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Preferred Programme Option Report: Modelling Appendix

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1. Executive Summary

This report summarises modelling of the two of the four short listed programme options – Options 1 and 4 - to inform the development of the preferred option report. The four programme options are clearly documented elsewhere, however in summary they constitute the following key elements:

- Option 1 – Light Rail Rapid Transit (LRT) between the station and Island Bay, grade separation at the Basin Reserve, and a duplicated Mt Victoria Tunnel providing increased bus capacity to the east.
- Option 2 – Bus Rapid Transit (BRT) between the station and Island Bay and between the station and Miramar/the airport, grade separation at the Basin Reserve and a duplicated Mt Victoria Tunnel catering for the eastern BRT branch.
- Option 3 – LRT between the station and Island Bay, grade separation at the Basin Reserve and small scale improvements to buses to the east (no Mt Victoria Tunnel).
- Option 4 – LRT between the station and Island Bay, at grade improvements at the Basin Reserve and small scale improvements to buses to the east (no Mt Victoria Tunnel).

Modelling to inform the preferred option report has focused on the refinement of existing models and assumptions, building on learnings from previous phases of the project. These refinements have included changes to the representation of travel demand within the CBD (particularly in relation to active travel), changes to capacity assumptions on key links (informed by additional analysis), and improved representation of parking capacity for reflect the transformational nature of the programme.

In addition to this, a new intensified land use scenario reflecting 16,000 additional dwellings in the CBD and along the southern and eastern corridors (on top of the 10,000 in the core scenario) has been identified by the LGWM team and tested using the modelling suite. This “what if” scenario, when interpreted alongside the core land use scenario, provide two “bookends” to understand the benefits of achieving higher levels of development along the mass rapid transit (MRT) corridors¹.

Three different future scenarios have been modelled, to reflect potential future uncertainty regarding travel demand and travel behaviours. Model outputs and forecasts should be considered indicative, based upon a series of input assumptions, and be interpreted as a range to inform and support decision making.

Output has focused on elements that provide differentiation between the options – principally mode shift, accessibility (catchment analysis), environmental metrics, public transport demand and capacity analysis. The refinements to the modelling provide more differentiation between all of the options and the do minimum, strengthening the case for investment. They also provide more differentiation between the options, particularly under the higher land use scenario. Although all options demonstrate similar levels of public transport patronage from the south, options that provide a duplicated Mt Victoria Tunnel are forecast to experience higher levels of PT uptake than those that don't, due to improved travel times, increased reliability and increased capacity.

¹ This is a “what if” scenario based loosely on work undertaken by The Property Group in January 2021. It is not intended to be a forecast land use response of the MRT investment.

2. Introduction

This document summarises the modelling work undertaken to support the Let's Get Wellington Moving preferred option report.

The preferred programme options report (PPOR) seeks to consolidate work done to date on the four short listed programme options and make a recommendation on a technically preferred option. It will draw on the Programme Affordability Short List Options (PASLO) report, the various business cases, the outcomes of the consultation process and 'Other Factors' from PASLO to help decide on a preferred option. It will also draw on a number of other technical reports (including a Carbon Analysis Technical Report and an Economics Technical Report). It will eventually form part of the business case deliverables.

The four programme options are clearly documented elsewhere, however in summary they constitute the following key elements:

- Option 1 – Light Rail Rapid Transit (LRT) between the station and Island Bay, grade separation at the Basin Reserve, and a duplicated Mt Victoria Tunnel with Enhanced bus to the east.
- Option 2 – Bus Rapid Transit (BRT) between the station and Island Bay and between the station and Miramar/the airport, grade separation at the Basin Reserve and a duplicated Mt Victoria Tunnel catering for the eastern BRT branch.
- Option 3 – LRT between the station and Island Bay, grade separation at the Basin Reserve and small scale improvements for Enhanced Bus to the east (no Mt Victoria Tunnel).
- Option 4 – LRT between the station and Island Bay, at grade improvements at the Basin Reserve and small scale improvements for Enhanced Bus to the east (no Mt Victoria Tunnel).

As well as making a recommendation on a technically preferred programme, the report also seeks to answer a number of key questions:

- LRT v BRT
- Mt Victoria Tunnel duplication v No Mt Victoria Tunnel duplication
- Basin grade separation v Basin at grade

It also covers a range of considerations that are not directly impacting on option choice. These include:

- Congestion Charging (would require legislative change)
- Speed of delivery
- Sequencing (including disruption (and therefore compensation))
- Staging (if part of a bigger programme)
- Funding
- Delivery mechanism

The preferred programme option report brings in information from a range of disciplines. Of most significance are the inputs from the urban development and carbon specialists. Modelling cuts

across a number of areas and has focused on providing a range and “bookends” as follows to guide decision making:

- two “bookend” options (options 1 and 4)
- two “bookend” land use scenarios (core and intensified).
- three model scenarios with different assumptions around active mode uptake and working from home to reflect a range for both PT and active mode demand

The intensified land use scenario has been developed externally to the modelling workstream and should be considered as a “what if” scenario rather than an attempt to predict the level of intensification stimulated by the infrastructure improvements.

The purpose of the modelling is to inform the decision making process.

3. Modelling Methodology – WTSM refinements

The overall approach to the modelling was to draw on existing modelling and implement small adjustments and improvements based on refined assumptions and improved knowledge of the constituent components of the transformational programme.

This section focusses on refinements to inputs to the Wellington Transport Strategy Model (WTSM). Unless documented below, all other assumptions and inputs remain unchanged and have been documented previously.

At a high level, the refinements have a relatively small impact both in isolation and combination when viewed in the context of a transformational programme of the scale of LGWM, and provide a more robust evidence base for the development of the preferred option.

Capacity and travel time refinements

Mt Victoria Tunnel

The duplicated Mt Victoria Tunnel as previously modelled in WTSM assumed a mid-block capacity of around 1600 vehicles per hour.

Subsequent AIMSUN modelling undertaken to inform the PASLO report showed that in order to accommodate movements at the eastern intersections of the tunnel, the effective mid-block capacity of the new tunnel will be nearer to 1,450, equivalent to that of the existing Mt Victoria Tunnel. This capacity constraint has been adjusted in WTSM.

This effectively means that a duplicated tunnel would not deliver a material increase in capacity from the east for private motor vehicles.

Hataitai Bus Tunnel

It was previously assumed that targeted bus priority to the east of the existing bus tunnel will deliver travel times of 8 minutes between Wellington Rd and Elizabeth St, with an In Vehicle Time (IVT) perception factor of 0.9 to represent the impact of the priority measures and reliable journeys.

Further investigation, including benchmarking against current observed travel times and spreadsheet modelling of future travel times for Options 3 and 4 has shown that the targeted bus priority might not deliver the level of travel time and reliability improvements that was previously assumed.

A pragmatic approach to modelling this has been adopted for the Preferred Option Report Modelling, whereby the in-vehicle perception factor between Wellington Rd and Elizabeth St via Hataitai was adjusted from 0.9 to 1.0 to reflect the impact of bus-on-bus congestion along the corridor and the resulting travel time has been adjusted from 8 minutes to 9 minutes to reflect slower future travel times than previously assumed (informed by benchmarking against current travel times and spreadsheet modelling of future travel times)

Second Spine travel times

Analysis of the second spine travel speeds showed that in the PASLO modelling, a faster speed was assumed along the Waterfront than is likely to be achieved in reality due to the representation of bus stops and side friction.

As a result, travel times along the second spine has been increased by 2 minutes in all options, ensuring consistency with the spreadsheet based modelling of travel times that has been used as a basis for the development of transport model assumptions.

Active mode and working from home scenarios approach

The travel demand management assumptions that reflect potential working from home and increases in the attractiveness of walking / cycling (due to the transformational programme) have been adjusted to test a range of outcomes to reflect future uncertainty.

Working from Home

These adjustments apply to both the Do Minimum and Option for two of the three modelled scenarios and effectively remove a small proportion of home-based work (commuter) trips according to job category (and propensity to work from home) to reflect a potential future with more people working from home

Active modes – walking and cycling

The approach for adjusting the attractiveness of walking and cycling (relative to other modes) to reflect significant walking and cycling investment and the extent to which this could achieve modal shift from car and PT is purposefully high level and indicative, with the following context and caveats:

- WTSM represents slow trips (walking / cycling) using a simple distance based approach to extract a proportion of demand based on trip length to apportion to walking / cycling.
- More detailed modelling using other tools is required at the DBC stage to further understand changes in behaviour from walking and cycling investment to feed into the broader assessment

The modelling approach uses a range of sector-based factors to adjust the attractiveness of both walking and cycling (in generalised minutes) relative to the Do Minimum. These factors are informed by existing work undertaken for the City Streets IBC and are broadly applied as follows:

- Within CBD – reflecting road space reallocation from car to walking / cycling and increasing attractiveness of walking / cycling
- From north / west to Wellington CBD to reflect City Streets investment in walking / cycling
- From the south and east to reflect the transformational programme and intensification resulting in increased attractiveness of and propensity to walk and cycle

- All scenarios assume an improved active mode facility through Mt Victoria Tunnel, with this reflected in the modelling
- Higher factors (leading to higher modal shift to walking / cycling) for the intensified land use scenario than the core scenario

Given the indicative “what if” nature of these adjustments and need for more refined work during the DBC stage, a scenarios based approach has been developed to provide a range within which future outcomes are likely to sit:

- Scenario 1 –some working from home (5% to 10%) and a significant modelled shift from car / PT to active modes as a result of the infrastructure improvements
- Scenario 2 – some working from home (5% to 10%) and small levels of modelled shift from car / PT to active modes as a result of the infrastructure improvements
- Scenario 3 – a no working from home and no modelled shift from PT to active modes under the Options as a result of improved infrastructure

This approach to modelling walking / cycling demand is considered appropriate for the IBC stage of the project and standard for strategic transport models. For the DBC stage it is recommended that a more detailed assessment of walking and cycling demand be undertaken, with this fed back into the analysis of other modes.

Under an intensified land use scenario, the representation of walking / cycling does result in an increase in underlying walking/ cycling demand regardless of infrastructure investment due to more people living within close proximity of work and leisure locations and thus favouring active modes. This is considered intuitive and reflective of both current behaviours and the desired outcomes that intensification would achieve.

Car ownership

The table below shows the assumed car ownership for the base model (2013) and 2046 future models.

In terms of adjustments made to the model:

- Small adjustments (that have been included in previous phases of LGWM modelling) have been made to both the base year and 2046 core land use to reflect more recent Stats NZ census data regarding car ownership and update the model assumptions (that were derived initially from the 2001 census) to a more current and appropriate baseline to reflect trends within Wellington CBD over the last 5 to 10 years where car ownership levels have reduced
- Further adjustments to car ownership along the MRT corridor have been made to reflect the nature of development along the corridor under an intensified scenario being similar in characteristics to current intensified developments in the CBD

This changes under the intensified land use scenario reflects the characteristics of the compact urban form that is envisaged under the intensified land use scenarios, and is based on an assumption that the MRT corridor would have similar levels of car ownership to current dwellings in the CBD. Whilst needing to be verified during the DBC stage, this assumption is considered pragmatic for testing the ‘what if’ intensified land use scenario.

The adjustment to car ownership assumptions are based upon the intensified land use scenario delivering multi-storey and multi-unit dwellings that have fewer car parks than dwellings that would result in lower rates of car ownership.

Analysis of the Household Travel surveys data shows that some areas of Wellington CBD already have household car ownership levels of around 0.3 – the intensified land use scenario assumes that this becomes the norm, in part driven by investment in PT and active modes, with development with these characteristics spreading from the CBD to the inner suburbs (Newtown) and to some extent further south towards Berhampore and Island Bay.

Table 1 - Car ownership rate adjustments

Zone	2013 Stats	2013 WTSM		2046 Core		2046 Intensified Land Use	
		Base	Adj	Base	Adj	Base	High
36	1.1	1.3	1.3	1.6	0.8	1.6	0.8
37	0.9	1.3	1.3	1.6	0.8	1.6	0.8
38	1	1.4	1.3	1.6	1	1.6	1
39	1.4	1.6	1.6	1.6	1.2	1.6	1.2
46	0.5	1.4	0.7	1.6	1	1.6	0.3
47	0.8	1.1	0.5	1.5	0.8	1.5	0.3
48	0.8	1	0.4	1.3	0.5	1.3	0.3
49	1.1	1.4	0.8	1.6	1	1.6	0.3
50	0.4	0.9	0.3	1.2	0.4	1.2	0.3
51	0.5	1	0.4	1.3	0.5	1.3	0.3
52	0.4	0.9	0.3	1.2	0.4	1.2	0.3
53	0.5	0.9	0.3	1.2	0.4	1.2	0.3
54	0.6	0.8	0.2	1.3	0.4	1.3	0.3
56	0.9	1	0.4	1.4	0.5	1.4	0.3
57	0.5	1	0.4	1.5	0.6	1.5	0.6
58	0	1	1	1.1	0.5	1.1	0.5
59	-	1.8	1	1.4	0.7	1.4	0.7
60	0.5	0.9	0.2	1.4	0.4	1.4	0.4
61	-	1.3	1.3	1.5	0.7	1.5	0.7
62	-	-	-	-	-	-	-
63	-	-	-	-	-	-	-
64	1	1.3	0.6	1.4	0.7	1.4	0.7
65	-	0.5	0.5	0.7	0.4	0.7	0.4
66	-	1	0.9	1.5	0.7	1.5	0.7
CBD	0.7	1.1	0.6	1.4	0.6	1.4	
13	0.9	1.2	0.4	1.4	0.6	1.4	0.4
14	1	1.2	0.5	1.5	0.7	1.5	0.4
19	1	1.2	0.5	1.5	0.7	1.5	0.4
21	1	1.3	0.6	1.5	0.7	1.5	0.4
44	0.6	1	0.4	1.4	0.7	1.4	0.4
45	0.7	1.2	0.4	1.5	0.7	1.5	0.4
Newtown	0.9	1.2	0.5	1.5	0.7	1.5	
16	1.5	1.6	1.6	1.6	1.1	1.6	0.7
17	1.4	1.6	1.6	1.6	1.2	1.6	0.7
20	1	1.2	0.6	1.5	0.8	1.5	0.7
IB / BP							
1	1.4	1.5	1.5	1.6	1.1	1.6	1
2	1.4	1.5	1.5	1.6	1.1	1.6	1
3	1.5	1.6	1.6	1.6	1.2	1.6	1.1
4	1.4	1.5	1.5	1.6	1.1	1.6	1
5	1.6	1.7	1.7	1.7	1.3	1.7	1.2
6	1.7	1.8	1.8	1.7	1.4	1.7	1.3

7	1	1	1	1.2	0.9	1.2	0.8
8	1.3	1.4	1.4	1.6	1	1.6	0.9
9	1	1.1	1.1	1.5	0.8	1.5	0.7
East	1.3	1.4	1.4	1.6	1	1.6	

Parking

CBD Parking in WTSM is represented by charges across zones in the CBD, with the charge varying by time period, purpose and area. Note that there is no parking capacity constraint within WTSM.

The Golden Mile, second spine and transformational programme will result in a reduction in on-street parking, and also potentially a significant reduction in off-street private parking due to the potential redevelopment of parking building sites for apartments / residential dwellings and the development of vacant lots that might currently be used for off-street parking.

Through time, it is also envisaged that the mix of parking would evolve from a 90/10 split between commuter vs short stay parking to a greater percentage of parking (off-street) being short stay parking.

The principles of supply and demand suggest that if parking supply were to decrease, the cost would likely increase to keep a balance between supply and demand, and therefore the modelling assumptions for all three scenarios assumes a 30% increase in parking charges in 2046 to reflect the reduced parking capacity in the CBD.

This is considered a pragmatic approach in order to replicate a transformational programme of the nature of LGWM, that is likely to reduce the supply of demand and restrict traffic circulation within and to the CBD.

It should be noted that further more detailed work is required during the DBC in order to test assumptions and outcomes in relation to the reduction in traffic capacity within the CBD and the reduction in parking spaces.

Revised land use assumptions

The land use inputs used in previous modelling work have been refined by the urban development team and revised inputs for the model have been produced. The previous assumptions – for an additional 16,000 dwellings over and above the 10,000 enabled by the spatial plan – are reported in the PASLO modelling report² and were based on projections of growth developed by The Property Group in January 2021 that themselves were based on previous option V1A that assumed MRT to the south and east.

The more recent changes undertaken for the PPOR maintain the same overall level of growth – 16,000 additional dwellings compared to the Do Minimum – but change the distribution of growth accordingly:

- Lower levels of growth in the eastern suburbs (relative to previous intensified land use scenario)
- Higher growth in Island Bay and Berhampore (relative to previous intensified land use scenario)

² https://lgwm-prod-public.s3.ap-southeast-2.amazonaws.com/public/Documents/Nov-1-MRT/2021-11-01-LGWM-PASLO-Modelling-Report_Redacted-v2.pdf

New land use inputs have been developed for the intensified land use scenarios and implemented in WTSM as shown below:

Table 2 - Land use adjustments

Area	Zone	MRT Enabled Population growth - Previous Intensified Land Use	MRT Enabled Population growth - Revised Intensified Land Use	MRT Enabled Employment growth - Previous Intensified Land Use	MRT Enabled Employment growth - Revised Intensified Land Use
Miramar	1	400	250	100	
Miramar	2	800	700	200	500
Miramar	3	800	250	200	
Miramar	4	1050	300	250	
Miramar	5	1050		250	
Lyll Bay	8	350	200	100	
Kilbirnie	9	1300	800	400	300
Eastern suburbs		5800	2500	1500	800
Newtown	13	3900	4600	1200	1200
Newtown	14	3900	4600	1200	1200
Berhampore / Newtown	19	2600	2000	800	300
Mt Cook	21	975	1300	300	150
Mt Cook	44	975	350	300	75
Mt Cook	45	650	350	200	75
Newtown / Adelaide Rd		13000	13300	4000	3000
Island Bay	16	650	1150	125	280
Island Bay	17	650	1150	125	280
Berhampore / Island Bay	20	1300	1550	250	140
Island Bay / Berhampore		2600	3900	500	700
Te Aro	46	2600	2850	1625	1800
Te Aro	47	2600	2850	1625	1800
Te Aro	48	2600	2850	1625	1800
Te Aro	49	2600	2850	1625	1800
Te Aro	50	2600	2850	1625	1800
Te Aro	51	2600	2850	1625	1800
Te Aro	52	2600	2850	1625	1800
Te Aro	53	2600	2850	1625	1800
CBD / Te Aro		20800	22600	13000	14500

As has been the case in previous modelling undertaken for the transformational programme, the intensified land use scenario retains the same population growth across the region overall as the

core land use scenario, with development focused on the MRT corridors rather than the wider region.

This approach allows us to assess the impact of the change (a faster rate of growth on a particular corridor enabled by transport investment) in isolation to other changes. It is also best practice in terms of the Waka Kotahi Monetised Costs and Benefits Manual.

It also enables us to understand potential trigger points – in terms of the level of additional development and / or timing of such growth – whereby demand might warrant a particular modal solution.

In this sense the 'core' and 'intensified' land use scenarios can be considered “bookends”, and the modelling can be used to understand the trade-offs between capacity, frequency and mode on the continuum between the core and intensified scenario

The scenario has been developed based on the assumption that PT network improvements catalyse development to the south and (to a lesser extent) the east and is loosely based on a land use response to option 1. It is intended to represent a “what if” scenario and provides an indication as to the implications on programme performance

Further analysis is required to determine a forecast level of response, however it is anticipated that the other programme options will respond differently to option 1:

- Based on international literature, BRT based systems are shown to catalyse lower levels of intensification than LRT based systems. Therefore, lower levels of intensification may be achievable for the southern corridor under option 2. Higher levels of intensification, however, may be achievable for the eastern corridor under option 2 reflecting an improved level of PT provision
- Option 3 will support identical levels of intensification to the south to option 1. It will, however, support limited levels of intensification to the east.
- Option 4 will support similar levels of intensification to the south to options 1 and 3. The MRT corridor follows a slightly less desirable route to the north of the Basin Reserve – further work would be required to determine whether this would have any effect on development. Similarly to option 3, it will support limited levels of intensification to the east.

A realistic outcome could also be one where the PT investment stimulates faster population and economic growth across the whole region, with this additional growth being focussed on the MRT corridor, however this would need to be taken together with other factors that could influence the speed of intensification, including national and regional economic factors and policies.

It should also be noted that the intensified scenario assumes:

- a similar demographic breakdown to the existing demographic breakdown for a particular zone
- a similar distribution of employment by type for each zone based on the existing breakdown for a particular zone

This is noted as an improvement area for the DBC, where improvements the dynamic nature of the transport-land use response will be refined and incorporated into modelling work.

