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LGWM Programme

Affordable Short List Options Modelling Report

MRT and SHI Team
Wellington Analytics Unit

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Executive Summary

This report sets out the transport modelling carried out by the Wellington Analytics Unit during 2021 to support the analysis undertaken for the Let's Get Wellington Moving programme.

Following the completion of the programme and package assessments for the Combined SHI and MRT IBC, LGWM confirmed an affordability threshold for the programme's investment. This threshold was applied to the programme short list of options, resulting in the current Programme Affordable Short List Options (also referred to as programme options in this report going forward):

- Option i – dedicated LRT to Newtown via a grade separated Basin, with mixed running LRT to Island Bay, bus priority via a diagonal tunnel to Miramar, with extended bus services to Seatoun and the Airport and dedicated active mode provision via the existing Mount Victoria tunnel.
- Option ii – dedicated BRT to Newtown via a grade separated Basin, with extended bus services to Island Bay, dedicated BRT via a diagonal tunnel to Miramar, with extended bus services to Seatoun and the Airport and dedicated active mode provision via the existing Mount Victoria tunnel.
- Option iii – dedicated LRT to Newtown via a grade separated Basin, with mixed running LRT to Island Bay, bus priority via Hataitai tunnel to Miramar, with extended bus services to Seatoun and the Airport and active modes will travel through the new parallel tunnel.
- Option iv – dedicated LRT to Newtown via an at grade Basin, with mixed running LRT to Island Bay, bus priority with localised treatments via Hataitai tunnel to Miramar, with extended bus services to Seatoun and the Airport and active modes will travel through the new parallel tunnel.

In light of this, additional modelling work was carried out by the Wellington Analytics Unit in late 2021. This work was predominantly undertaken using the Wellington Transport Strategic Model (WTSM), also drawing from the Wellington Public Transport Model (WPTM) and the Ngauranga to Airport AIMSUN model when needed.

Modelling has been undertaken based on the core land use assumptions developed from projections produced for the regional Territorial Local Authorities (TLAs) in November 2019, with additional 'high land use, redistributed' sensitivity scenarios modelled to represent the effect that intensified land use enabled by MRT might deliver.

The focus of this document is as follows:

- Outline the assumptions for the Programme Affordable Short List Options modelling
- Summarise KPIs and key model outputs from the core and sensitivity tests

It is worth noting that the modelling assumptions and options have evolved between the programme modelling, package modelling and Programme Affordable Short List Options modelling. Therefore, outputs are not directly comparable.

The primary purpose of the modelling undertaken at all stages of the project is to understand the relative differences between options at a high level, to inform MCA analysis and high-level economic analysis.

Similarly, the strategic model (WTSM) and AIMSUN model have different assumptions, a different representation of travel demand and are being used for different purposes. WTSM provides a high-level view of relative differences between options in terms of key metrics (mode shift, regional VKT, carbon emissions) whilst the AIMSUN model provides a more detailed level of granularity and differentiation

focussed on key components of the programme (Basin Reserve, Waterfront and connections to the east).

Both WTSM and AIMSUN are used to highlight the key differentiators between options, key impacts and areas where mitigation and further improvements should be considered at subsequent stages of the investigations.

Programme Affordable Short List Options Modelling

The WTSM tests carried out for the Programme Affordable Short List Options modelling show the following:

- All Programme Affordable Short List Options generate an increase in PT mode share from the south and east to the CBD, ranging from 700 (13% - Option i) to 500 (8% - Option iv). These numbers are significant in the context of a catchment that already has high levels of PT mode share. Sensitivity analysis has indicated that further increases may be achievable if the programme is able to stimulate further land use intensification. Additional sensitivity testing shows that if the programme is accompanied by effective travel demand measures (represented as a congestion charge in the model), further increases are achievable.
- All Programme Affordable Short List Options generate a significant increase in cycle mode share from the south and east suburbs to the CBD of around 70%, equivalent to an additional 1,000 cyclists per day.
- Options i and ii have marginally higher PT mode share from the south and east compared to Option iv, largely driven by the 6-minute differential in PT travel times from the east between both sets of options
- Car cordon crossings decrease by around 5% for all options. Again, the sensitivity tests indicate that further reductions may be possible if the programme is accompanied by greater levels of land use intensification and effective travel demand management.
- Non-car (walk, cycle, PT) cordon crossing volumes from the south and east are forecasts to increase by approximately 30% between the Do Minimum and Programme in 2036
- As highlighted above, sensitivity analysis building on the core programme option i and adding intensified land use along the MRT corridor and a congestion charge shows the following:
  - PT patronage from the south and east could increase by between 2,700 (50%) and 4,000 (80%) compared to the Do Minimum for 2036 and 2046 respectively
  - Levels of demand along the MRT corridor from Newtown could reach 4,800 and 6,400 people in the peak hour in 2036 and 2046 respectively
  - Fuel consumption could reduce by up to 10% in Wellington City relative to the Do Minimum and by up to 20% when assessed in per capita terms. These numbers do not take into account improvements to fleet efficiency over time. Previous analysis of this has indicated much more significant emissions savings are achievable.
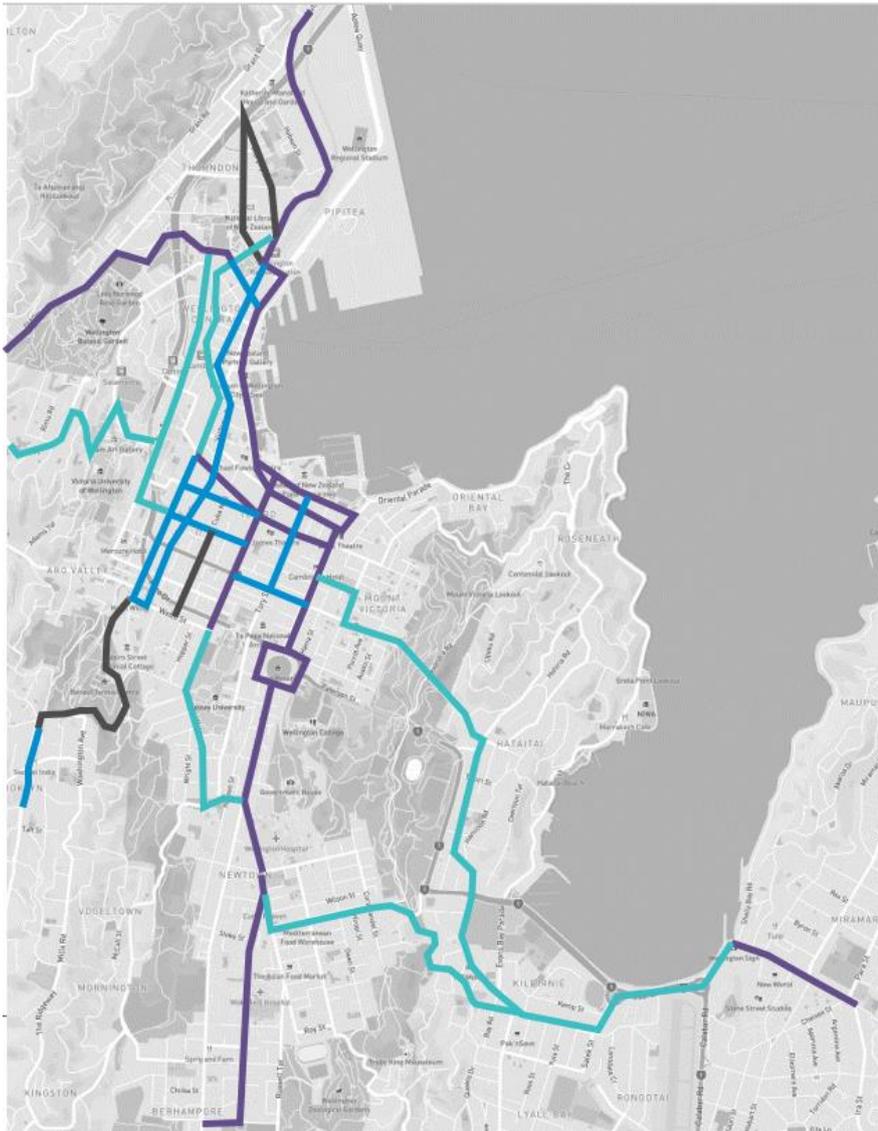
Figure 1: WTSM Modelled cycle facilities

Conclusions and limitations

The purpose of transport modelling is to guide decision making. Given inherent uncertainties relating to future growth, changes in travel behaviour and technology, transport modelling that forecasts 15+ years into the future will not tell you "what will happen" but will give you an indication of "what might happen" based upon a series of assumptions. Modelling can add value by helping provide answers to "what if" questions.

All models are approximations of reality, are only as good as the input assumption and have strengths, weaknesses and limitations. They should be used to inform rather than make decisions.

The level of detail and accuracy of the models used for the Programme Affordable Short List Options is considered appropriate for the primary purpose of informing the relative option performance at an IBC level.

As highlighted above, there are a number of limitations that will need to be addressed in subsequent work:

- The land use scenarios are currently 'indicative' and further work is required to provide greater confidence in the assumptions, staging and overall capacity for housing growth and intensification along the corridor (acknowledging that infrastructure investment is necessary, but not sufficient in isolation to achieve land use intensification – further measures will be required and these sit outside of the LGWM programme).
- Whilst unlikely to change the relative performance of MRT options, additional scenarios with the options, including additional investment in rail (which would comprise a package known as "RS2"), should be undertaken to understand the impact on the wider network and the LGWM programme and assess the importance of rail improvements to the north as part of a wider suite of future interventions
- Once a preferred MRT option has been identified, additional detailed PT patronage modelling should be undertaken together with more detailed AIMSUN modelling, informed by more detailed PT network design, in order to optimise any preferred MRT option. This work should also fully explore the benefits of reduced bus frequencies along the Golden Mile, due to the introduction of MRT.
- Furthermore, detailed modelling is required to better understand the impacts within the CBD, provide a more robust assessment of the impacts and benefits and develop (if required) appropriate mitigation
- The modelling does not address weekend network performance, and this will need to be completed as part of the Detailed Business Case assessment. It is noted that weekends have prolonged multi directional loading at areas such as the Basin that can mean the performance is worse than weekdays. This is likely to have an impact on PT network performance which may, in turn, limit the opportunities to improve the level of PT service at the weekend.

The modelling work and analysis showed the following conclusions:

- Overall, the modelling shows that all options perform very similarly, with marginal differences when assessed against performance indicators.
- In general, without the programme in place there will be an increase in traffic volume around the city, this is due to the increases in population and employment forecasted for 2036
- All programme options generate a significant increase in non-car mode share of trips, particularly from Wellington's southern and eastern suburbs.
- Analysis shows that infrastructure improvements need to be accompanied by travel demand management or land use changes to maximise performance against investment objectives.
- Options i and ii perform marginally better than Options iii and iv, with higher non-car mode share form the east being the main differentiator, driven by the more direct route via the diagonal tunnel delivering 6 minutes additional travel time saving for public transport compared to Option iii and iv.
- Options i and ii have slightly worse travel time reliability for private vehicles when compared to Option iii and iv due to the reallocation of road space to PT.
- All options will have a more competitive PT network, with improved PT travel times on routes to the east and south.
- Whilst the LGWM programme itself is forecast to reduce carbon emissions by around 2%, a more intensified land use scenario could potentially reduce emissions by a further 6% to 10% within Wellington City (and up to 20% in per capita terms).

1. Introduction

This document summarises the modelling work undertaken by the Wellington Analytics Unit (WAU), to support the development and assessment of the LGWM Programme Affordable Short List Options:

- Option i – dedicated LRT to Newtown via a grade separated Basin, with mixed running LRT to Island Bay, bus priority via a diagonal tunnel to Miramar, with extended bus services to Seatoun and the Airport and dedicated active mode provision via the existing Mount Victoria tunnel.
- Option ii – dedicated BRT to Newtown via a grade separated Basin, with extended bus services to Island Bay, dedicated BRT via a diagonal tunnel to Miramar, with extended bus services to Seatoun and the Airport and dedicated active mode provision via the existing Mount Victoria tunnel.
- Option iii – dedicated LRT to Newtown via a grade separated Basin, with mixed running LRT to Island Bay, bus priority via Hataitai tunnel to Miramar, with extended bus services to Seatoun and the Airport and active modes will travel through the new parallel tunnel.
- Option iv – dedicated LRT to Newtown via an at grade Basin, with mixed running LRT to Island Bay, bus priority with localised treatments via Hataitai tunnel to Miramar, with extended bus services to Seatoun and the Airport and active modes will travel through the new parallel tunnel.

The report is structured as follows:

- Executive Summary
- Introduction – purpose of modelling, high level approach, tools used
- Summary of assumptions
- Core results
- Sensitivity Tests
- The use of the more detailed AIMSUN traffic model
- Limitations and next steps
- Key conclusions

The LGWM programme modelling combines all of the following short-term and long-term package elements:

- SHI and MRT (IBC)
- Golden Mile (SSBC)
- Hutt Rd Thorndon Quay (SSBC)
- City Streets (Programme IBC)
- Cobham Drive safety improvements (SSBC)
- Travel Demand Management (TDM)

While the workstreams outlined above will deliver an investment proposal that will be assessed and evaluated at a programme level, this report focusses on assessing the programme as a whole.

The analytical tools and approaches that have been used for the development of the MRT and SHI options are outlined below:

- WTSM – Wellington Transport Strategy Model
  - o 4-stage transport model, uses population and employment inputs to model changes in travel demands and travel patterns resulting from infrastructure and policy interventions

- o used to understand relative difference in performance between options and provide inputs to economic analysis and to the other transport models identified below
- o key metrics include changes in traffic volumes, public transport passenger volumes, vehicle and passenger kilometres, emissions
- WPTM – Wellington Public Transport Model
  - o more detailed public transport model, used to assess changes in PT patronage between options
  - o used to optimise the performance of the public transport network
  - o key metrics include PT patronage, PT boardings and alightings, PT travel times
- Ngauranga to Airport AIMSUN model
  - o developed to assist understanding of the operational performance of the central CBD network, drawing estimates of demand from WTSM
  - o key metrics include changes in travel times, delays and extent of peak spreading
  - o used to inform analysis of network pinch-points

The tools have different strengths and weaknesses and will therefore be used appropriately for analysis associated with the IBC depending on the issue being assessed and the level of detail required. The core modelling reported in this report focusses on a 2036 WTSM / WPTM model year and a 2026 model year for AIMSUN. Additional 2046 WTSM / WPTM model year outputs were also produced to inform the programme economic evaluation.

Modelling has been used for a range of different purposes by the LGWM programme team and by the different packages. These purposes include design development, the multi-criteria assessment of options, and economic analysis. The modelling presented in this report is documented objectively – it is the role of other documents to discuss the implications of the modelling results on option performance.

2. Objectives of Modelling

2.1 Objectives

The main objectives for the modelling for the Programme Affordable Short List Options assessment are set out below:

- To assess programme options at a high level against an agreed baseline (i.e. the Do Minimum)
- To understand the impacts of the different options in relation to Key Performance Indicators to inform the multi-criteria analysis
- To understand the key points of differentiation between different options
- To understand the extent to which different assumptions (higher active mode uptake, alternative land use scenarios, congestion charge) may change outcomes
- To provide inputs to the economic assessments

The KPIs that are derived from the transport modelling and reported in this report are as follows:

- Attracting traffic from city streets
- Comparative travel times between general traffic and public transport
- Public Transport (PT) delays
- Mode share, both into the CBD and at a regional level
- Carbon Emissions (only partially informed by modelling – documented separately in Technical Specialist reports

3. Technical specification

This section focusses on the technical specification for the programme modelling as follows:

- Population and employment growth projections
- A description of the Do Minimum
- Key modelling assumptions

4.1 Population and employment projections

4.1.1   Overview

Demographic projections are one of the key inputs to the analytical tools. In simple terms, changes in the amount and distribution of population and employment are the fundamental drivers of changes in travel demand.

The base year population inputs to WTSM are derived from 2013 Census population data, with base year employment inputs derived from corresponding ANZIC category employment data gathered from the Census. These base estimates are the building blocks upon which future forecasts are developed.

The core population and employment forecast inputs to the strategic model are developed as follows:

- Population – derived from population projections developed for each of the regional Territorial Authorities (TAs), with the latest update occurring in November 2019
- Employment – derived from the population projections, with the following assumptions:
  - Distribution of future employment growth is proportionate to distribution of recent (last 5 year) employment growth
  - Labour force participation rate remains relatively constant through time, resulting in a relatively stable population to employment ratio
  - A continuation of recent trends where a greater percentage of over 65s are staying in the workforce (either part-time or full-time)

The core 2036 population and employment projections were developed at a point in time (November 2019) using a common process across all TAs within the Wellington region.

Whilst it is accepted that population projections will continuously evolve as a result of spatial planning processes such as the Wellington City Council Planning for Growth process and the Regional Growth Framework and as a result of changing external factors (such as Covid-19), the core projections are accepted as a plausible baseline to be used for the assessment of LGWM programme options.

4.2 Population growth

The forecast population figures for the various land use scenarios are set out in the following table. Note that the percentage changes are expressed relative to the 2018 estimate.

Table 1. Population projections by area / Territorial Authority

	2013 Base	2018 Estimate	Core 2036 Abs	% Diff	% Diff	2046 Abs
CBD	17,400	19,800	27,200	37%		31,000	57%
Inner Suburbs	24,400	26,800	32,200	20%		34,700	29%
Eastern	36,800	38,100	40,300	6%		42,300	11%
Southern	30,300	31,400	34,000	9%		35,300	12%
Western	27,300	28,000	29,000	4%		30,100	8%
Northern	64,100	67,800	78,100	16%		83,200	23%
Wellington City	**200,300**	**211,900**	**240,800**	**14%**		**256,600**	**21%**
Lower Hutt	101,100	107,600	116,600	8%		124,500	16%
Upper Hutt	41,400	45,300	47,300	4%		51,400	13%
Porirua	53,700	58,700	79,400	35%		87,500	49%
Kapiti	50,700	55,400	62,600	13%		68,600	24%
Wairarapa	42,400	46,700	50,900	9%		54,800	17%
Region	**489,600**	**525,600**	**597,600**	**14%**		**643,400**	**22%**

4.3 Updated employment projections

Alongside population projections, employment projections are another key input to the modelling framework. **Table** 2 below summarises the employment projections for respective scenarios by area (Wellington City only) and Territorial Authority, together with the percentage growth between the 2018 estimate and future scenarios.

The projections have been broadly developed assuming the following:

- Continuation of base year population to employment ratio
- No significant change in distribution of employment within region, with Wellington CBD remaining the largest employment area in the region

Table 2. Forecast employment growth

	2013 Base	2018 Est	2036	% Diff	2046	% Diff
CBD	88,100	93,300	109,500	17%	117,700	26%
Inner Suburbs	11,300	12,000	14,300	19%	15,500	29%
Eastern	10,600	11,300	12,800	13%	13,600	20%
Southern	4,600	4,900	4,900	0%	5,000	2%
Western	6,400	6,700	7,900	18%	8,500	27%
Northern	16,200	17,200	19,200	12%	20,400	19%
Wellington City	**137,200**	**145,600**	**168,500**	**16%**	**168,500**	**16%**
Lower Hutt	40,500	42,600	46,100	8%	49,400	16%

	2013 Base	2018 Est	2036	% Diff	2046	% Diff
Upper Hutt	11,300	12,300	12,600	2%	13,500	10%
Porirua	15,100	16,400	20,000	22%	21,200	29%
Kapiti	14,000	15,200	16,500	9%	17,700	16%
Wairarapa	17,500	19,100	21,000	10%	22,600	18%
Region	**235,600**	**251,200**	**284,700**	**13%**	**292,900**	**17%**

The forecasts assume a level of growth that is considered plausible and can be accommodated by BAU investment in the PT network. Metlink are planning to increase capacity to meet demand at a rate of 1.5% to 2% per annum over the next 10 to 15 years on average across the network, although there will be parts of the network where this level of capacity increase may not be achievable without infrastructure upgrades.

4.4 Do Minimum Summary

A baseline scenario, i.e. the do minimum, has been developed to allow comparison of the performance of the identified short list options. The do minimum includes network changes that are either under construction or have been committed. This represents the receiving environment for the LGWM programme. Table 3 below summarises the elements that make up the Do Minimum and the common elements of the Programme Options. It also includes some of the key modelling parameters/assumptions.

Table 3 Summary of Do Minimum and Options assumptions

	LGWM Programme Do Minimum	Programme Options
Land Use - Core	November 2019 land use assumptions (2036 forecast)	As per Do Minimum
Land Use - Revised	N/A	Alternative Scenarios drawing on work undertaken by The Property Group (TPG)
State Highways	• Transmission Gully • Peka Peka to Otaki • Otaki to North Levin • Melling interchange	As per LGWM Programme Do Minimum, plus LGWM Cobham Drive Crossing and relevant SHI changes (scenario specific)
Local Roads	☐ No change	As per LGWM Programme Do Minimum, plus • Changes required to support MRT/PT network changes (scenario specific) • LGWM Thorndon Quay/Hutt Road • LGWM Golden Mile related changes • LGWM City Streets intersection improvements • Karori to Bowen ST • Johnsonville to CBD, Courtenay Place to Kilbirnie bus priority improvements (IVT perception factor = 0.95)
PT: General	• Integrated Ticketing and fares	• Relevant MRT related network changes (scenario specific)

	LGWM Programme Do Minimum	Programme Options
	- Crowding – represented on links (factor ranges from 1.05 to 1.3) - Reliability – worse on GM to reflect more vehicles (factor of 1.6)	- Integrated Ticketing and fares - Crowding – represented on non-MRT corridors (IVT perception factors range from 1.05 to 1.31) - Reliability – IVT perception factor of 1.0 for both GM and Second spine, reflective of higher priority for second spine and fewer vehicles on both
Rail	Committed Regional Rail Improvements – previously referred to as RS1, mainly track infrastructure upgrades, no significant capacity increases	As per LGWM Programme Do Minimum
Bus	- Existing bus network, frequencies increases by factor of 1.17 - Crowding represented on link basis	As per LGWM Programme Do Minimum, plus - LGWM Thorndon Quay/Hutt Road bus priority measures - LGWM Golden Mile Improvements that improve bus travel time reliability – link based IVT factor of 0.95 - LGWM City Streets bus priority on key corridors – represented by link based IVT factor of 0.95
Active modes	- WCC Cycle Masterplan results in modest improvements to walk / cycle mode share - Ngauranga to Petone Shared Path	Realisation of 100% of the uplift in walk / cycle demand, through MRT / SHI filling in the critical gaps and the active mode tunnel enabling increased walking and cycling
TDM	- Workplace travel plans (and resulting measures): minor effects - Education place travel plans (and supporting measures): minor effects - Work from home – minor effects - Limited removal of parking – in line with PT and active mode investment - Removal of parking – in line with PT and active mode investment - Overall – 3% shift of HBW car commuter trips to CBD from car to HBW / PT	As per LGWM Programme Do Minimum + Overall – 5% shift of HBW car commuter trips to CBD from car to HBW / PT
Behaviour Change	Assume no significant change in trip rates due to Covid-19 / working from home	As per Do Minimum

4.5 Strategic Modelling Assumptions

During the earlier stages of investigation, model limitations were identified. The Do Minimum assumptions have been modified accordingly, with justification, as follows:

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[1] An IVT perception factor of 1 means that users will perceive their journey to take as long as it takes in reality, a factor below 1 indicates that users will perceive their journey to be faster than it actually is.

- Representation of PT crowding – both bus and rail
- Representation of PT unreliability in the future
- Treatment of future rail investment
- Assumptions around city streets
- PT service and capacity improvements delivered by BAU investment
- City Streets corridors
- Congestion charging

This section summarises some of the key technical inputs and assumptions.

4.5.1 PT parameters

This section documents, with rationale, the PT parameters that are used in WTSM / WPTM for the future Do Minimum and Options. It should be noted that different parameter values have been considered as part of the options assessment, to understand the extent to which different values could materially impact project outcomes and viability.

The assumptions regarding the public transport network are crucial for determining the effectiveness of the system as a whole. The following table summarises the high-level PT network assumptions used to inform the modelling. No network optimisation has been undertaken for the scenarios below, so that comparisons can be drawn between scenarios on a like for like basis.

Table 4: High-level PT network assumptions

Option	MRT Assumptions	Other Network Assumptions
Option i	- LRT - Station to Island Bay via Quays, Wakefield, Kent/Cambridge Terrace, Basin 5-minute frequency - Best perception factor between rail station and Newtown, then medium priority perception factor between Newtown to Island Bay - Enhanced (BRT) services to airport, Miramar and Seatoun with some through routed to Karori (18m articulated vehicles – capacity 120/130). 5 min frequencies replacing route 2.	- Route 1 – changed to JVL to Lyall Bay via Taranaki / Constable St (Bus), 5 min frequency (fleet would be electric double deckers). - Routes 30X and 31X – enhanced bus services, express from Miramar to CBD only stopping Kilbirnie, 10 min frequencies in peak, 20 min rest of day - Route 36 – replaced by new route 1 - New connection (stopping service) from Kilbirnie to CBD via bus tunnel to service Hataitai, 10 min frequency
Option ii	- BRT services replacing routes 1 and 2 5-minute frequency on both routes - Operated by a fleet of 18m high quality articulated buses (capacity 120-130) - Medium priority perception factor on both routes	- Route 3 – Station to Lyall Bay via Taranaki / Constable St (Bus), 5 min frequency – assume electric DD buses are retained - Routes 30X and 31X – bus services supplementing BRT, express from Miramar to CBD only stopping Kilbirnie, 10 min frequencies in peak, 20 min rest of day - Route 36 – Lyall Bay to CBD, 10 min frequency via Mt Vic tunnel at peak (Bus) - New connection from stopping service from Kilbirnie to CBD via bus tunnel to service Hataitai, 10 min freq.

