improved access between the Ports of Auckland and the industrial areas in East Tamaki. Modelled travel times improved by 35% for both the Motorway option in the AM and 16% for the Expressway option when compared against the Providing Supply Package.
- The Motorway option shifts commuters from State Highway 1 and improves congestion in the Manukau region.
- Preliminary BCR's for both options as modelled present poor value for money coming in at 0.2 for the Expressway and 0.4 for the Motorway meaning that the NPV benefits do not outweigh the investment costs. While no refinement or optimisation of the options and costs has been undertaken, improvements to the benefit streams are likely to be counter balanced or cancelled out once the costs of property acquisition and operating and maintenance are factored in.

6.0 Conclusions

When compared against the Providing Supply package, both options decrease travel time in the AM peak for trips in the south and south-east of Auckland. Subsequently, freight travel times decrease from the Ports of Auckland to the industrial hubs in the south. Furthermore, the Motorway option is more attractive than the Expressway and thereby draws traffic off State Highway 1 reducing congestion in the Manukau area. However, when compared against the whole network, congestion only decreases by 1% for the Motorway option.

The modelled options do not substantially reduce forecast congestion on the key section of State Highway 1 between Esmonde Road and Mt Wellington, but do provide additional traffic throughput and resilience to the regional strategic road network.

Typically during the development phase of a project effort is put into refining the road alignment to optimise traffic performance and mitigate cost and constructability problems. The very limited project development of an eastern corridor and additional harbour crossing project means that the potential benefits have not been optimised. To do so would improve the Benefit Cost Ratio.

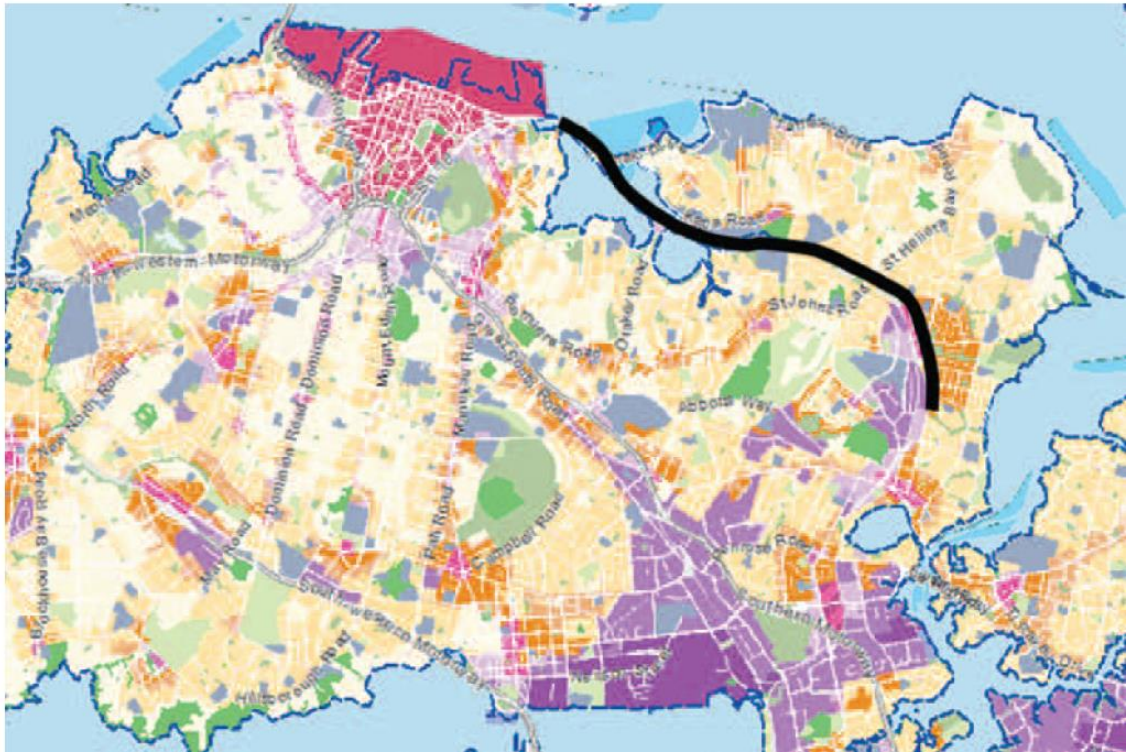
However it must also be recognised there would be significant land costs associated with either option considered. The expressway would require land acquisition of land to construct 5km of new road, one new intersection and upgrade 3 existing intersections. The motorway would require the acquisition of land to construct 15.5 km of road and 8 intersections/interchanges. Given the above it is unlikely that further more detailed development of the eastern corridor and refinement of costings would improve the BCR. On balance if seems more likely that if would result in a lower value.