Do Minimum

Further details around the Do Minimum are provided in the IBC document, however in summary the Do Minimum includes no significant interventions on the highway and rail network and only

incremental improvements to PT frequencies to accommodate future demand (which it is assumed would have consequences in the central city for PT reliability).

Importantly, it does not assume any rail improvements that would result in increased service frequencies and improved levels of service compared to the current status quo.

4. Modelling Methodology – Aimsun

Strategic models by their very nature are not designed to accurately represent highway impacts at a more local level within compact urban areas, due to their simplified representation of mid-block queuing and congestion and coarse zone systems

As a result, a more refined approach is required to improve our understanding of the traffic impacts of Options 1 and 4.

The AIMSUN meso-scopic model has been used to provide a more faithful representation of the traffic impacts of the Options 1 and 4 and provide a more robust differentiation between options, in particular relating to:

- the impact of reduced capacity in Wellington CBD
- the performance of the Basin Reserve and Mt Victoria tunnel

The approach taken for the AIMSUN modelling that has informed the preferred option assessment is as follows:

- Run AIMSUN Options 1 and 4 with growth / change in demand derived from revised WTSM demand (Scenario 1)
- Derive benefits from these options, quantitative assessment of network performance, input to economics

The AIMSUN model uses a nominal 2026 model year, focussing on the impact that a given change in traffic volumes could have on the operation of the CBD and state highway network.

The outputs of the AIMSUN modelling are shown in Appendix B

5. Output Metrics

The programme wide KPIs are well documented elsewhere and draw input from a range of technical disciplines including modelling. The previous work indicated that there is limited differentiation between the options for some of the modelling related KPIs, therefore the focus of the modelling output for the preferred options report has been on the elements that do show some differences in performance.

The following table highlights where updated modelling output has been extracted (modelling outputs are highlighted in bold). In summary, WTSM modelling has been used to inform the option comparison work. It has also been used to inform the economic analysis. Aimsun modelling has been used to answer some of the key questions highlighted in the introduction to this document as well as inform the option comparison work.

It is important to acknowledge that the results from WTSM and Aimsun are not directly comparable – WTSM modelling has been undertaken for 2046 (as this shows the greatest amount of differentiation), whereas Aimsun modelling has been undertaken for a notional scheme opening year (it is based on a modified 2026 forecast, but the date is less critical due to the operational nature of the model).

Table 3 - Key output metrics

Objective	KPI	Measure	Application in Preferred Programme Report
A transport system that enhances the urban amenity and enables urban development outcomes	Urban Amenity	The quality of the urban environment associated with Comfort, Composition, Connectivity and Activation	Not a large differentiator in PASLO so no further work has been carried out
	Urban Development	Qualitative assessment and quantified net value uplift (Yield, Viability and Value Uplift and Opportunity)	Not a differentiator due to modelling approach but a key consideration by Partners. Modelling does not forecast urban development potential. Modelling has been used to show the difference in performance between core and intensified options for the key metrics outlined below in this table.
	Attracting traffic off city streets	Number of vehicles using highway rather than waterfront or city streets at key screen lines	Revised Aimsun modelling output has been used to understand the implications of the Basin Reserve grade separation and the second Mt Victoria Tunnel on key city streets (and route choice around the city).
A transport system that provides efficient and reliable access for users	People living within close proximity of key destinations	Resident population within a 30-minute journey time of Wellington City Centre and key social and economic opportunities	This is a differentiator when considering the impact of congestion charging and/or urban development Updated WTSM modelling has been used to derive 15 and 30 minute catchment areas to understand differentiation
	Travel time reliability	Travel time reliability for general traffic and public transport across the Wellington region	Not a differentiator in PASLO. Aimsun outputs have been reviewed to determine the extent to which Basin and Mt Vic Tunnel influence travel time reliability
	Comparative travel time between modes	Travel time ratio for key modes and routes	Slight differentiator only – this report draws on PASLO analysis
	Equitable Travel	Changes to accessibility (measured using effective density) for higher deprivation areas in Wellington.	Slight differentiator only (some options have 2-3% increase vs 4-5% increase). This report draws on PASLO analysis
	Pedestrian Level of Service	Qualitative assessment of quality of infrastructure and likely delays at intersections	Not a differentiator

	Public Transport Delay	Comparison of public transport peak travel times vs free flow travel time	This is a differentiator when considering congestion charging. Updated PT travel time metrics have been extracted from Aimsun model.
	The quality of cycling facilities	Qualitative assessment of quality of infrastructure.	Not a differentiator
A transport system that reduces carbon emissions and increases mode shift by reducing reliance on private vehicle travel	Mode share in the central city	Number of people travelling across the central city screenline by mode	Not a differentiator for the region but high interest, therefore a new metric has been developed using WTSM outputs to show mode share of trips with a start or end point in the Wellington CBD. This is reported on for core and intensified land use scenarios, as well as for the congestion charge sensitivity test. In addition to this, analysis of PT line loadings on the two MRT branches has been undertaken.
	Mode share across the region	Person kilometres travelled by mode around the region	
	Carbon Emissions	Composite assessment using Carbon Assessment Tool for investment (CATi), Fleet emissions (VKT and fuel consumption) and amount of active transport enabled	Slight differentiator from previous work and high interest for the stakeholders. New methodology for assessing enabled carbon has been developed, drawing on model outputs – particularly fuel consumption and VKT. These are reported for core and intensified land use scenarios and for the congestion charge sensitivity test
	Embodied Carbon	Estimation of the carbon embodied in the construction of new infrastructure.	Slight differentiator and high interest. No modelling required for this KPI
A transport system that improves safety for all users	Deaths and serious injuries for people walking or cycling	Deaths and serious injury equivalents for people walking and cycling in and around the central city	Not a differentiator
	Deaths and serious injuries of all transport users	Deaths and serious injury equivalents for all transport users	Not a differentiator but safety is an investment objective, so reporting is provided. No modelling implications
A transport system that is adaptable to disruptions and	Enhances the resilience of land transport access to critical facilities	Qualitative assessment of journeys impacted and resilience gaps	Differentiator but combined across all three KPIs – no modelling implications

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future uncertainty	and within the city	
	Resilient to HILP events and contributes to access for communities	Qualitative assessment of access for emergency response and recovery after a high impact event
	Enhances the resilience of access to provide socio-economic functionality in LIHP and unplanned events	Qualitative assessment of how the socio-economic functionality is changed after a low to moderate impact event
		Combined into above
		Combined into above

Outputs from the WTSM modelling are presented in Appendix A and outputs from the Aimsun modelling are presented in Appendix B.

6. Discussion

The analysis presented in Appendices A and B can be summarised as a range based on the three scenarios that have been modelled as follows:

VKT – Regional

- Options 1 and 4 reduce daily VKT by around 1 to 2%
- This increases to between 7% and 10% under the intensified land use scenario, a direct result of shifting growth from outside of Wellington City (with relatively high car dependency) to the MRT corridor with relatively low levels of car dependency and high PT / active mode trip rates
- Option 1 is forecast to result in a slightly greater reduction in VKT than option 4 due to the greater level of PT improvements to the east

VKT – Wellington City

- Options 1 and 4 reduce daily VKT by between 2% to 4% in Wellington City (relative to Do Minimum), rising to 3% to 7% under intensified scenarios
- In per capita terms, the intensified scenario reduces VKT in Wellington City by up to 15% compared to the core scenario and up to 20% compared with the current

PT Passenger Kilometres – Regional and Wellington City

- Options 1 and 4 increase daily PT passenger kilometres in Wellington City by 15% compared to the Do Minimum, with the intensified land use scenarios generating a 25% to 30% increase

- At a regional level, daily PT passenger kilometres travelled increase by up to 10% between the Do Minimum and Options 1 and 4
- The increases noted above are greater in the peak periods than in the inter-peak
- In per capita terms, daily PT passenger kilometres increase by around 10% between the Do Minimum and Options

PT Passenger Kilometres – Southern and eastern suburbs

- Public transport passenger KMs travelled (PKT) indicate a greater level of difference between options 1 and 4 when assessed at a more granular level
- Option 1 indicates a 25% to 35% uplift in PKT from the south and east under the core land use scenario
- Option 1 indicates a 20% to 25% uplift (relative to the do minimum in 2046)
- These figures increase to 80% to 85% and 65% to 70% respectively for the respective intensified land use scenarios.

Accessibility

- The differences between the options are reflected to a greater extent in the catchment analysis than they are in some of the other metrics
- Over 500,000 people live within one hour (by car) of the airport under option 1, whereas around 420,000 people live within one hour of the airport under option 4 (around 380,000 people live within one hour of the airport in the do minimum)
- The assessment of public transport accessibility shows a very similar outcome, with significant improvements to accessibility seen for Option 1 relative to Option 4 to the east
- This differentiation between Options 1 and 4 to the east is driven by the Mt Victoria tunnel duplication and the Basin Reserve grade separation.

Mode Share – Trips to CBD

- All options increase the non-car mode share of trips to the CBD in the AM peak
- Relative to the Do Minimum, Options 1 and 4 increase non-car mode share of trips to the CBD in the AM peak from around 58% to 66%
- The intensified land use scenarios result in a further increase in non-car mode share, to around 71%
- The difference in increased non-car mode share between the options is small up to 2046, however it is expected to increase beyond this date as there is limited capacity to accommodate additional PT demand in option 4 due to the capacity constraint at the Hataitai tunnel.

Mode Share – Trips to CBD from south and east

- All options increase the non-car mode share of trips to the CBD in the AM peak from the southern and eastern suburbs
- Relative to the Do Minimum, Options 1 and 4 increase non-car mode share of trips to the CBD from the south and east in the AM peak from 40% to around 55% (Option 1) and 54% (Option 4)

- The intensified land use scenarios result in further increases in the non-car mode share, to 64% for both Options 1 and 4
- The main difference between Options 1 and 4 relates to around 400 to 500 fewer PT trips in Option 4 compared to Option 1 under both the core and intensified land use scenarios - This is due to slower PT travel times from the east under option 4, leading to a lower level of modal shift

Emissions

- All options have a positive impact in terms of reducing vehicle emissions
- Option 1 and 4 generate a 2% to 4% reduction in daily emissions within Wellington City (1% to 2% across region) relative to the Do Minimum
- Option 1 results in a marginally greater reduction in daily emissions compared to Option 4, primarily due to higher modal shift from the east
- Intensified land use scenarios reduce daily emissions by around 7% to 10% at a regional level

Active Modes

- An estimated 50% increase in AM peak cycle trips to the CBD in Options 1 and 4 (relative to the Do minimum), increasing to 100% in intensified land use scenarios
- An estimated 50% increase in AM peak walk trips to the CBD in Options 1 and 4, increasing to 100% for intensified land use scenarios
- Inner suburbs – Adelaide Road, Mt Cook, Newtown – account for the majority of the growth in walking trips
- Minimal forecast differentiation between the options reflecting the assumed high quality of provision for the active modes in all options.

AIMSUN Modelling – travel times

- Option 1 – 3 minutes faster travel times from Miramar to Taranaki St (AM Peak) than Option 4
- Similar travel times between options 1 and 4 for other travel time routes

AIMSUN Modelling – congestion

- Taranaki St is a more constrained corridor for general traffic (with MRT) compared to Kent / Cambridge
- This is predicted to result in greater congestion at intersections along Taranaki St and in the environs in option 4, compared to option 1

7. Summary of scenario modelling metrics

As noted above, three scenarios have been modelled looking at different assumptions around active modes, working from home and parking charges, to provide a range of outcomes:

- **Scenario 1** –high shift to active modes and PT as a result of the transformational programme, some working from home (~5% to 10%) and other TDM measures, 30% increase in parking charge as proxy for reduced capacity

- **Scenario 2** – lower level of shift to active modes as a result of the options, some working from home (~5%)/ broader TDM, 30% increase in parking charge as proxy for reduced capacity
- **Scenario 3** – no modelled shift to active modes, no TDM or working from home, 30% increase in parking charge as proxy for reduced capacity

These future scenarios reflect the inherent uncertainty of forecasting future outcomes that are dependent on the eventuation (or otherwise) of multiple assumptions.

Key metrics

The table below summarises the changes in key metrics as a result of these tests in relation to Scenario 1 under the core land use.

Note **green** signifies an increase, **orange** a decrease and **blue** no material change

Table 4 Scenario testing summary - Core Land Use

	DM	Option 1			Option 4		
		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
PT cordon crossing, South (2hr, AM)	3,000	2,500	3,500	3,900	2,900	3,700	4,200
PT cordon crossing, East (2hr, AM)	3,300	4,800	4,800	5,500	4,000	4,100	4,700
PT cordon crossing from S&E (2hr, AM)	6,300	7,400	8,200	9,400	6,900	7,800	8,900
Car cordon crossing from S&E (2hr,AM)	11,200	10,200	10,600	10,700	10,100	10,500	10,600
PT Mode Share to CBD from S&E	35%	44%	46%	48%	42%	44%	47%
Increase in PKT in S&E suburbs (cf DM)		25%	30%	35%	13%	20%	25%
Walk / cycle cordon crossings	2500	4800	3800	3800	4800	3800	3800
Non-car mode share from S&E	40%	54%	53%	55%	54%	53%	55%
PT cordon crossings - Total	36,000	39,700	41,000	45,800	39,200	40,300	44,800
MRT Load - Basin	1,250	1,500	2,000	2,400	1,800	2,000	2,500
PT Load – Diagonal / Bus Tunnel	1,700	2,400	2,300	2,600	2,300	2,400	2,600
Reduction in VKT – Wellington CBD		7%	5%	3%	7%	5%	3%
Reduction in VKT – Wellington City		4%	3%	3%	3%	2%	2%
Reduction in VKT – Wellington Region		2%	1%	1%	2%	1%	1%
General traffic travel time Miramar to CBD (AIMSUN)	12.0 min	8.5 min	8.5 min	8.5 min	11.5 min	11.5 min	11.5 min

Persons within 60 min to Airport by PT	160,000	230,000	230,000	230,000	160,000	160,000	160,000
Persons within 60 min to Airport by Car	380,000	500,000	440,000	440,000	420,000	420,000	430,000

The table below summarises the changes in key metrics as a result of these tests in relation to the intensified land use scenarios. As set out above, the land use scenario has been developed to be reflective of Option 1.

The Option 4 metrics are in italics as it is unclear whether the same level of intensification could be achieved under option 4.

Table 5 Scenario testing summary - Intensified Land Use

	DM	Option 1			Option 4		
		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
PT cordon crossing, South (2hr, AM)	3,000	4,500	5,900	6,600	5,200	6,400	7,200
PT cordon crossing, East (2hr, AM)	3,300	6,300	6,100	6,800	5,100	5,000	5,700
PT cordon crossing from S&E (2hr, AM)	6,300	10,800	11,900	13,400	10,300	11,500	12,800
Car cordon crossing from S&E (2hr,AM)	11,200	10,000	10,500	10,600	10,000	10,500	10,600
PT Mode Share to CBD from S&E	35%	55%	56%	58%	54%	55%	57%
Increase in PKT in S&E suburbs (cf DM)		75%	80%	85%	60%	65%	70%
Walk / cycle cordon crossings (estimate)	2500	7200	5800	5800	7200	5800	5800
Non-car mode share from S&E	40%	64%	63%	64%	64%	63%	63%
PT cordon crossings – Total	36,000	43,600	43,800	48,300	43,000	43,200	47,600
MRT Load – Basin	1,250	2,500	3,400	3,900	2,500	3,400	4,000
PT Load – Diagonal / Bus Tunnel	1,700	3,400	3,200	3,500	3,000	3,200	3,300
Reduction in VKT – Wellington CBD		6%	2%	1%	6%	2%	1%
Reduction in VKT – Wellington City		6%	5%	5%	6%	5%	4%
Reduction in VKT – Wellington Region		10%	9%	8%	10%	8%	8%
General traffic travel time Miramar to CBD (AIMSUN)	12.0 min	8.5 min	8.5 min	8.5 min	11.5 min	11.5 min	11.5 min
Persons within 60 min to Airport by PT	160,000	280,000	280,000	280,000	230,000	230,000	230,000
Persons within 60 min to Airport by Car	380,000	500,000	440,000	440,000	420,000	420,000	430,000

Economic Summary

The tables below show highway and PT benefits for Scenarios 2 and 3 relative to Scenario 1 based on indicative model outputs. Note this should not replace to more detailed programme economics, but provide a guide as to the relativity between options.

Table 6 Comparison of benefits – Sensitivity Tests, Core land use

	Option 1 - Core			Option 4 - Core		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
PT	100%	95%	105%	100%	95%	105%
Highway (exc intra CBD)	100%	50%	20%	100%	40%	-10%
Highway (exc intra CBD and to / from CBD)	100%	65%	70%	100%	50%	60%
Walking (estimate)	100%	50% to 75%		100%	50% to 75%	
Cycling (estimate)	100%			100%		
Agglomeration ³	100%	80%	75%	100%	90%	80%

Table 7 Comparison of benefits – Sensitivity Tests, Intensified land use

	Option 1 – High			Option 4 - High		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
PT	100%	95%	105%	100%	95%	105%
Highway (exc intra CBD)	100%	30%	25%	100%	30%	15%
Highway (exc intra CBD and to / from CBD)	100%	75%	90%	100%	75%	90%
Walking (estimate)	100%	50% to 75%		100%	50% to 75%	
Cycling (estimate)	100%			100%		
Agglomeration ⁴	100%	75%	70%	100%	75%	75%

³ Based on EJD outputs

⁴ Based on EJD outputs

Whilst the figures show a decline in highway benefits (relative to Scenario 1), this is largely a function of less trip suppression due to different working from home assumptions, less modelled shift to active modes (from car and PT) and less resulting de-congestion benefits.

Analysis of model outputs also shows that:

- the majority of the dis-benefits relate to trips to / from the CBD in the inter-peak and, to a lesser extent, PM peak
- the nature of these dis-benefits are largely a result of changes to accessibility to particular zones (re-routing resulting in longer trips) as opposed to increases in congestion

In reality, people would be likely to either change their destination (car park, parking location) rather than incur significant dis-benefits of the nature indicated by the strategic model – neither the strategic model nor the AIMSUN model will represent this response and therefore it is considered pragmatic from an economics perspective to potentially discount these dis-benefits.

It should also be noted that the modelling reported in this note does not specifically reflect the potential transformational nature of plans such as the Multi-modal Network Plan that envisages up to a 30% reduction in road capacity within the central city network, generating a significant increase in walking and cycling trips nor does the strategic model fully capture the transformational nature of the programme and fundamental changes in land use and behaviour (and increase in walking / cycling and less general traffic) in the Wellington CBD.

Furthermore, the active travel benefits and figures (cyclists / pedestrians) are estimated from the strategic model at a high level and should in future stages be benchmarked against those derived from other workstreams such as the City Streets IBC and various SSBC documents for the Golden Mile and Thorndon Quay / Hutt Rd.

Therefore overall, the view of the modelling team is that the highway travel time benefits and cycle benefits are likely to be conservative, particularly for scenarios 2 and 3, as the full transformational nature of the programme has not been fully captured.

During the subsequent DBC stage of the project, it is recommended that a more detailed assessment of active mode uptake and benefits be undertaken and fed back into the wider assessment, together with a more detailed assessment of the transformational nature of the programme be undertaken to feed into subsequent analysis.

It is therefore in this context that the figures in this report should be taken as indicative of a range, and are likely to be on the conservative side in terms of reductions in traffic volumes / VKT that could be achieved from a transformational programme of the nature of LGWM.