Option	MRT Assumptions	Other Network Assumptions
		• Express and stopping services run via Kilbirnie (no services on Cobham Drive)
Option iii	• LRT - Station to Island Bay via Quays, Wakefield, Kent/Cambridge Terrace, Basin • 5-minute frequency • Best perception factor between rail station and Newtown, then medium priority perception factor between Newtown to Island Bay	• Route 1 – JVL to Island Bay changed to JVL to Lyall Bay via Taranaki / Constable St (Bus), 5 min frequency • Route 2, 30X and 31X – Enhanced Bus – 2 has 5 min frequencies, 30X and 31X have 10 min peak frequencies, 20 min rest of day • Express and stopping services run via Kilbirnie (no services on Cobham Drive) • Identical to the current network to the east.
Option iv	• LRT - Station to Island Bay via Quays, Taranaki Street, Tasman, Rugby, Adelaide Road • 5-minute frequency • Best perception factor between rail station and Newtown then medium priority perception factor between Newtown to Island Bay	• Route 1 – JVL to Island Bay changed to JVL to Lyall Bay via Taranaki / Constable St (Bus), 5 min frequency • Route 2, 30X and 31X – Enhanced Bus – 2 has 5 min frequencies, 30X and 31X have 10 min peak frequencies, 20 min rest of day • Express and stopping services run via Kilbirnie (no services on Cobham Drive) • Identical to the current network to the east.

Wait time factor

Generally, evidence gathered from various preference surveys and international studies reveals that waiting is less attractive than travelling in a vehicle. This is due to the perceptions over the ability of transit services to stick to time and the fact that waiting facilities are generally open and exposed to the elements and thus less attractive than sitting on a bus.

In the base year, it is assumed that all modes have a wait time perception factor of 2 (i.e. 1 minute waiting is perceived as 2 minutes of travel time).

Rail improvements that have largely been implemented since 2013 have resulted in increased rail patronage, above what was previously forecast by the model. Improving punctuality and reliability, improved waiting facilities and improved service quality are thought to have been the key drivers of this increase.

In order to replicate this observed increase in the Do Minimum model, the rail wait time perception factor was reduced (from 2.0 to 1.6) and the rail in-vehicle time (IVT) perception factor remained at 0.9. 'Back-casting' and interpolation of revised 2026 forecast rail patronage (to estimate 2018 patronage) showed that the revised assumptions resulted in the model better representing recent observed trends.

For the options it is assumed that since only the Regional Rail Plan RS1 package of work will have been delivered, the same crowding and wait time perception factors as the Do-Minimum have been adopted.

For the LGWM City Streets package, it is assumed that improved bus priority measures would lead to the bus wait time perception factor decreasing from 2.0 to 1.8 across the city network, with a similar improvement in the wait time perception factor delivered by the Golden Mile and Thorndon Quay early delivery projects. Whilst approximate, this approach is considered appropriate for the purpose of reflecting the improved level of service that the early delivery and City Streets programmes could provide and the corresponding modal shift that could be achieved. However, this assumption may need to be refined as the project details are firmed up.

For the LGWM programme it is assumed that the overall package of PT improvements would result in a better quality, more reliable PT network. This is represented by reduced wait time perception factors across all modes, with particular focus on MRT, with the factors developed by the MRT team based upon factors such as vehicle type, stop facilities, segregation, travel time variability improvements etc.

Walk time perception factor

The factor of 2.0 is assumed to be unchanged between base and Do Minimum, for all PT modes, effectively meaning that people perceive a 2-minute walk as equivalent to 1 minute on a vehicle as walking is less attractive relative to travelling in a vehicle.

In-vehicle time perception factor

People perceive travelling by certain modes to be more attractive than waiting, walking or travelling by other modes. This is modelled by applying a factor to the in-vehicle time to model 'perceived' in-vehicle time, with all modes ranked according to their relative attractiveness compared to a standard bus journey (1.00).

As mentioned above, the rail IVT perception factor remained at 0.9.

Similarly, the City Streets package would improve the bus IVT perception factor from 1.0 to 0.95 along selected corridors to reflect the improved infrastructure and levels of service.

For MRT, an IVT perception factor of 0.8 has been used. This has been checked against current practices around New Zealand (referring solely to Auckland) and a number of cities around Australia where MRT has been planned or implemented, including Sydney and Brisbane, along with Australian Transport Modelling (T1) Guidance. In particular, we have checked that the relativity of the IVT factors between rail, bus and MRT are within the range assumed elsewhere.

Boarding penalties

Alongside the perception factors, other constants are used to apply costs (time penalties) to certain components of a journey such as stops (nodes) and services (lines), designed to accurately represent the hierarchy of perceived attractiveness across all interchange types and modes.

In general, people perceive high quality interchanges to be more attractive than standard interchanges and perceive premium services (i.e. LRT) to be more attractive than standard services.

Boarding penalties depend on stop quality and characteristics of the various interventions being considered. High quality stops with good waiting facilities would have lower boarding penalties; it is envisaged that the Golden Mile early delivery project would deliver such enhanced stop facilities, with the MRT options delivering a further step change in stop characteristics.

Table 5 below summarises the parameter range that has been used for modelling.

Table 5. Parameters used for WTSM and WPTM modelling of Base and Do Minimum

	Growth	2013 Base	2036 Do Minimum
Global parameters	VoC (fuel)	1.00	1.33
	Parking – HBW Parking – Non-work	1.00	2.04 1.40
	HCV GDP per capita growth	1.00	e=0.9, 1.8%
	Car Ownership	1.00	1.00
	PT Fare	1.00	1.00
	VoT Work VoT Non-Work	1.00	1.40 1.32
	TDM	1.00	3%
Wait time	Headway function	0.25	0.25
Wait time perception factors	Bus	2.0	2.0
	Rail	2.0	1.5 [2]
Walk perception	Standard	2.0	2.0
Boarding penalties	Fare	10	10
	Boarding	3	3
	Pen – bus	10 – 5	10 - 4
	Pen - rail	7 – 2	7 - 2
In-vehicle time perception factors	Bus	1.0	1.00
	Rail	0.9	0.8 [3]

4.5.2 Rail crowding

It is assumed that for the 2036 Do Minimum and Options that only the RS1 improvements will be delivered. This is a much lower level of intervention than was previously assumed and is indicative of small-scale incremental capacity and frequency improvements.

Based on analysis of rail demand vs capacity for the previous Do Minimum, crowding will become an increasing problem on the rail network, resulting in a decline in customer experience and potential changes in behaviour such as peak spreading or modal shift back to the private car.

In order to represent the potential impact of this capacity constraint, the rail in-vehicle time perception factor will be adjusted from 0.85 (2026) to 0.9 (2036) and 0.9 (2046) to reflect the fact that the attractiveness of rail (compared to alternatives) is likely to decrease due to crowding constraints. Note that these changes to IVT factors were informed by research contained in the Australian Transport Assessment and Planning Guidelines (M1) dated July 2019.

The IVT factor of 0.9 was held constant across all options.

4.5.3 Bus crowding and unreliability

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[2] Improvement reflective of rail fleet investment between 2013 and 2018 (2.0 to 1.6) and further improvement from 2030 onwards (1.6 to 1.5)
[3] Recalibrated to 0.85 in 2026 to reflect patronage uplift and increased attractiveness of rail following introduction of Matangi fleet; back casting was used to verify that a factor of 0.85 was appropriate

During the initial IBC investigations, future PT crowding was dealt with using 'out of model assessments' of the potential dis-benefits in the Do Minimum that would be alleviated by the options that would provide higher capacity.

A more representative approach has been developed for this stage of modelling, whereby PT crowding has been represented in the model to reflect both the economic dis-benefits but also changes in modal shift resulting from a higher cost of crowding.

The approach has been developed from an assessment of current crowding on the network. The table below shows observed cordon survey data for people on buses passing the peak load points at the entry to the CBD between 7am and 9am in March 2019; it shows the number of people on buses, together with:

- Number of people on services where the V/C ratio is 100% or more (i.e. all seats taken)

- Number of people standing on bus services

Table 6: Standees and persons on services with V/C ratio greater than 100% - AM peak, 2019, 7am to 9am, peak load points

				Persons on services where Seated V/C ratio greater than 100%	
	Total	Standing	Standees as % of total	Absolute	% of total
Oriental Parade	478	76	16%	346	72%
Elizabeth Street	1,700	93	5%	215	13%
Cambridge Terrace	2,217	670	30%	1,232	56%
Taranaki Street	956	63	7%	195	20%
Willis Street	1,135	154	14%	527	46%
Bowen Street	1,351	316	23%	711	53%
Salamanca Street	597	41	7%	242	41%
Murphy Street	508	63	12%	316	62%
Thorndon Quay	2,663	205	8%	805	30%
	11,605	1,681	14%	4,589	40%

It shows that whilst some corridors are worse than others, between 7am and 9am between 5% and 20% of people are standing at the cordon crossing location

Using the following ATAP factors[4], an estimate of how crowding / standing can change peoples' perception of time can be derived:

- Persons on services where V/C ratio is greater than 100% - factor of 1.2 applied (i.e. every 10 min of travel time would be perceived as 12 due to crowding)

- Persons standing - factor of 1.65 applied (i.e. every 10 min of travel time would be perceived as 16.5 minutes, due to crowding)

Applying these figures to the observed crowding / standing data generates revised link based IVT factors that can be applied to the following sections as shown in Table 7.

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[4] https://www.atap.gov.au/sites/default/files/M1_Public_transport.pdf

Table 7 shows the factors that are applied on a corridor basis for the Do Minimum and example options to reflect the following:

- Crowding on key corridors that will get no worse between the current and 2036 (Metlink fleet growth can accommodate the forecast growth in patronage) but will deteriorate between 2036 and 2046

- Unreliability on the Golden Mile that will worsen through time but be alleviated by MRT or BRT options

Table 7 Crowding and unreliability adjustment factors

Section	Crowding adjustment factor – Do Minimum 2036	DM 2046	Options i, iii and iv	Option ii
Golden Mile unreliability	**1.6 DM**	**1.8 DM**		
Point Jerningham to Courtenay Place (Oriental Parade)	**1.25**	**1.25**	1.25	1.25
Kilbirnie to Courtenay Place (Elizabeth St)	1.06	1.38 (2036 * 1.3 due to unreliability)	1.00	1.00
Wellington Hospital to Courtenay Place (Cambridge Terrace)	1.31	1.70 (2036 * 1.3 due to unreliability)	1.00	1.00
John St to Courtenay Place via Taranaki St	1.08	1.08	1.08	1.08
Brooklyn to Boulcott St	1.18	1.18	1.18	1.18
Karori Tunnel to Lambton Quay	1.26	1.64 (2036 * 1.3 due to unreliability)	1.26	1.00
Kelburn to Lambton Quay	1.13	1.13	1.13	1.13
Murphy Street	1.21	1.21	1.21	1.21
Jarden Mile to Wellington Bus Station	1.11	1.44 (2036 * 1.3 due to unreliability)	1.11	1.00

4.5.4 Modal attractiveness and PT travel times

The attractiveness of travelling by public transport is a function of a number of factors such as:

- Travel times (which itself is a function of PT priority)
- Reliability / variability (also a function of PT priority)
- Vehicle quality

- Quality of interchange and wait facilities
- Crowding

As noted above, crowding and unreliability is accounted for in the 2036 and 2046 Do Minimum and the various option scenarios.

The other components of attractiveness are as noted, PT travel times, vehicle quality and infrastructure quality. This section outlines how these are treated for the various programme modelling tests.

4.5.5 Perceptions of travel time

Perceptions of travel time are modelled as follows for both infrastructure and vehicles:

Infrastructure

- Highest quality MRT / BRT infrastructure, fully segregated, signal priority = perception factor of 0.9 (compared to 1.0 for street running in with general traffic)
- Medium quality, mostly segregated, continuous bus lane standard, priority at signals = perception factor of 0.925
- Targeted priority, partial bus lanes, some signal priority = perception factor of 0.95

Vehicles

- MRT (LRT or Trackless Tram) – highest quality, up to 200 capacity, perception factor = 0.9
- BRT – high quality, articulated electric buses, up to 130 capacity, perception factor = 0.95
- Enhanced bus / bus – assumed to be standard Metlink electric vehicles as delivered through Metlink fleet evolution strategy, perception factor = 1.0

The perceived in-vehicle time on a particular link is a function of both the infrastructure and vehicle attractiveness.

The table below summarises what a 20-minute journey would be perceived as under different combinations – it shows that travel times could be perceived as taking 4 minutes less (i.e. a 20% improvements) due to the benefit of investing in the fleet and infrastructure.

Table 8: Perceived journey times by vehicle type

Section	Highest quality infrastructure (0.9)	Higher quality infrastructure (0.925)	Targeted priority (0.95)	No priority
MRT (LRT / Trackless Tram)	16.2	16.65	17.1	18
BRT	17.1	17.575	18.05	19
Bus	18	18.5	19	20

4.5.6   Vehicle assumptions – Programme Modelling

The table below summarises the vehicle assumptions for the various programme options for typical journeys:

Table 9: Vehicle types used in short listed programme options

Section	Option i	Option ii	Option iii	Option iv
Miramar to CBD	Enhanced bus	BRT	Enhanced bus	Enhanced bus
Airport to CBD	Enhanced bus	BRT	Enhanced bus	Enhanced bus
Karori to CBD	Enhanced bus	BRT	Enhanced bus	Enhanced bus
Johnsonville to CBD	Enhanced bus	BRT	Enhanced bus	Enhanced bus
Island Bay to CBD	**MRT**	BRT	**MRT**	**MRT**
Newtown to CBD	**MRT**	BRT	**MRT**	**MRT**

4.5.7   Strategic modelling parameters

This section documents, with rationale, the parameters that are used in WTSM / WPTM for the Do Minimum and Options.

Vehicle operating costs

This is assumed to increase at a rate equal to GDP/capita and a multiplier of 1.05 to 1.2 (depending on modelled year), based upon an assumption that costs of owning and driving a car will increase at a moderate rate independently of technological changes (i.e. if Electric Vehicles become more common, it is assumed that other methods to obtain road user charges will be implemented resulting in the cost of operating a motor vehicle continuing to increase).

Parking price – applied only to trips that begin or end in the Wellington CBD.

The parking charge is calibrated to ensure that car trips to the CBD during the AM peak remain relatively constant through time – this is what has been observed in reality over the last 10 to 15 years.

A component of the cost of parking is a "proxy" in WTSM to account for the fact that WTSM does not fully capture intersection delays and the costs / inconveniences associated with vehicles circulating to try and find a car park in the central city.

This approach is considered appropriate for a strategic demand model and results in an approximate 100% increase in commuter parking charges in Wellington CBD between 2013 and 2036. Evidence gathered for the LGWM parking levy suggests that over the last 5 years – a period of strong economic growth – shows that commuter parking charges in Wellington CBD have increased by around 40% to maintain the balance between supply and demand, suggesting that a 100% increase out to 2036 is not implausible.

HCV Trips

It is assumed that HCV trips (approximately 5% of trips within region) increase at a rate equal to GDP and a multiplier of 0.9, a relationship that is based upon medium term trends.

Car Ownership

The modelling of car ownership in WTSM uses an implicit assumption that if car ownership increases and all other factors are equal, this will equate to more people driving and an increase in VKT/capita.

In recent years, however, car ownership has increased while VKT/capita within the Wellington Region has remained relatively unchanged, suggesting that people are owning more cars but travelling less distance (or using their cars less frequently).

Based on these observations, no growth in car ownership is assumed in WTSM, reducing the rate of growth in car trips compared to what has historically been assumed and modelled.

Whilst relatively simplistic, this approach is considered appropriate and based on empirical data. Note that further adjustments to car ownership is applied under the higher intensified land use scenarios.

PT fares

It is assumed that PT fares will not increase (in real terms), based upon recent trends and an assumption that there will be active measures to keep PT attractive relative to the private car.

Summary

Whilst the broad structure and underlying relationships that underpin WTSM date from 2001, the forecasting assumptions outlined above have been revised specifically to reflect a future that reflects a continuation of recent trends, namely flat / decreasing VKT per capita, net growth in commuter trips to Wellington CBD attributable to PT and active modes, no increase in car trips to CBD at peak times.

4.5.8 Active modes

Active mode improvements are a significant part of the City Streets package, with improvements to walking / cycling provision delivered on key corridors entering the CBD and within the CBD.

This has been represented in the model by the application of alternative specific constants (ASC) to change the attractiveness of walk / cycling, drawing on and benchmarked against what was undertaken for City Streets.

Walk ASC adjustments

The following ASC adjustments were made to increase the attractiveness of walking from particular sectors:
- Intra CBD (1,2,3) = -10
- 5,6,7,10,12 to / from CBD = -15
- 8,9,11 to / from CBD = -10
- 13,14,16 to / from CBD = -15
- 15,17,18,23,24 to / from CBD = -10

Cycle ASC adjustments

The following ASC adjustments were made to increase the attractiveness of cycling from particular sectors:
- Intra CBD (1,2,3) = -10
- 5,6,7,10,12 to / from CBD = -15
- 8,9,11 to / from CBD = -20
- 13,14,16 to / from CBD = -15
- 15,17,18,23,24 to / from CBD = -20

The sector system is shown below – the greatest improvements are forecast from areas to the south and east that will benefit from both City Streets and MRT / SHI investments
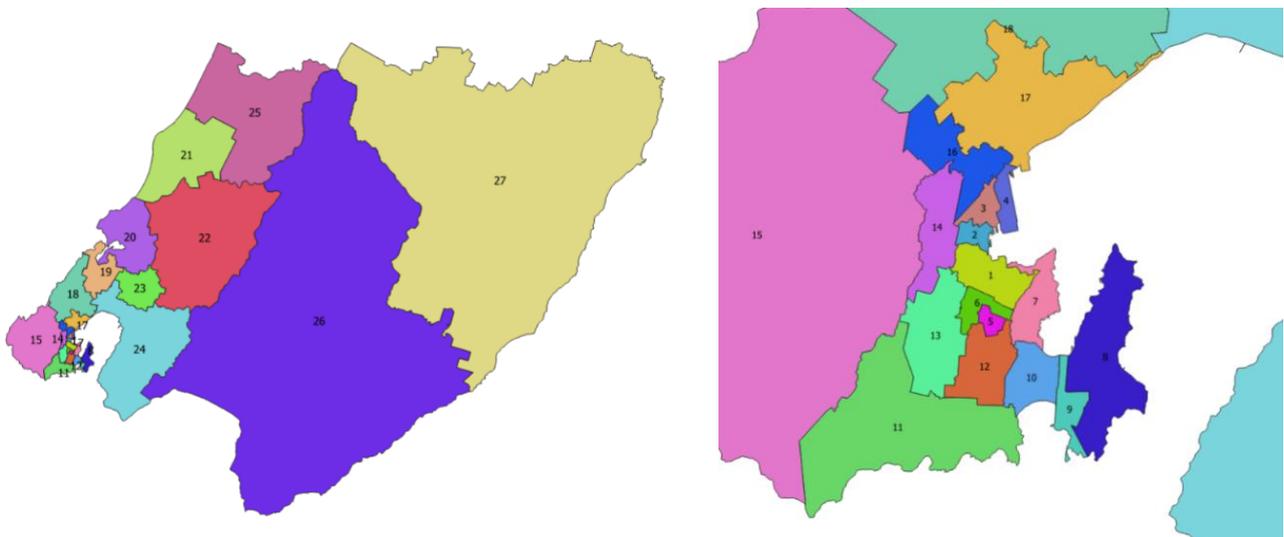

Figure 2: Active Modes Sector System

A sensitivity test has also been undertaken without any active mode improvements assumed; this is documented in Section 7.

4.5.9   Land use

A land use sensitivity test was undertaken to model the impact that a redistributed land use scenario, with growth focussed on the MRT corridor, might have on PT patronage and other project outcomes.

These can be considered 'what if" tests, with the population and employment assumptions developed from work undertaken by The Property Group (TPG)[5] to understand development potential along the MRT corridor.

The revised land use assumptions also include revised car ownership assumptions for the areas where additional medium to high density residential growth is being planned, to reflect the fact that there would be lower levels of car ownership in these areas.

The approach taken for car ownership was as follows:

- CBD – assume similar low levels of car ownership for future development
- Newtown / Adelaide Rd – assume that through time, average car ownership would reduce to levels equivalent to those in the CBD
- Southern suburbs – more modest reduction in car ownership due to intensification in Berhampore and, to a lesser extent, Island Bay
- Eastern suburbs - more modest reduction in car ownership due to limited intensification opportunities to eastern suburbs

Table 10 below summarises the car ownership assumptions

Table 10. Car ownership for all programme options

Programme	Area	Year		
		2013	2036	2046
All	CBD	0.7	0.5	0.5
	Mt Cook/Newtown	0.9	0.6	0.5
	South & East	1.3	1	1

The forecast population figures for the various land use scenarios are set out in the following table. Note the following:

- The 2036 / 2046 'baseline' figures are based on the November 2019 population updates and the percentages relate to growth between 2018 and 2036/2046
- The 2036 / 2046 alternative scenarios are developed from the TPG work, with 50% of TPG assumed maximum additional residential growth along the southern and eastern corridors respectively assumed to occur by 2036, with the remainder occurring in the 10 years between 2036 and 2046
- In terms of absolute growth in the table below:
  - o BAU growth = baseline forecast growth between 2018 and the 2036 / 2046 Do Minimum respectively
  - o Abs growth (BAU + MRT) growth = baseline forecast growth between 2018 and the 2036 / 2046 Do Minimum + additional MRT enabled growth
  - o MRT growth = additional MRT enabled growth only

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[5] Let's Get Wellington Moving Urban Development Metrics Report, January 2021

| | 2013 Base | 2018 Estimate | 2036 | | 2036 - 50% growth from TPG work | | | | |
| | | | Abs | change cf 2018 | Population | Change cf 2018 | | | |
						% change	Abs growth (DM+ MRT)	Do Min Growth	MRT generated growth
CBD / te Aro	17,400	19,800	27,200	37%	37,600	90%	17800	7400	10400
Adelaide / Mt Cook	6,400	7,300	10,200	40%	13,450	84%	6150	2900	3250
Newtown	8,700	9,600	11,900	24%	15,150	58%	5550	2300	3250
berhampore / Island Bay	10,800	11,100	12,200	10%	13,500	22%	2400	1100	1300
Kilbirnie / Lyall Bay	9,200	9,500	10,700	13%	11,522	21%	2022	1200	822
Miramar	10,300	10,600	11,100	5%	12,140	15%	1540	500	1040
Strathmore	6,200	6,500	6,500	0%	7,020	8%	520	0	520
Seatoun	2,800	2,900	3,000	3%	3,520	21%	620	100	520
Other	37,000	38,800	40,800	5%	40,200	4%	1400	2000	-600
Western suburbs	27,300	28,000	29,000	4%	28,500	2%	500	1000	-500
Northern suburbs	64,100	67,800	78,100	15%	74,100	9%	6300	10300	-4000
Wellington City	**200,200**	**211,900**	**240,700**	**14%**	**256,702**	**-6%**			**16002**
Lower Hutt	101,100	106,500	116,600	9%	114,100	7%	7600	10100	-2500
Upper Hutt	41,400	44,800	47,300	6%	46,800	4%	2000	2500	-500
Porirua	53,700	58,100	79,400	37%	70,400	21%	12300	21300	-9000
Kapiti	50,700	54,800	62,600	14%	59,600	9%	4800	7800	-3000
Wairarapa	42,400	46,300	50,900	10%	49,900	8%	3600	4600	-1000
Region	**489,500**	**522,400**	**597,500**	**14%**	**597,502**	**14%**			**-4058**

Figure 3: 2036 Land Use Sensitivity Test Assumptions

| | 2013 Base | 2018 Estimate | 2046 | | 2046 - Full Growth from TPG work | | | | |
| | | | Abs | change cf 2018 | Population | Change cf 2018 | | | |
						% change	Abs growth (DM+ MRT)	Do Min Growth	MRT generated growth
CBD / te Aro	17,400	19,800	31,000	57%	51,800	162%	32000	11200	20800
Adelaide / Mt Cook	6,400	7,300	11,200	53%	17,700	142%	10400	3900	6500
Newtown	8,700	9,600	13,300	39%	19,800	106%	10200	3700	6500
berhampore / Island Bay	10,800	11,100	12,600	14%	15,200	37%	4100	1500	2600
Kilbirnie / Lyall Bay	9,200	9,500	11,600	22%	13,243	39%	3743	2100	1643
Miramar	10,300	10,600	12,000	13%	14,080	33%	3480	1400	2080
Strathmore	6,200	6,500	6,500	0%	7,540	16%	1040	0	1040
Seatoun	2,800	2,900	3,100	7%	4,140	43%	1240	200	1040
Other	37,000	38,800	42,000	8%	40,800	5%	2000	3200	-1200
Western suburbs	27,300	28,000	30,100	8%	29,100	4%	1100	2100	-1000
Northern suburbs	64,100	67,800	83,200	23%	75,200	11%	7400	15400	-8000
Wellington City	**200,200**	**211,900**	**256,600**	**14%**	**288,603**	**36%**			**32003**
Lower Hutt	101,100	106,500	124,500	17%	119,500	12%	13000	18000	-5000
Upper Hutt	41,400	44,800	51,400	15%	50,400	13%	5600	6600	-1000
Porirua	53,700	58,100	87,500	51%	69,500	20%	11400	29400	-18000
Kapiti	50,700	54,800	68,600	25%	62,600	14%	7800	13800	-6000
Wairarapa	42,400	46,300	54,800	18%	52,800	14%	6500	8500	-2000
Region	**489,500**	**522,400**	**643,400**	**23%**	**643,403**	**23%**			**-8117**

Figure 4: 2046 Land Use Sensitivity Test Assumptions

4.5.10 Congestion Charge

PwC were commissioned by the programme to undertake a study of congestion charging. The PwC recommended congestion charge assumptions were used to inform this sensitivity test. A congestion charge was modelled as an incremental additional test building on the high land use scenario using the following assumptions:

- Cordon inside of SH1
- $3.50 inbound in AM peak, $1.75 inbound / outbound in Inter-peak, $3.5 outbound in PM peak

The approach for modelling assumed that the $3.50 charge (in 2013 dollars) is applied to all vehicles crossing the cordon. In terms of implementation, the $3.50 is factored down by 0.76 to 'deflate' to a 2001 price base.

Therefore, in reality, a $3.50 charge in 2013 would (taking into account inflation) be more like $5 if implemented today.

5   Programme Level Assessment

5.1 LGWM Programme Overview

This section of the report summarises the performance of the Programme Affordable Short List Options using the KPIs[6]. Analysis was undertaken to determine a best scoring programme options[7] using detailed modelling discussed below.