Based on the findings of this investigation and our understanding of the benefits evaluation of other measures being considered by ATAP, AECOM recommends no further consideration of an Eastern Alignment within the current ATAP project. However we also recommend that corridor protection for the eastern alignment should be maintained until such time as the ATAP Government agencies commit to both the additional western alignment of AWHC and the use of the smarter road charging approach being developed within ATAP.

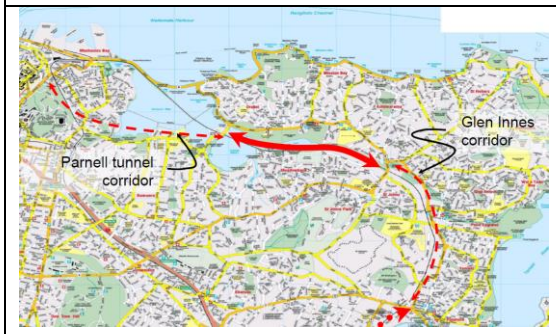
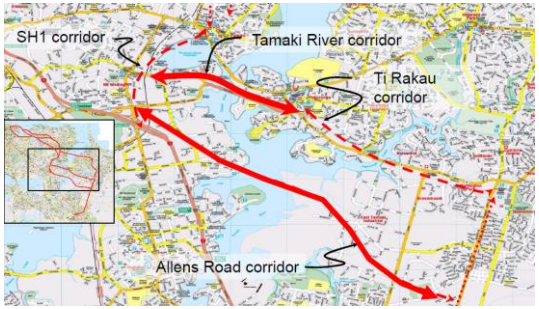
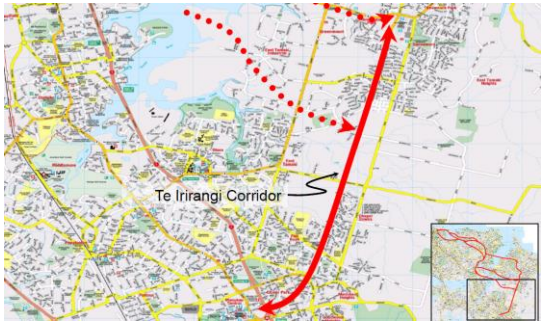
Appendix A