High level summary

In summary, the scenario tests show the following:

- Increases in PT patronage, a shift from walking / cycling and working from home
 - Option 1 Core - a 25% to 35% increase in PKT to the south and east
 - Option 4 Core - a 20% to 25% increase in PKT to the south and east
 - Option 1 High - a 75% to 85% increase in PKT to the south and east
 - Option 4 High - a 60% to 70% increase in PKT to the south and east

- Reductions in VKT
 - A 1% to 2% reduction at a regional level for the core scenario, rising to 7% to 10% under the intensified scenario
 - Changes in VKT within Wellington CBD of between 2% and 7% reduction (note that this is largely driven by changes in active mode assumptions – the modelling does not reflect the potentially more transformational impact of the City Centre Traffic Circulation Plan)
- Increases in non-car mode share to the CBD from the south and east
 - Increase from 40% to 55% under core scenario
 - Increases from 40% to to 64% under intensified scenarios

Line loadings

One of the key metrics is MRT / BRT / bus line loadings during the peak hour. The table below summarises the MRT line loadings at the following locations:

- MRT approaching the Basin (Option 1 and 4)
- Bus approaching the basin (Option 1⁵) and bus tunnel (Option 4)

Table 8 MRT Line loadings - Sensitivity Tests, Core and Intensified Land Use, AM peak 1hr

		Option 1			Option4	
		DM	Core	High	Core	High
Approaching Basin (Options 1 and 4)	Scenario 1	1,250	1,500	2,500	1,600	2,600
	Scenario 2		2,000	3,400	2,000	3,300
	Scenario 3		2,400	3,900	2,500	4,000
East – approach to Basin (Option 1), Bus Tunnel (Option 4)	Scenario 1	1,650	2,400	3,400	2,300	3,000
	Scenario 2		2,300	3,200	2,300	3,000
	Scenario 3		2,600	3,500	2,600	3,300

The modelling shows the following:

- hourly demand at the peak load point approaching the Basin Reserve could be up to 4,000 passengers in the peak hour, suggesting that high capacity MRT / LRT would be required to accommodate this kind of growth
- hourly demand at the peak load point from the east under a high land use scenario (3,300 to 3,500) is unlikely to be able to be accommodated reliably under option 4 without-resulting in a deterioration in travel times through Hataitai and the bus tunnel

⁵ Note that Option 1 only includes demand approaching the basin and does not include local bus passengers who would still use the bus tunnel under Option 4

Analysis and interpretation around what these loads mean in terms of service frequencies, mode and reliability is provided in the Preferred Programme Options Report

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Appendices

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Appendix A – WTSM Model Output

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PREFERRED OPTION MODELLING RESULTS

Appendix A – WTSM modelling

29th April 2022



General

- Modelling based on assumptions that were developed at a particular point of time in relation to:
 - Population projections
 - Urban development outcomes
- **Three scenarios have been developed, reflecting different assumptions around active modes and working from home**
- **Result presented in this note relate to a mid-point scenario; results and outcomes should be considered as indicative of a range**, given the inherent uncertainty forecasting 20 to 30 yr into the future
- Further more detailed work to be undertaken during the DBC will be used as a basis to refine assumptions and further develop the analysis

Modelling approach

- Modelling undertaken to inform aspects of the preferred option reporting
- Two areas of focus for preferred option reporting:
 - Areas of differentiation between options – mode choice, accessibility, carbon and economics
 - Key outstanding question to be answered (LRT vs BRT, Mt Vic vs no Mt Vic, Basin Grade separation vs at grade)
- Where possible, draw on previous work – PASLO modelling, business cases, engagement feedback
- Model refinements based on assumption changes and network clarifications prioritising options 1 and 4 (two bookend options with interpolation used to understand the relative impact of options 2 and 3)

Changes to assumptions – Core

- Mt Victoria Tunnel – lower capacity for general traffic in Option 1 (based on a more detailed understanding of capacities derived from the Aimsun model)
- Hataitai bus travel times optimized for Option 4 based upon updated input travel times
- Walking and cycling more attractive within CBD and within southern suburbs (MRT corridor)
- Small increase in cost of parking as proxy for likely reduction in parking supply (on and off-street) due to transformational change
- Minor changes to improve representation of cycling to east, resulting in Option 1 and 4 having similar attractiveness
- Modal adjustments to correct for short trip bias

Changes to assumptions – Intensified

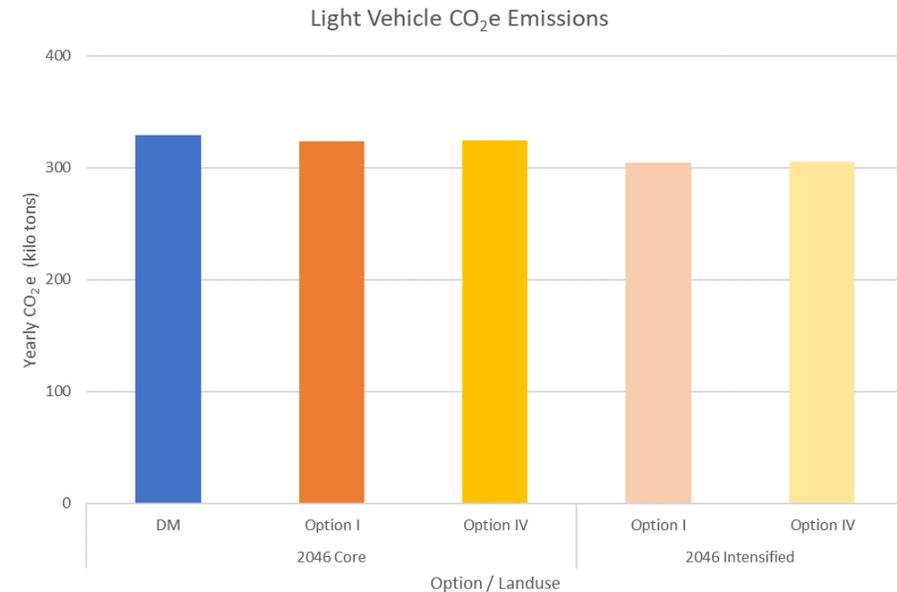
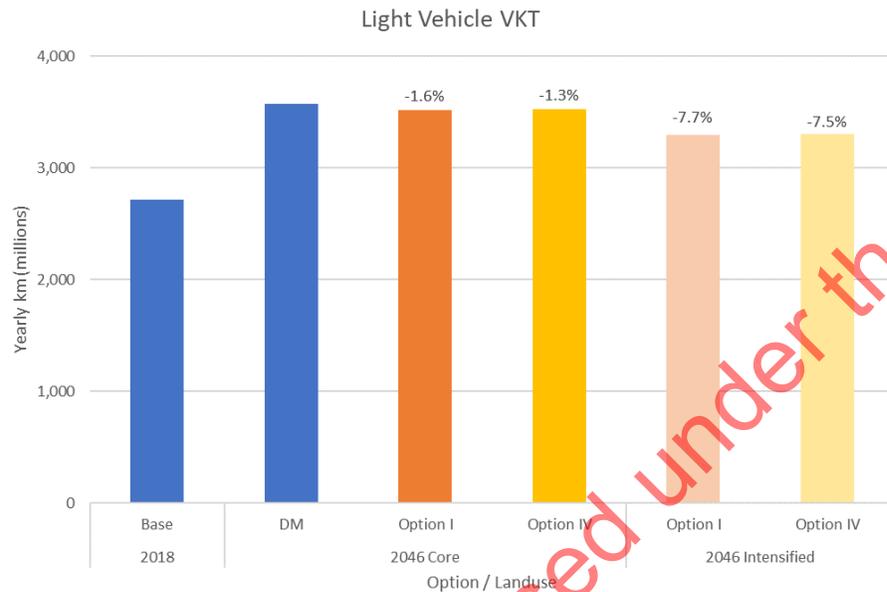
- Intensified scenario used to understand the implications on the network should higher levels of development intensity occur along the MRT corridor (it is **not** a forecast of level of intensification)
- As for core plus:
 - Walking and cycling **significantly** more attractive within CBD and within southern suburbs (MRT corridor)
 - **More significant** increase in cost of parking as proxy for likely reduction in parking supply (on and off-street) due to transformational change
 - Revised land use inputs – MRT enabled UD focused more on southern corridor and less to east (compared to previous)
 - **Lower car ownership** rates along MRT corridors

Carbon Assessment

Modelling forms an input to the carbon assessment – this section provides an overview of the changes in fuel consumption and VKT/PKT

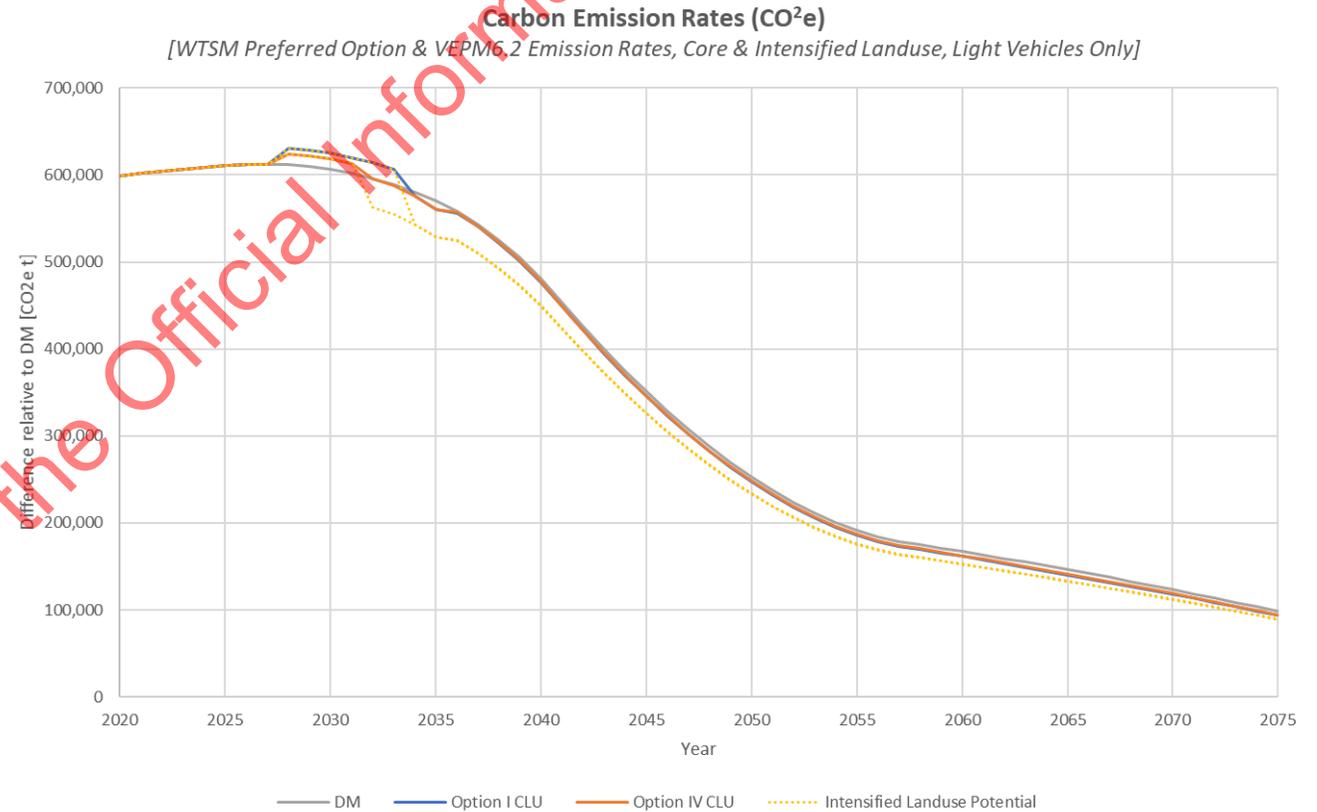
VKT/ CO2 Emissions for Light Vehicles in 2046

- ~1.5% reduction of region-wide VKT and emissions under Option I and IV
- ~7% reduction of region-wide VKT and emissions under Option I and IV with the High Land Use (HLU) assumptions
- Opt I and Opt I HLU show higher reductions than Opt IV and Opt IV HLU



Yearly emissions extrapolated to 2034 to 2074 evaluation period

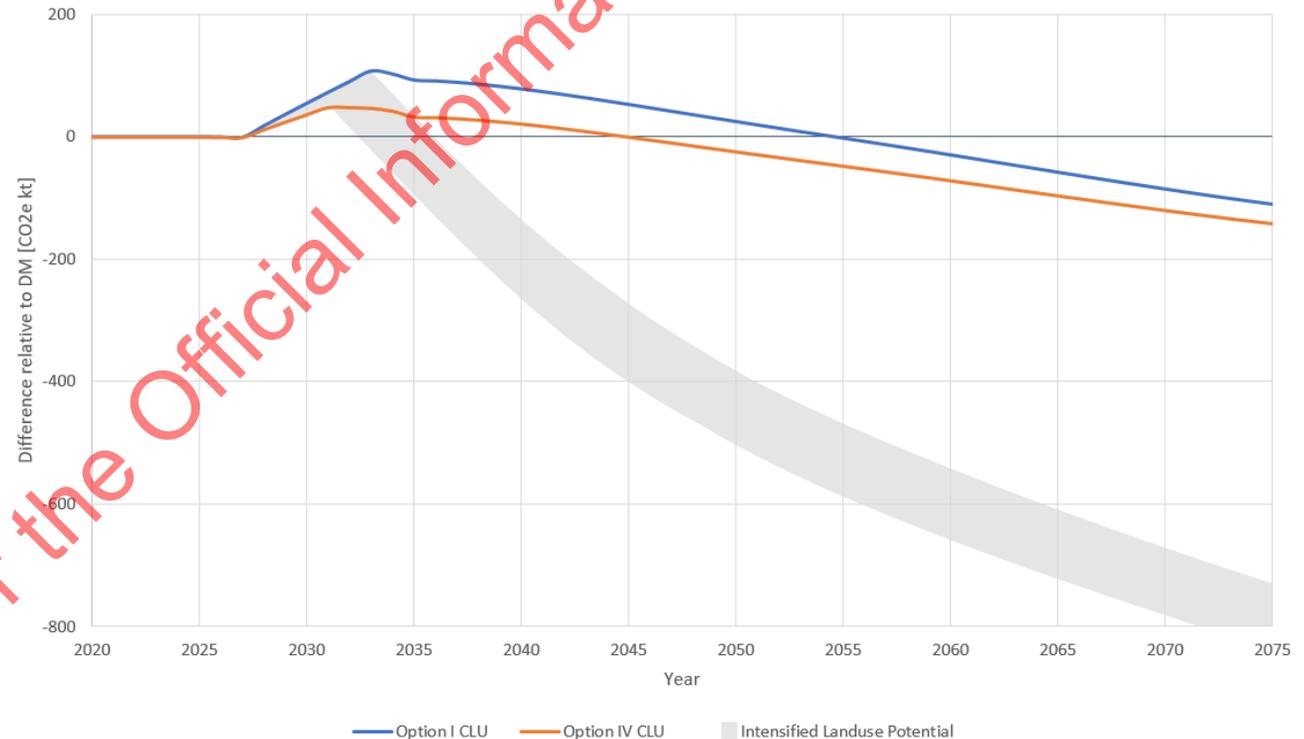
- Modelling suggests that VKT keeps increasing over time, but better fuel efficiency means total emissions decrease year on year
- Biggest difference between scenarios in early years



Construction Emissions balanced by Accumulated Savings

- Enabled emissions are very similar for Options 1 and 4 – the main differentiator between these options is the embodied emissions
- The difference between core and intensified scenarios is significant, the result of more people living in close proximity to their place of work, resulting in an increase in PT patronage, walking and cycling
- HLU outcomes expressed as range to account for uncertainty regarding urban development outcomes

Cumulative Carbon Emissions (CO₂e) - Relative kilotons to DM - Wellington Region
[WTSM Preferred Option Modelling & VEPM6.2 Emission Rates, Core & Intensified Landuse, Light Vehicles Only]



Changing the delivery timeframes

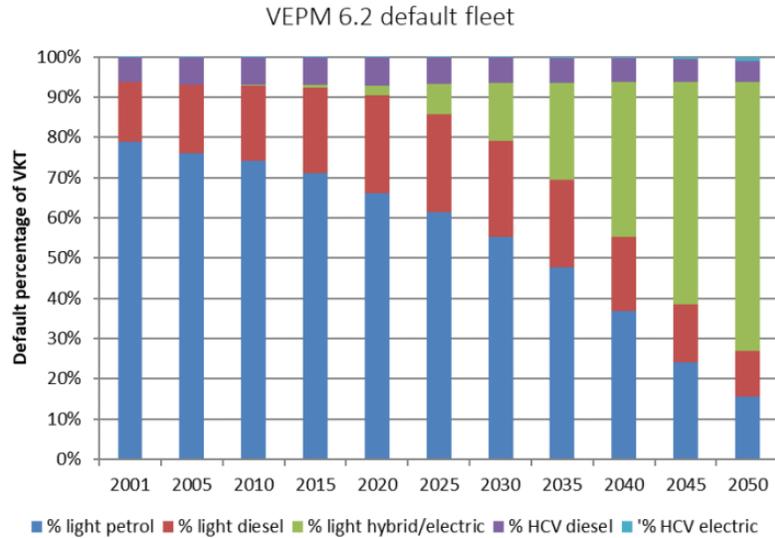
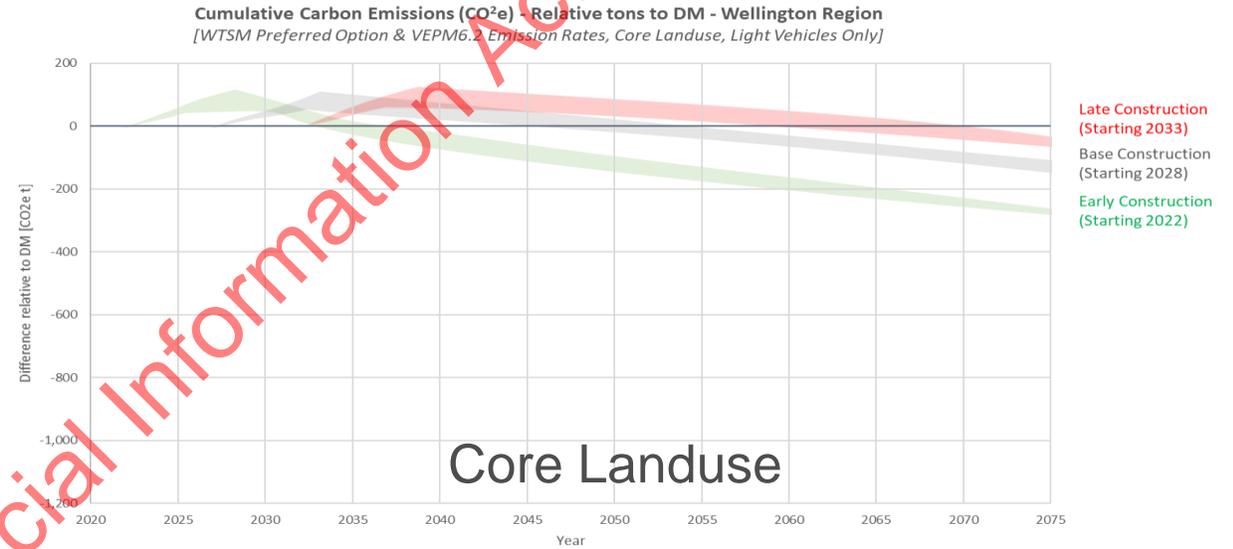


Figure 2: Default fleet (%VKT by vehicle class) in VEPM 6.2. Note that HCV includes buses

- The EV / Hybrid fleet mix is forecast to increase to 15% in 2030, 40% in 2040, 65% in 2050
- These are median figures and there is significant uncertainty regarding EV uptake
- Early delivery of interventions that might lead to increased mode shift and lower VKT between now and 2030 will (proportionately) have a greater impact in terms of emissions reductions as average emissions are forecast to be much greater between 2020 and 2030 (compared to later years) due to the lower EV fleet proportion in earlier years
- Conversely, later delivery of interventions that contribute towards modal shift and VKT reduction will result in a lesser impact in terms of emissions reductions