5.2 KPI 1.3 Attracting traffic off city streets

The following graphs show the change in volumes across four screenlines between the base (2013), Do Minimum (2036) and Programme Affordable Short List Options (2036). In summary these show:

- Traffic is generally forecast to increase across all of the screenlines between 2013 and 2036 without any LGWM interventions by between 3 and 15% depending on the screenline. This is caused by increased population and employment across the region.
- Traffic volume increases vary depending on the location of growth. It is influenced by location of growth and available capacity.
- The options generally see a reduction in traffic demand relative to the Do Minimum. This reflects the effectiveness of the elements of the LGWM programme in encouraging mode shift. The Northern screenline sees a reduction in demand due to the removal of traffic capacity on Lambton Quay and Customhouse Quay. Similarly, the Te Aro screenline sees a reduction in demand due to the removal of traffic capacity on Courtenay Place. In both cases, although there are some increases on other roads in the screenline, the removal of capacity does indicate an overall reduction in traffic demand.

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[6] Criteria include – Investment Objectives 1 to 5, Mana Whenua, Noise and Vibration, Heritage and Archaeology, Social, Economic incl. Business Disruption, Landscape and Visual, Contaminated Land, Engineering and Property Difficulty and Scaleability
[7] LGWM MRT and SHI Programme Affordable Short List Options Report
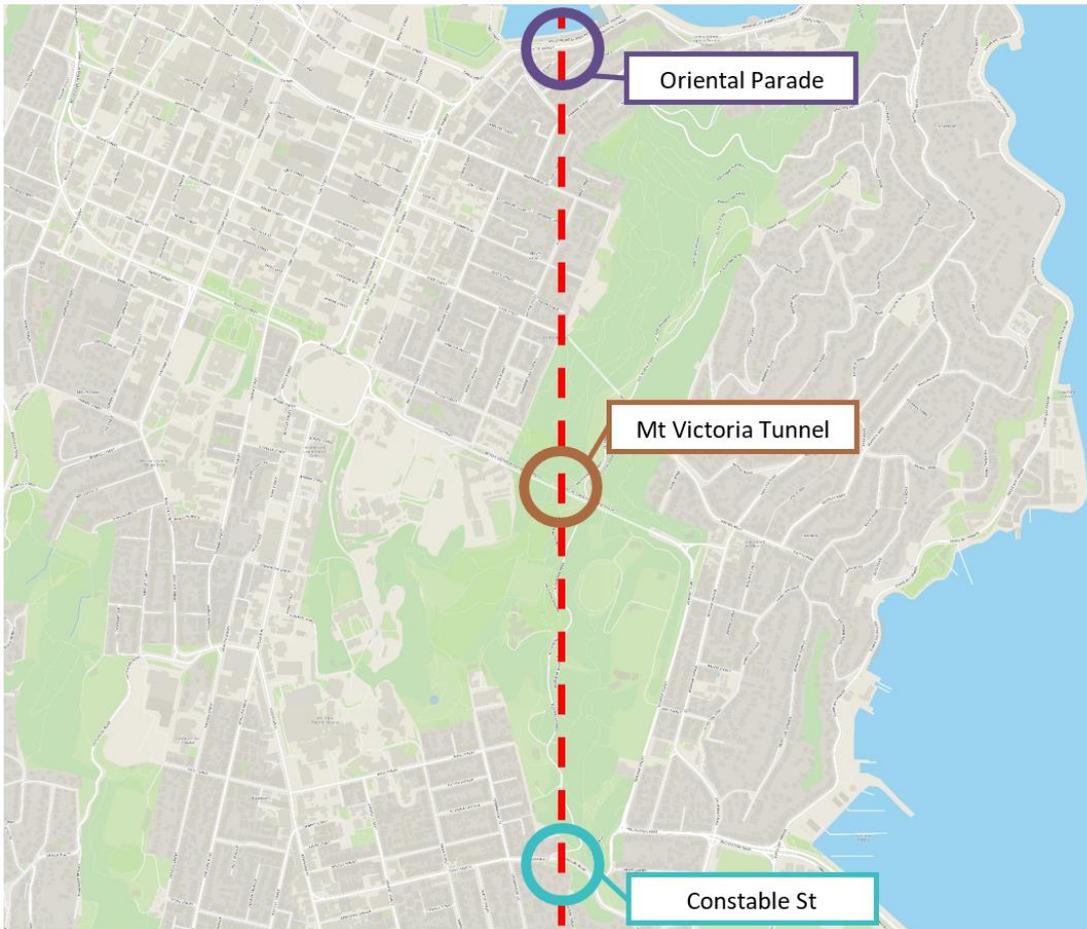
Figure 5: Eastern screenline route
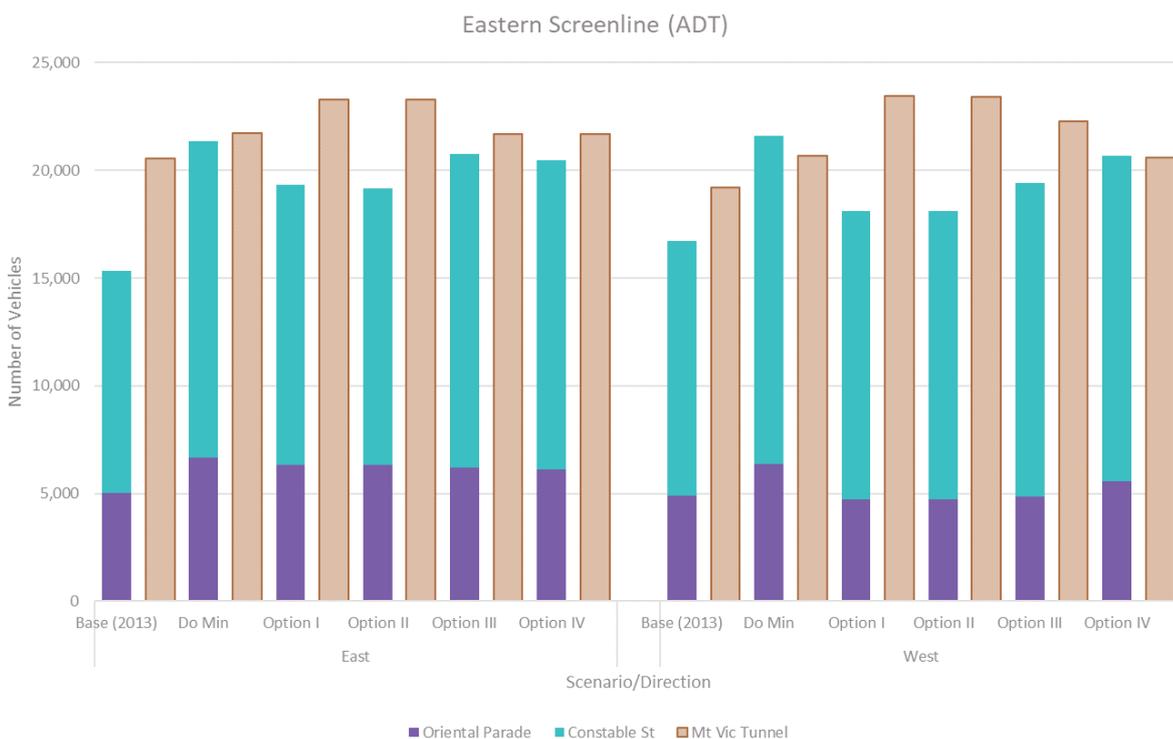
Figure 6: Eastern screenline for Programme Options
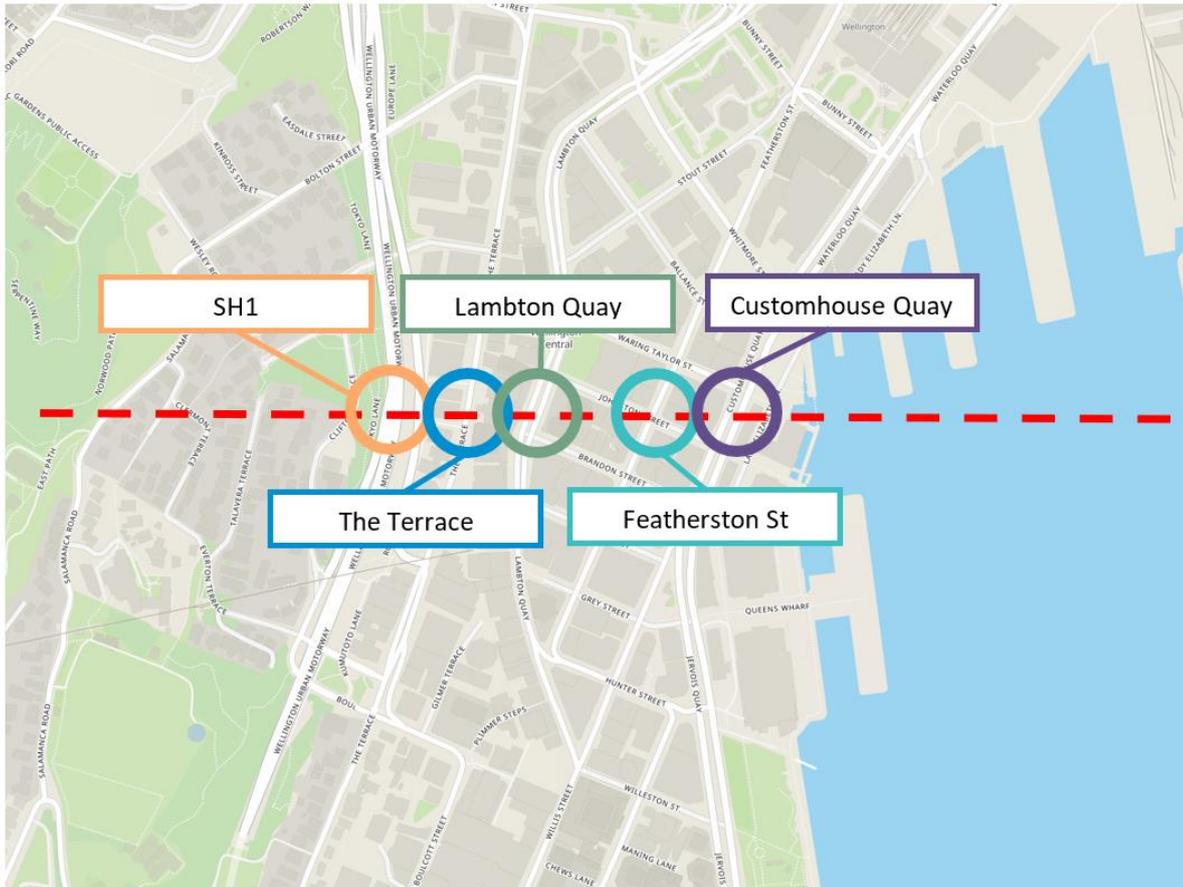
Figure 7: Northern screenline route
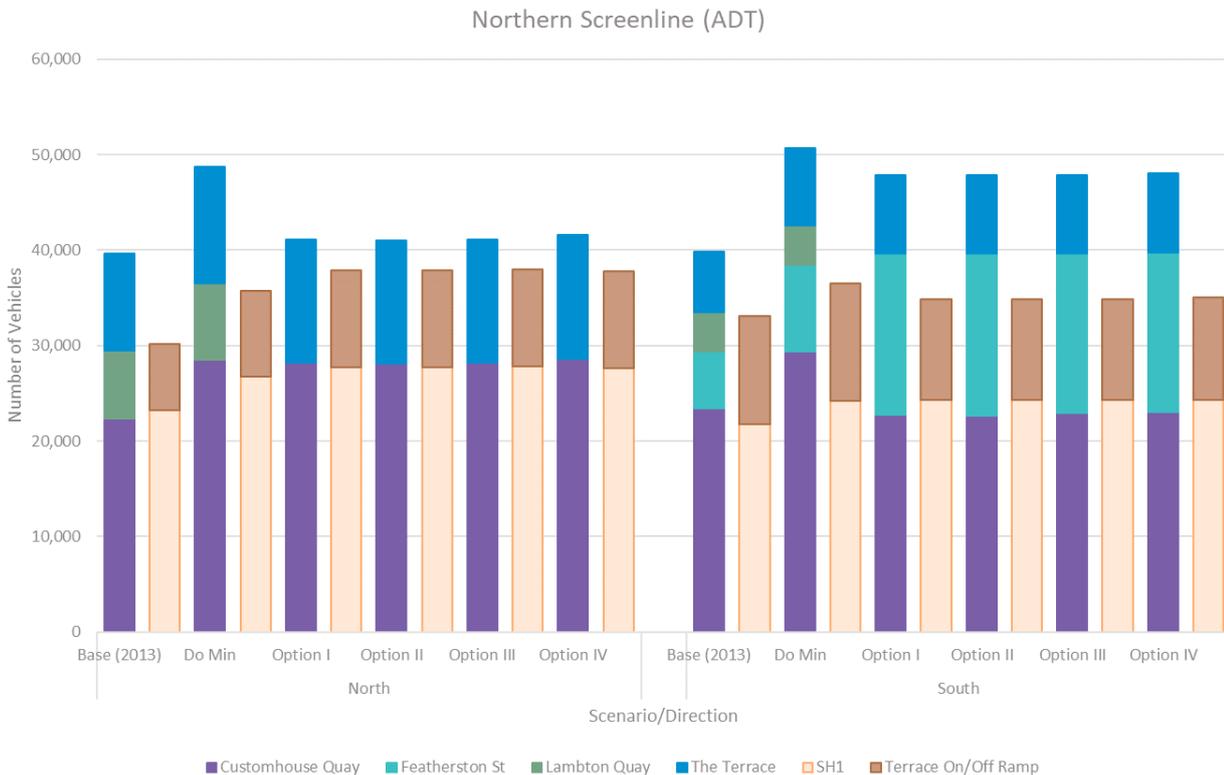
Figure 8: Northern screenline for Programme Options
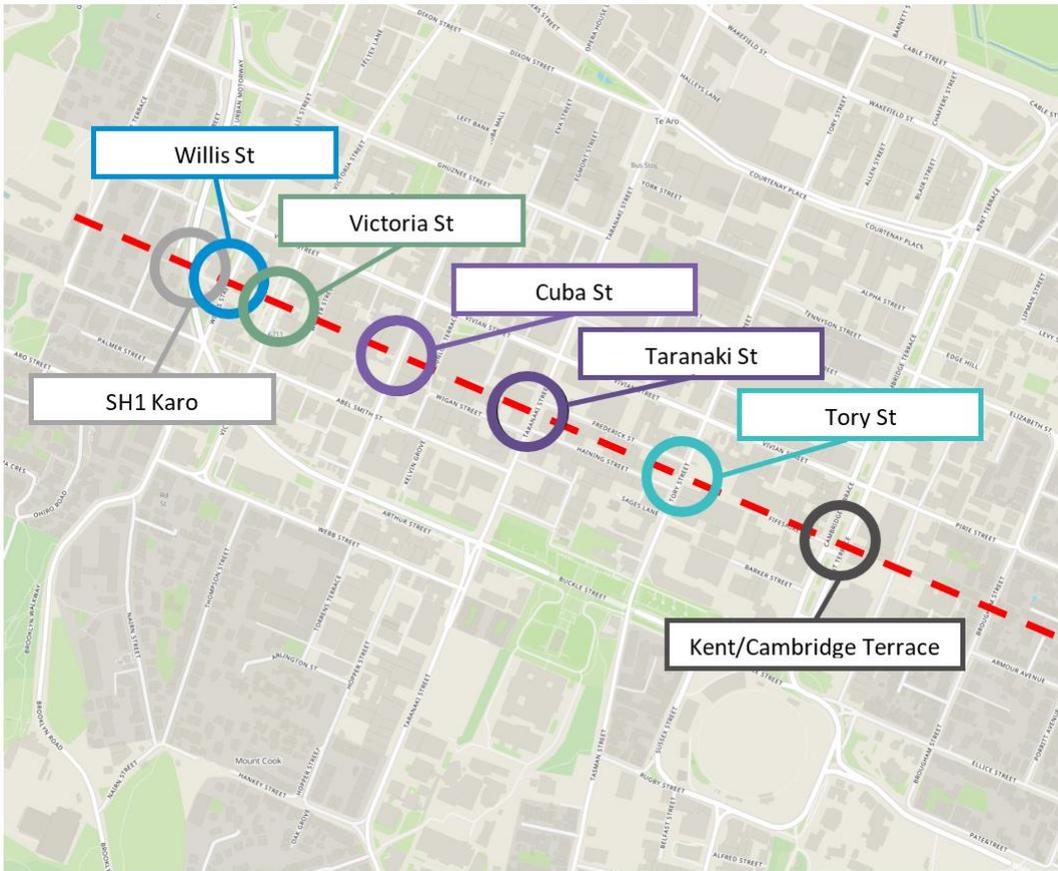
Figure 9: Southern screenline route
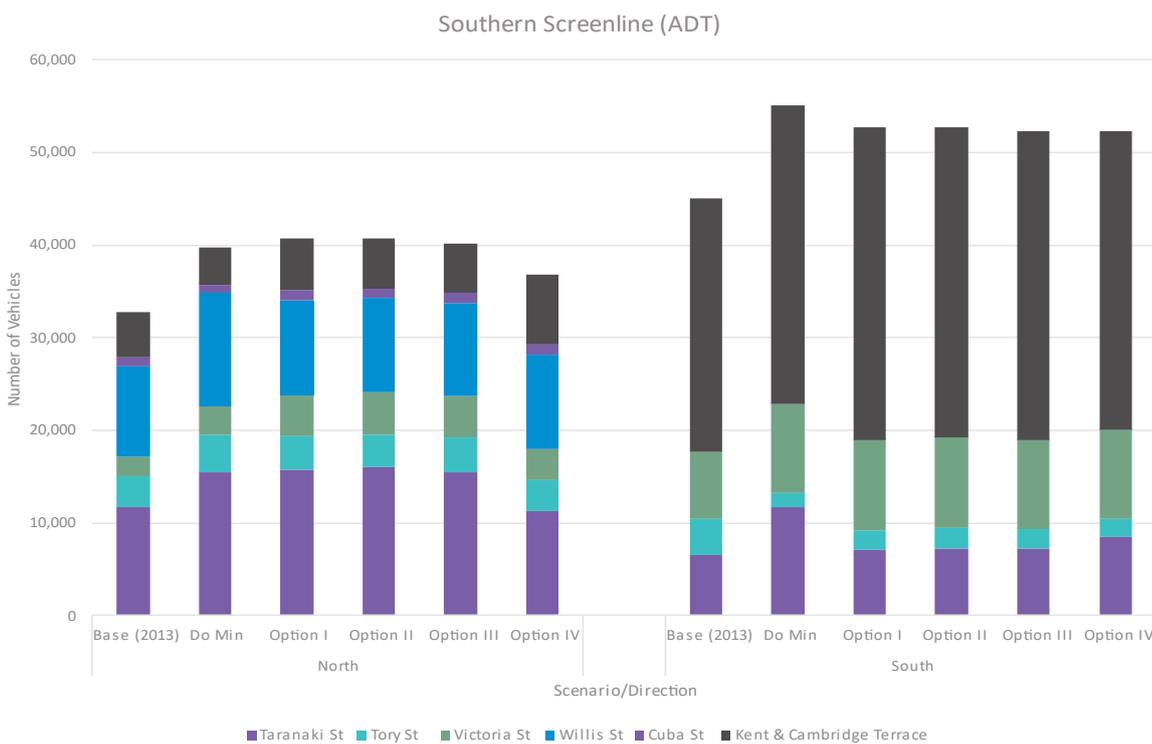

Figure 10: Southern screenline for Programme Options

Figure 11: Te Aro screenline route

Te Aro Screenline (ADT)
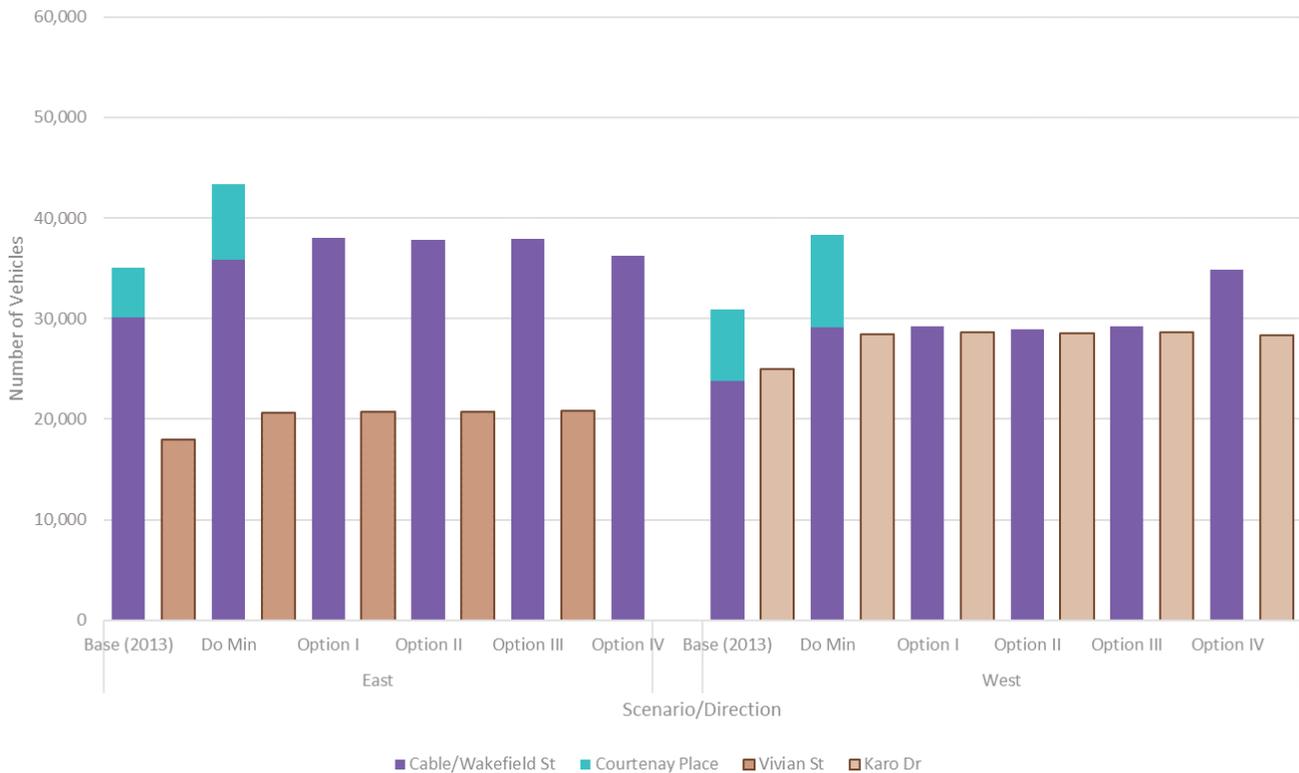
5.3 KPI 2.2 Travel time Reliability

The following table and graphs demonstrate the performance of the various programme options in terms of the "Travel time Reliability" KPI.

- The table shows the change in travel time reliability for general traffic between the Base, Do Minimum and the various programme options.
- Overall, all options will have a reduced reliability when compared to the Do-Minimum.
- Options i and ii show a greater deterioration in travel time reliability for key strategic routes compared to Options iii and iv, although the difference is relatively marginal. This is a reflection of the reallocation of road space in favour of public transport and active travel in these programme options.
- Although public transport reliability has not been specifically reported (PT travel times are an input to the model rather than an output), the level of investment in PT priority through MRT/BRT and the City Streets programme will result in significant improvements. For the dedicated MRT corridors, close to 100% reliability will be achievable. Bus priority will also deliver reliability improvements. As such, it is anticipated that the programme options with the highest amount of dedicated infrastructure (Options i and ii) will deliver the best reliability outcomes

Table 11: Buffer Index for Programme Options – General Traffic

Buffer Index	AM						PM					
	Base (2013)	DM	Option i	Option ii	Option iii	Option iv	Base (2013)	DM	Option i	Option ii	Option iii	Option iv
Johnsonville - Airport	71%	85%	95%	97%	88%	89%	55%	72%	76%	77%	66%	70%
Airport - Johnsonville	53%	64%	78%	79%	73%	67%	47%	64%	83%	83%	74%	70%
Johnsonville - Airport via Customhouse Quay	51%	66%	70%	72%	74%	74%	21%	60%	42%	42%	46%	47%
Airport - Johnsonville via Customhouse Quay	25%	30%	47%	47%	42%	38%	26%	32%	64%	65%	54%	52%
Johnsonville - Hospital	88%	100%	108%	110%	105%	108%	48%	71%	66%	68%	65%	70%
Hospital - Johnsonville	39%	58%	50%	53%	57%	52%	40%	53%	56%	58%	63%	59%
Johnsonville - Hospital via Customhouse Quay	62%	79%	87%	89%	86%	90%	21%	43%	40%	41%	39%	45%
Hospital - Johnsonville via Customhouse Quay	31%	44%	39%	40%	43%	36%	34%	47%	62%	64%	64%	62%
Airport - Bowen St	66%	78%	95%	96%	89%	81%	48%	75%	101%	101%	88%	83%
Bowen St - Airport	59%	74%	83%	85%	73%	76%	72%	88%	93%	93%	81%	85%
Island Bay - Bowen St	20%	23%	22%	23%	23%	23%	11%	14%	17%	17%	18%	17%
Bowen St - Island Bay	52%	52%	59%	60%	57%	57%	20%	38%	38%	38%	37%	37%
Island Bay - Bowen St via Quays	34%	43%	42%	42%	43%	41%	17%	29%	57%	58%	55%	54%
Bowen St - Island Bay via Quays	22%	17%	20%	20%	19%	21%	24%	36%	34%	35%	33%	39%
Karori - Taranaki Street via Glenmore	48%	49%	43%	43%	43%	42%	18%	20%	27%	28%	28%	27%
Taranaki Street - Karori via Glenmore	21%	29%	25%	25%	25%	27%	16%	27%	44%	46%	41%	47%

5.4 KPI 2.3 Comparative travel times

The following section demonstrates the performance of the various programme options in terms of the "Comparative travel times" KPI. This provides information on modelled travel times before evaluating the ratio between private vehicle and PT travel times.