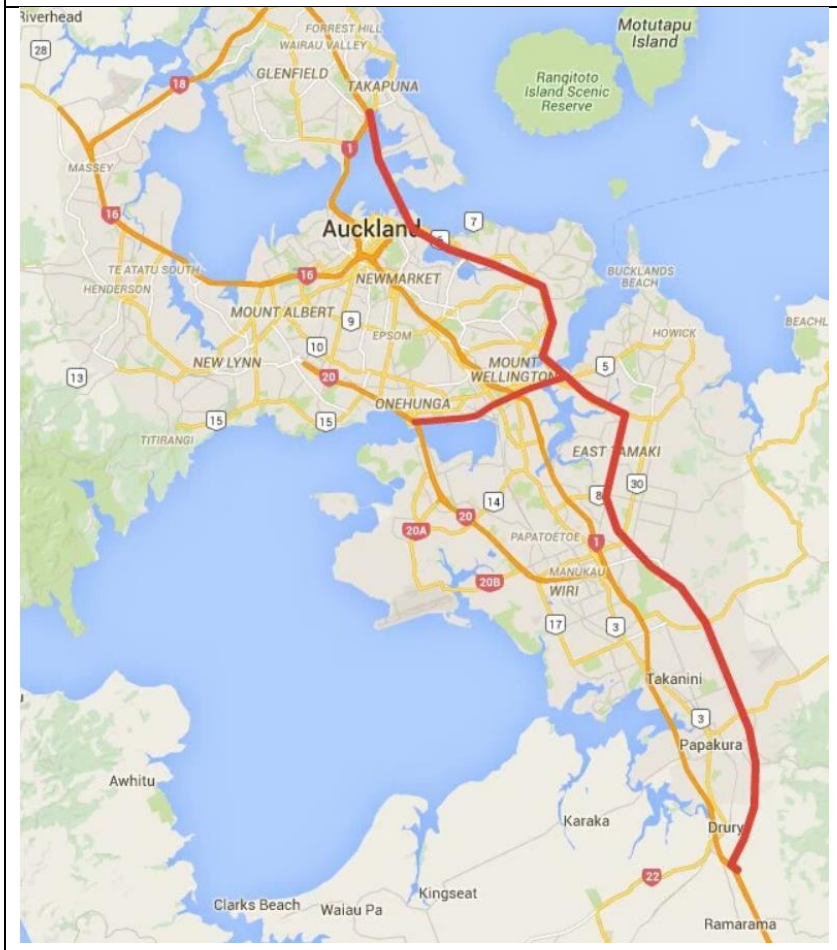
Eastern Alignment Options

Appendix A Eastern Alignment Options

Plan	Features	Comments
Report: NZCIDs Transport Solutions for a Growing City / Auckland Transport Report FINAL E-COPY: source NZCID Website Figure 53		
FIGURE 53 The Eastern Corridor 	An alignment shown following the existing eastern railway line from Parnell, through Orakei, North of Meadowbank, and Glen Innes, terminating at Point,	The alignment is shown in the report but not described or referred to in the text. No information on nature of the link or intersection / connections to SH network

Plan	Features	Comments
Presentation: "Transport Solutions for a Growing City": source NZCID Website [Slide 36]		
	A "Smart transport corridor for Driverless cars, busway, MoV comprising: • An Eastern Harbour Crossing Alignment from Orewa to Grafton • A connecting Eastern Corridor from Grafton, through Orakei, North of Meadowbank, Glen Innes, Point England and Panmure connecting to SH1 at Mt Wellington • A further Eastern Corridor diverging at Panmure through Pakuranga shadowing Ti Rakau Drive, Te Irirangi Drive through East Tamaki connecting to SH1 at Redoubt Road.	Very little information on: • the nature of the link (motorway, at-grade improvements etc) • frequency of intersections

Plan	Features	Comments
Presentation: "Eastern Corridor NZCID Presentation on Route and Rationale": source NZCID		
  	Overall diagram is as per the report above supported by some more detailed plans: • Parnell to Mt Wellington Corridor • Mt Wellington, Panmure through Ti Raku and Te Irirangi Corridor • Highbrook to from Allens Road in Highbrook to the west across (or beneath ?) the Tamaki river to • Along Te Irirangi Drive joining SH1 at Redoubt Road.	Unclear which option has been costed.

Plan	Features	Comments
Transportblog.co.nz Interpretation of the NZCID Proposed Alignment		
	Primary connection to the south appears to be much further south at Drury, rather than redoubt Road at Manukau. A clear link to East-West connection is shown in this figure.	Unsure of the origin of this option. This alignment would add cost and has not been modelled to assess benefits. The connection to east west may have merit in that North South congestion on SH1 may be transferred to the EA – enabling more of the benefits of East-West to be realised.