Core Landuse

Carbon analysis summary

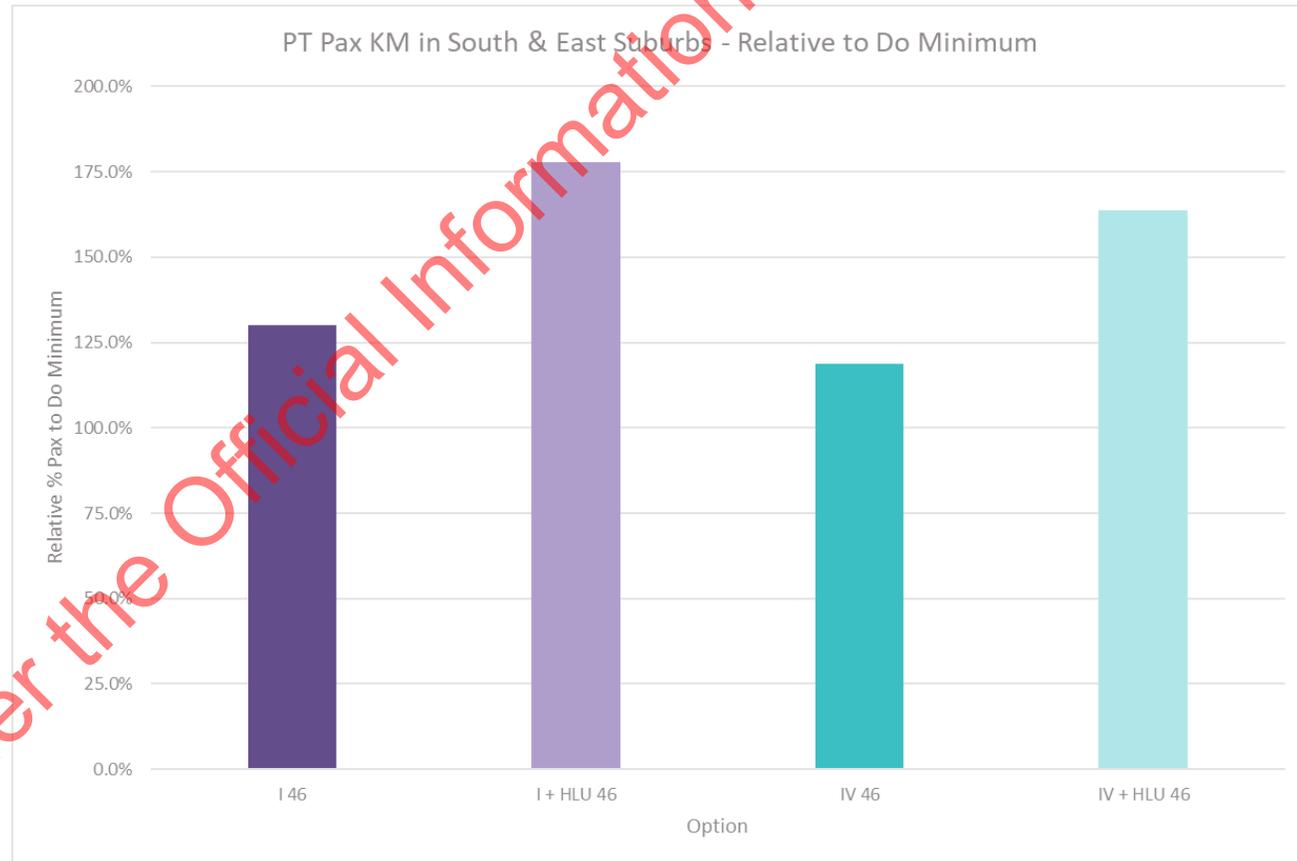
- The main difference in carbon emission performance (as assessed through the modelling) between Option I and Option IV is embodied emissions during the construction phase; there no significant difference in terms of enabled emissions
- The difference in whole of life emissions between the Core Scenario and Intensified Scenario is significantly higher than the difference between Option I and Option IV, highlighting the importance of intensification in terms of reducing emissions regardless of the option
- The difference between delivering an option earlier or later can be more significant than the difference between Option I and Option IV, highlighting the need to invest and reduce emission as quickly as possible from the present day in order to have meaningful impacts in terms of emissions reductions

Mode Share

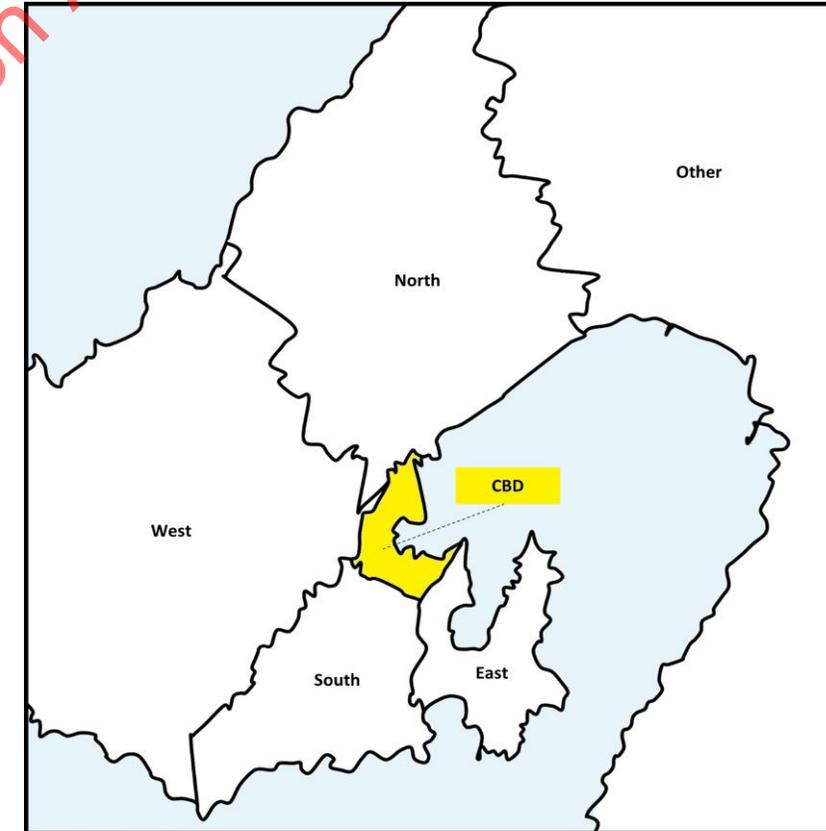
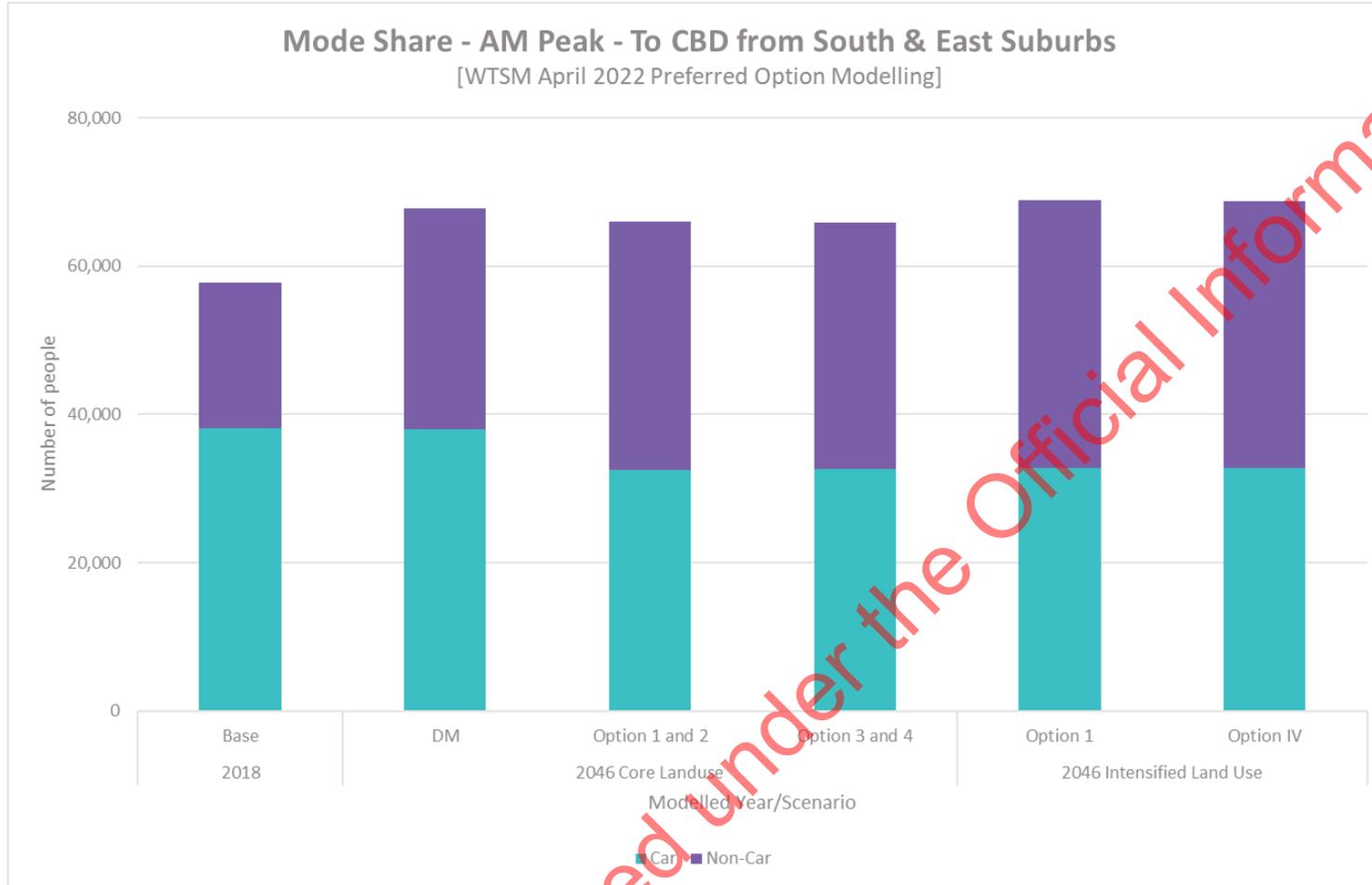
Mode share has been calculated at a number of levels to understand differences between options. Focus has been on mode share to the CBD rather than at a regional level as this demonstrates the greatest impact

PT Pax Km – South and East suburbs

- PT km travelled increase overtime between base and do min
- Options 1 and 4 increase PT km travelled relative to the do min
- Option 1 delivers roughly twice the increase of option 4
- Intensified land use results in the highest increase in PT uptake



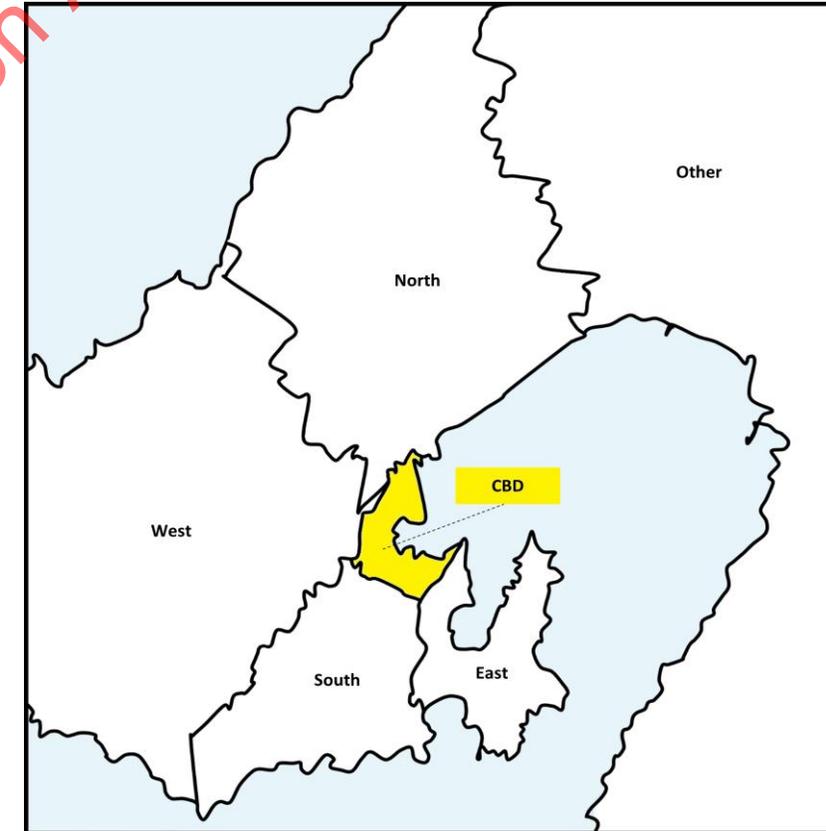
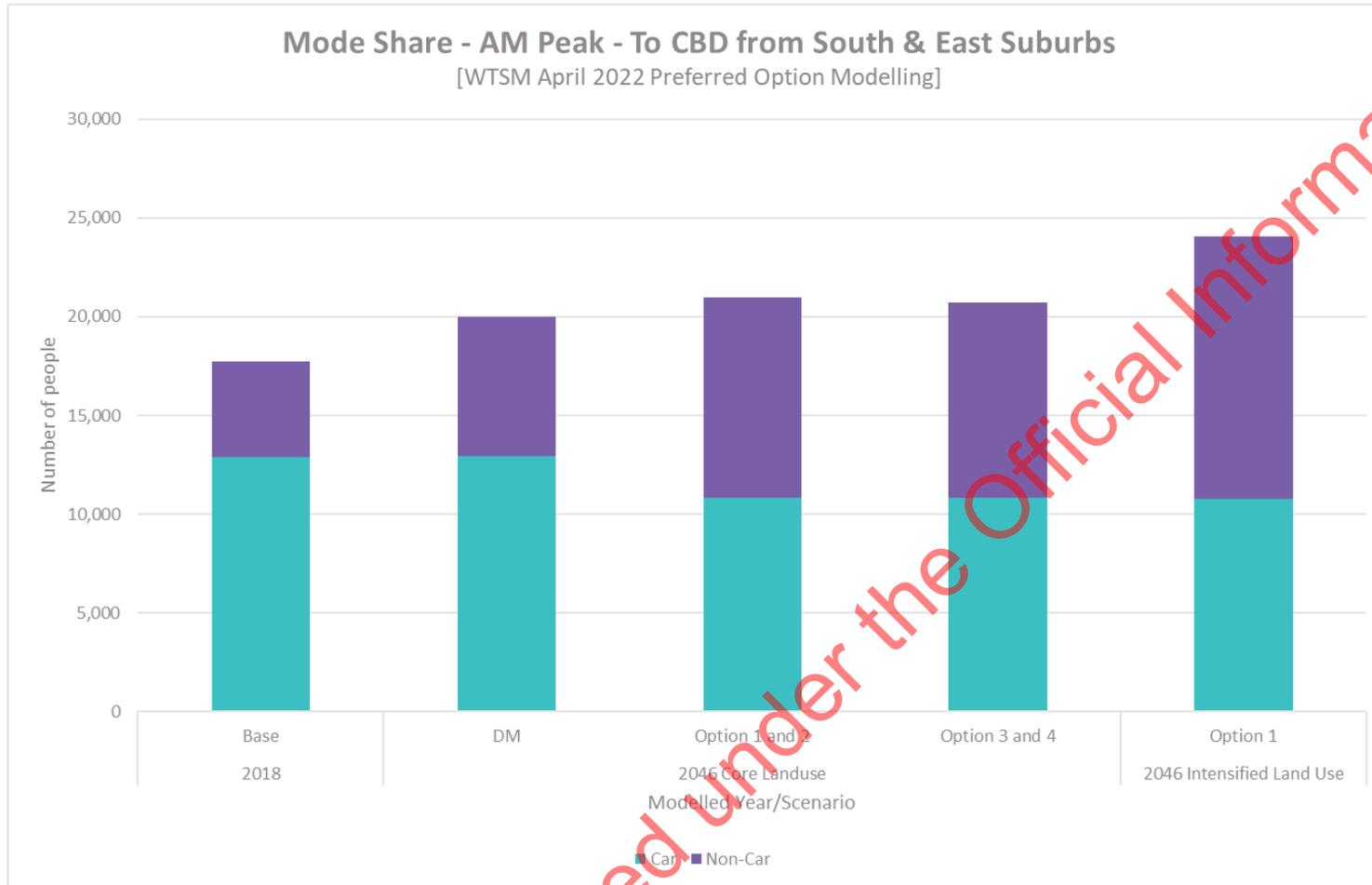
Person trips by mode – To CBD



LGWM WTSM Sectors

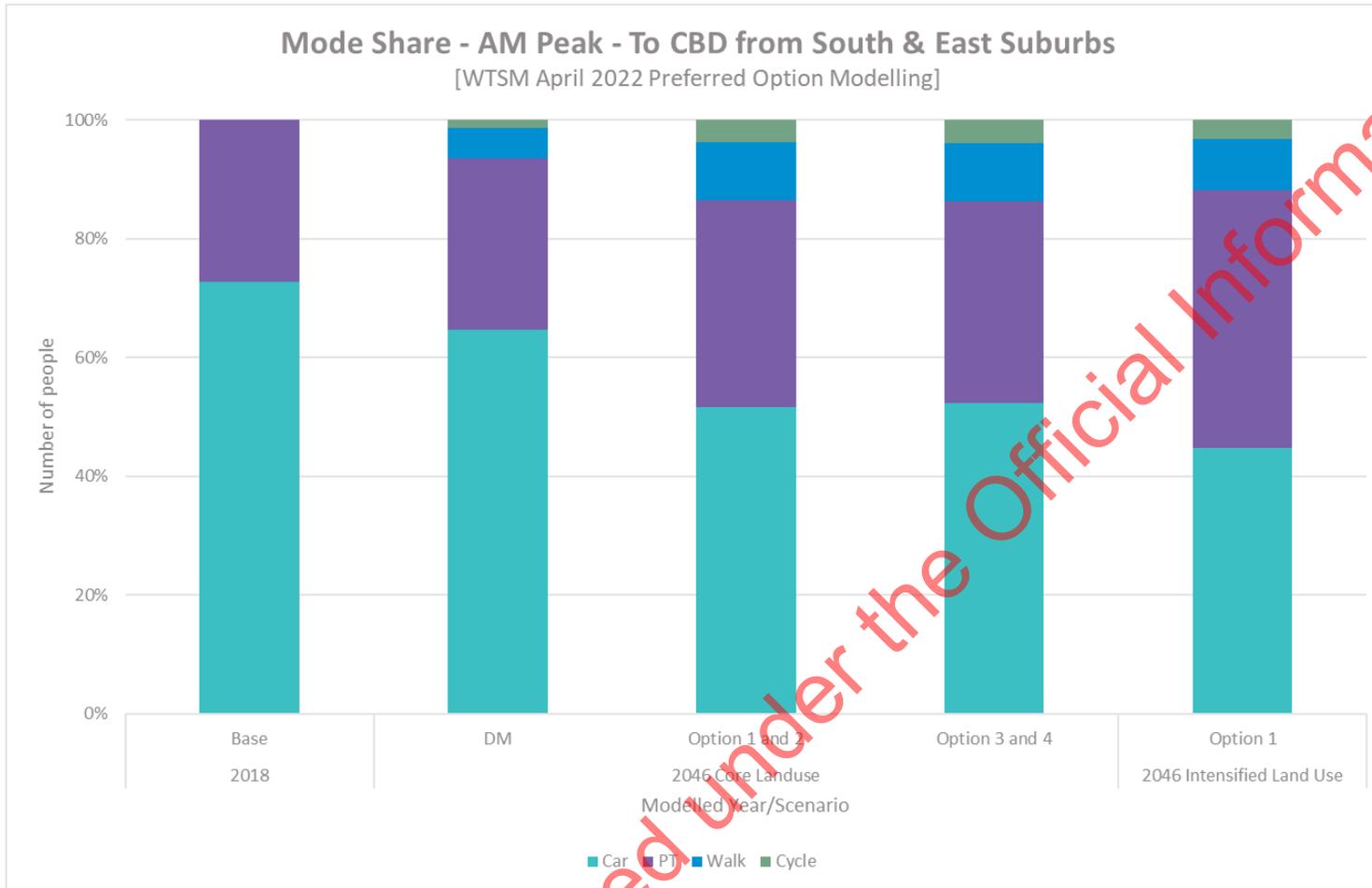
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Person trips – To CBD from South and East



LGWM WTSM Sectors

Mode Share - Cordon crossings from south and east



Overall mode share commentary

Background growth is forecast to be more significant on PT and active modes than for general traffic

LGWM investment sees drop in traffic and increased uptake on PT, particularly to the south and east and an increase in active travel across the city

Intensification results in further shift from car to PT and active travel

Very limited differentiation between the options

Accessibility

Graphs show an assessment of the number of people and jobs within key time increments of the airport and railway station

Accessibility - Airport



Graph shows number of people who live within x minutes of the airport by car.