5.4.1 Private Vehicle Travel Times

- Overall, the programme options have a relatively modest effect on travel time for general traffic. Options that include the diagonal tunnel and the removal of conflicts at the Basin Reserve deliver some improvements, particularly for State Highway traffic. Routes that use local roads through the City Centre are forecast to be slightly slower reflecting the prioritisation of other modes.
- Option i and ii will perform slightly better than the other options. Trips that travel on the State Highway between the airport and Johnsonville, for example, are forecast to be 13% faster and trips between Johnsonville and the hospital are forecast to be 9% faster. These figures are 8% and 2% for option iii (reflecting the contribution of the diagonal tunnel in options I and ii). Option iv has very

similar travel times to the do minimum for the airport corridor reflecting the reduced level of investment at the Basin Reserve.

- Trips that use the waterfront corridor are projected to be slower in all options. For example, trips between Johnsonville and the hospital via Customhouse Quay are 8% slower in options I and ii, 11% slower in option iii and 14% slower in option iv.

Private Vehicle Travel Times - AM Peak
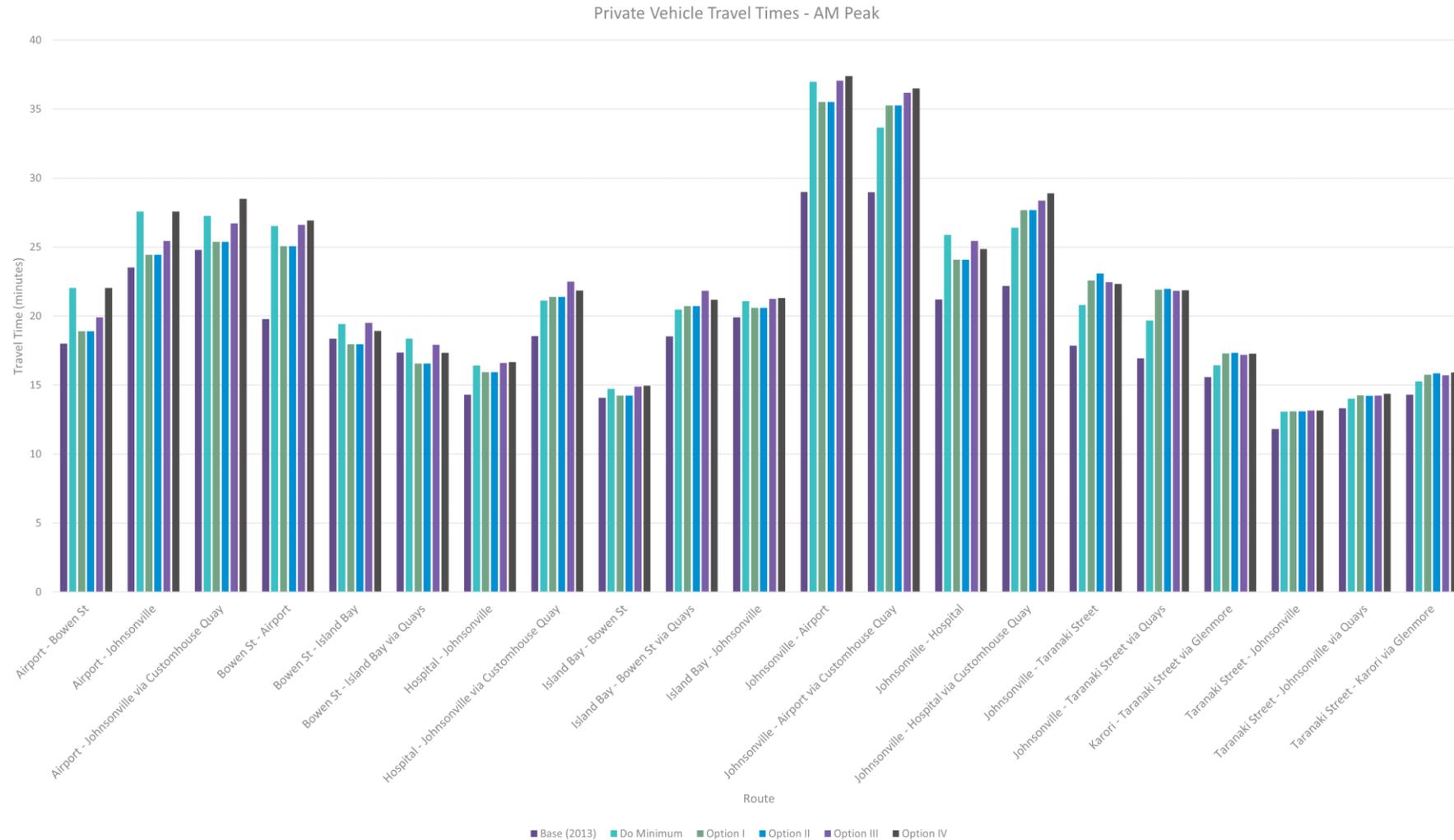
Figure 13. Private Vehicle travel Private Vehicle travel times for selected routes during the AM peak - 2036 do minimum and programme options

5.4.2 Public Transport Travel Times

In general, the graphs indicate that the MRT and SHI programme options will improve travel times.

- All options deliver a significant improvement in travel time from Newtown to the Station, a result of this section having a high level of segregation, fast travel times and high levels of crossing and unreliability under the Do minimum scenario
- Compared to the base (current), the options would deliver up to a 12-minute improvement in travel times to the Wellington Station from the south
- From the east to the CBD, Options i and ii deliver around a 6-minute faster travel time compared to Options iii and iv due to the directness and speed of the new diagonal Mt Victoria tunnel
- Overall, Options i and ii could deliver up to a 16-minute improvement in travel times at peak times, together with improved reliability, for example on the Central Station to Island Bay route (should BRT services extend to the north and west it may be possible to achieve further travel time savings although this hasn't been assumed in the modelling.)
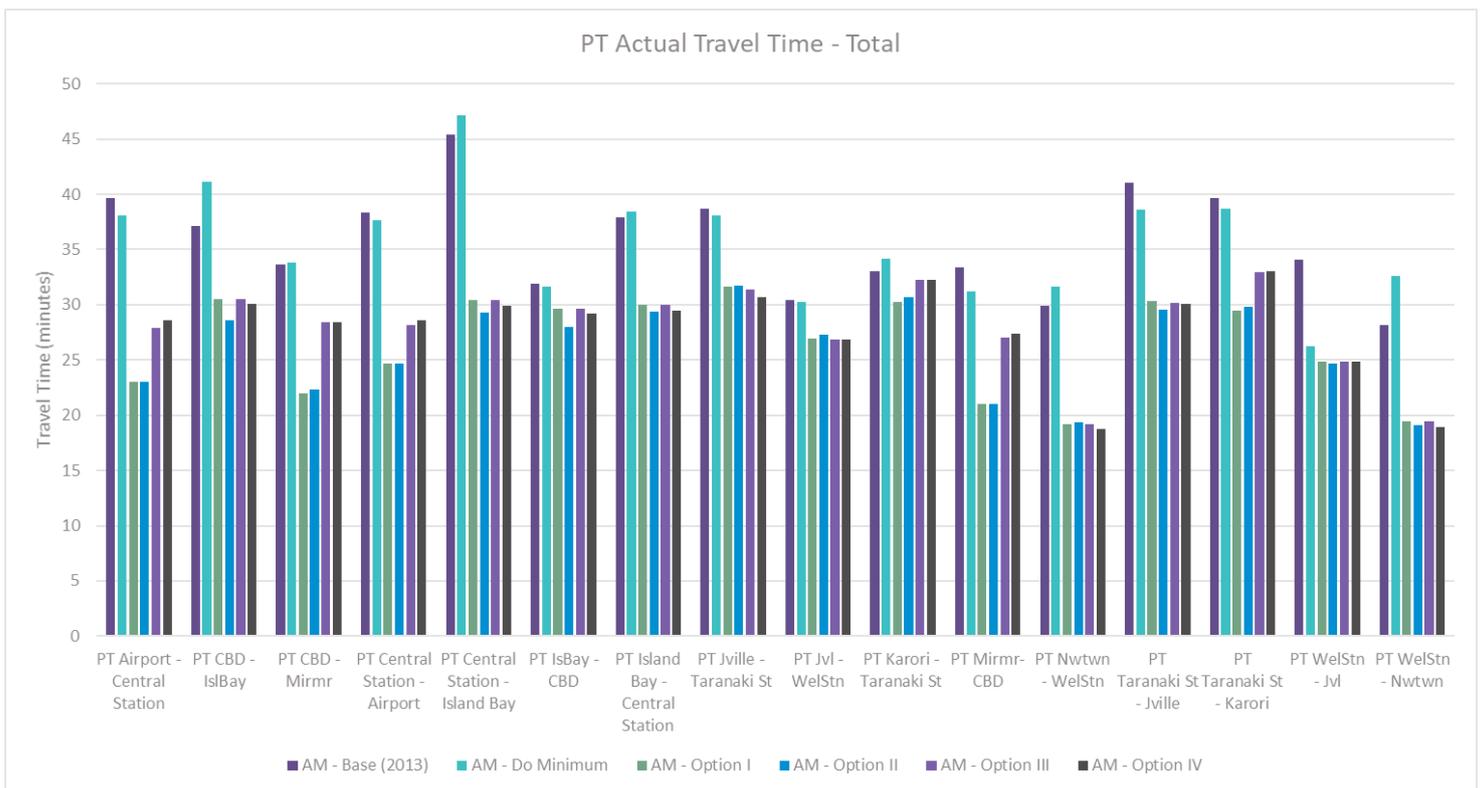
Figure 14: Public Transport Times for Programme Options

5.4.3 Comparative Travel Time Summary

The following tables demonstrate the performance of the various programme options in terms of the ratio between traffic and PT travel times. Numbers greater than one show that private vehicles are faster, whereas number less than one indicate that PT is faster. For example, a figure of 1.40 on the Johnsonville - Taranaki Street route indicates that the PT journey is 40% longer than the equivalent traffic journey These show the following:

- Overall, the tables demonstrate that programme options will improve PT performance relative to the Do Minimum. However, the table also shows that for most routes, with the exception of the Airport travelling by private vehicle will still be faster than using public transport.
- Option ii generally offers the most competitive PT travel times relative to general traffic, followed closely by option i. These options both feature PT via a diagonal tunnel, with Options iii and iv continuing to use the Hataitai bus tunnel. Option ii provides the broadest geographical coverage of PT network improvements.

Table 12. AM Peak relativity between car travel time and PT IVT (total)

Route	Base (2013)	Do Minimum	Option i	Option ii	Option iii	Option iv
Johnsonville - Taranaki Street	2.17	1.83	1.40	1.38	1.40	1.37
Taranaki Street - Johnsonville	3.47	2.95	2.31	2.26	2.29	2.29
Airport - Bowen St	2.20	1.73	1.22	1.22	1.40	1.30
Bowen St - Airport	1.94	1.42	0.98	0.98	1.06	1.06
Island Bay - Bowen St	2.70	2.61	2.10	2.06	2.01	1.97
Bowen St - Island Bay	2.47	2.43	1.69	1.63	1.56	1.58
Karori - Taranaki Street via Glenmore	2.12	2.08	1.75	1.77	1.87	1.87
Taranaki Street - Karori via Glenmore	2.77	2.53	1.87	1.88	2.10	2.08
Seatoun - Bowen St	1.99	1.56	1.36	1.36	1.50	1.42
Bowen St - Seatoun	2.36	1.09	1.20	1.14	1.33	1.27

5.5 KPI 3.1 Mode share to the central city

The following tables and graphs demonstrate the performance of the various programme options in terms of the "Mode share to the central city" KPI. The forecast mode share crossing the CBD cordon, from the eastern and southern suburbs for each of the scenarios is summarised below, relating to the weekday morning peak period.

- Overall, the graphs show that there is little difference between programme options with all programme options delivering an increase in PT patronage relative to the Do Minimum.
- The graph below shows the walk, cycle, PT and car (persons) mode share of cordon crossings in the AM peak in 2036. It shows the following:

- around a 200 to 300 person increase in PT cordon crossings in options iii and iv, but nearer 600 to 700 for Options i and ii
- a similar increase in cycle cordon crossing volumes of around 70% (800 to 900 additional cyclists) in 2036 for all programme options
- an increase of around 1,200 across all option of pedestrians crossing the cordon[8]

- It should be noted that in reality there would likely be a level of cross-over between PT, cycling and walking demand, depending on factors such as the weather.
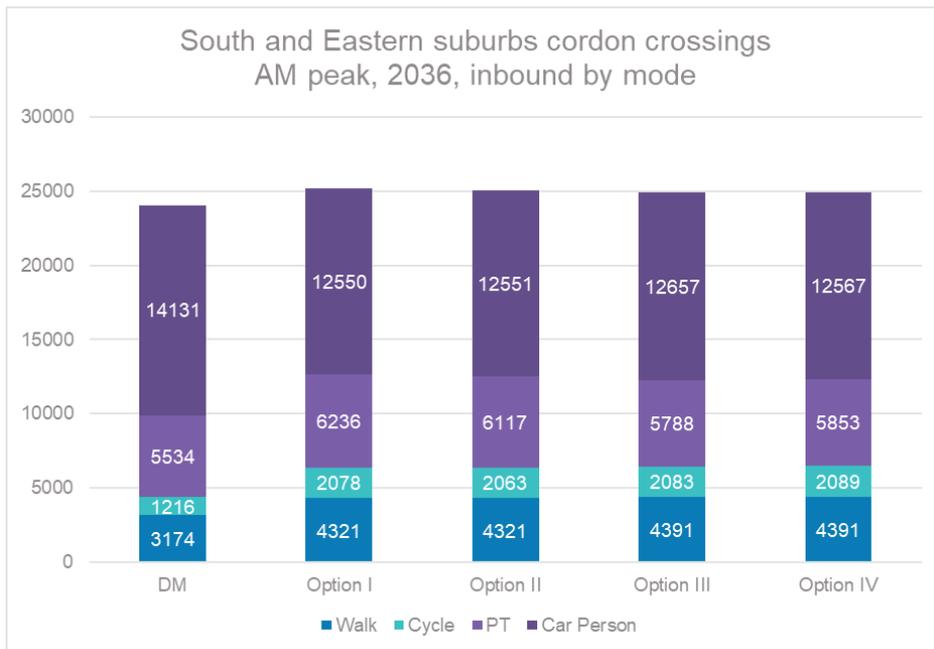
Figure 15. Mode share from Eastern Suburbs to CBD – Do min and Programs (AM)
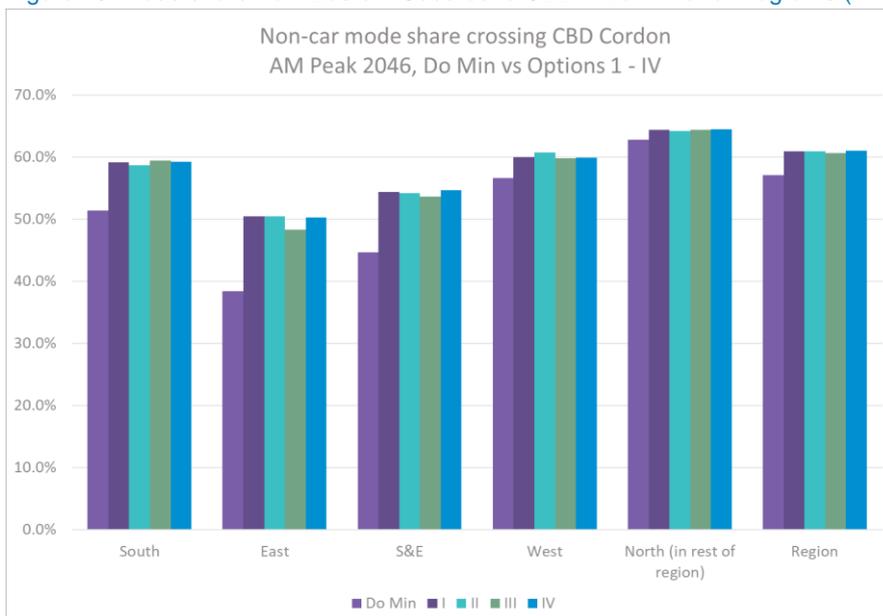
Figure 16. Mode share from Southern Suburbs to CBD – Do Minimum and Programme options (2046, AM Peak)

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[8] Note the pedestrian estimates are indicative based on a proportion of the 24hr walking demand matrix, therefore should be treated with caution

- Figure 9 shows the change in non-car mode share of trips entering the CBD from all directions in the AM peak.
- As highlighted above, the non-car mode share accounts for the potential crossover between PT, walk and cycling
- The information shows that all options increase the non-car mode share of trips, particularly from the southern and eastern suburbs. Options i, ii and iv perform marginally better than option iii in this respect.
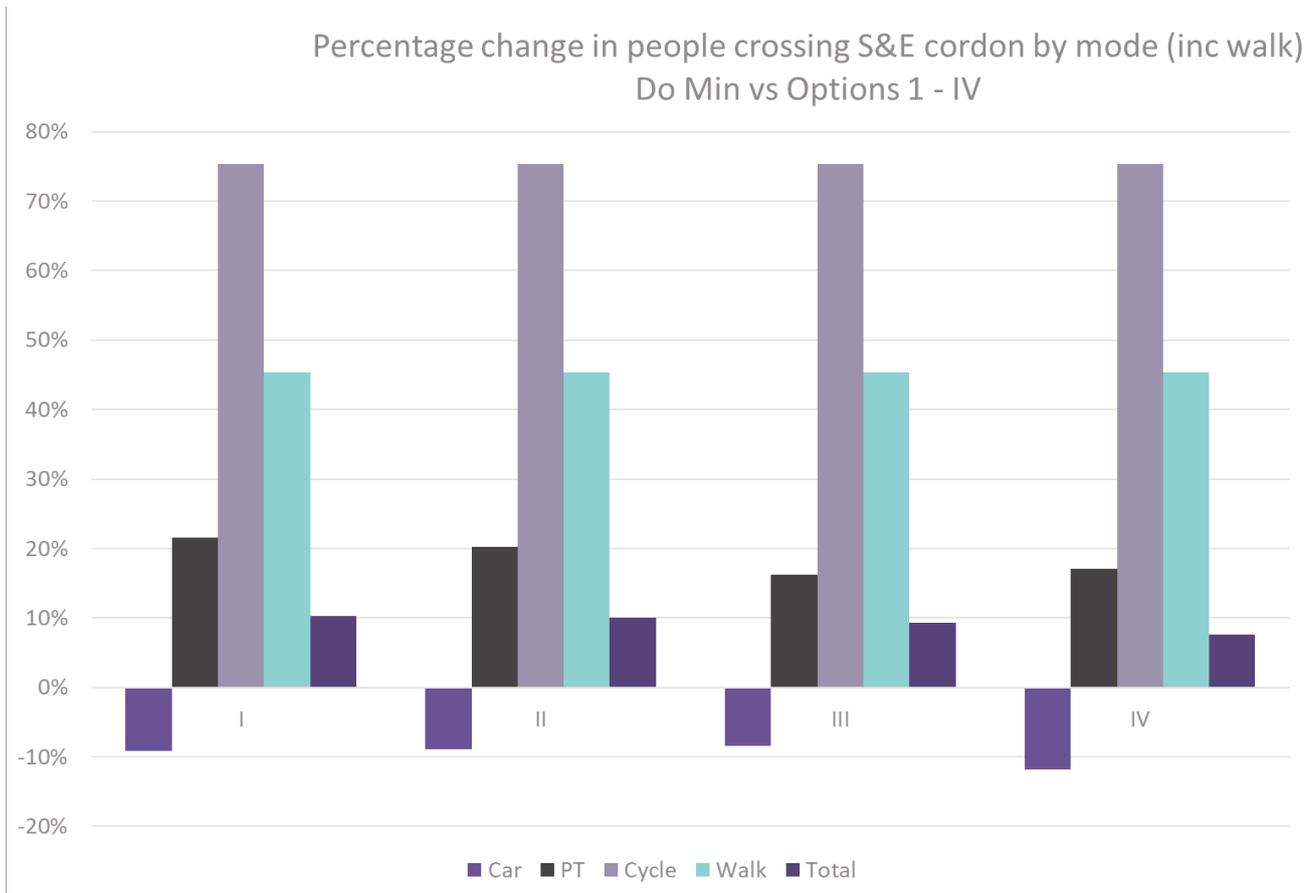
Table 13: Percentage Change in Public Transport Patronage compared to the Do Minimum

5.6 KPI 3.2 Mode share across the region

The following graph demonstrates the performance of the various programme options in terms of the "Mode share across the region" KPI.

- Overall, these show that the programme options deliver a similar level of modal shift across the region (car vs PT).

2036 Vehicle Mode share To CBD - AM Peak
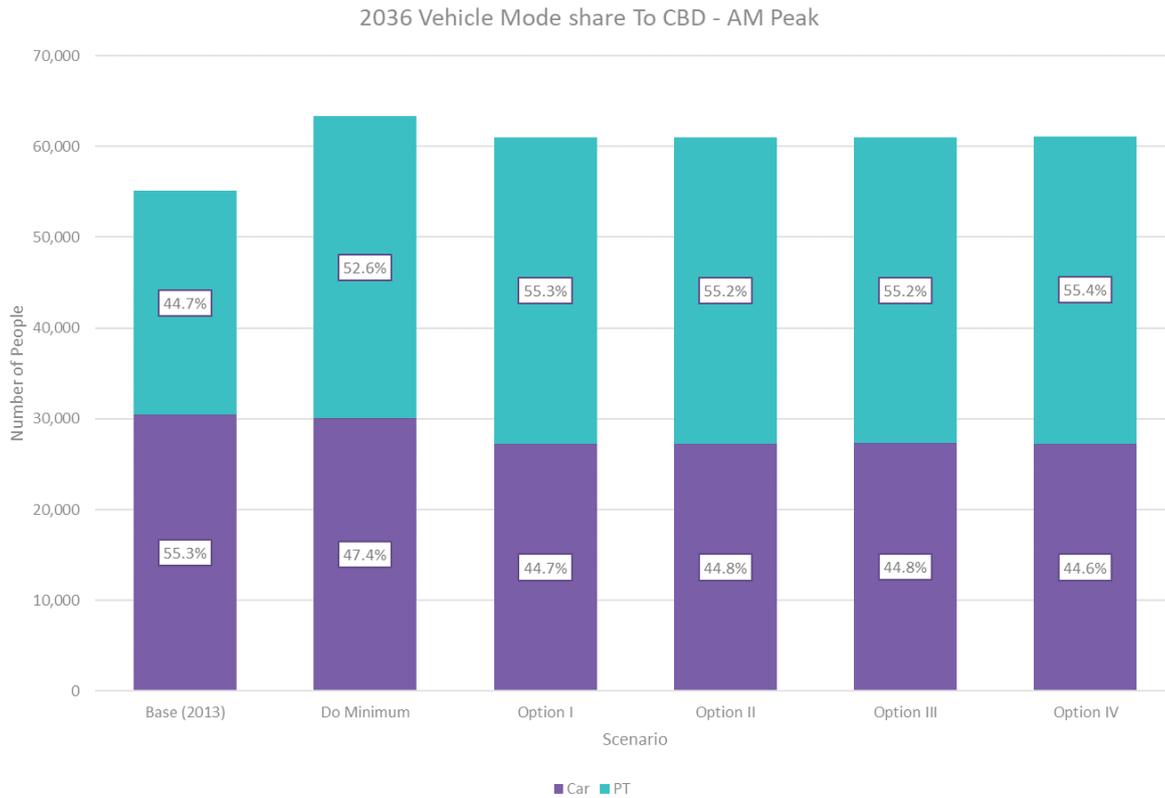
Figure 17: 2036 AM Peak - Vehicle Mode Share to the CBD

Mode share - All Region - AM Peak
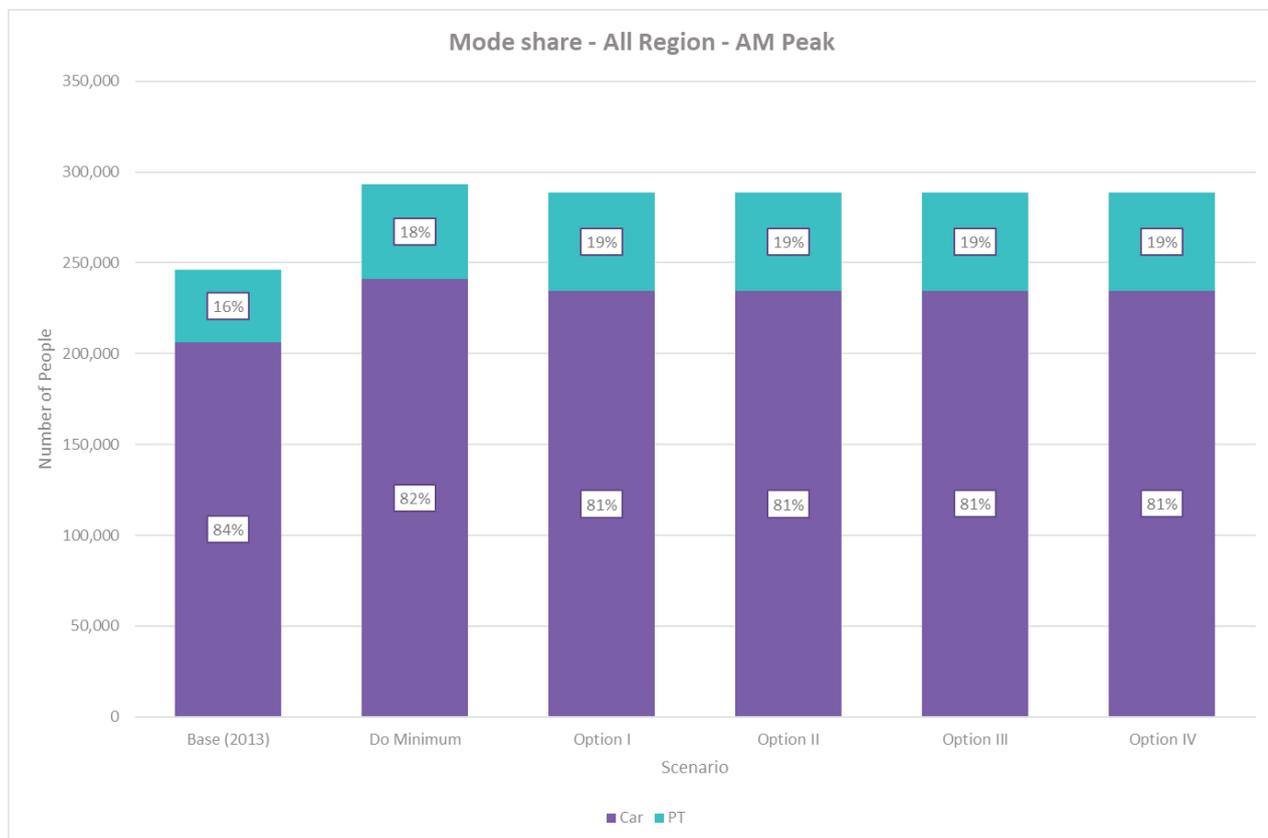
Figure 18: 2036 AM Peak - Vehicle Mode Share through the Region