Appendix B

Eastern Highway Alignment - Route Descriptions

Appendix B Eastern Highway Alignment - Route Descriptions

Location	Eastern Alignment (Interpreted from NZCID materials)	Expressway Option	Motorway Option
Auckland Western Harbour crossing (AWHX)	An approximate 5 km alternative eastern alignment for the Additional Waitematā Harbour tunnels under the harbour from near Onewa Road to portals in the vicinity of State Highway 16 near Aiken Road in Parnell.	As previous	As previous
Connection to city, SH16, SH1 and AWHX-Eastern Corridor	A grade separated interchange at SH16 on Stanley Street, opposite Alten Road (which would be closed).	As previous	As previous
SH16 to Orakei	An approximate 4 km tunnel from the SH16 interchange under the Domain, Parnell and Hobson Bay to Orakei.	As previous	As previous
Orakei to Panmure	Surface route beside the North Island Main Trunk Railway line through Orakei to Panmure, using the NZTA Eastern Highway designation.	As previous	As previous
Panmure to Mt Wellington / SH1	Connection to Mt Wellington Highway and ultimately SH1 at the Mt Wellington Intersection.	Mt Wellington Highway interchange east of Carbine St	As previous
Mt Wellington to Te Irirangi - Tamaki River corridor	Upgraded link along Penrose Road / Waipuna Road along crossing the Tamaki Estuary along the South Eastern Arterial (SEART).	As previous	As previous
Mt Wellington to Te Irirangi - Ti Rakau Drive corridor	Upgraded link through Pakuranga, along Ti Rakau Drive, Te Irirangi Drive, East Tamaki, to Clover Park.	As previous	As previous
Mt Wellington to Te Irirangi - Allens Road corridor	New alignment from Mt Wellington Highway to Te Irirangi Drive via Highbrook Drive/Allens Road in East Tamaki utilising a tunnel under the Tamaki Estuary.	5.5 km tunnel from Mt Wellington interchange under the Tamaki Estuary to Highbrrok Drive.	As previous with exit ramps at Highbrook Drive with the motorway continuing straight through to Ti Irirangi Drive.
Highbrook Drive to Te Irirangi Drive	-	-	10.5km new alignment from the Highbrook Drive exit ramps to Te Irirangi Drive
Ti Irirangi Drive corridor	A new link south connecting Te Irirangi Drive to SH1 at Redoubt Road.	As previous	Exit ramps at Te Irirangi Drive and north facing ramps at Harris Road.

Location	Eastern Alignment (Interpreted from NZCID materials)	Expressway Option	Motorway Option
Murphys Road	-	-	Exit ramps
Redoubt Road	-	-	Motorway 'flanks' existing Redoubt Road to connect to SH1 at the SH20 interchange.
	Mention of "1 bus lane in each direction" but lack of clarity on new or diverted services	Bus and cycle lanes on relevant sections	Bus lanes on relevant sections

Appendix C

BCR Worksheet

Worksheet 3: Benefit cost analysis

Benefit cost analysis **Worksheet 3**

	Benefits	PV of benefits as calculated			PV of net benefits Compared to Providing Supply	
		Providing Supply	EHA Expressway	EHA Motorway	EHA Expressway	EHA Motorway
1	Travel time savings				224,461,463	550,267,500
2	VOC savings				12,919,213	-35,339,083
3	Crash cost savings				14,251,245	31,443,892
4	Vehicle emission reductions				645,961	-1,766,954
5	Reduced driver frustration					
6	Monetised external impacts (list)					
	Public Transport Benefits				422,509	1,535,871
	Congestion Relief				33,669,219	82,540,125
	Trip Reliabilty				12,906,534	31,640,381
	Wider Economic Benefits				89,782,843	198,096,520
7	**PV total net benefits**	**0**	**0**	**0**	**389,058,988**	**858,418,252**
	Costs	**PV of costs as calculated**			**PV of net costs Compared to Providing Supply**	
8	Investigation					
9	Design					
10	Property					
11	Construction/ implementation (incl. preconstruction)	0	2,365,220,692	2,445,585,614	2,365,220,692	2,445,585,614
12	Maintenance	0	0	0	0	0
13	Renewal					
14	Operating	0	0	0	0	0
15	External impact mitigation					
16	Project contingency					
17	Risk management					
18	**PV total net costs**	**0**	**2,365,220,692**	**2,445,585,614**	**2,365,220,692**	**2,445,585,614**
19				**BCR = (7)/(18) =**	**0.2**	**0.4**

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