Over 500,000 people are within an hour of the airport under option 1, compared to around 420,000 under option 4 and 380,000 under the do minimum, indicating the contribution of the Basin and Mt Vic Tunnel

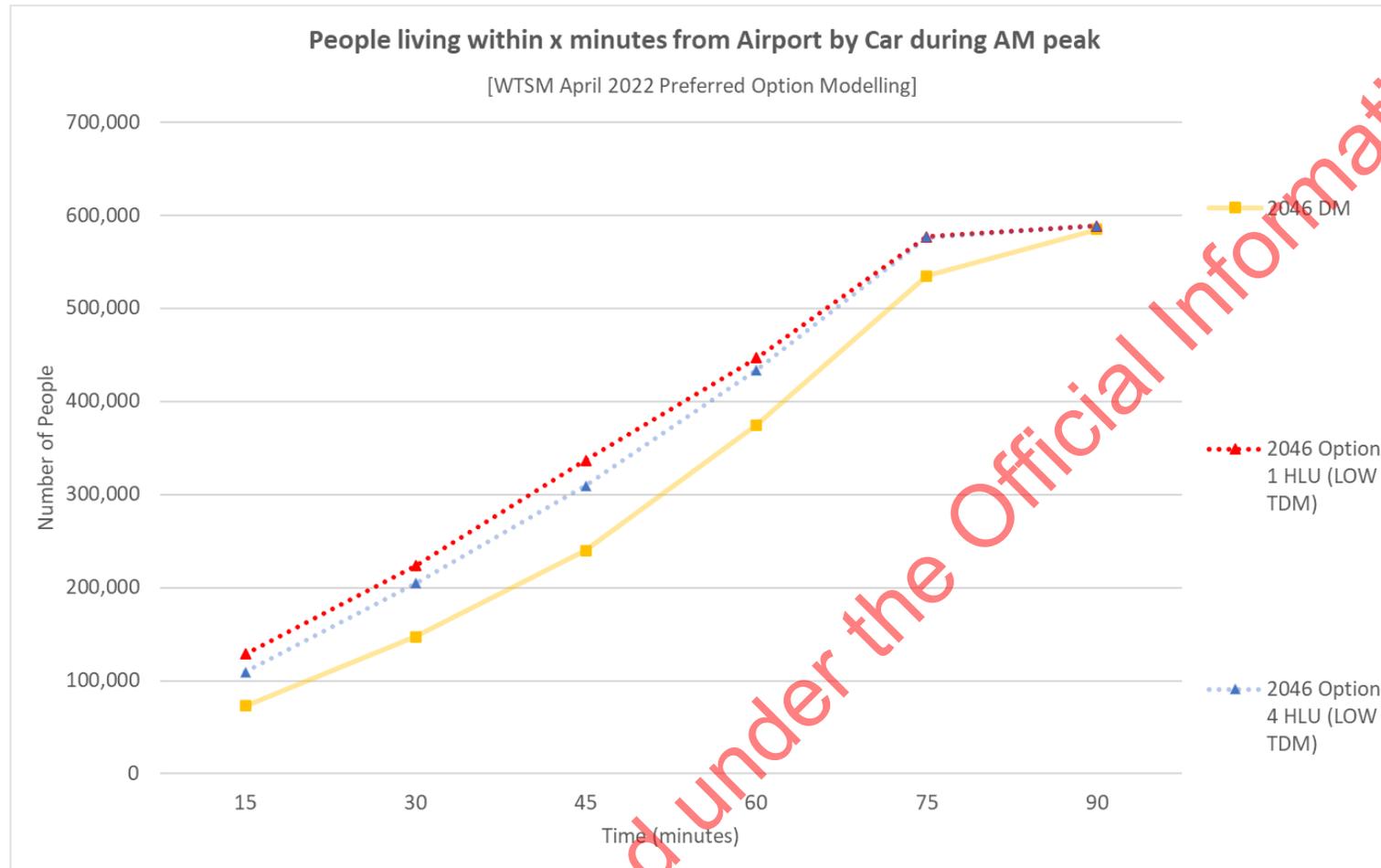
Accessibility - Airport



PT accessibility shows a similar pattern to traffic accessibility reflecting the benefit to PT of the interventions to the east

Under option 1, around 270,000 people can access the airport in under an hour by PT compared to 210,000 people for option 4 and 160,000 for the do minimum

Accessibility - Airport



Land use intensification results in improved accessibility.

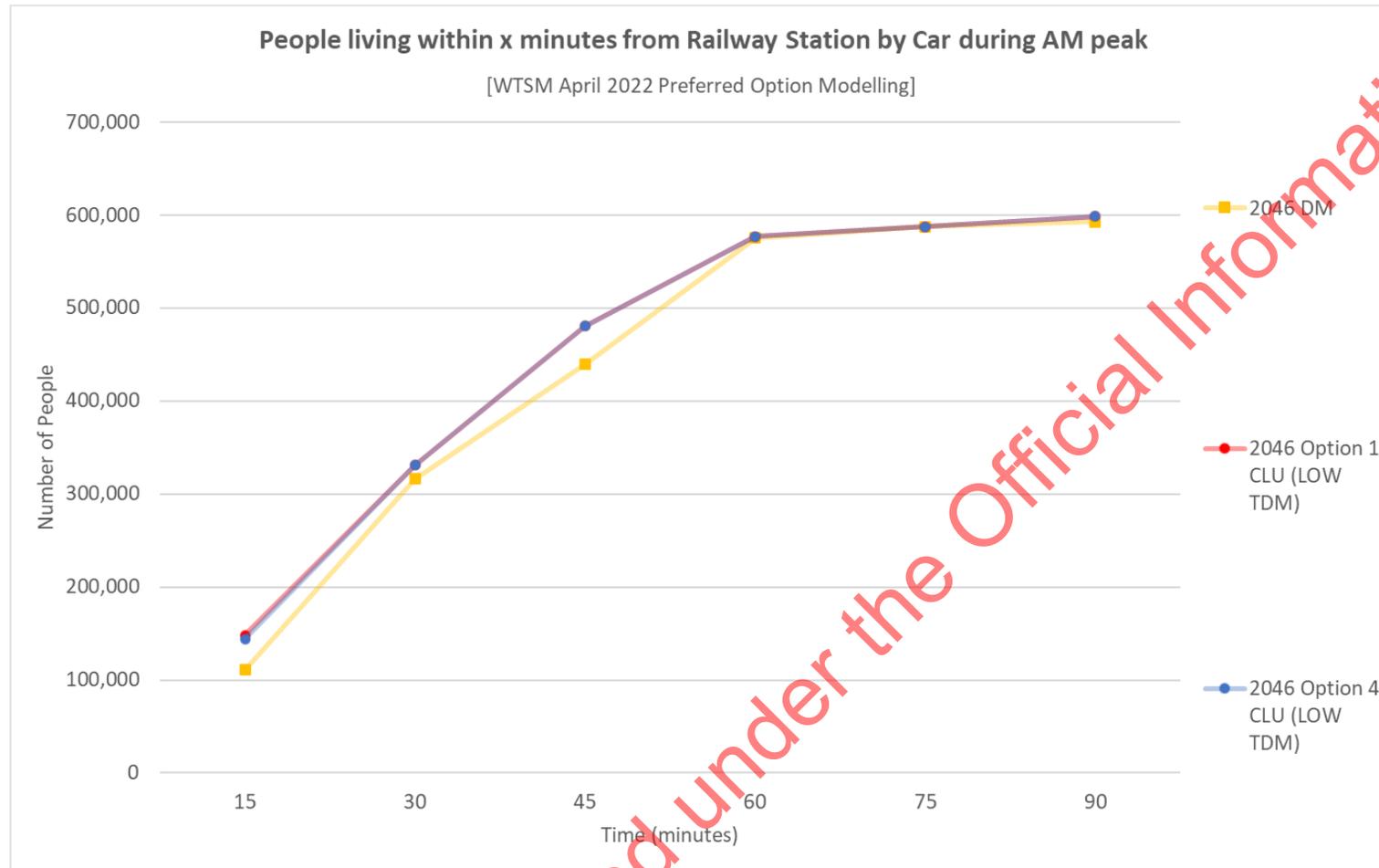
260,000 people can access the airport by car in 30 minutes in the intensified option 1 scenario compared to just over 200,000 in the core land use scenario

Accessibility - Airport



Land use intensification also results in increased public transport accessibility for the airport

Accessibility - Station



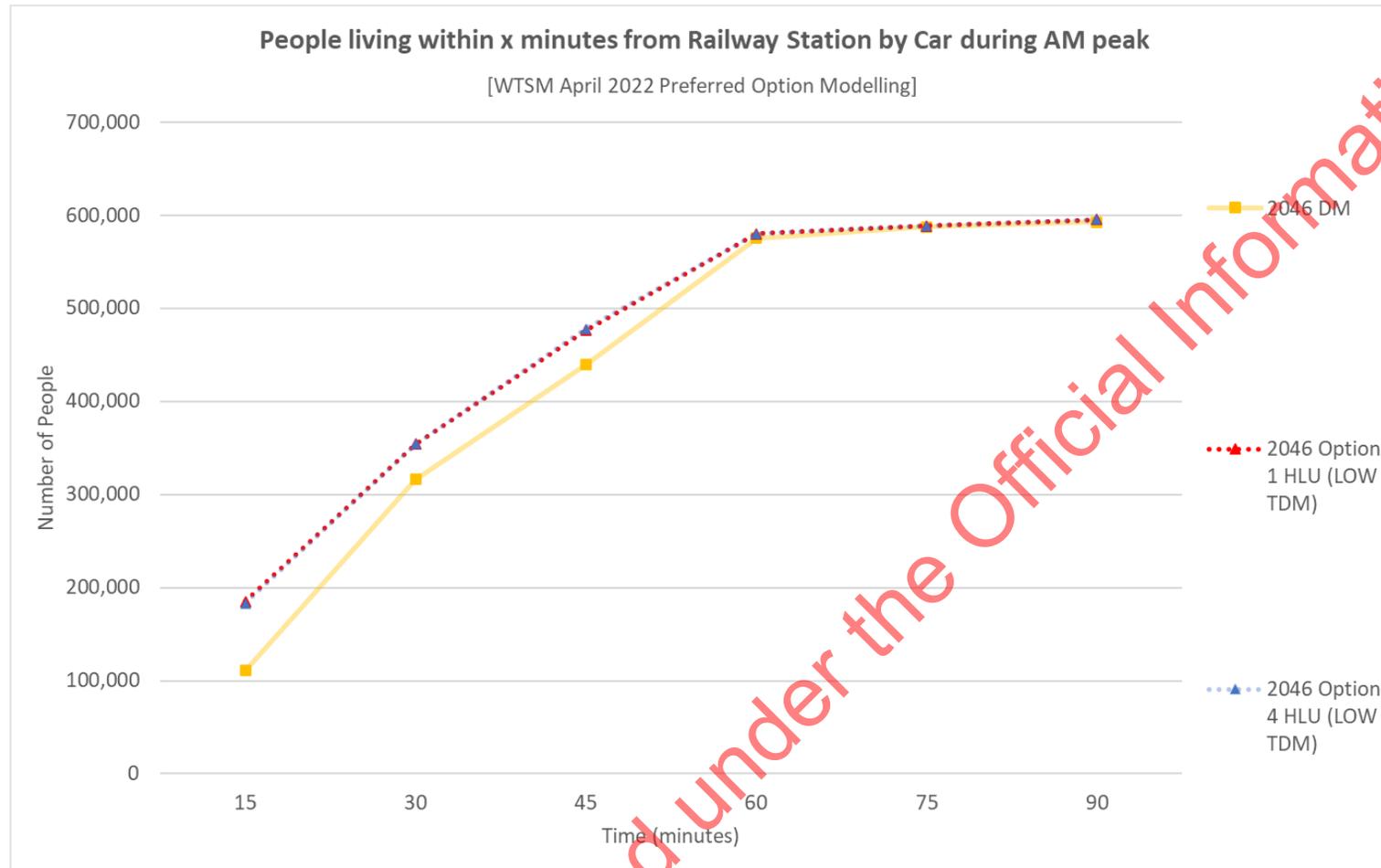
Both tested options demonstrate an increase in accessibility from the northern part of the CBD (taken from the railway station), however there is little differentiation between the options

Accessibility - Station



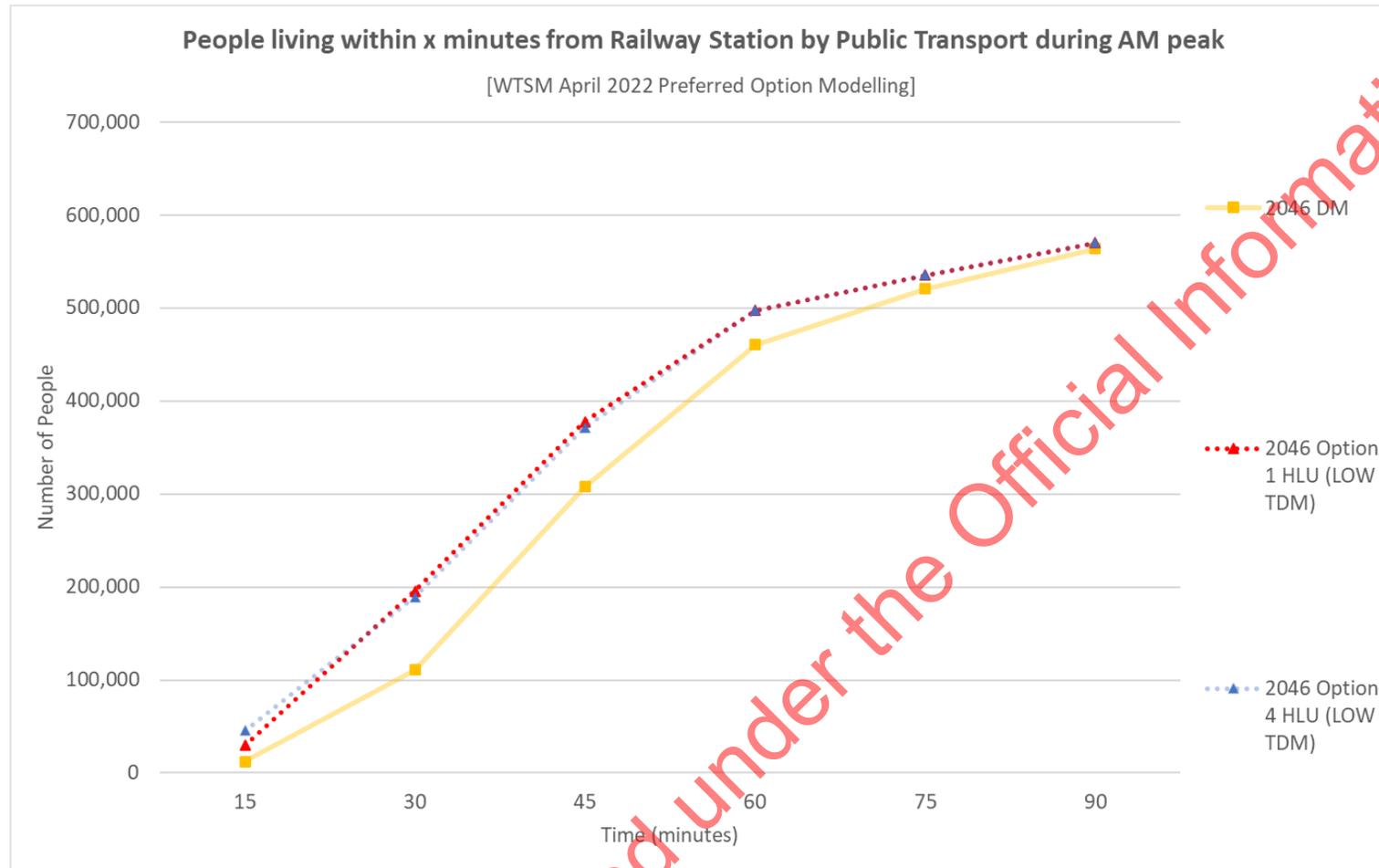
Public transport accessibility to the northern CBD is improved by both options relative to the do minimum. Again, there is little differentiation between the two tested options

Accessibility - Station



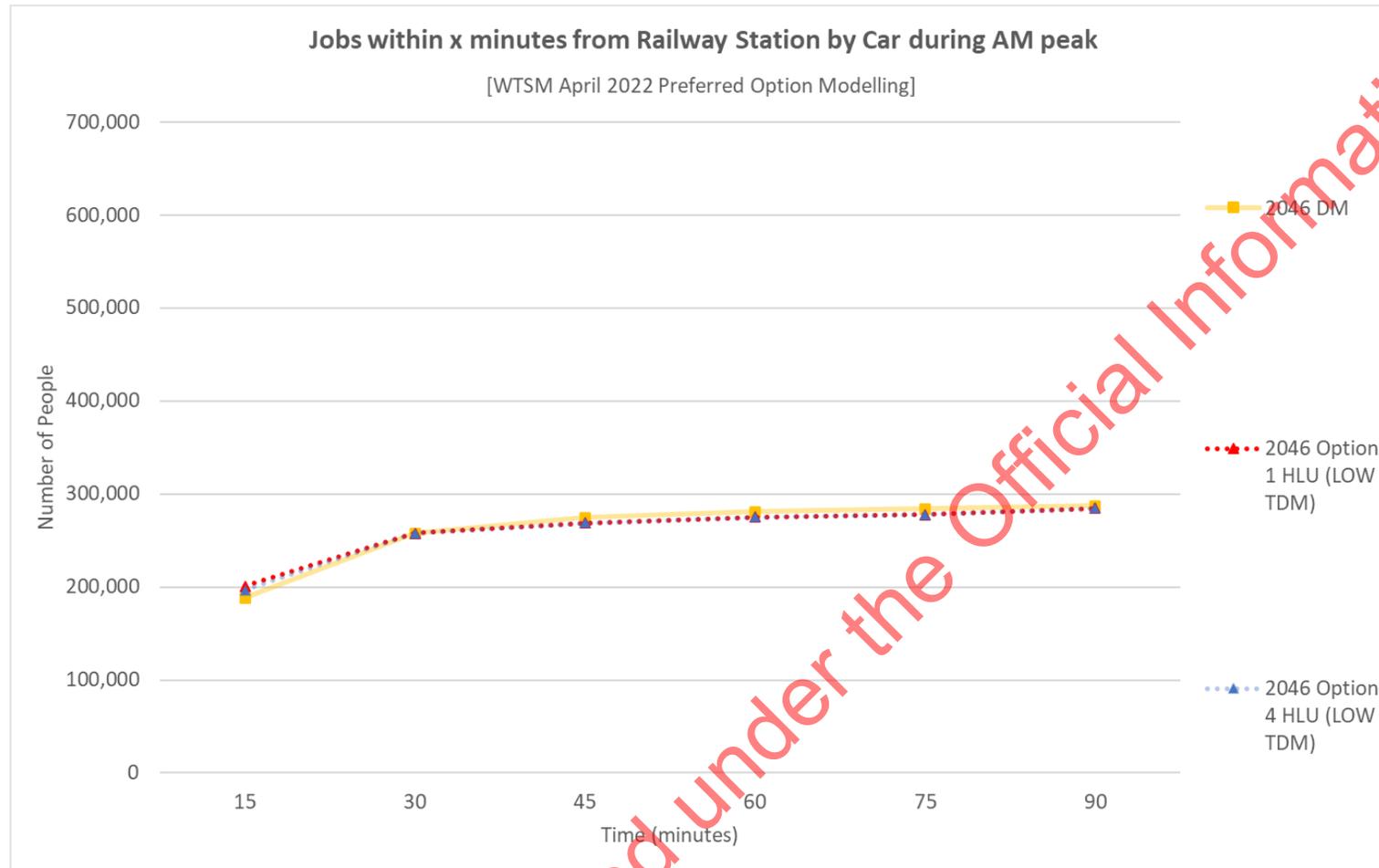
Increased residential density means that more people live within closer proximity of the northern CBD (again, little difference between the options)

Accessibility - Station



Increased residential density means that more people live within closer proximity of the northern CBD (again, little difference between the options)

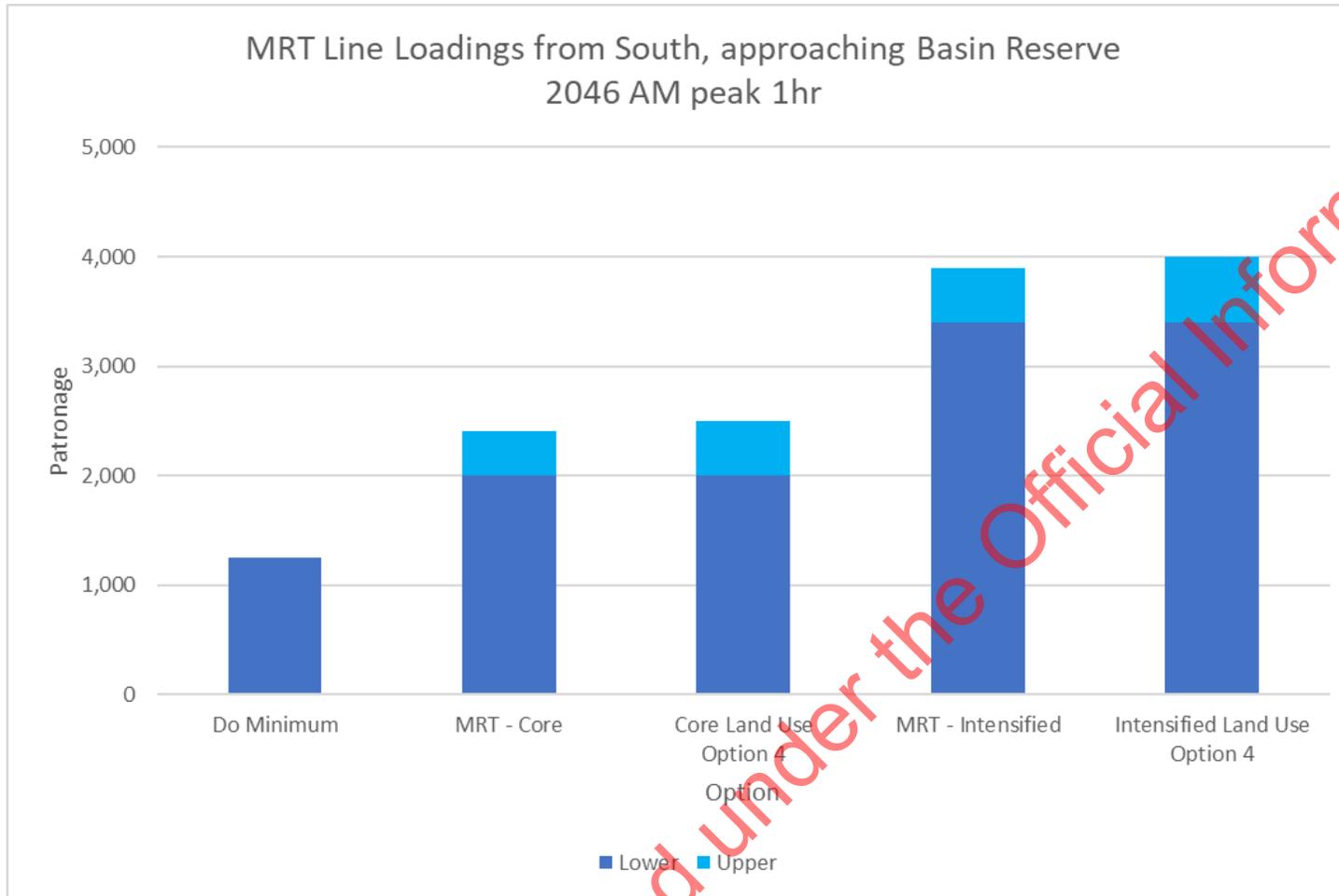
Accessibility - Station



Line loadings

This section presents line loadings for the southern and eastern corridors. This can be used to determine required capacity and therefore inform decisions on mode and vehicle size.