5.7 Carbon Emissions

Although carbon emissions cannot be produced directly from the modelling, VKT and litres of fuel consumed have been used as a proxy, it is important to note that no changes in fleet mix have been assumed for the purposes of like for lie comparison. These are estimated from the modelling as a function of the following:

- Overall, in the AM peak period, the modelling indicates a reduction in VKT for all programme options relative to the do minimum.
- Option i and Option ii will perform slightly better than Options iii and iv, likely due to the marginally better mode shift.
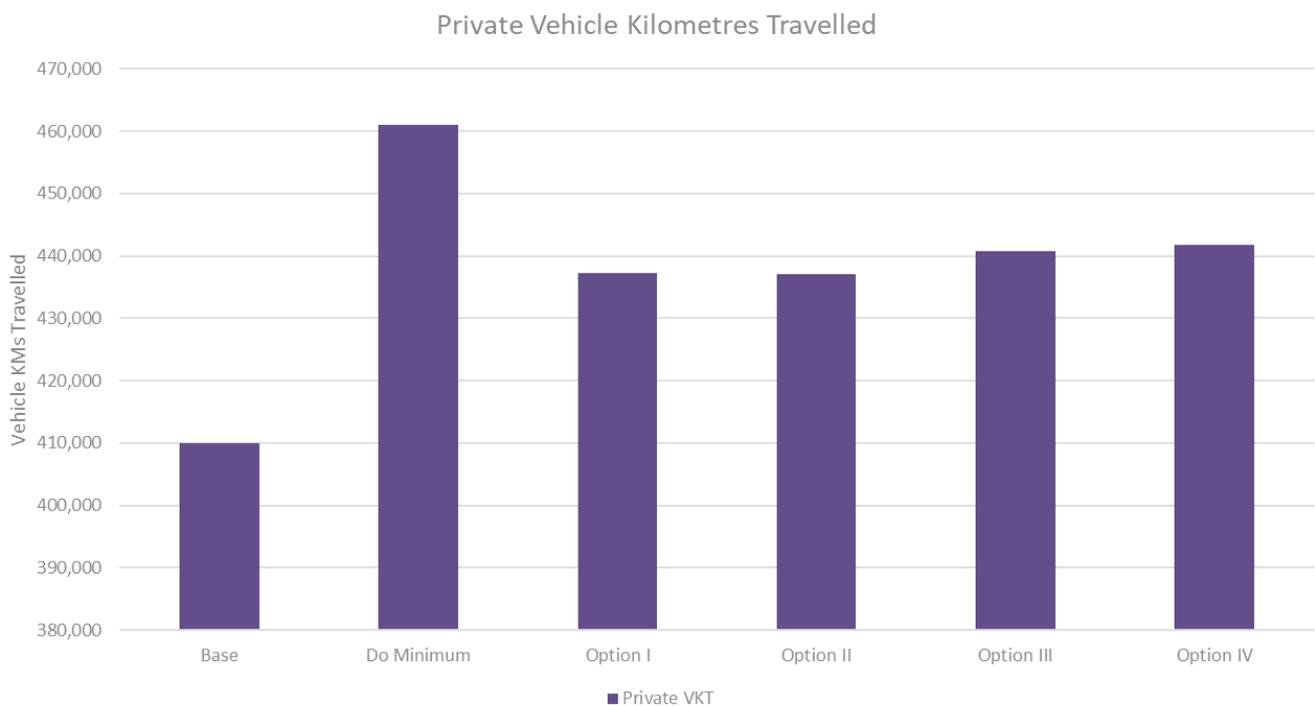
Figure 19: Private Vehicle Kilometres Travelled during the AM peak, 2036

The following graphs show emissions for 2046 by scenario and area – Wellington Region, Wellington City

- Overall, it shows relatively small decreases in fuel consumption (and emissions) across the Wellington Region between the Do minimum and option, with a slightly greater increase in Wellington City given the focus and impact of the LGWM programme is within Wellington City
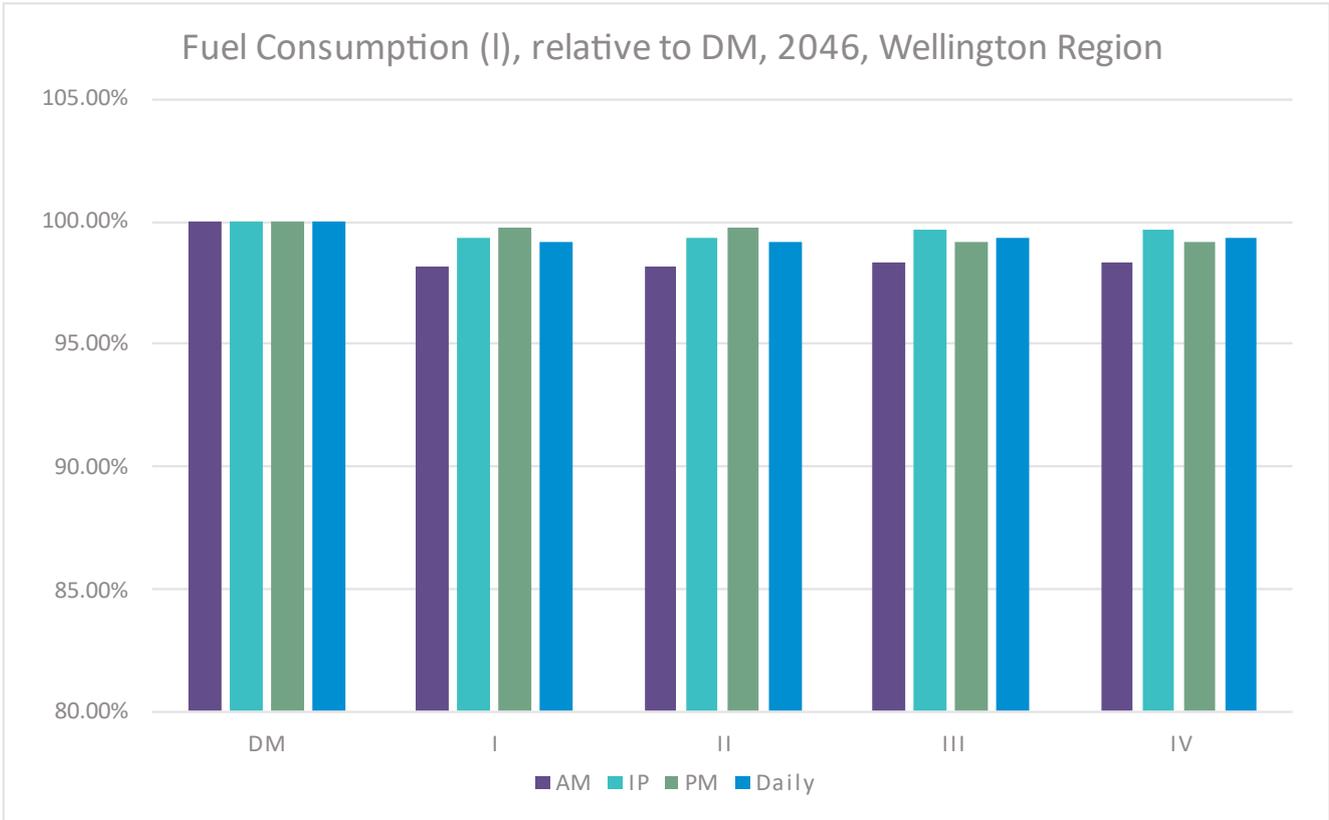
Figure 20: 2046 Fuel Consumption for the Wellington Region
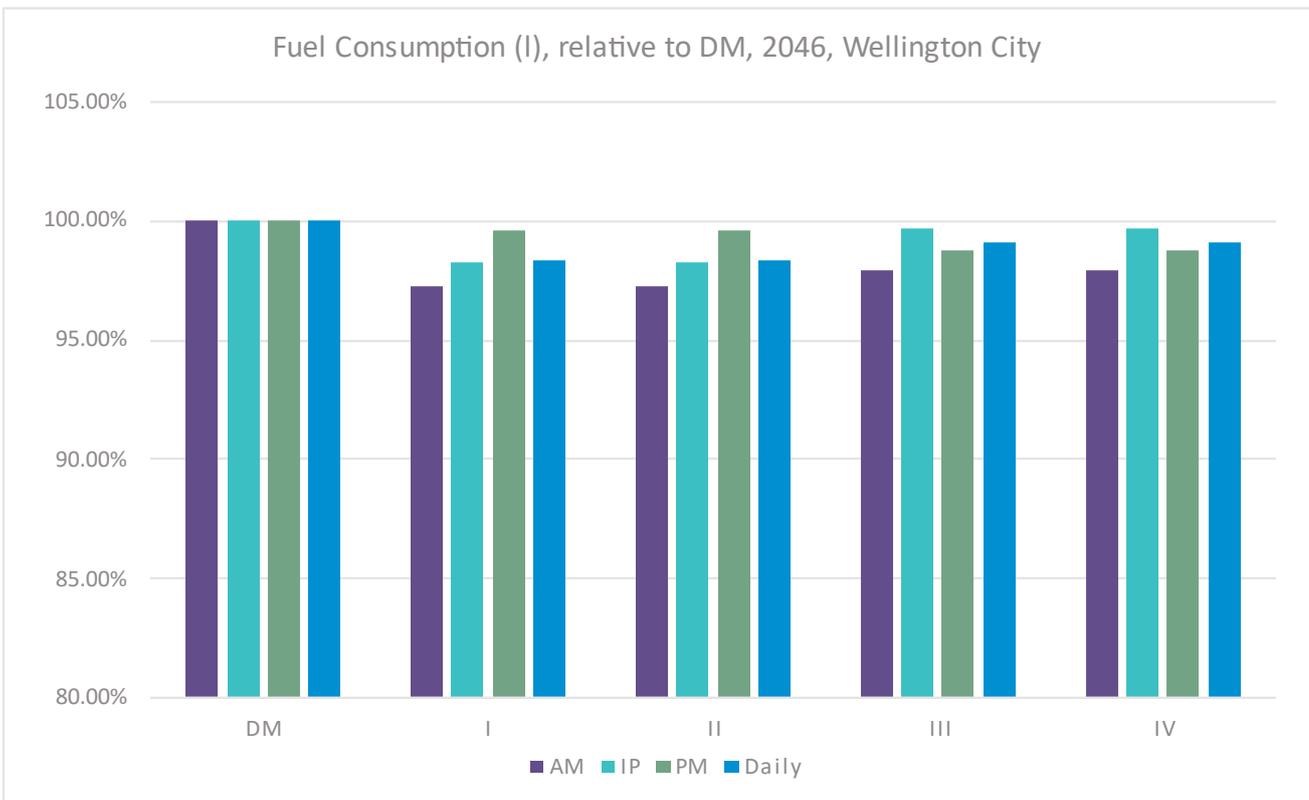
Figure 21: 2046 Fuel Consumption for the Wellington City

5.8 Sectored travel time benefits

The purpose of this report is not to focus on the cost-benefit analysis, as it has been performed separately and documented in the LGWM Programme Report. However, indicative 'rapid' economics on sectorised travel time benefits have been conducted and used for the purpose of understanding the relative differences between the options and the distribution of the benefits streams.

The figures below show daily PT benefits aggregated by origin sector (left) and destination sector (right) for the Options I to IV in 2046, expressed relative to Option ii (100%).
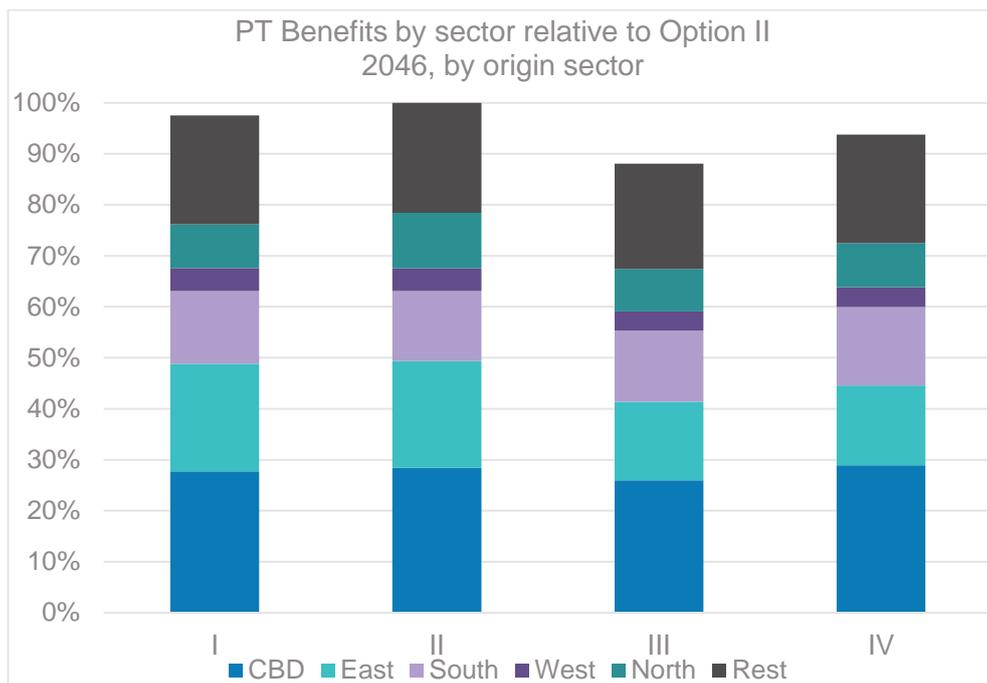
Figure 22: PT Sector Benefits by origin 2046
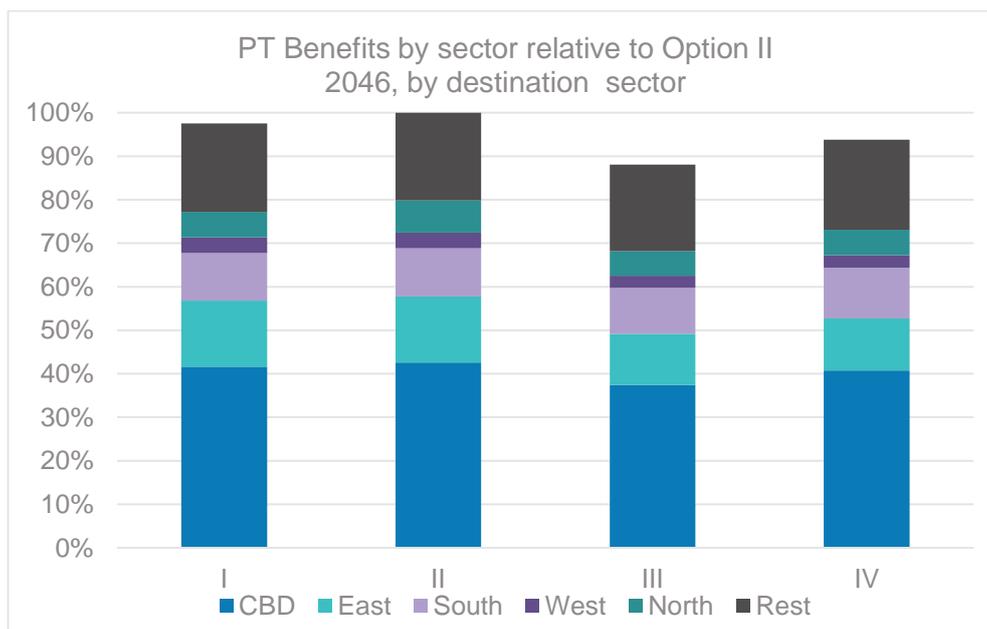
Figure 23: PT Sector Benefits by destination 2046

The analysis highlights the following observations at a high level:

- Southern, eastern and CBD sectors account for the majority of benefits, with lower levels of benefits to the north and west
- There are some benefits for people coming in by rail, due to improved connectivity and transfers from rail to MRT / BRT / bus at Wellington Station
- The assumed MRT vehicle in Option ii provides opportunities to generate marginally higher benefits to the northern and western sectors compared to other options as the vehicles are able to extend beyond the dedicated infrastructure.
- At this stage the relative performance of MRT around the Basin are comparable in option iii and iv, Previous analysis undertaken indicated that an MRT route through Kent/Cambridge Terrace was preferable to Taranaki Street which is not possible under option iv.

The figure below summarises benefits by origin-destination (Option i as an example), further highlighting that whilst benefits are focussed on the south and east there are broader benefits elsewhere as a result of the programme investment.

Table 14: Benefits by origin-destination for Option i

		Destinations					
		CBD	East	South	West	North	Rest
Origins	CBD	1%	9%	6%	2%	4%	7%
	East	14%	1%	1%	1%	1%	3%
	South	9%	1%	1%	0%	0%	2%
	West	3%	1%	1%	0%	0%	0%
	North	8%	1%	1%	0%	1%	0%
	Rest	8%	3%	2%	0%	0%	8%

In terms of highway benefits, the figure below shows benefits relative to the Do Minimum by origin and destination sector (excluding dis-benefits within Wellington CBD – this is due to the overestimation of short distance private vehicle trip within the CBD which is over estimating disbenefits by option).
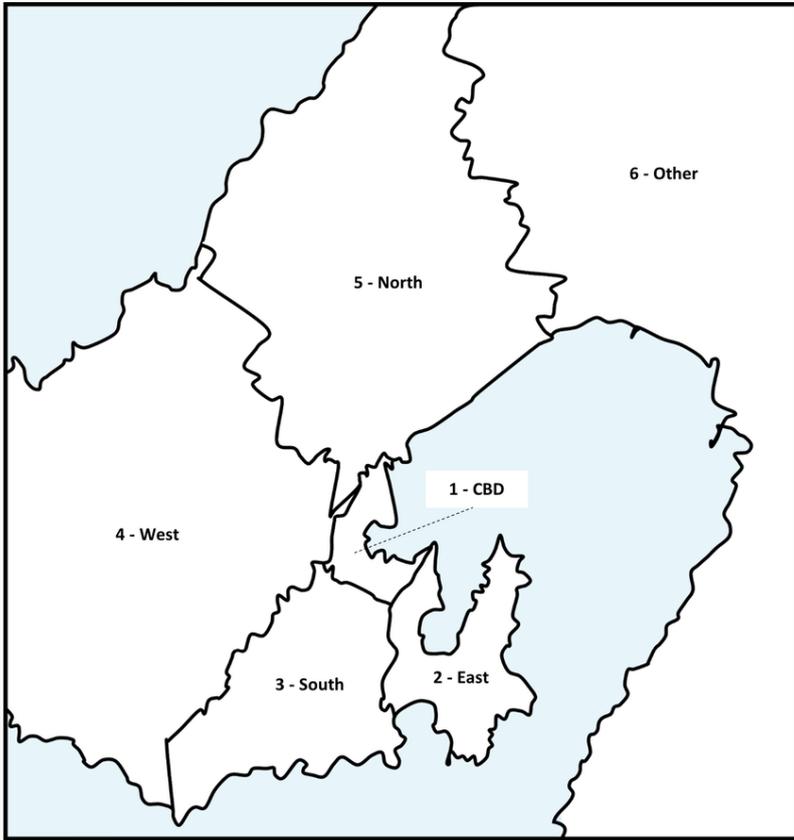
Figure 24: Sectors

Figure 25: Highway benefits by origin sector
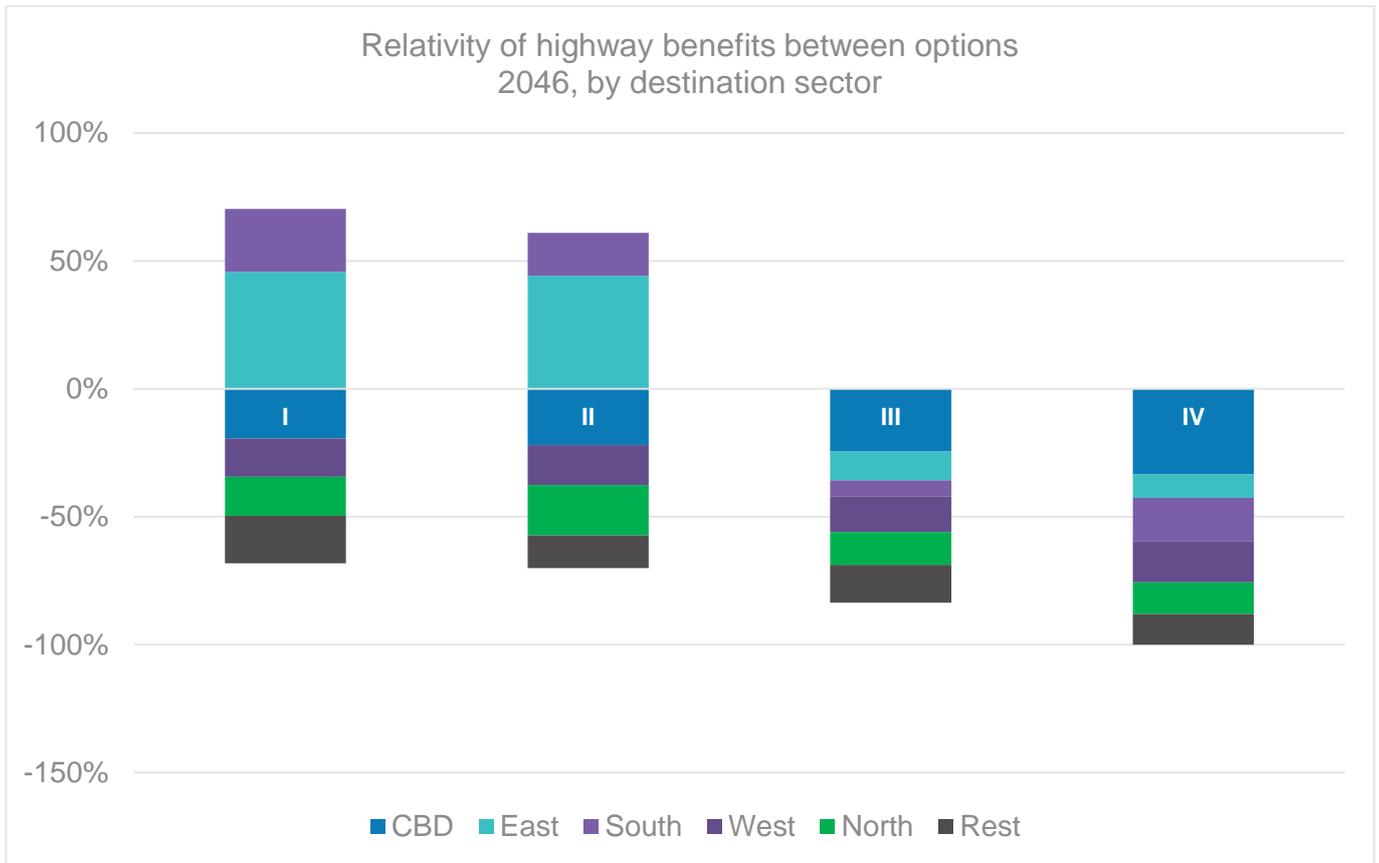
Figure 26: Highway benefits by destination sector

The figures above highlights the following observations at a high level:

- Options i and ii – a balance of benefits to / from the east and south, a result of the diagonal tunnel and Basin grade separation, balanced against dis-benefits from the north, west and rest of region
- Options iii and iv – small dis-benefits to / from all sectors

It should be noted that this analysis is undertaken in the strategic transport model, WTSM, that has a relatively coarse representation of the highway network particularly within the CBD

The primary purpose / strength of WTSM is to assess the relative performance of each option and not the assessment of highway benefits and impacts in urban areas and therefore these results show be taken as indicative.

Further AIMSUN modelling will be undertaken during the next stage of investigations to refine the assessment of the impact of the options on general traffic

6 AIMSUN Modelling

The strategic model (WTSM) and AIMSUN have been used for different purposes. WTSM provides a high-level view of relative differences between options in terms of key metrics (mode shift, regional VKT, carbon emissions) whilst the AIMSUN model provides a more detailed level of granularity and differentiation focussed on key components of the programme.

AIMSUN modelling has been used as an input to the assessment. The graphs below look at two options around the Basin Reserve

- At grade Basin reserve (Option iv)
- Sussex Street extension - Grade separated Basin reserve (Options i, ii and iii)

Overall, the results showed that an at grade Basin option is workable but only on the assumption that MRT does not run through the Basin. If MRT does run through the basin, then the sub-network modelling suggests that grade-separation would be required. These graphs demonstrate that the Sussex Street extension option delivers between 60 and 90 seconds of travel time benefits, on average, during peak periods. The most significant improvement is to the east-west movements reflecting the fact that this traffic no longer has to circulate around the Basin. The optimised at-grade option also delivers travel time improvements relative to the do minimum (current state) and even delivers some slight travel time improvements relative to the Sussex Street extension option for some routes (North-South, South-North and South-East journeys have a slightly more efficient journey).
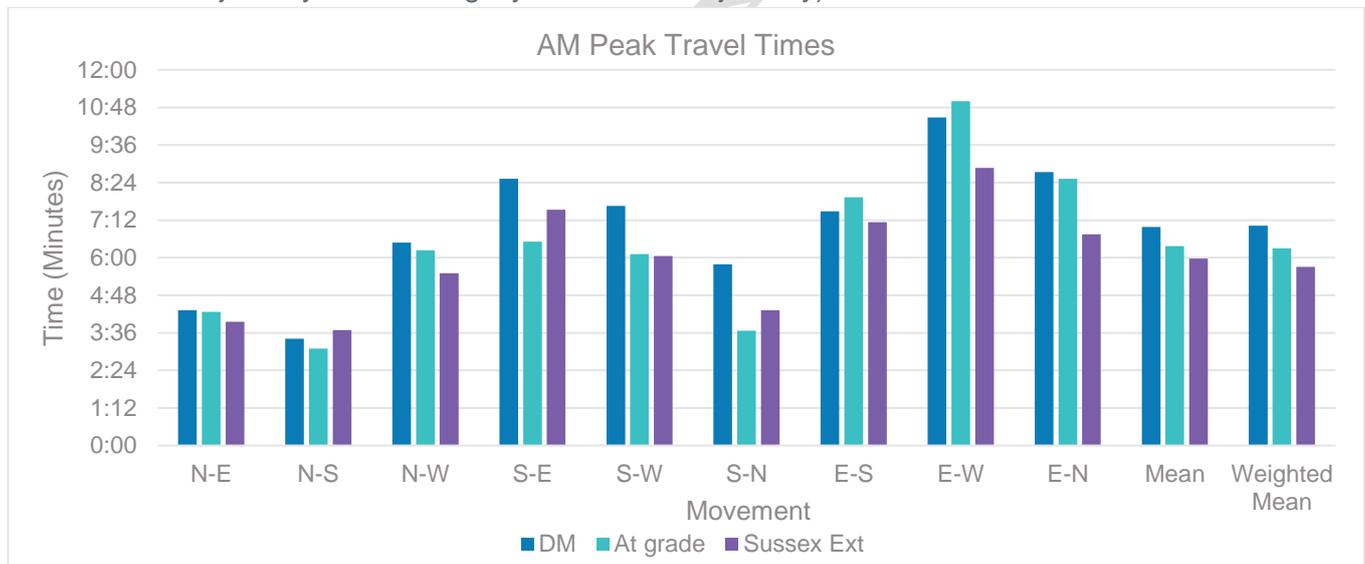

Figure 27: Travel Times for the AM Peak (2026)

Both options will deliver significant travel time benefits for public transport over the current state due to the prioritisation of the MRT corridor. Each option does this in a different way, however. The MRT corridor has to bypass the optimised at-grade option (Taranaki Street, Tasman Street, Rugby Street and Adelaide Road) whereas it is able to travel directly along Sussex Street in the alternative option. Extending Sussex Street across the Arras Tunnel means that the MRT services can run along Kent/Cambridge Terraces (identified as the preferred MRT corridor during the IBC phase). Further work is required to optimise the operation of MRT during the DBC phase of the project regardless of the option chosen.

Weekend performance with prolonged multidirectional loadings would be expected to severely limit PT performance with an at-grade solution.

7 Other Modelling Results

The figures below show line loadings on the key PT corridors delivered by the SHI/MRT project.

- The data indicates that Option i will result in the highest overall PT usage on the southern corridor when compared to other options.
- Options i and ii result in higher levels of PT patronage on the eastern corridor than options iii and iv reflecting the benefits of the new dedicated tunnel (note that the map for option ii only shows BRT demand to the east – additional patronage will use the residual bus service)
- Option iii and iv will attract a similar volume of PT users to each other.

Figure 28: Option i - PT Line Loading 2036 AM Peak

Figure 29: Option ii - PT Line Loading 2036 AM Peak
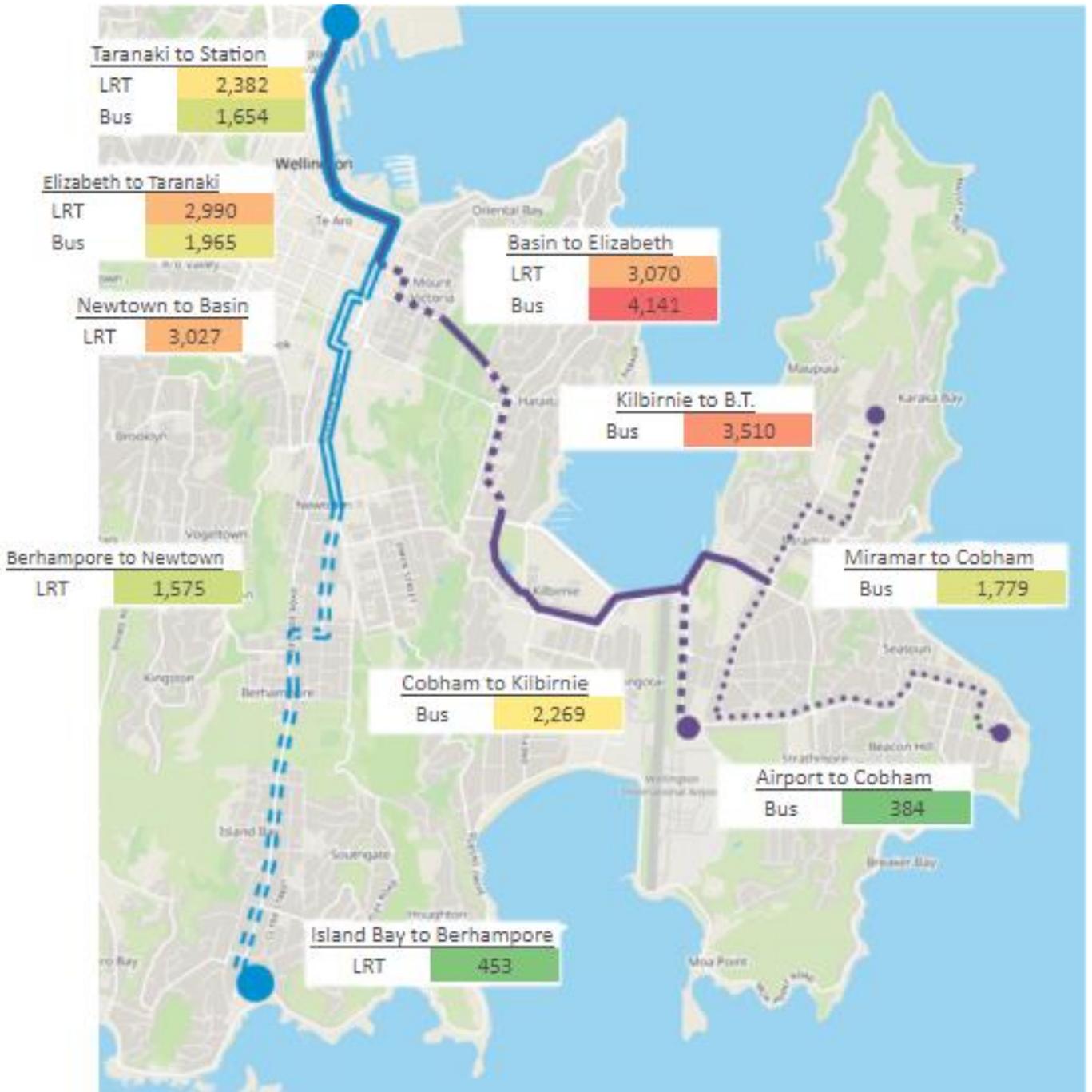
Figure 30: Option iii - PT Line Loading 2036 AM Peak
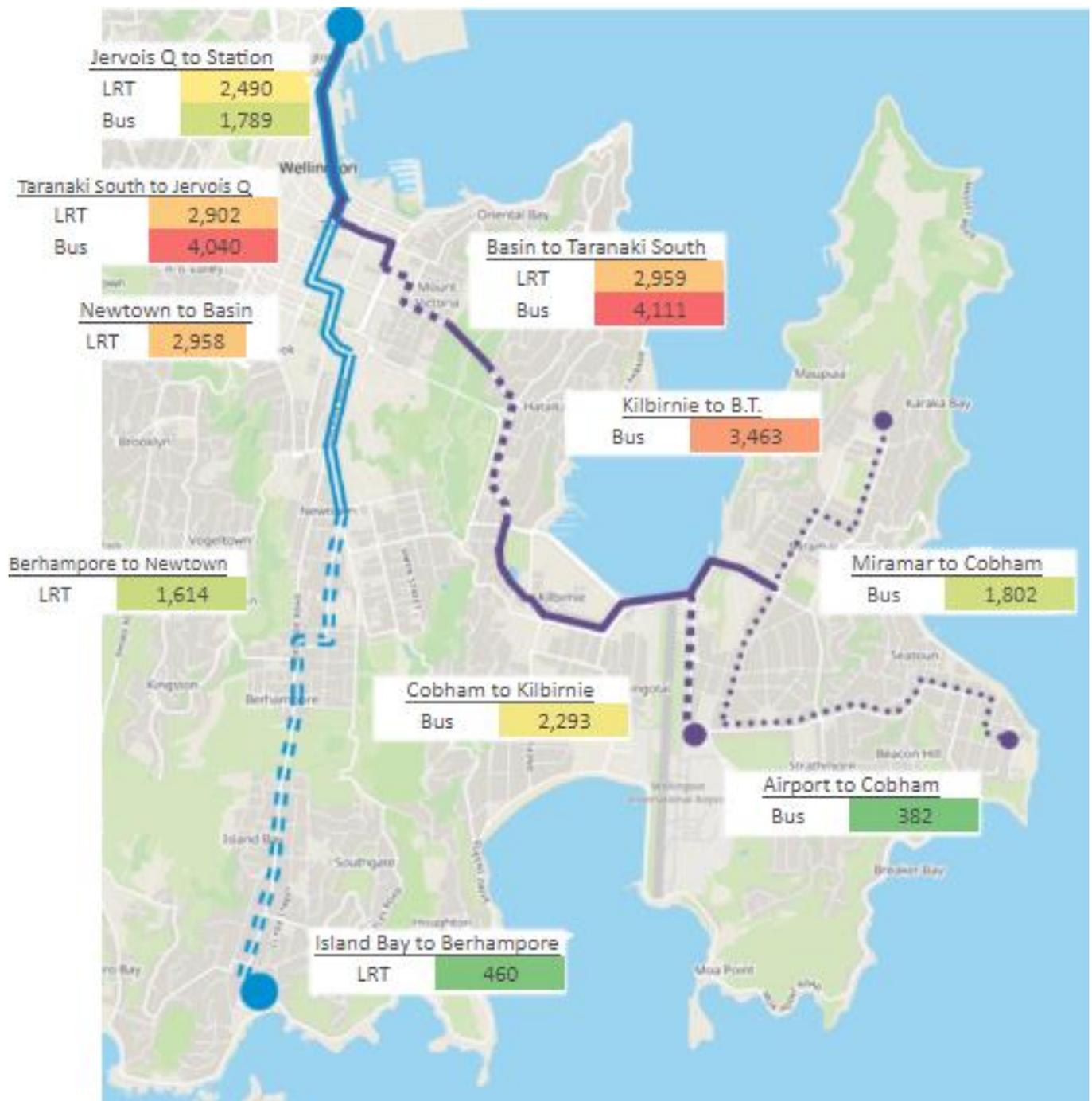
Figure 31: Option i - PT Line Loading 2036 AM Peak

8 Sensitivity Testing

8.1 Introduction

This section summarises results from a range of sensitivity tests undertaken. Although the sensitivity testing has been undertaken for Option i, given the similarity in option performance, the results are likely to provide an adequate reflection of the performance of other options[9]. The sensitivity testing includes the following:

- Active modes
- High land use and high land use + congestion charge
- Reduced frequency to the north under option ii
- Option ii truncated at station (no through running of BRT)

Most sensitivity tests have been undertaken using Option i as the starting basis. Whilst this decision was a pragmatic one, the impacts seen for Option i would likely be similar if similar tests were modelled for Options ii, iii and iv and therefore these sensitivity tests should be seen as representative of impacts across the range of options.

8.2 Active modes

All tests documented in this report assume and forecast a level of modal shift and change in behaviour to walking and cycling driven by the significant investment in walking and cycling that will be delivered through City Streets and the MRT / SHI programme.

As mentioned previously, there is significant overlap between walk, cycling and PT. Many people will have options for journeys from the south and east to the CBD and their choice of mode might vary from day-to-day dependent on factors such as the weather, work commitments and social activities.

A sensitivity test has been undertaken without the active mode improvements to understand the impact.
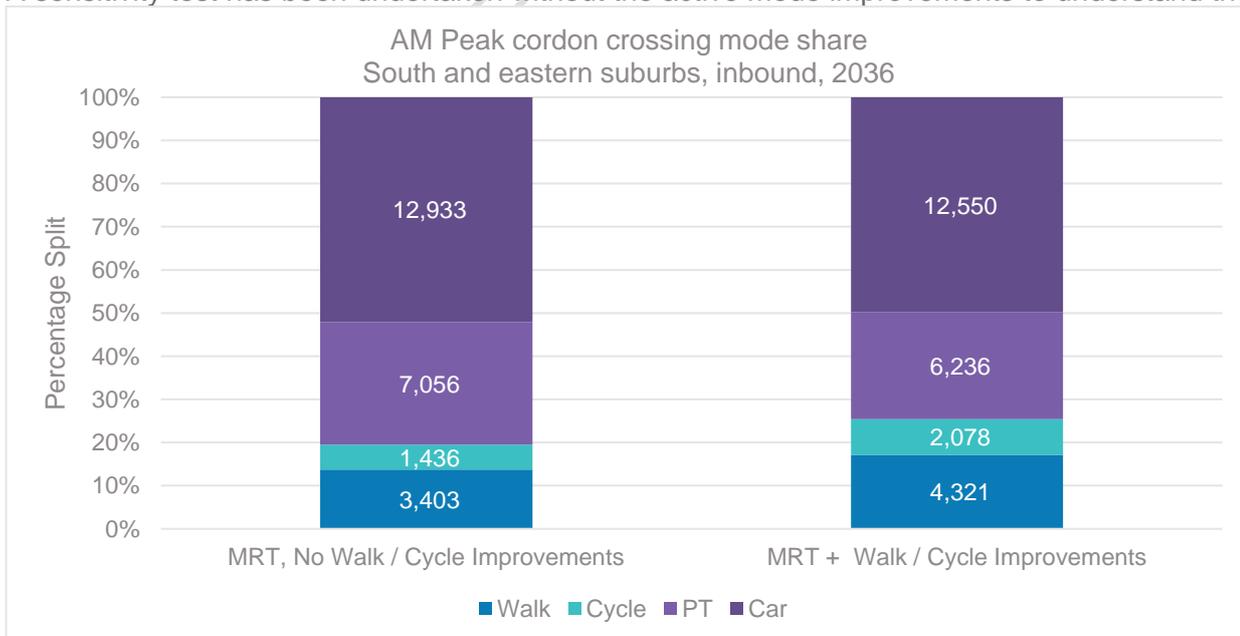

Figure 32: 2036 AM Peak Mode Share to the south and east

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[9] It should be noted that the high land use sensitivity test has only been developed for option i. The other options may result in alternative land use responses.

The graphs show that without the walking and cycling improvements, there would be 400 more vehicles crossing the CBD cordon and up to 800 additional PT passengers.

In terms of ranges:

- PT – would increase from 5,500 (DM) to between 6,250 and 7,000 depending on the level of increase in walking and cycling
- Cycling – would increase from 1,200 (DM) to between 1,400 and 2,100 depending on the increase in cycling numbers generated by the proposed investment

The table below further shows the inter-dependency between walking, cycling and PT. At an aggregate level:

- The "No walk / cycle improvements" test generates a 27% increase in AM peak PT cordon crossings from the S&E relative to the Do Minimum and a corresponding 18% and 8% increase in cycle and walk trips respectively
- When walking and cycling improvements are included, there could be a 40% and 70% increase in walk and cycle cordon crossing volumes respectively from the south and east but a corresponding 13% increase in PT cordon crossing volumes
- In both scenarios, car cordon crossing volumes decreased by between 8% and 11

Table 15: Option i volumes by mode for with and without walking / cycling improvements

		MRT, No Walk / Cycle Improvements	MRT + Walk / Cycle Improvements
South	Walk	2,352	2,926
	Cycle	653	900
	PT	2,869	2,558
	Car	5,831	5,608
	Total	5,874	6,384
East	Walk	1,052	1,395
	Cycle	783	1,179
	PT	4,187	3,678
	Car	7,102	6,942
	Total	6,022	6,252
S&E Combined	Walk	3,403	4,321
	Cycle	1,436	2,078
	PT	7,056	6,236
	Car	12,933	12,550
	Total	11,895	12,636

Table 16: Comparison of Option i with and without walking / cycling improvements

		MRT, No Walk / Cycle Improvements	MRT + Walk / Cycle Improvements
South	Walk	7%	34%
	Cycle	6%	47%
	PT	3%	-8%
	Car	-11%	-14%
	Total	**5%**	**13%**
East	Walk	9%	46%
	Cycle	30%	96%
	PT	53%	34%
	Car	-7%	-9%
	Total	**41%**	**45%**
S&E Combined	Walk	8%	38%
	Cycle	18%	71%
	PT	27%	13%
	Car	-8%	-11%
	Total	**20%**	**27%**

This analysis highlights the inter-dependencies between walking and cycling. Many people will have a choice between the different modes - PT, cycle or walk - and their choice on any one day may depend on multiple factors such as the weather, social commitments, and work requirements. Therefore, the forecast increase in PT, walking and cycling numbers highlighted above should be consider as a range alongside the overall increase in non-car mode share.

Prior studies have shown that connectivity is the key to unlocking active mode uptake, this can only be achieved by the combined LGWM programme including City Streets, Basin upgrades, upgrade around Mount Victoria, Ruahine Street and others. If the proposed improved active travel connection through Mt Victoria is in place the potential cycling uptake between the the Eastern suburbs and CBD could increase by approximately 400 during the AM peak, while walking volumes could increase by 350 in the AM peak. This will reduce traffic volumes by just over 150 vehicles in the AM peak and free up PT capacity (PT volumes will reduce by around 500 relative to not including the active travel connection).

8.3 High land use test

A high land use sensitivity tests have been undertaken for 2036 and 2046 and are summarised below in terms of key metrics – PT patronage, MRT loadings by line.

The tables and graphs below summarise the increase in PT mode share between the Do minimum and Option i (no walk / cycle), Option i (including walk / cycle improvements), Option i + Intensified land use and Option 1 + Intensified land use + Congestion charge for 2036 (left) and 2046 (right) scenarios.

PT Patronage

The graphs below show the forecast increase in PT patronage from the south and eastern suburbs for 2036 and 2046. It shows that the greatest incremental increase in PT patronage arises from the higher land use scenario, resulting in 2,000 additional PT patrons in 2036 in the AM peak rising to 3,200 in 2046.
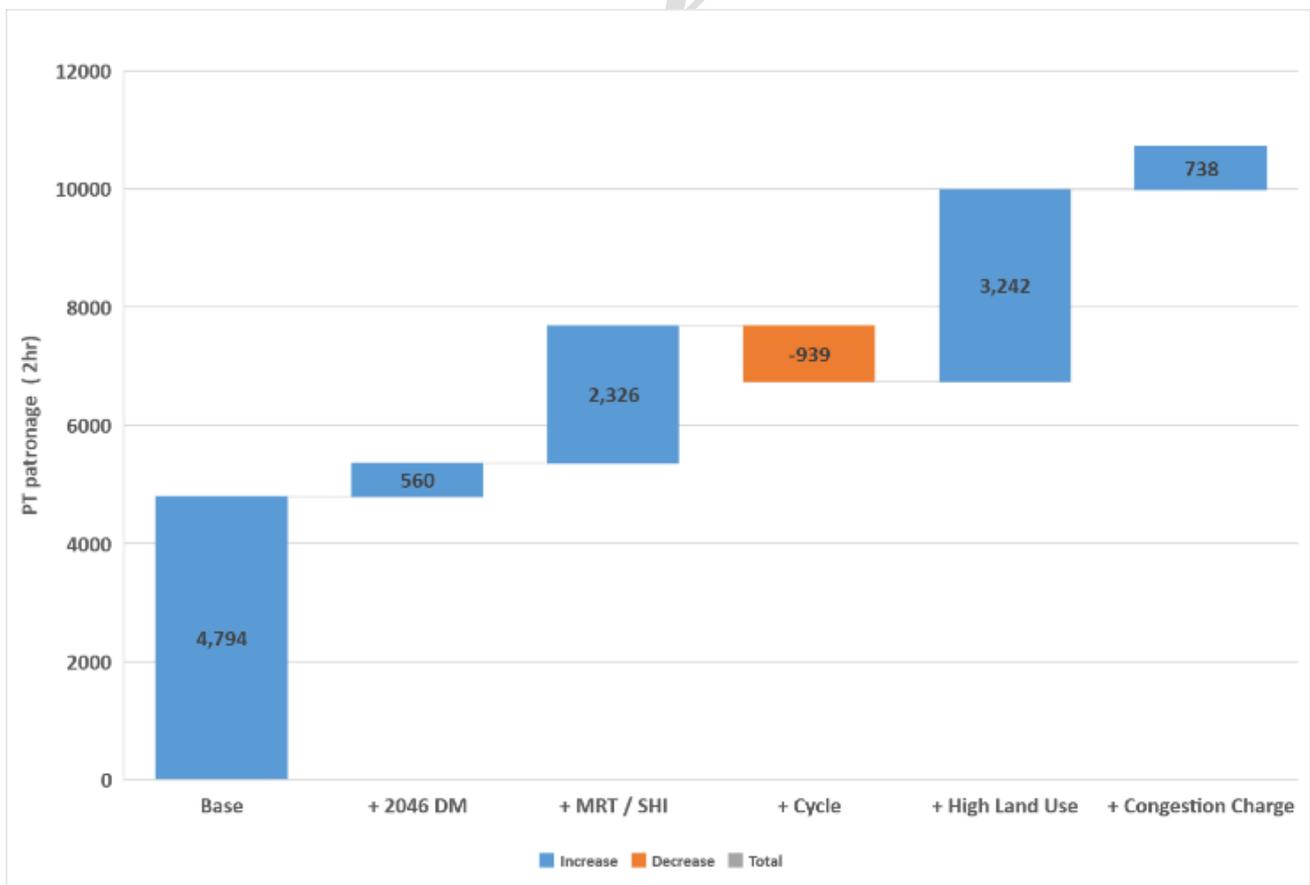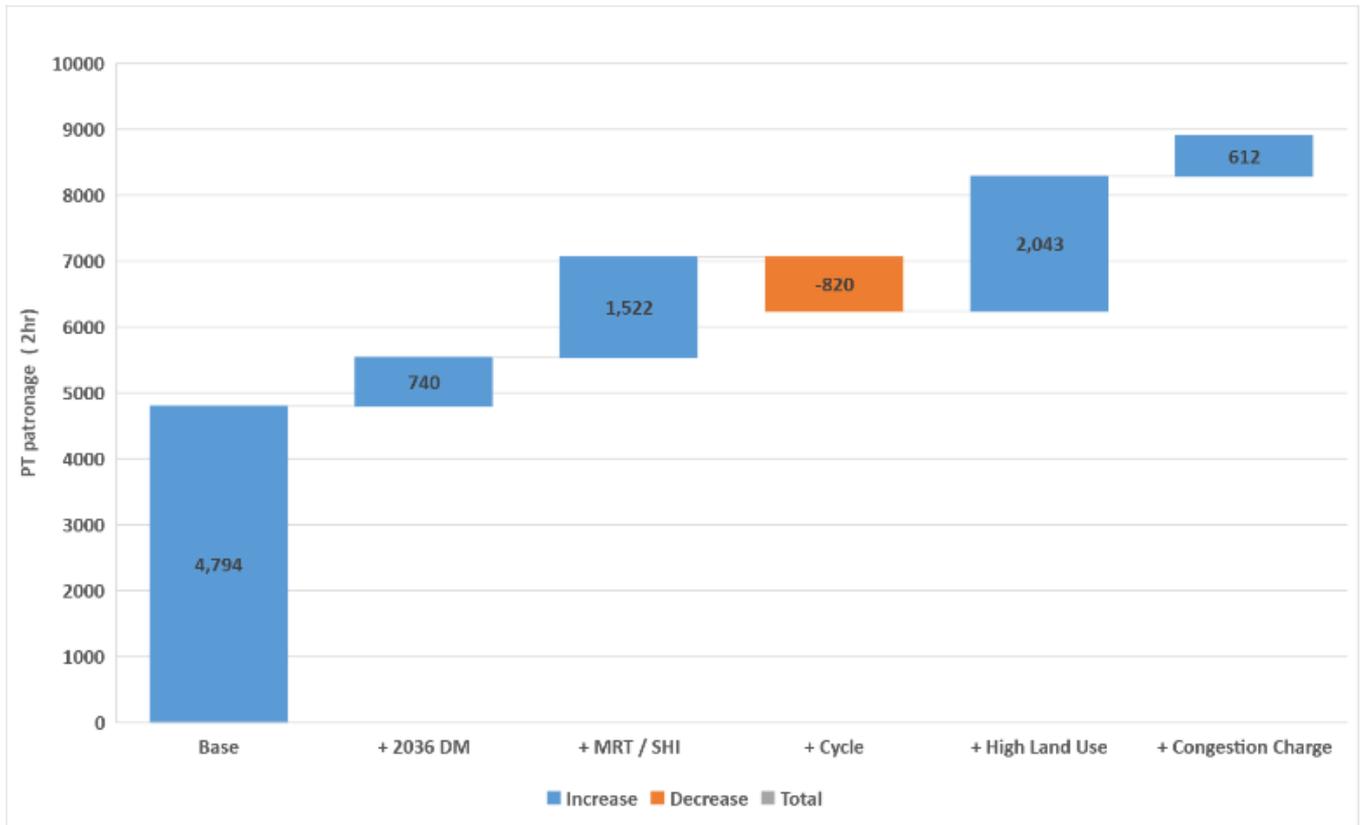
Figure 33: Change in AM peak PT cordon crossings from south and east – 2036 (first), 2046 (second)

At a regional level, the biggest increase in PT patronage crossing the CBD cordon from all directions is between the base and Do Minimum, largely generated by additional rail patronage from the north.

The impact of the high land use scenario is relatively small given it only really affects PT trips from the southern and eastern suburbs and does result in a small reduction in rail trips from the north due to growth being redistributed form the rest of the region to the MRT corridor.