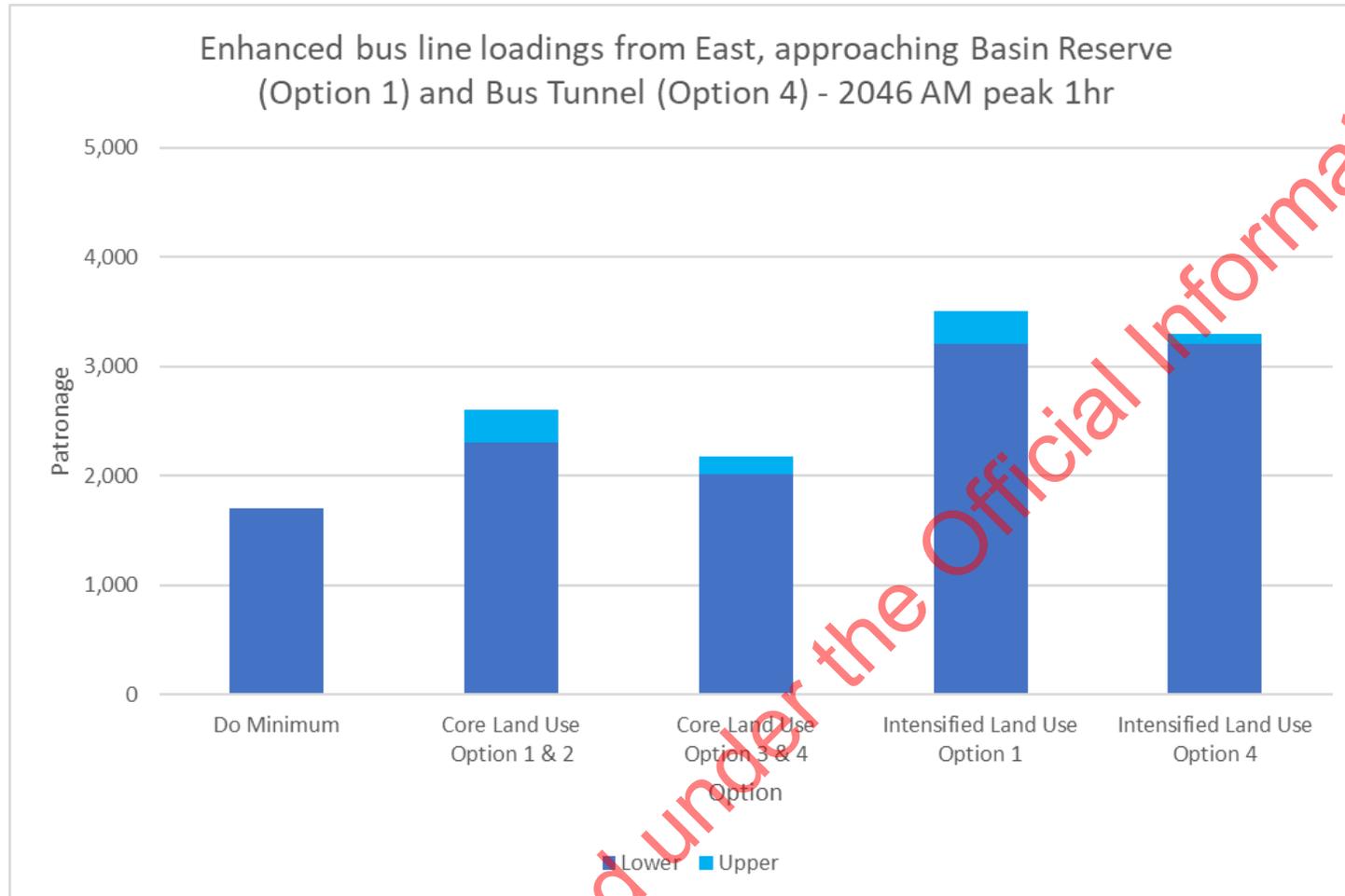
Line loadings from the south



Line loadings show the following:

- 2,000 to 2,500 on MRT at the peak load point in 2046 under the core scenario
- 3,400 to 4,000 on MRT at the peak load point in 2046 under the intensified scenario

Line loadings from the east



Line loadings show the following:

- 2,300 to 2,600 on MRT at the peak load point in 2046 under the core scenario
- 3,400 to 4,000 on MRT at the peak load point in 2046 under the intensified scenario
- Note Option 1 excludes 600 to 800 people from the Hataitai catchment who continue to use the bus tunnel

Appendix B – Aimsun Model Output

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PREFERRED OPTION MODELLING RESULTS

Appendix B – Aimsun modelling

13th April 2022



Modelling approach

- Modelling undertaken to inform aspects of preferred option reporting
- Two areas of focus for preferred option reporting:
 - Areas of differentiation between options – mode choice, accessibility, carbon and economics
 - Key outstanding question to be answered (LRT vs BRT, Mt Vic vs no Mt Vic, Basin Grade separation vs at grade)
- Where possible, draw on previous work – PASLO modelling, business cases, engagement feedback
- Model refinements based on assumption changes and network clarifications prioritising options 1 and 4 (two bookend options with interpolation used to understand the relative impact of options 2 and 3)

Travel Time Summary AM and PM Peaks

Travel Time Comparison - AM



Travel Time Comparison - PM



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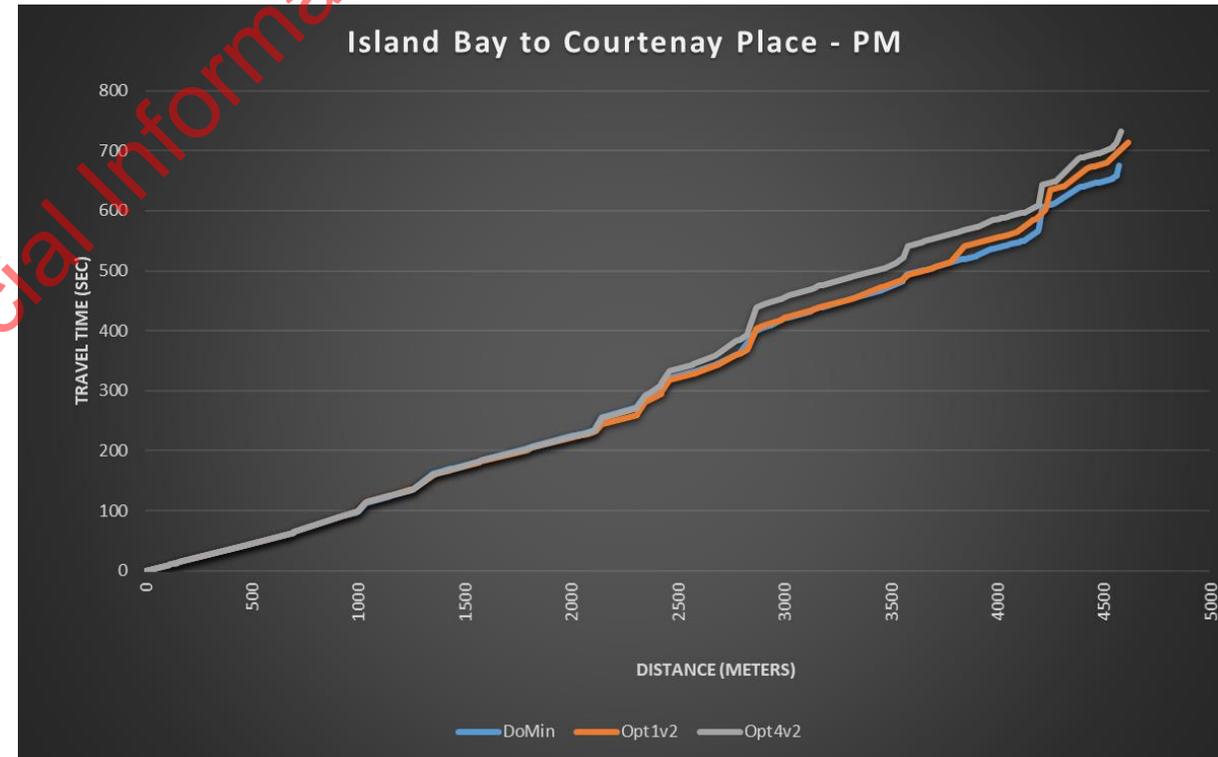
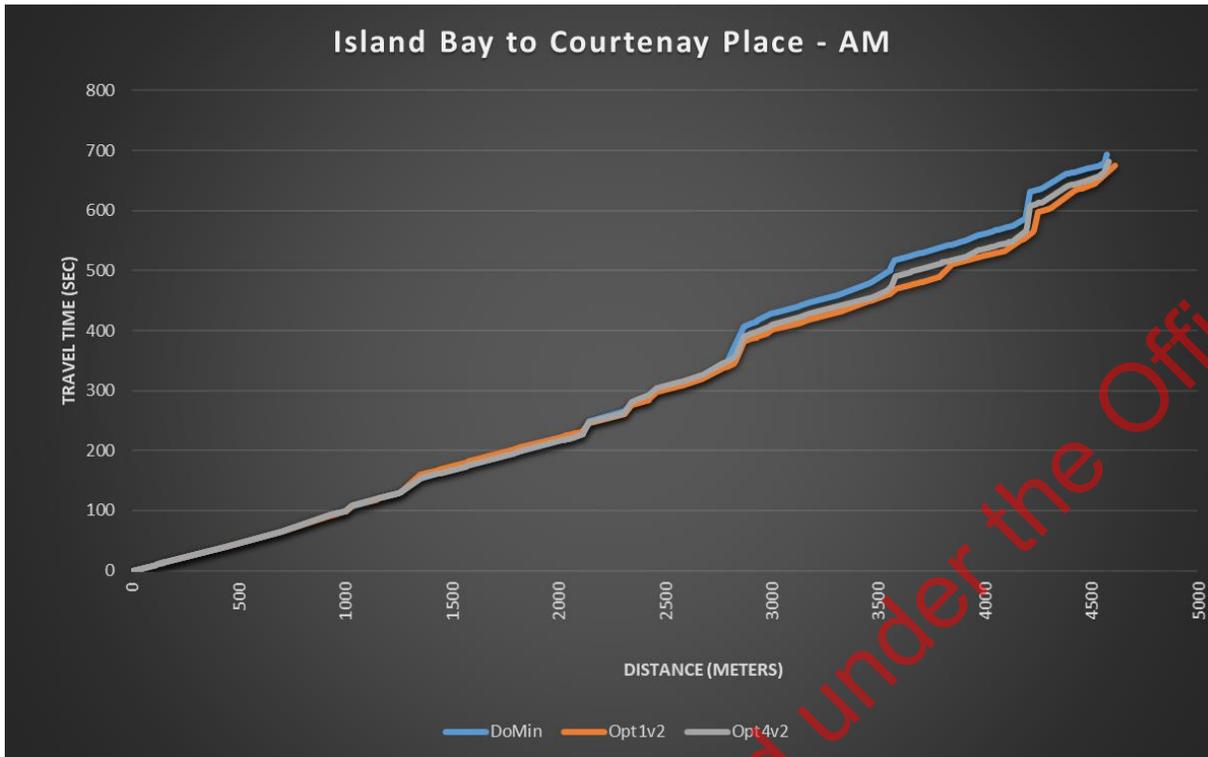
Travel Time Summary AM and PM Peaks

	Do Min	Opt1	Opt4
Island Bay To Courtenay Place	11:30	11:15	11:15
Kaiwharawhara to Courtenay Place	09:00	09:15	09:00
Karori To Taranaki Street	09:15	10:30	10:15
Miramar To Taranaki Street	11:30	08:15	11:15
SH1 to Taranaki Street	12:30	15:45	16:30

	Do Min	Opt1	Opt4
Island Bay To Courtenay Place	11:15	11:54	12:11
Kaiwharawhara to Courtenay Place	08:36	09:12	09:52
Karori To Taranaki Street	09:51	10:01	12:27
Miramar To Taranaki Street	10:24	08:17	10:26
SH1 to Taranaki Street	10:10	10:28	11:48

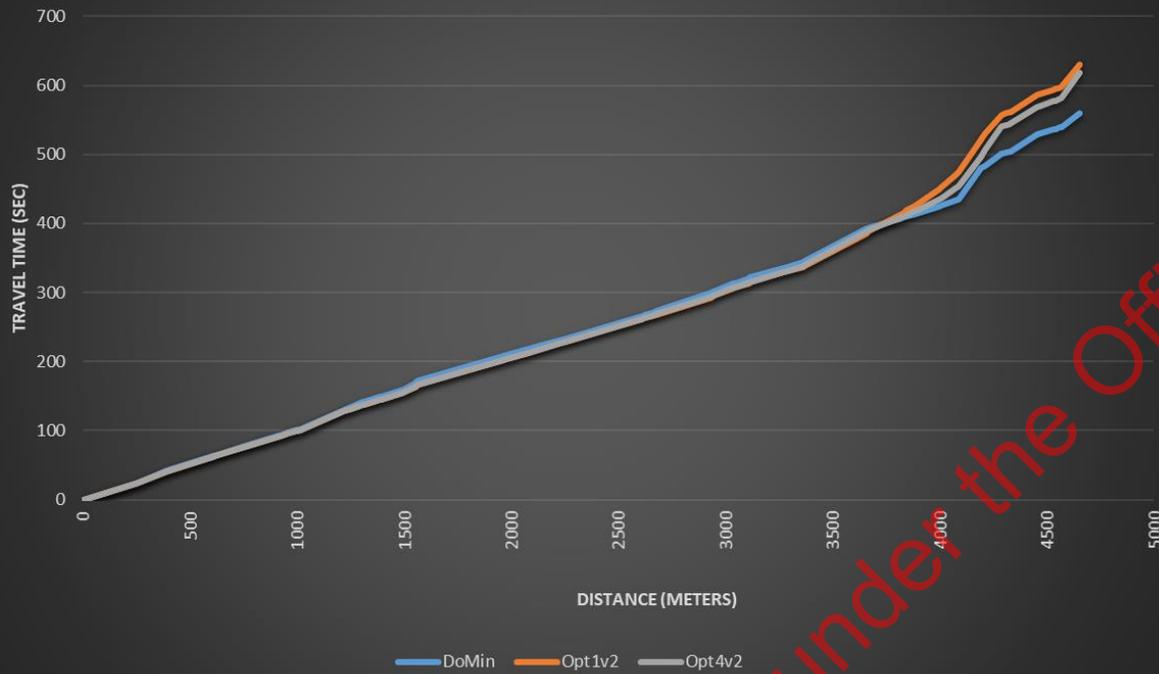
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Travel Time – Island Bay to Courtenay Place

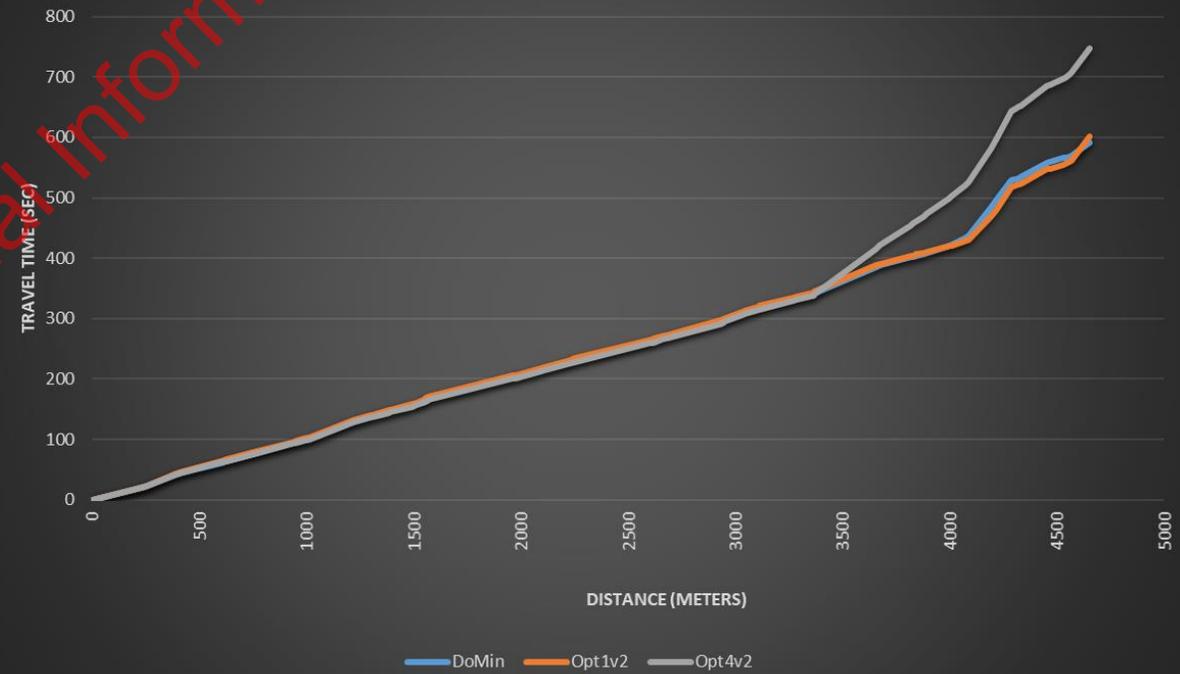


Travel Time – Karori to Taranaki Street

Karori To Taranaki - AM



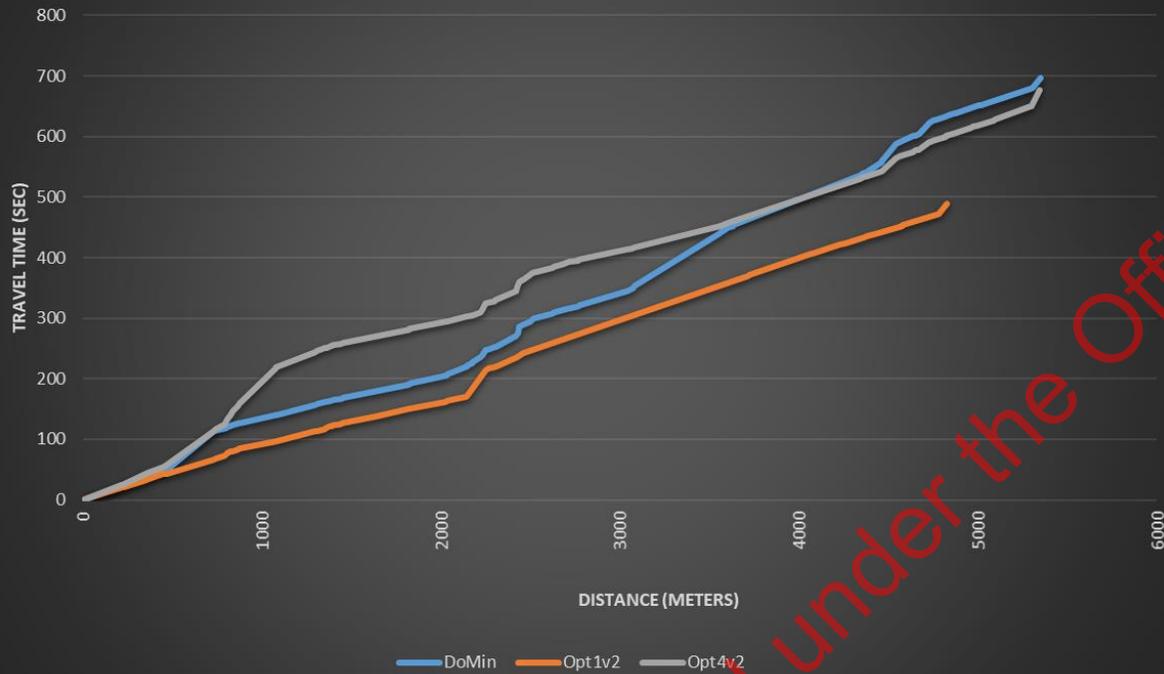
Karori To Taranaki - PM



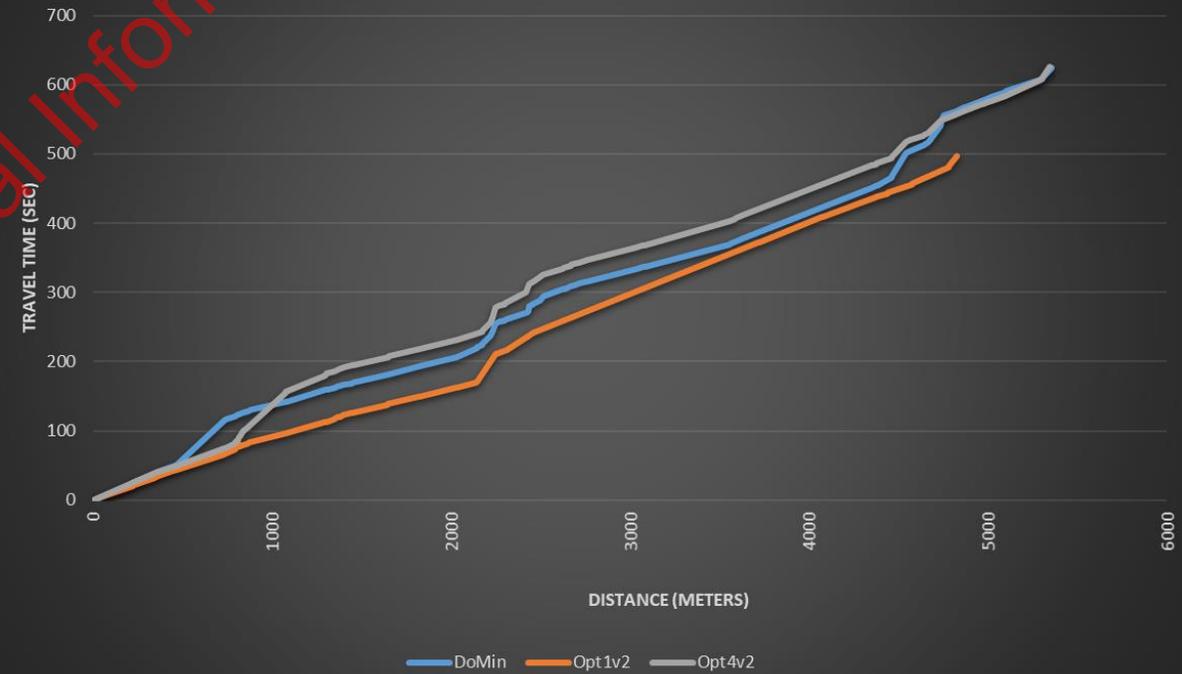
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Travel Time – Miramar to Taranaki Street