The congestion charge has a large impact, with over two-third of the additional rail patronage coming from the north.
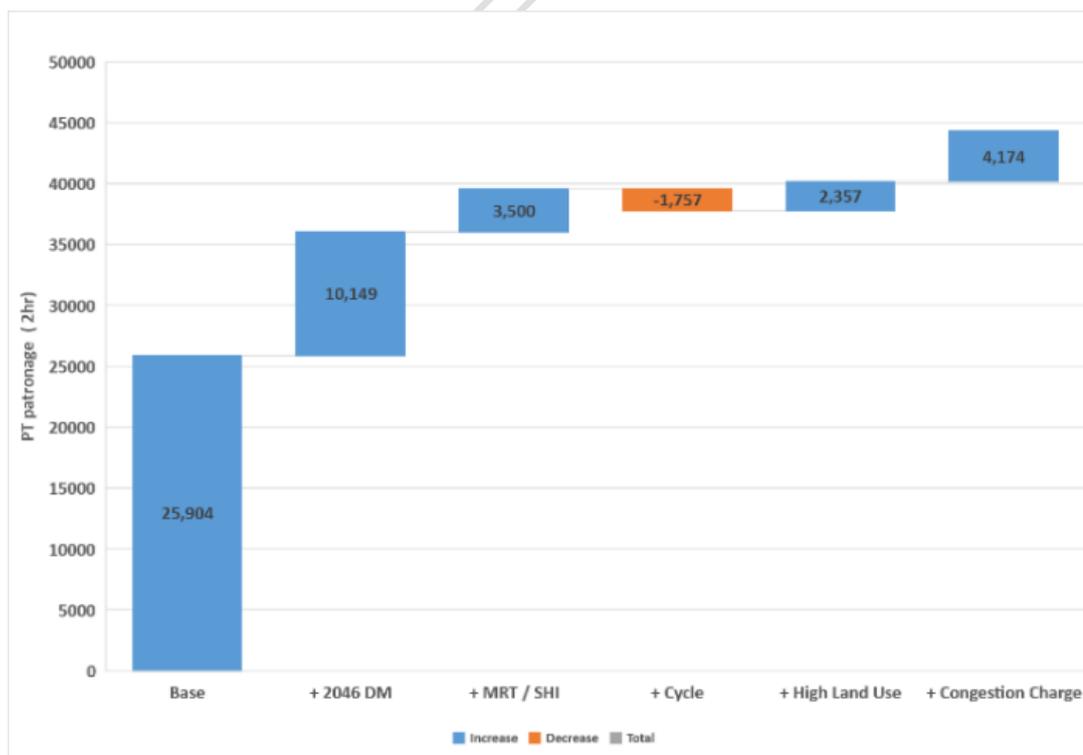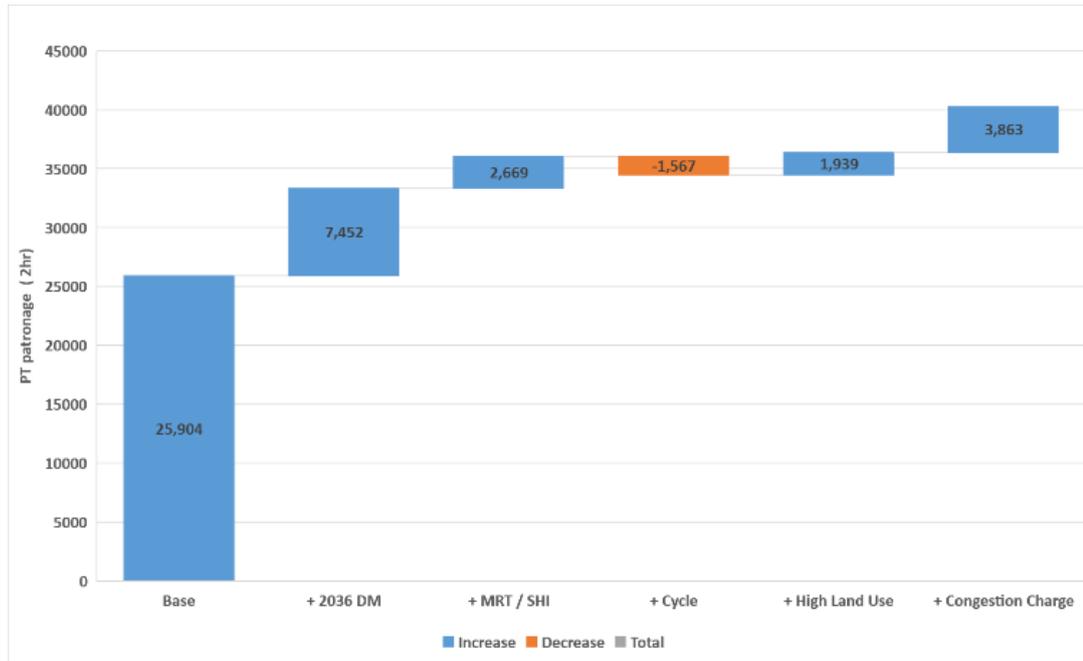
Figure 34: Change in AM peak PT cordon crossings from all areas – 2036 (first), 2046 (second)

Passenger kilometres

The charts below show the potential increase in PT passengers kilometres in the CBD and southern / eastern suburbs. It shows a significant increase, particularly from the south and east, when the high land use scenario is assumed.
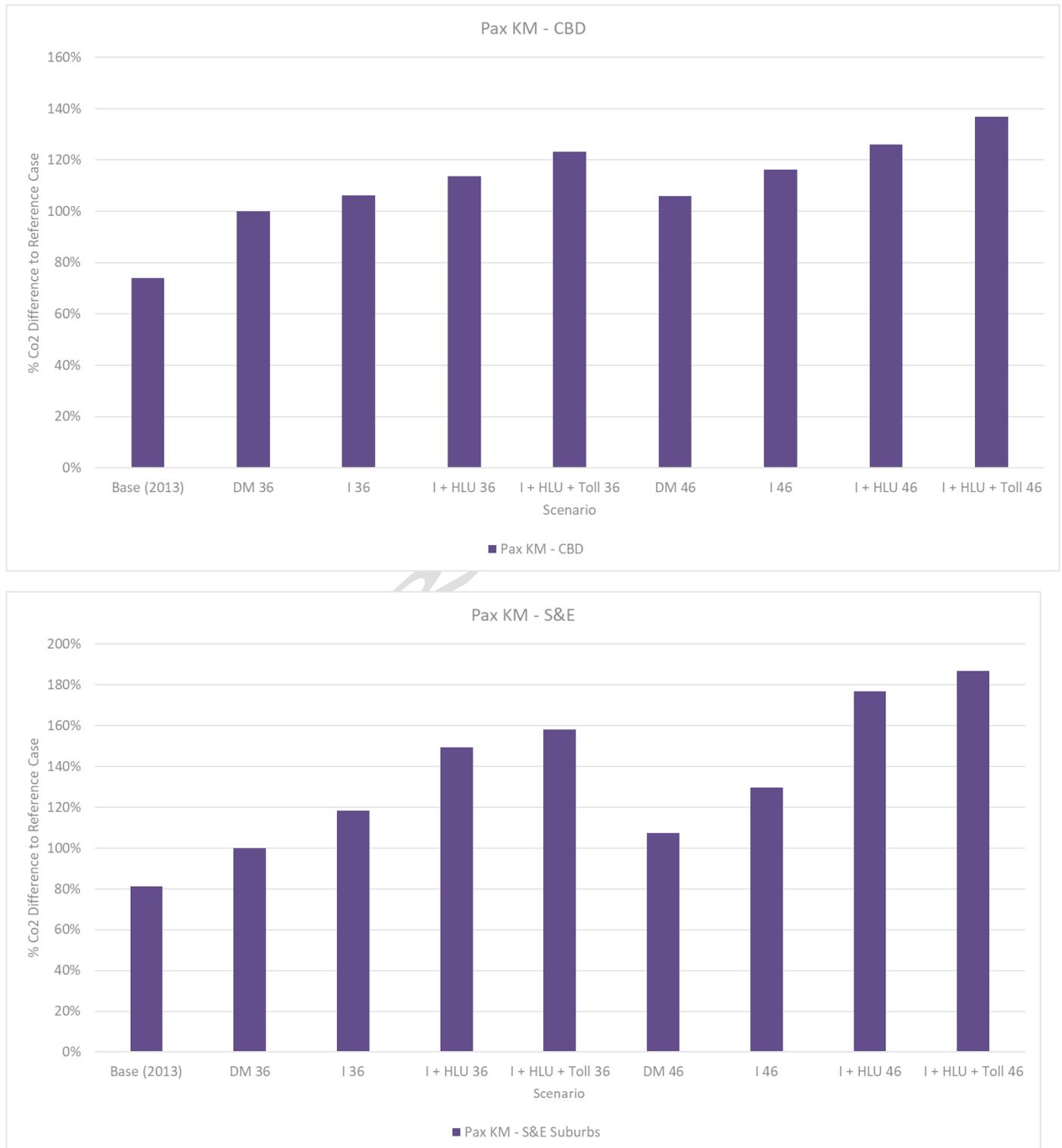
Figure 35: PT Passenger Kilometres Travelled – CBD (first), South and East (second)

Carbon Emissions

The charts below summarise carbon emissions (absolute and per capita) for Wellington City and the region for the AM peak and daily.

It shows that the higher land use and congestion charge scenarios could potentially decrease regional emissions by up to 10% (compared to the Do Minimum). In Wellington City, the potential decrease could be up to 13% in per capita terms (daily) and up to 18% in per capita terms for the AM peak. Please note that this does not account for changes in vehicle fleet efficiency, which if assumed will further improve the outturn reduction in carbon.

Daily City
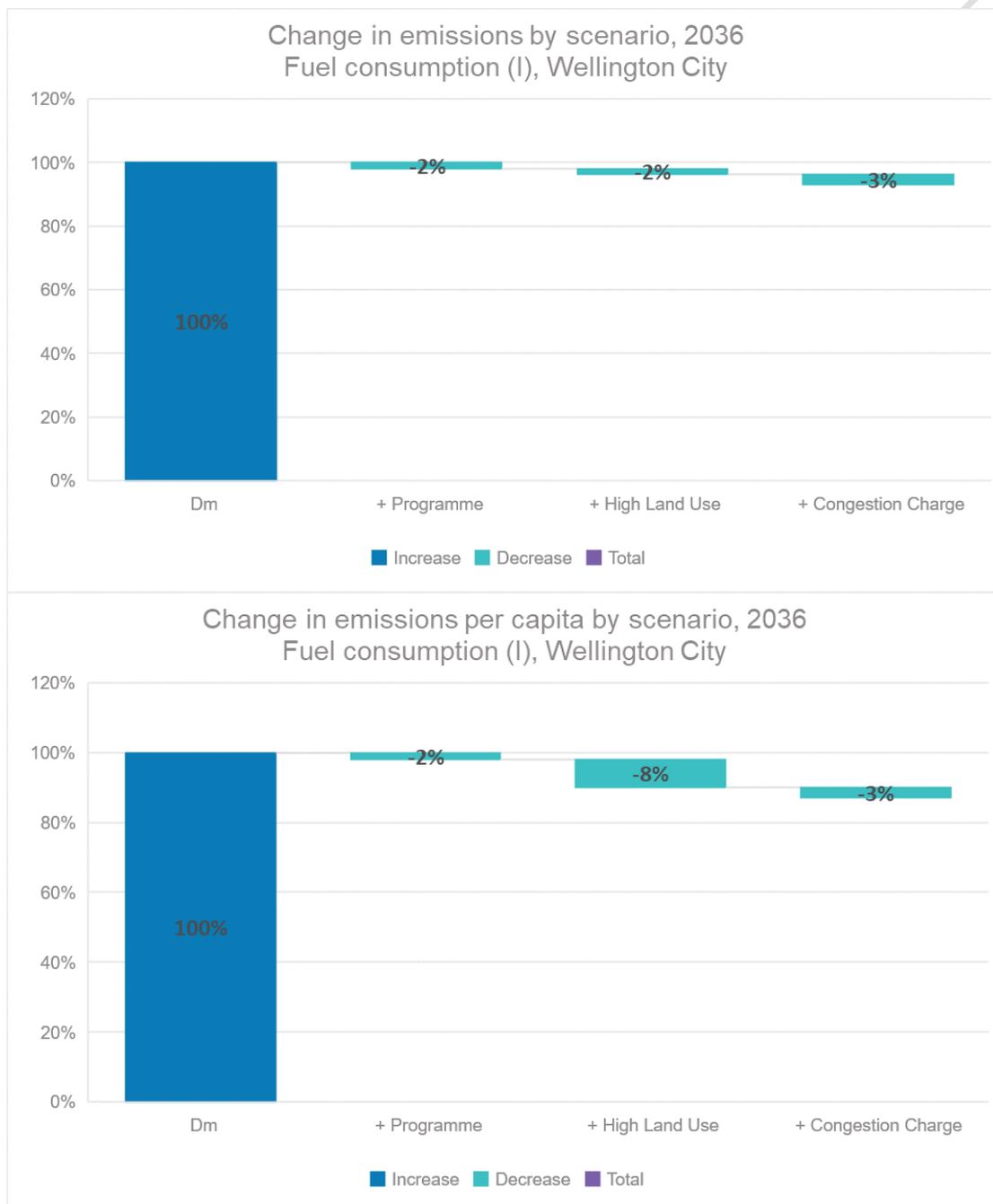
Figure 36:Change in emissions and emissions per capita – daily, Wellington City

Daily Region
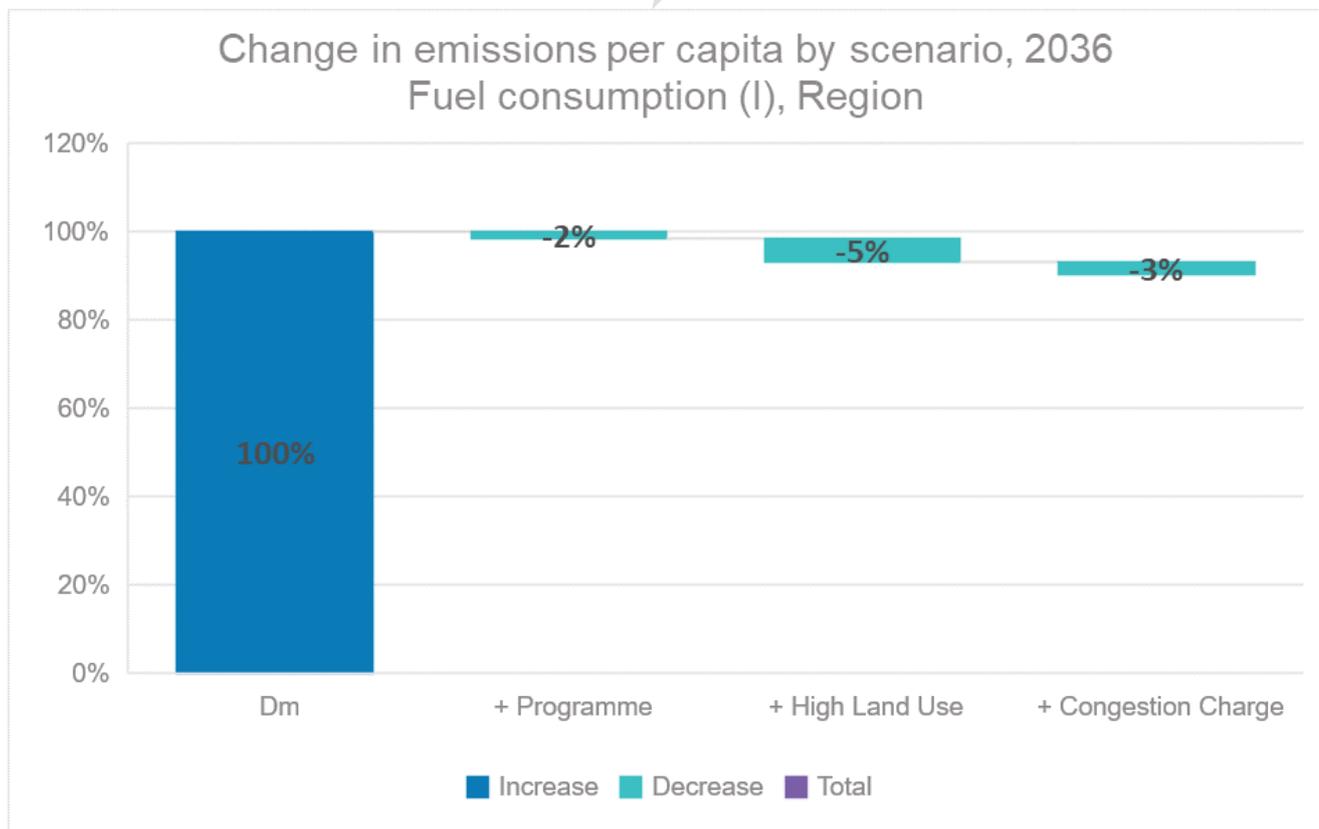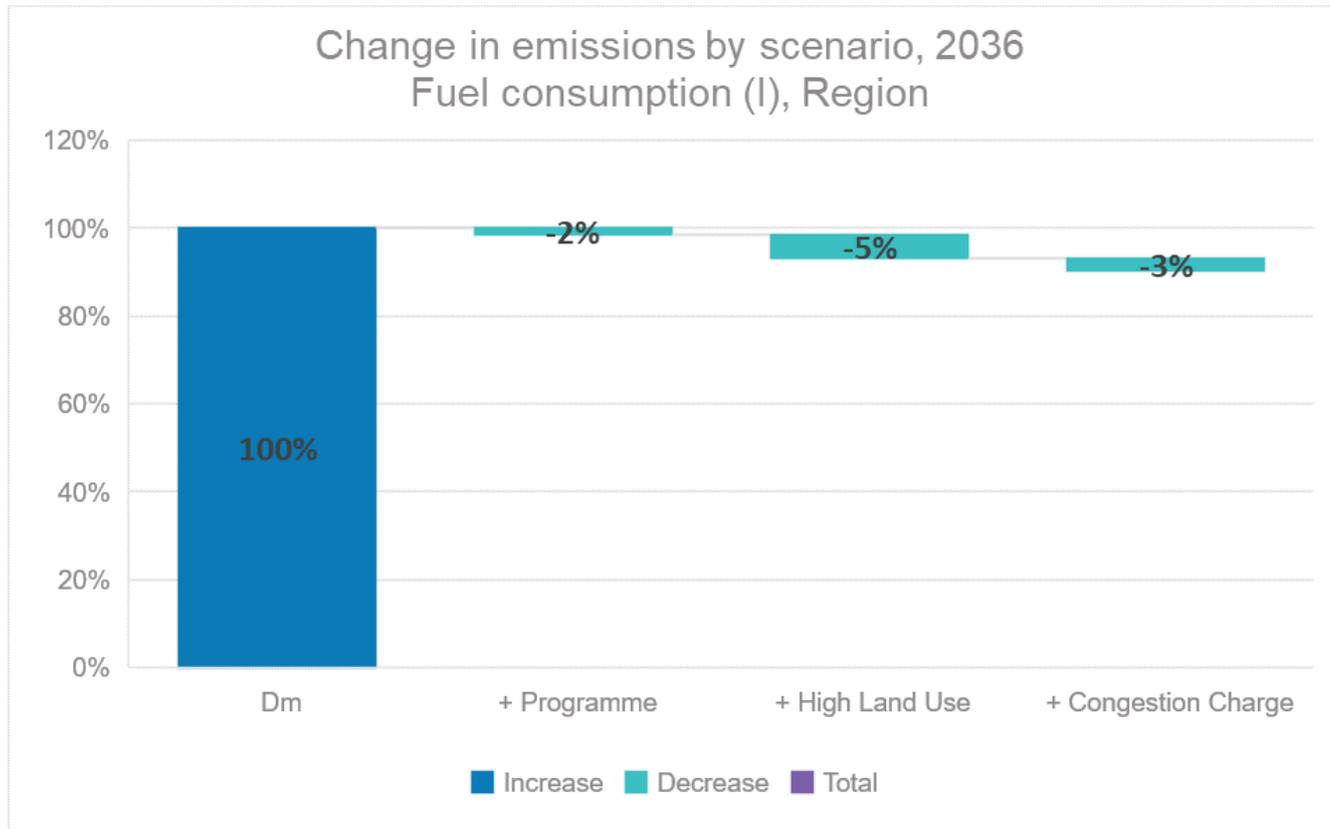
Figure 37: Change in emissions and emissions per capita – daily, Region

Change in emissions by scenario, 2036
Fuel consumption (I), Wellington City

Change in emissions per capita by scenario, 2036
Fuel consumption (I), Wellington City
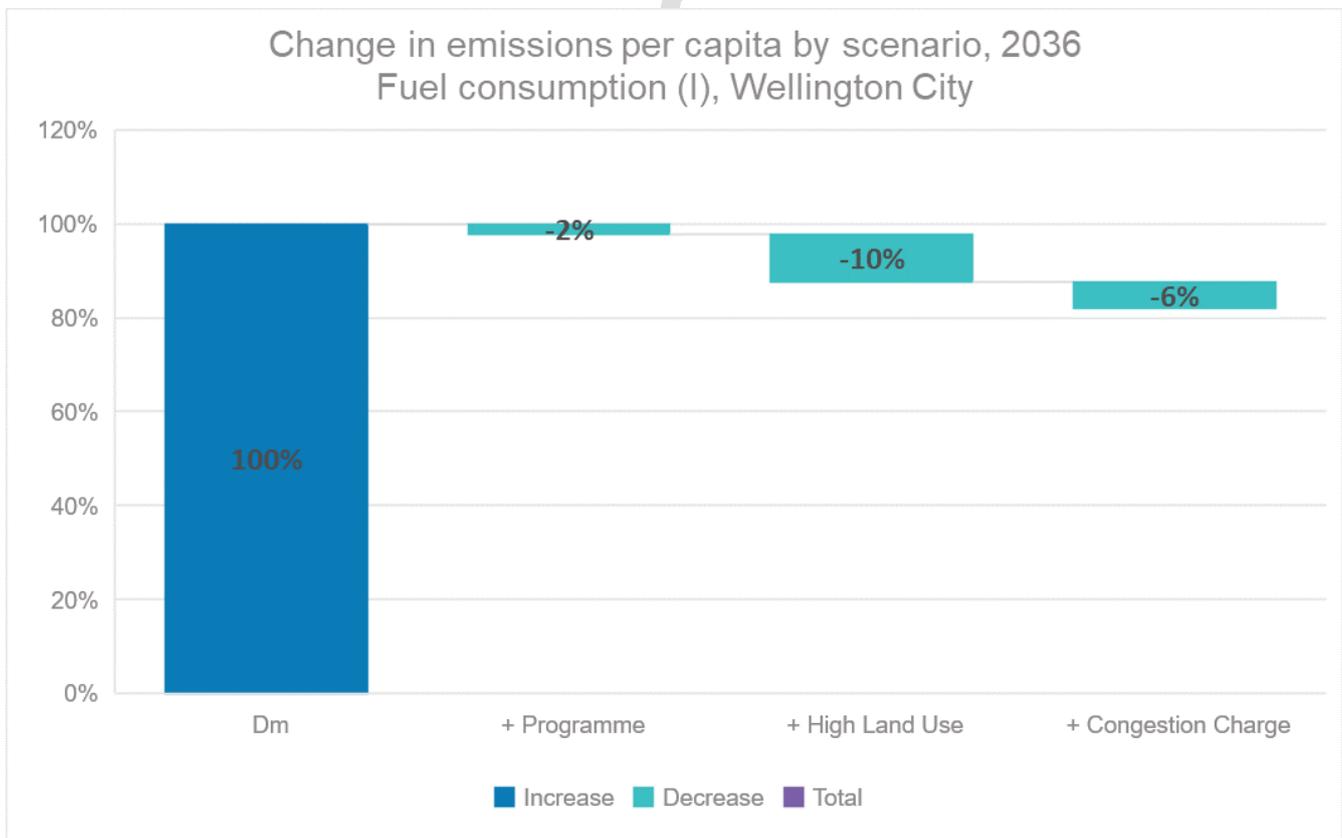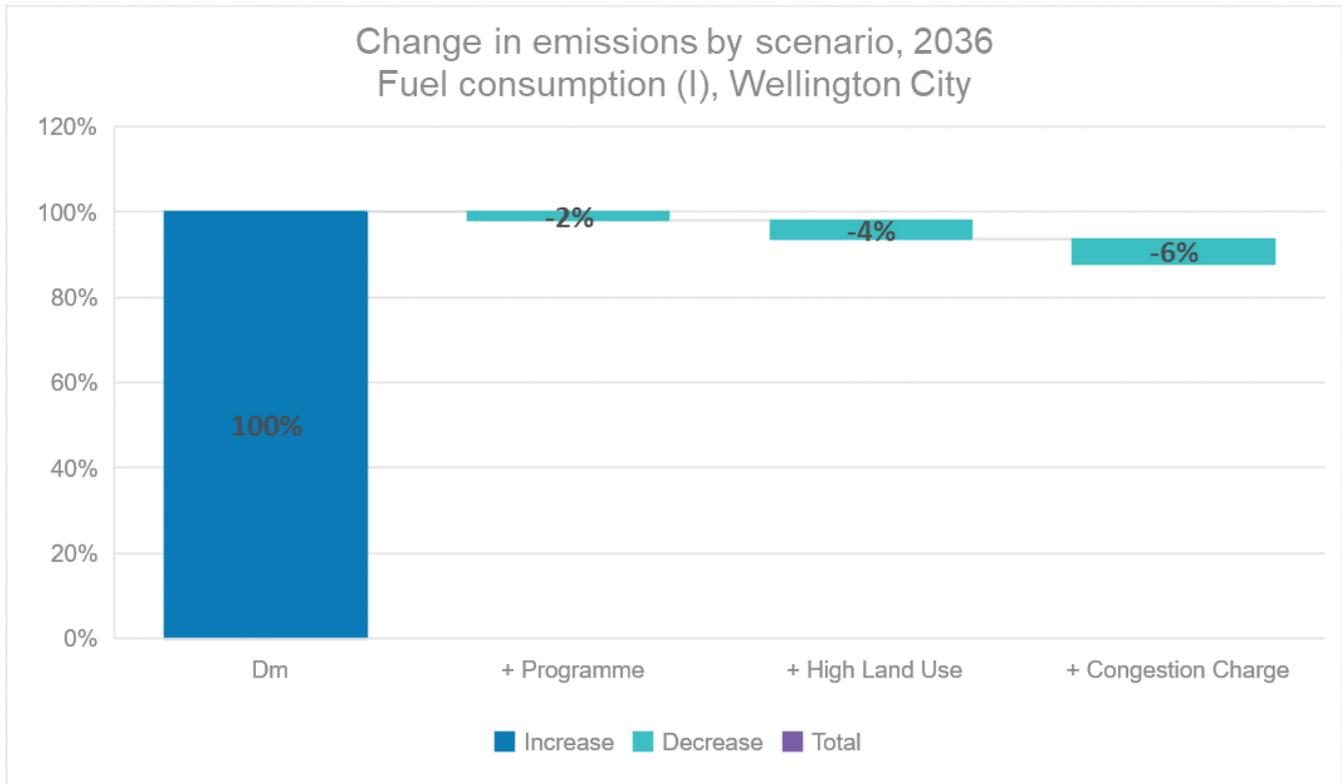
Figure 38: Change in emissions and emissions per capita – AM Peak, Wellington City
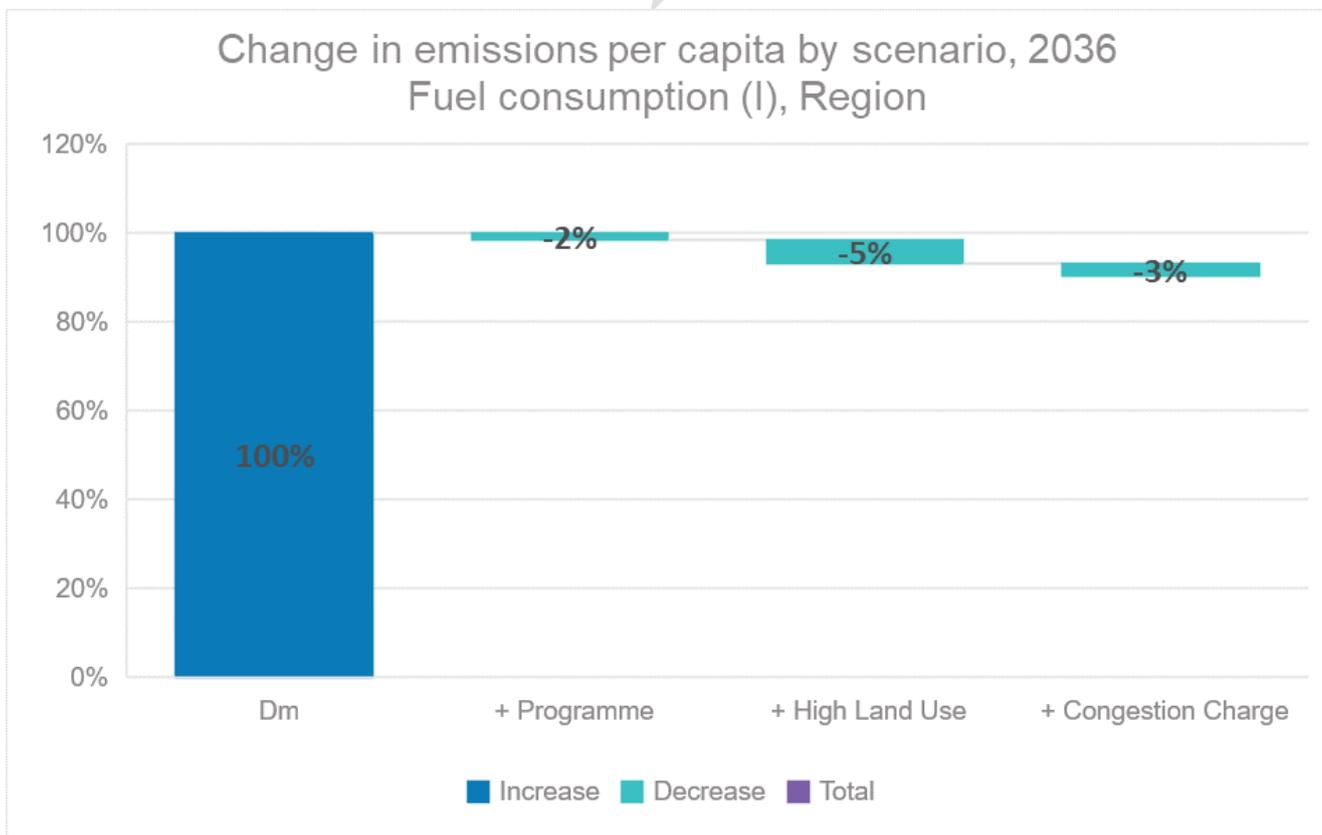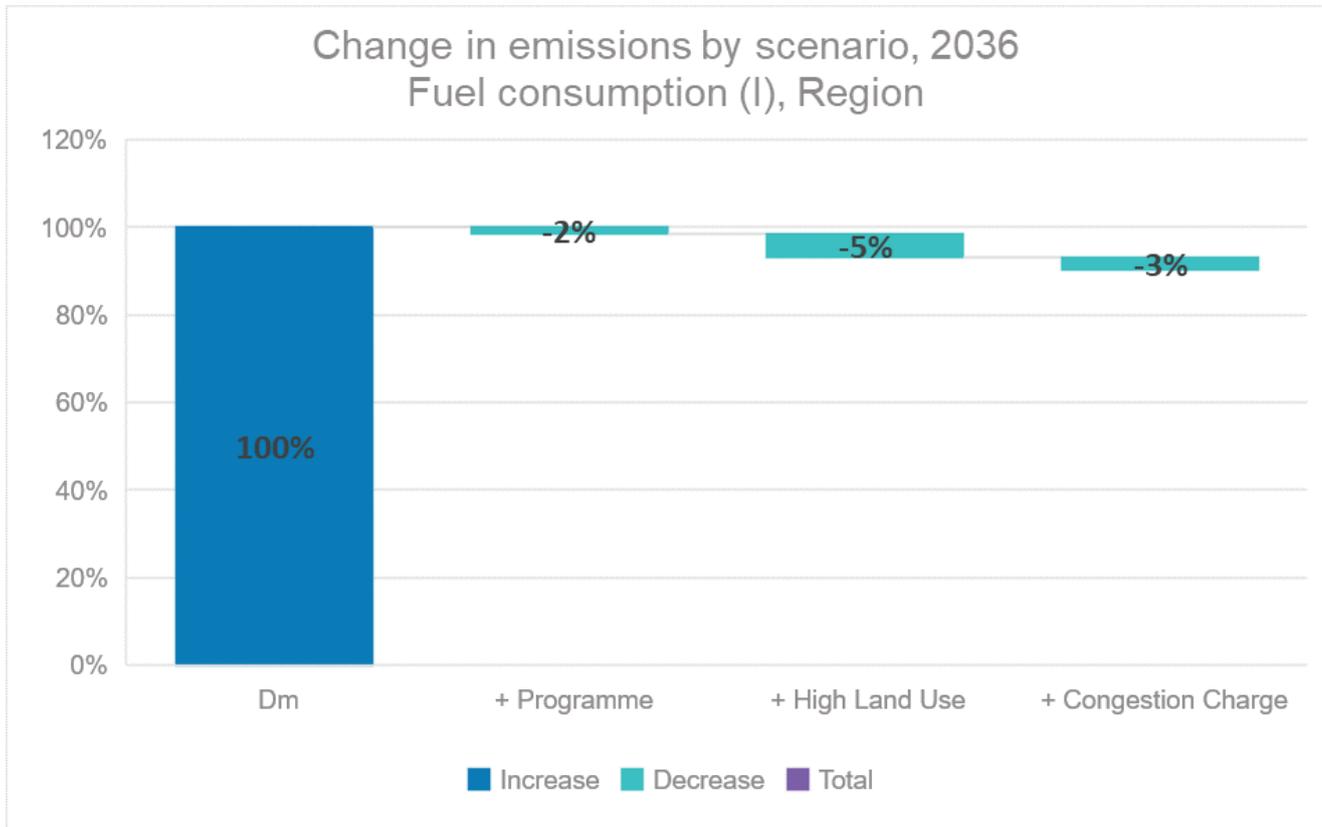
Figure 39: Change in emissions and emissions per capita – AM peak, Wellington Region

VKT

The graph below highlights how VKT could change in the AM peak by area. Note that whilst there are some increases forecast in Wellington City, when expressed in per capita terms these would show a reduction in VKT
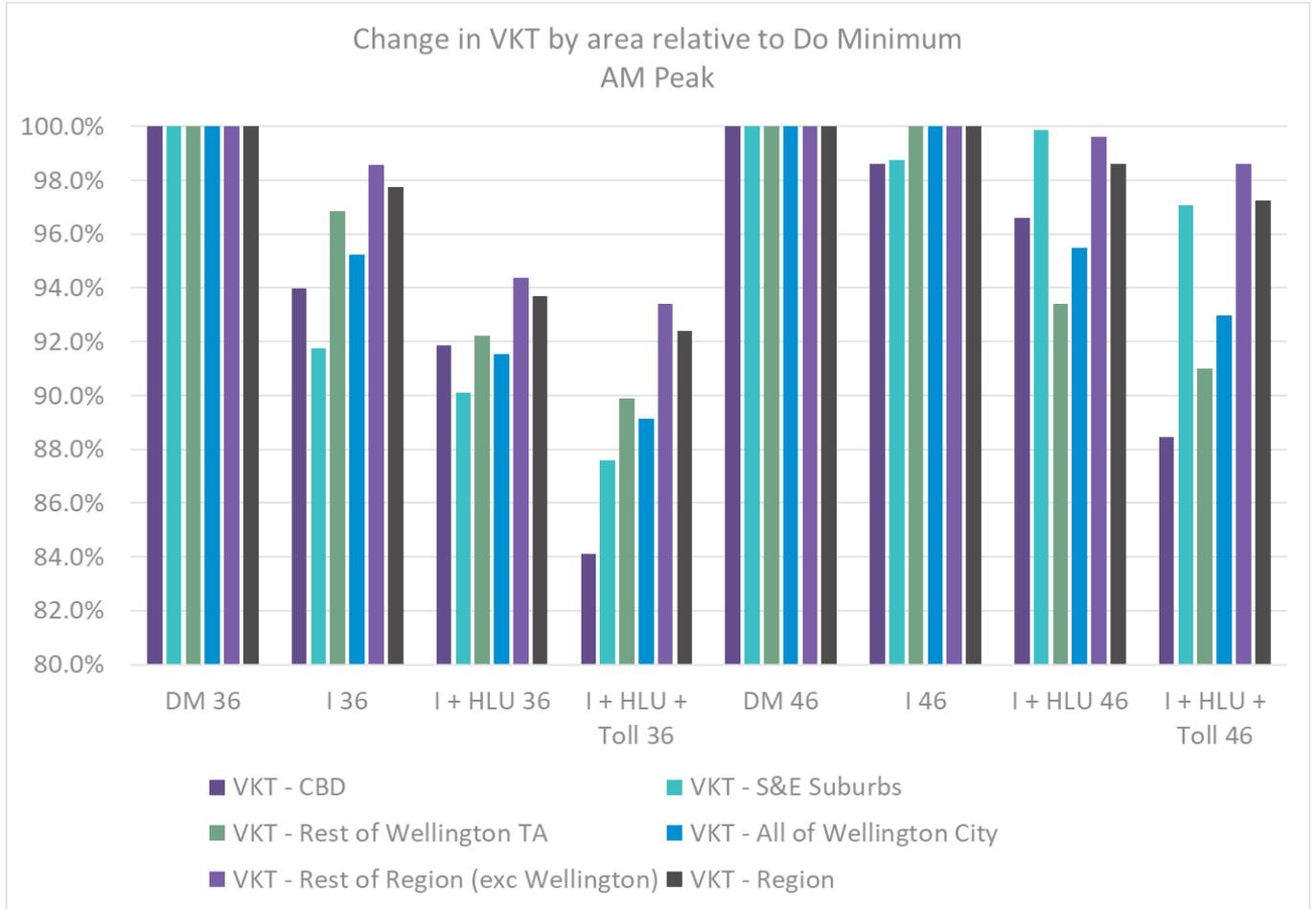

Figure 40: Change in VKT by Area for the 2036 AM Peak

Cordon crossing mode share – AM peak

The charts below show how the modal split of AM peak and PM peak cordon crossings could change incrementally between the Do Minimum, Programme and higher land use scenarios.

From the southern and eastern suburbs, car mode share could decrease from 60% to 40% with walking / cycling / PT trips increasing by over 7,000.
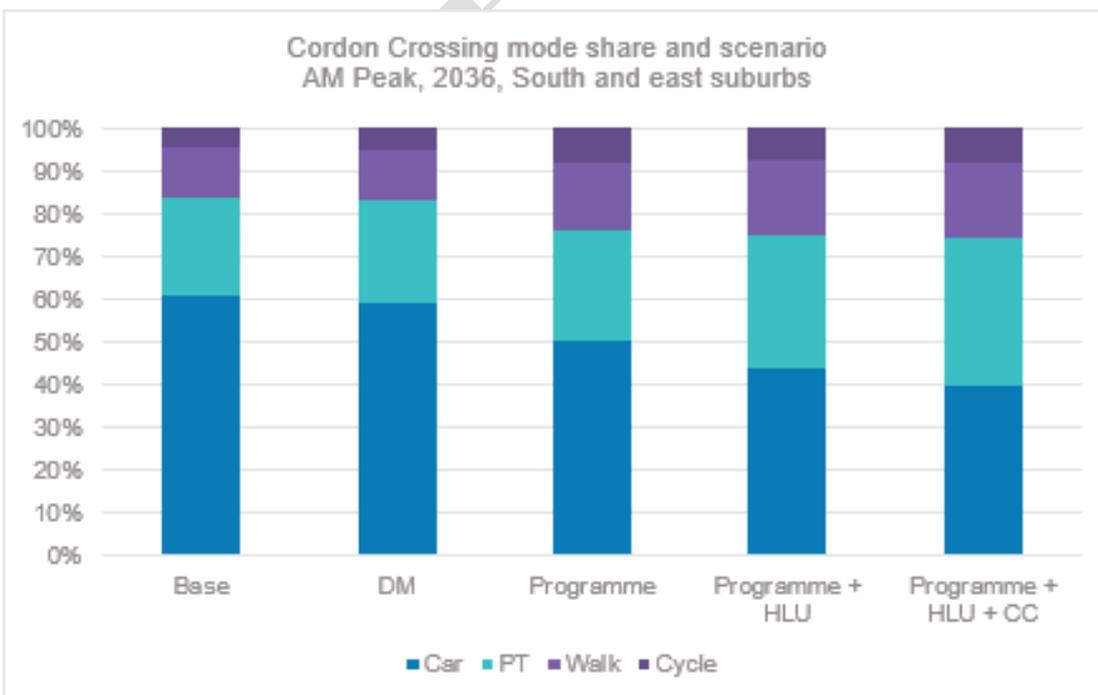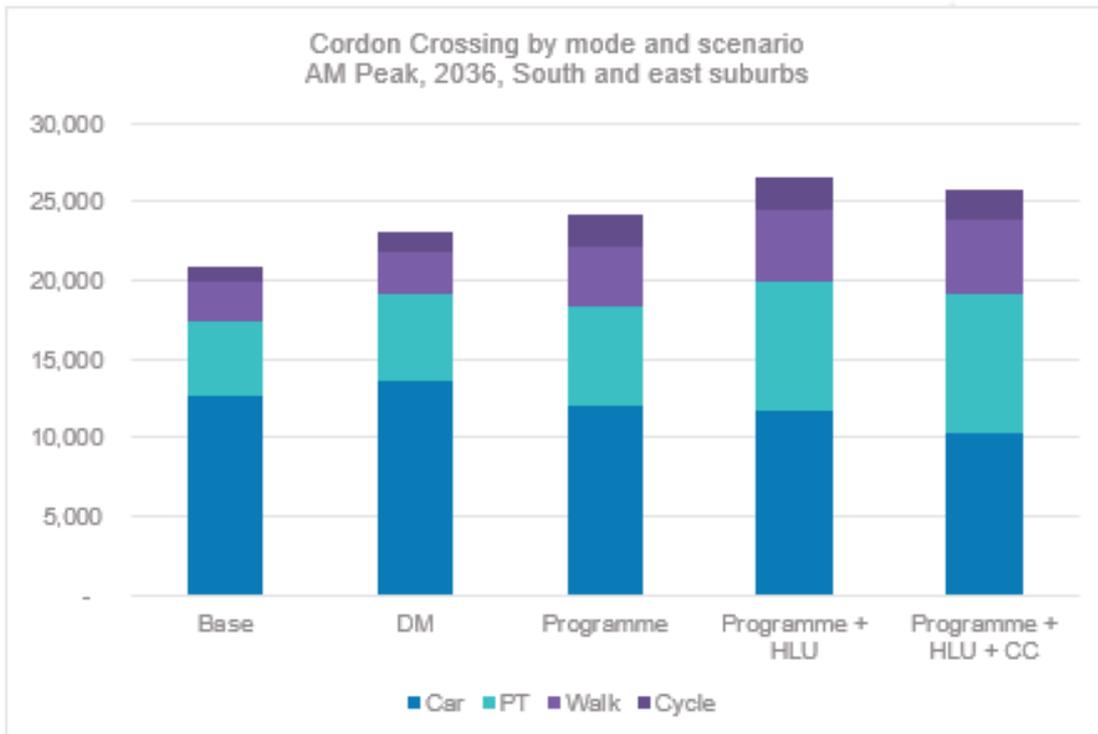
Figure 41: Cordon Crossing by Mode Share – 2036 AM Peak

Even at a whole of CBD level, non-car mode share could decrease from around 53% to nearer 40%, with almost 20,000 more people forecast to use non-car modes to cross the CBD cordon under the high land use + cordon charge scenario compared to the current case
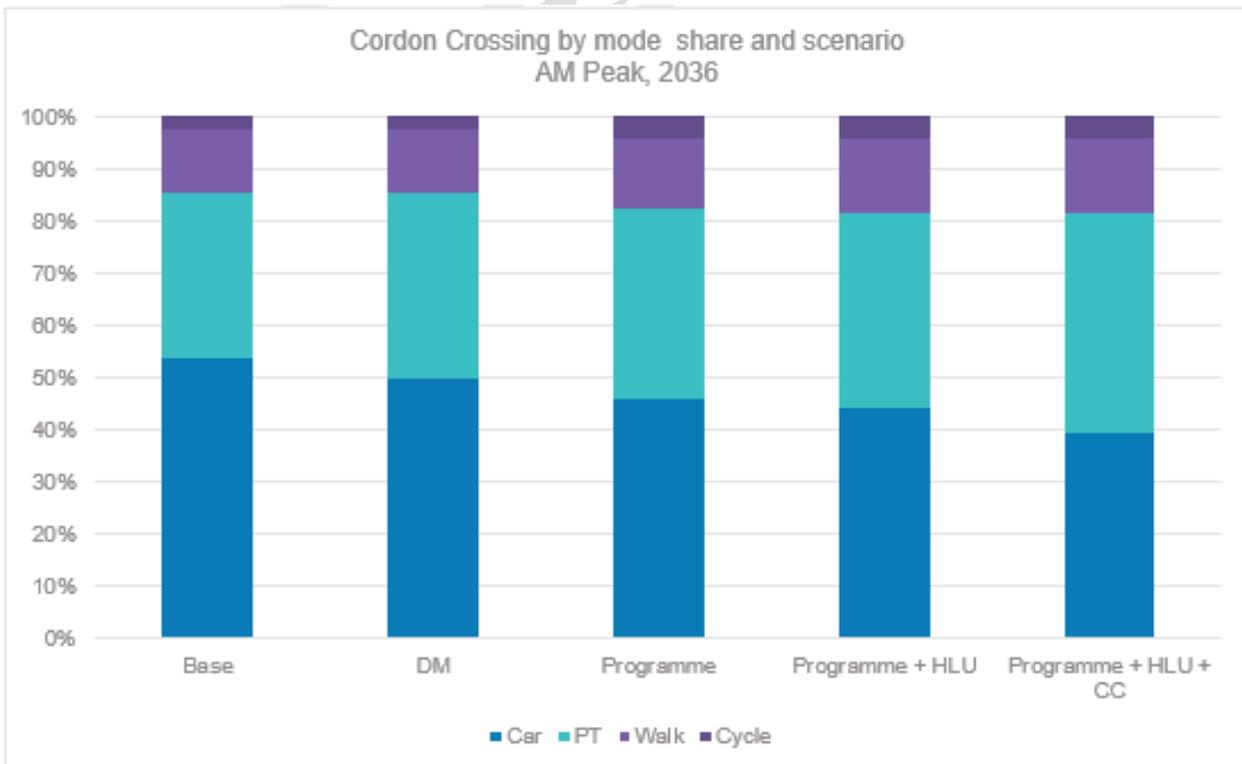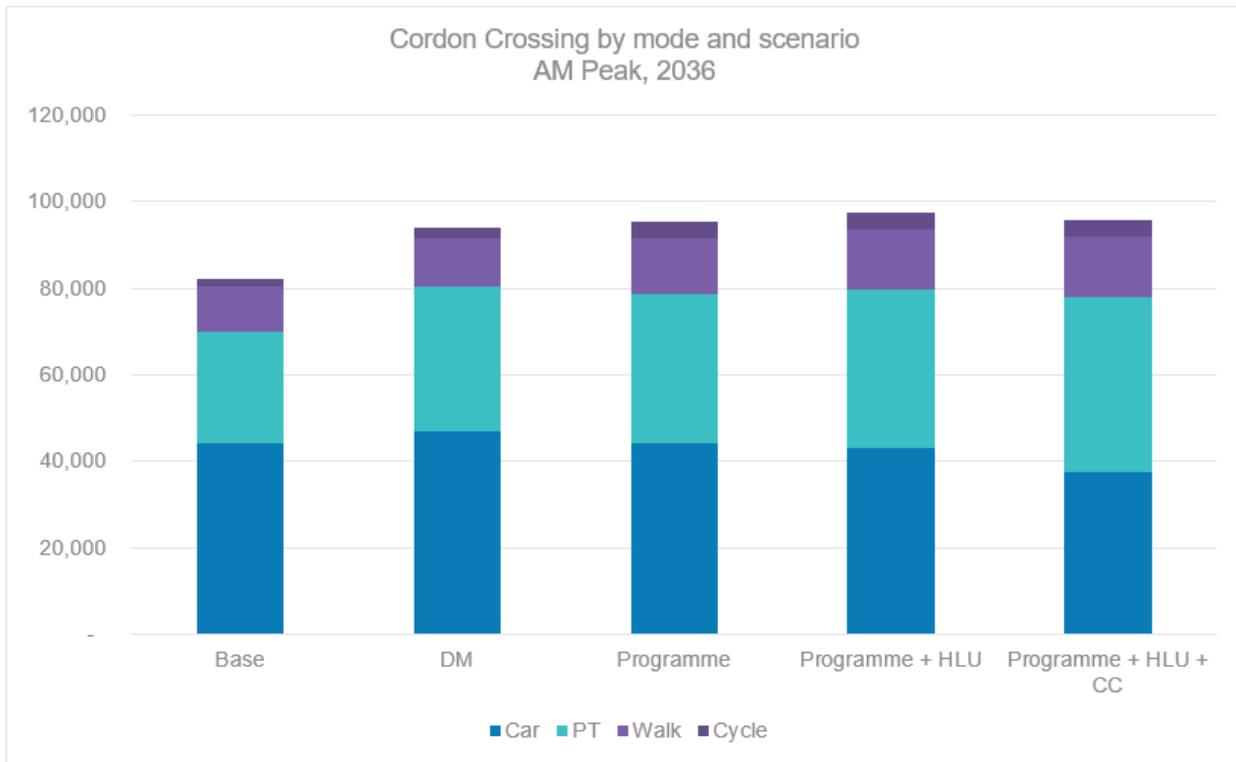

Figure 42: Cordon Crossing by Mode for the 2036 AM Peak

8.4 Option ii sensitivity tests

Two sensitivity tests were undertaken on Option ii as follows

- Reduced BRT frequency from Johnsonville to Station (from 20 to 12 per hour)
- BRT as a 'closed system' with BRT from Miramar / Island Bay to Wellington Station and bus services from Johnsonville to Island Bay (12 vehicles per hour (vph), alternating services via Taranaki St / Hataitai bus tunnel and Karori to Courtenay Place via second spine

The results from these tests showed the following:

- No change in PT patronage from the south and east
- Small reductions in PT patronage from the north and west
- No change in the differentiation between the options, with Options i and ii performing slightly better from a PT perspective compared to Options iii and iv

It should be noted that for these sensitivity tests and all of the option tests, there is a level of PT network design and optimisation that is required during subsequent stages of investigations to ensure that there is an even split of services between the second spine and Golden Mile, there are convenient interchange opportunities between MRT / BRT / bus and frequencies and service patterns are designed to maximise benefits and minimise operational costs.

9 Conclusions

9.1 Programme Affordable Short List Options

Based on analysis the following conclusions can be drawn on the Programme Affordable Short List Options:

- Overall, based on the traffic modelling analysis showed that all options perform very similarly, with marginal differences when assessed against agreed performance indicators
- In general, without the programme in place there will be an increase traffic volume around the city, this is due to the increase population and employment forecasts estimated
- All options generate a significant increase in non-car mode share of trips, particularly from Wellington's southern and eastern suburbs
- Analysis shows that infrastructure improvements need to be accompanied by travel demand management or land use changes to maximise performance against investment objectives
- Options i and ii perform marginally better than Options iii and iv, with higher non-car mode share form the east being the main differentiator, driven by the more direct route via the diagonal tunnel delivering 6 minutes additional travel time saving compared to Option iii and iv
- Options i and ii have slightly worse travel time reliability for private vehicles when compared to Option iii and iv due to the reallocation of road space to PT.
- All options will have a more competitive PT network, with improved PT travel times on routes to the east and south.
- Whilst the LGWM programme itself is forecast to reduce emissions by around 2%, a more intensified land use scenario could potentially reduce emissions by a further 6% to 10% within Wellington City (and up to 20% in per capita terms)

9.2 Next steps

From the modelling work undertaken for the Programme Affordable Short List Options, the following next steps are suggested in order to improve the robustness of the modelling and analysis:

- Additional modelling in AIMSUN, focussing on traffic impacts around the CBD to understand and quantify any impacts on general traffic and the level of additional trip suppression and behaviour change that might be required to mitigate these impacts
- Improved definition around the high land use scenarios
- Optimisation of the MRT and supporting PT networks to maximise benefits and minimise costs
- Refinement of PT travel time assumptions, potentially using feedback from the AIMSUN model
- Further sensitivity testing to better understand potential impacts of additional walking and cycling trips
- Analysis of weekend travel patterns. The development of a full weekend model is not considered to be justified at this point in time, however a greater understanding of trip making during weekends will help understand the extent to which weekend travellers will benefit from the proposed improvements.