Miramar To Taranaki - AM

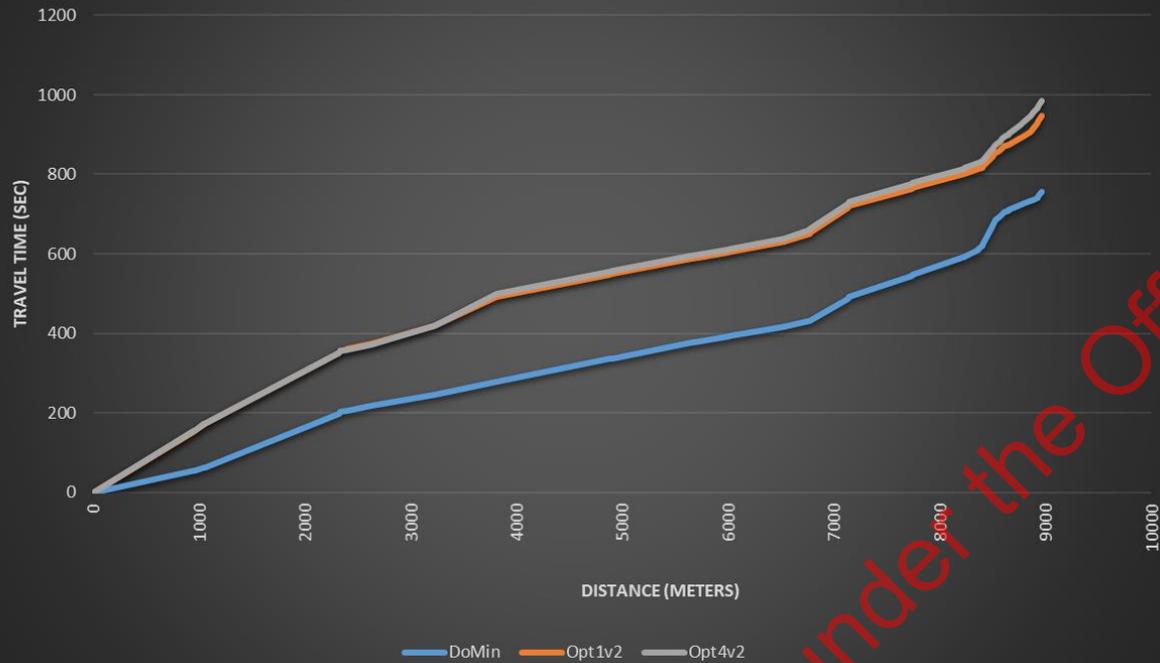


Miramar To Taranaki- PM

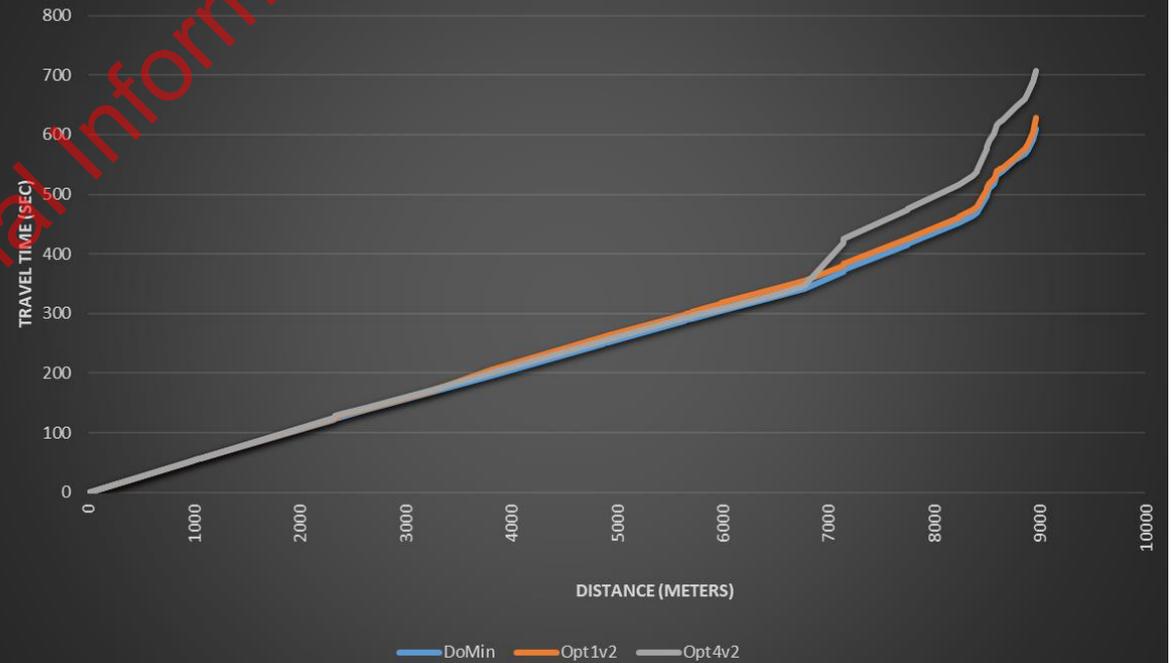


Travel Time – SH1 to Taranaki Street

SH1 to Taranaki via TT- AM

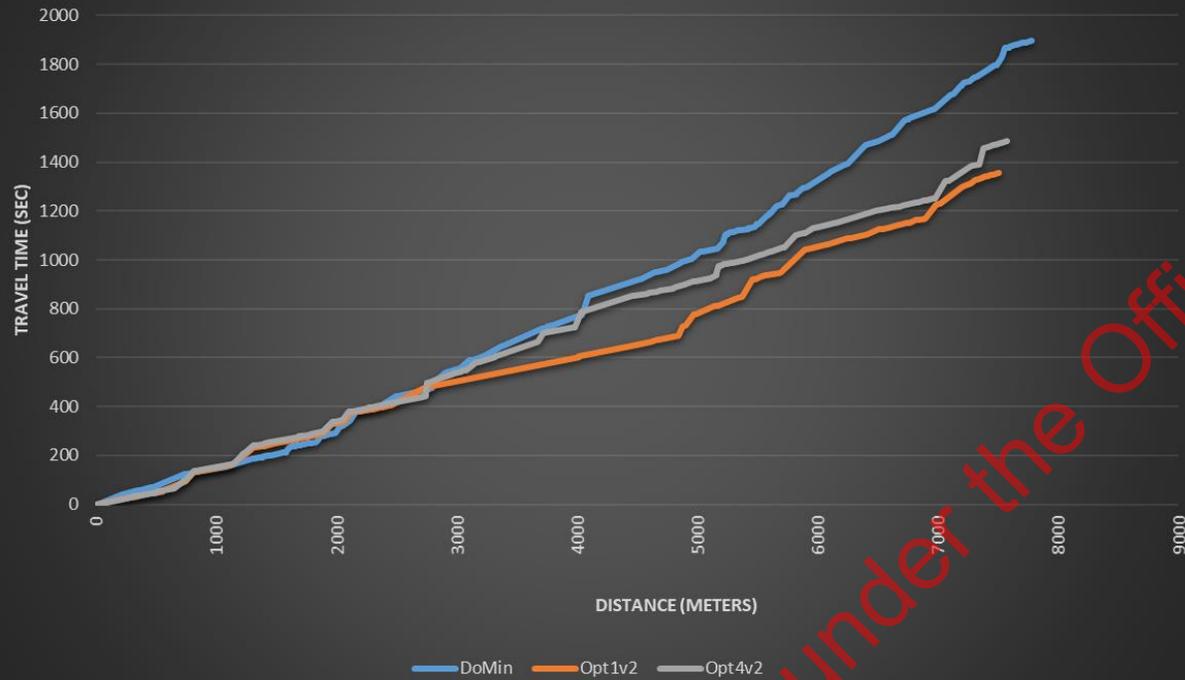


SH1 to Taranaki via TT- PM

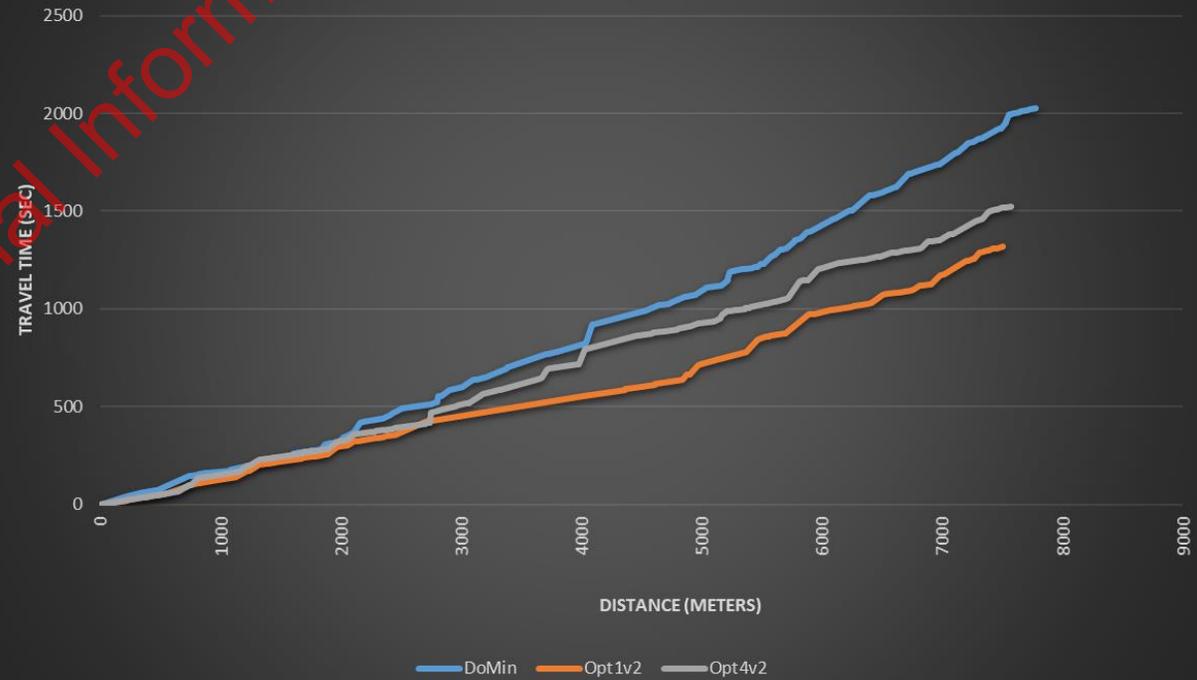


PT Travel Time – Miramar to Station

PT Miramar to Station - AM



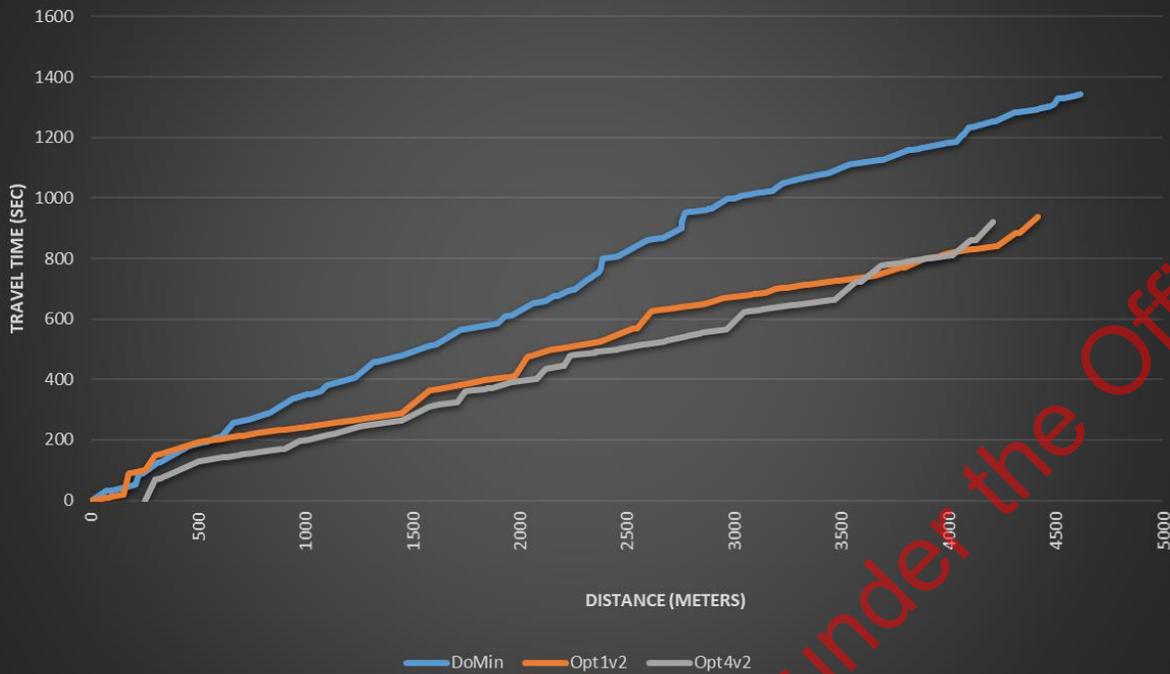
PT Miramar to Station - PM



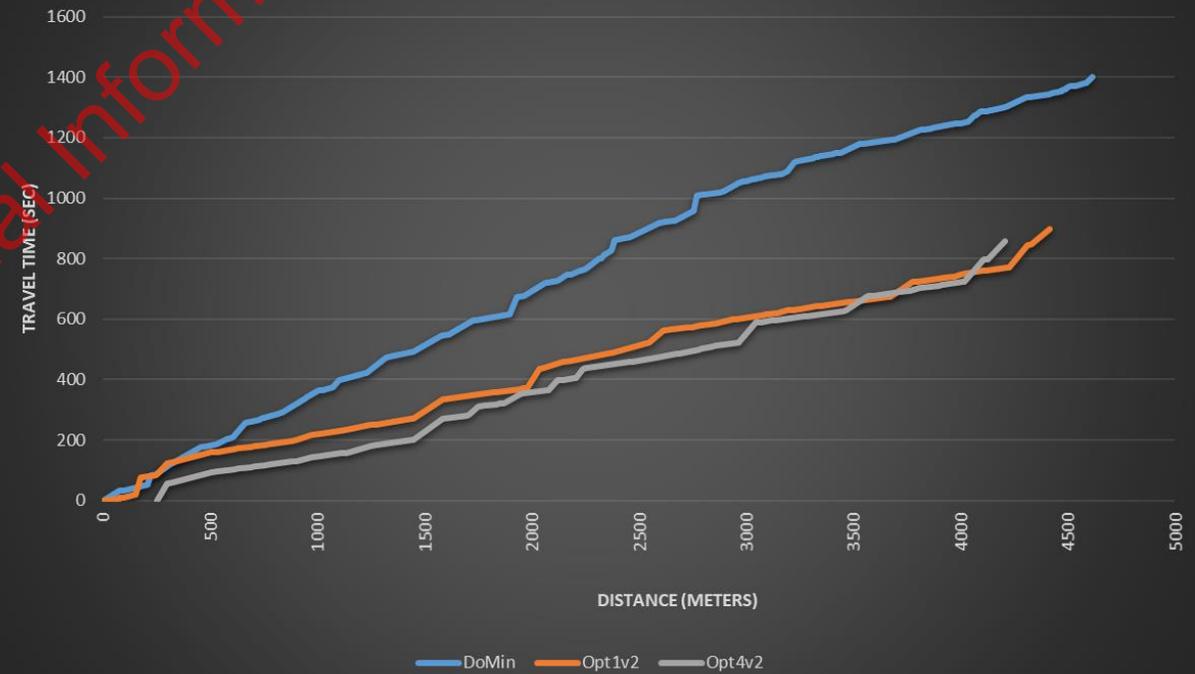
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PT Travel Time – Station to Newtown

PT Station to Newtown - AM

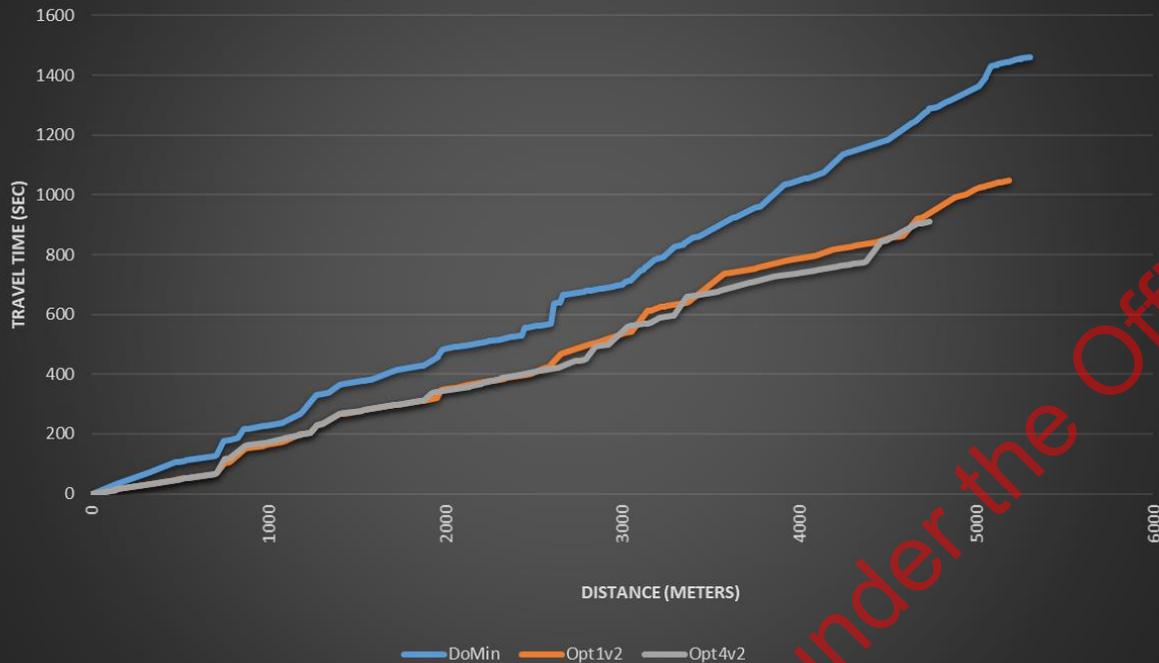


PT Station to Newtown - PM

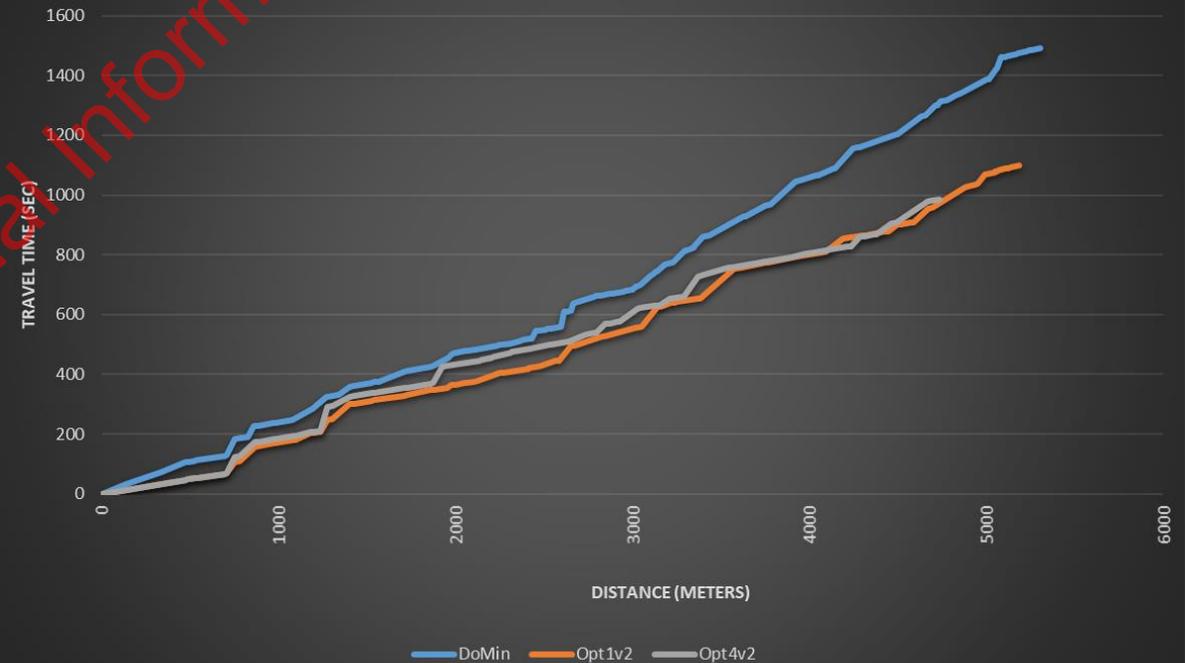


PT Travel Time – Newtown to Station

PT Newtown to Station - AM



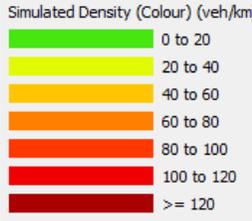
PT Newtown to Station - PM



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LGWM – Kaiwharawhara/Aotea Quay Area

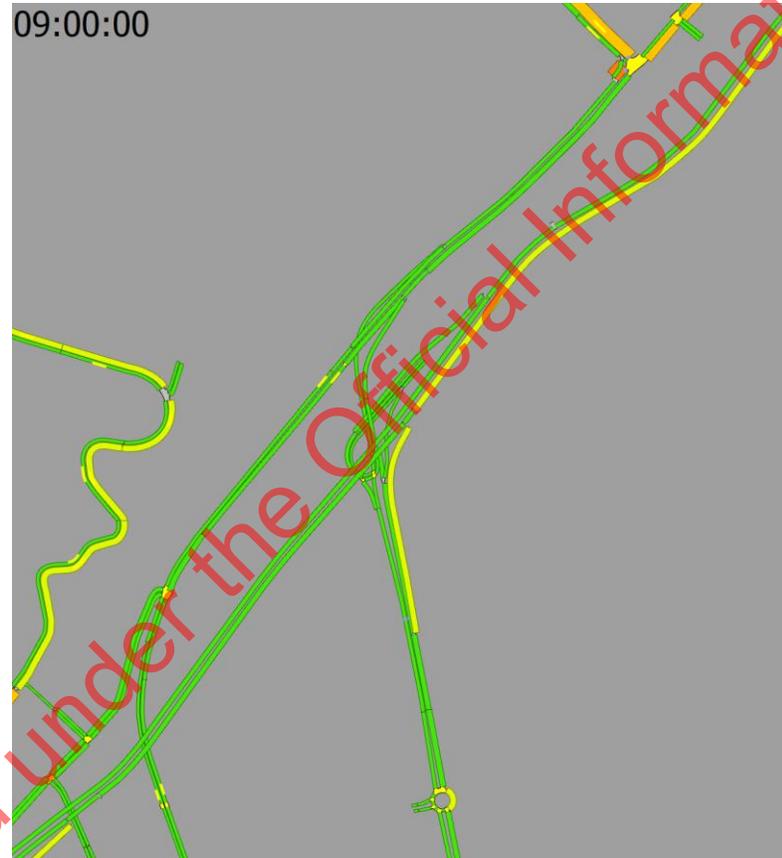
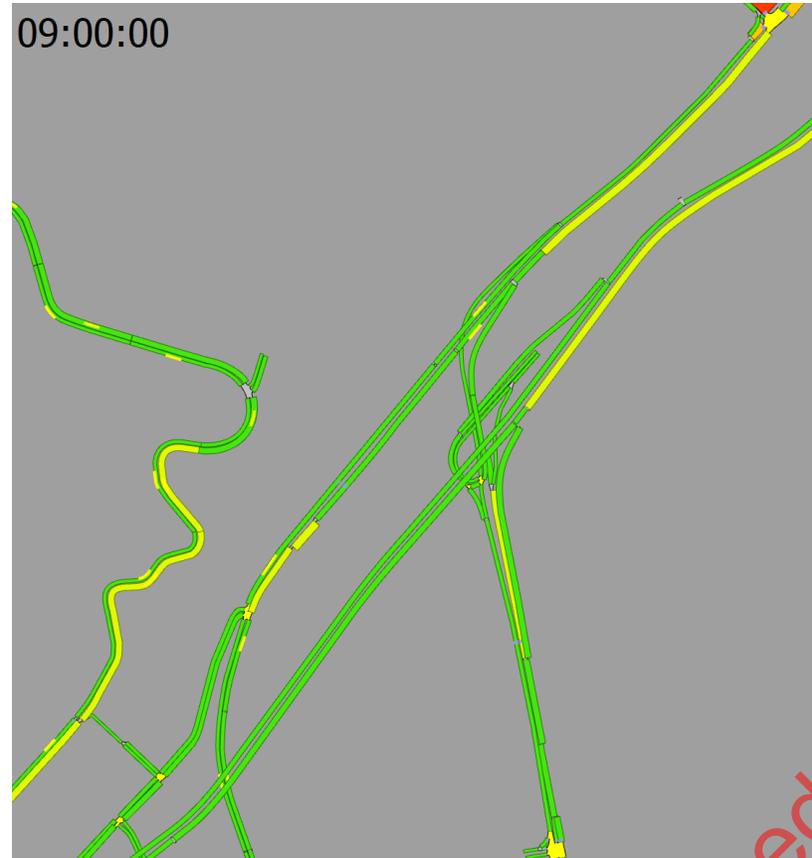
AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

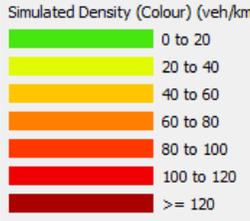
Consultation Option 4



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LGWM – Thorndon Area

AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

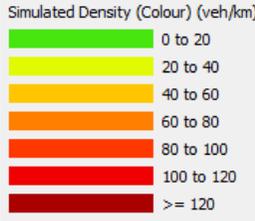
Consultation Option 4



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LGWM – Wellington Central Area

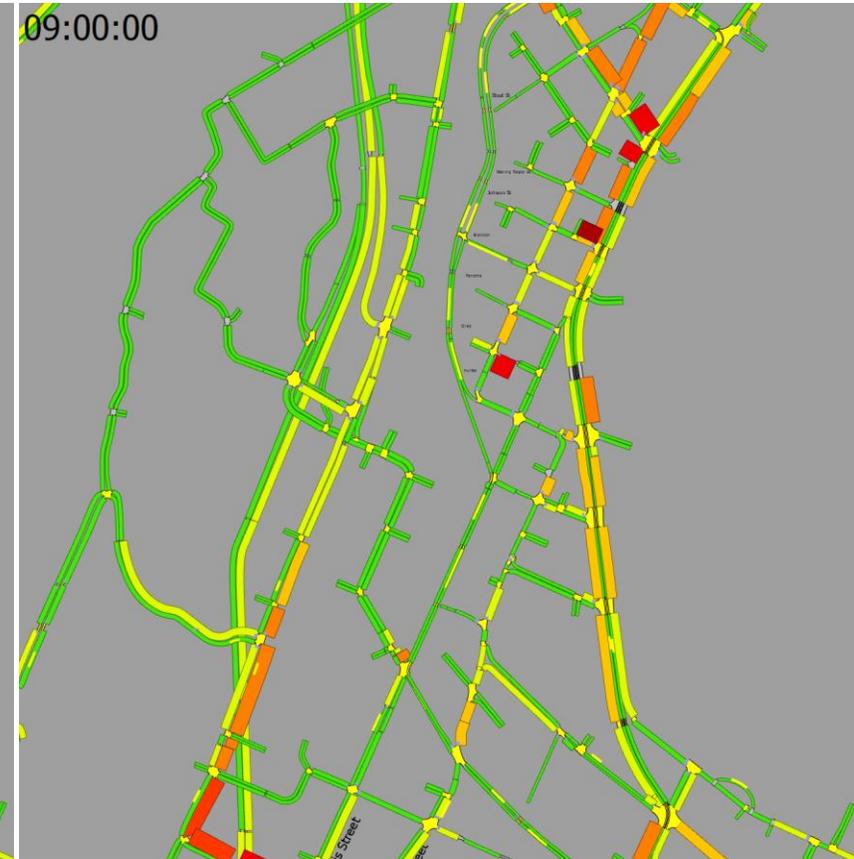
AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

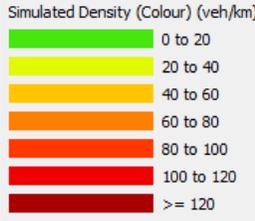
Consultation Option 4



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LGWM – Te Aro Area

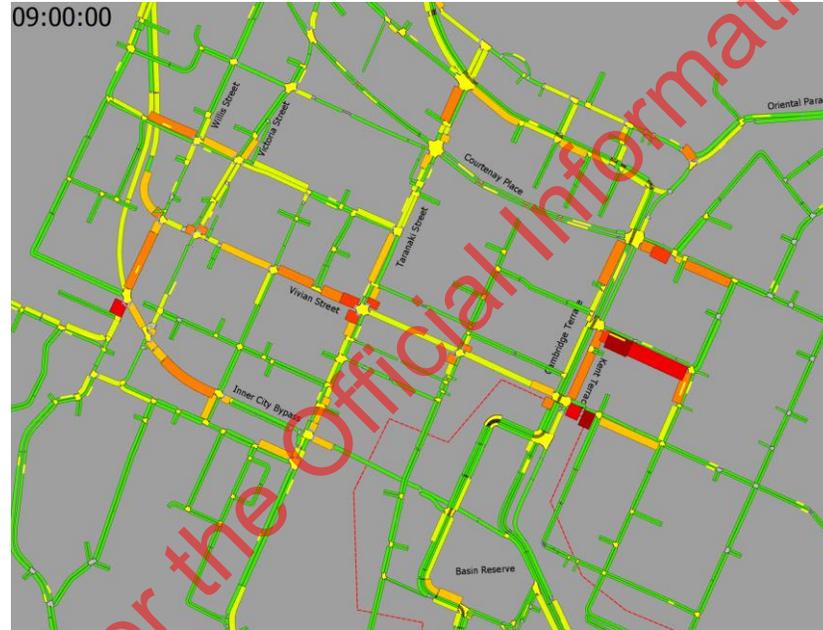
AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

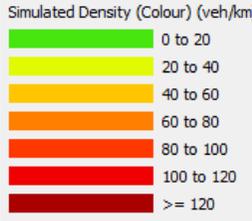
Consultation Option 4



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LGWM – South of Basin

AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

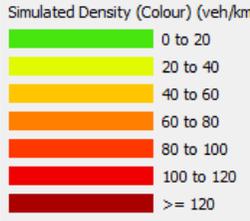
Consultation Option 4



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LGWM – East of Basin

AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

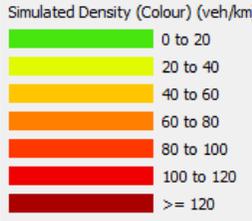
Consultation Option 4



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LGWM – Kilbirnie/Hataitai

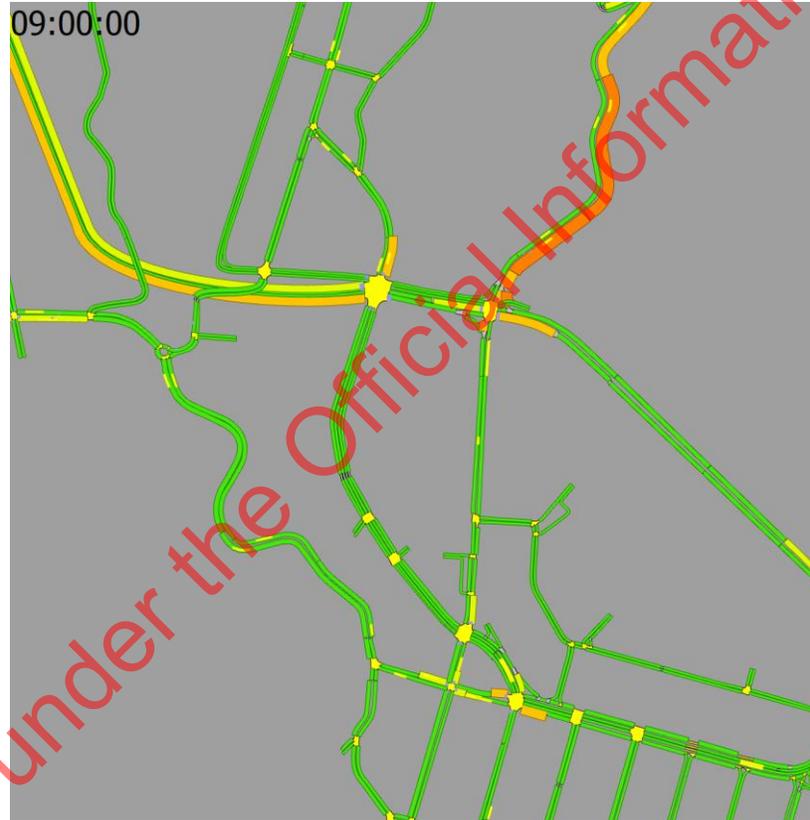
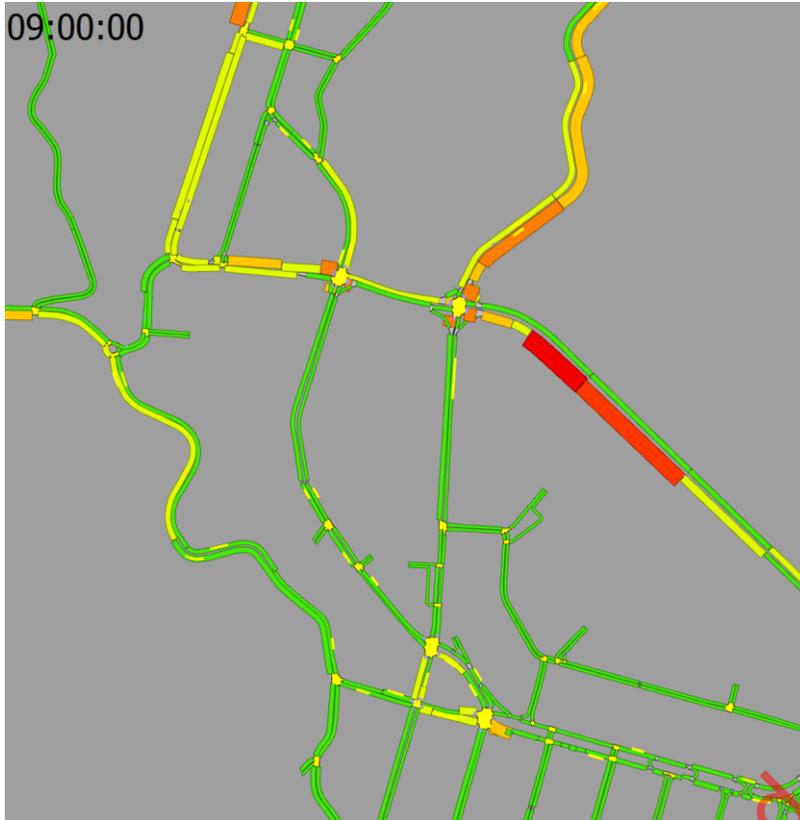
AM (8:00AM to 9:00AM)



Do-Minimum

Consultation Option 1

Consultation Option 4



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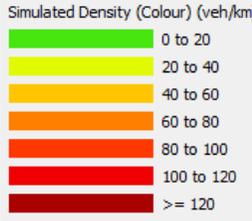
Aimsun Density Plot Comparison

- Evening Peak (4:00PM to 6:00PM)
 - Kaiwharawhara/Aotea Quay
 - Thorndon
 - Wellington Central
 - Te Aro
 - South of Basin
 - East of Basin
 - Kilbirnie/Hataitai
 - Airport

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LGWM – Kaiwharawhara/Aotea Quay Area

PM (5:00PM to 6:00PM)



Do-Minimum



Consultation Option 1



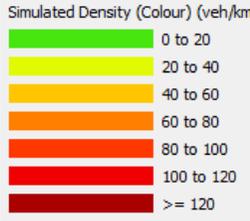
Consultation Option 4



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LGWM – Thorndon Area

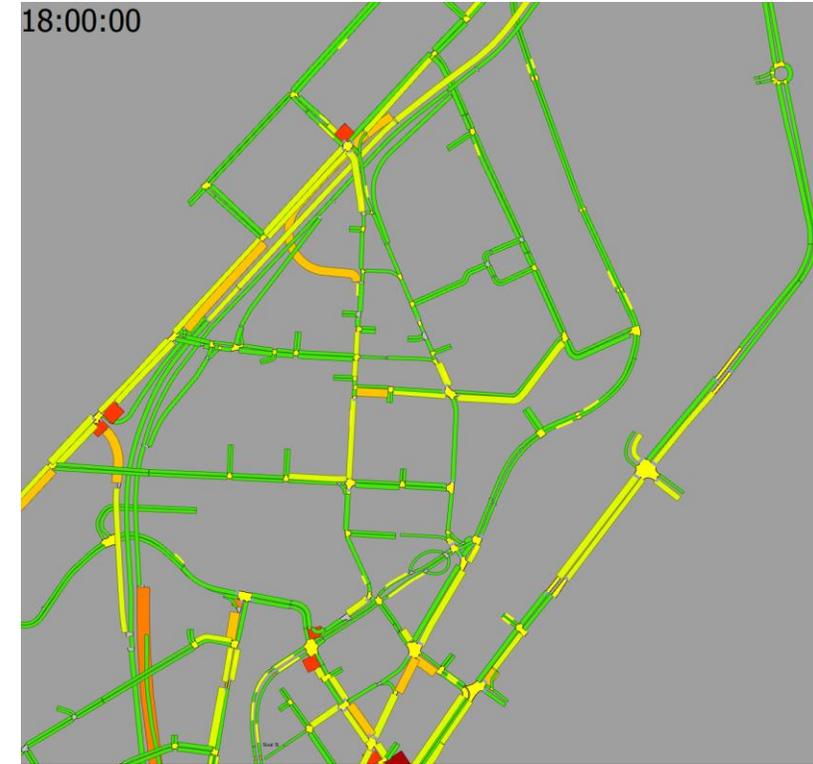
PM (5:00PM to 6:00PM)



Do-Minimum

Consultation Option 1

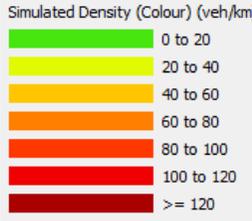
Consultation Option 4



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LGWM – Wellington Central Area

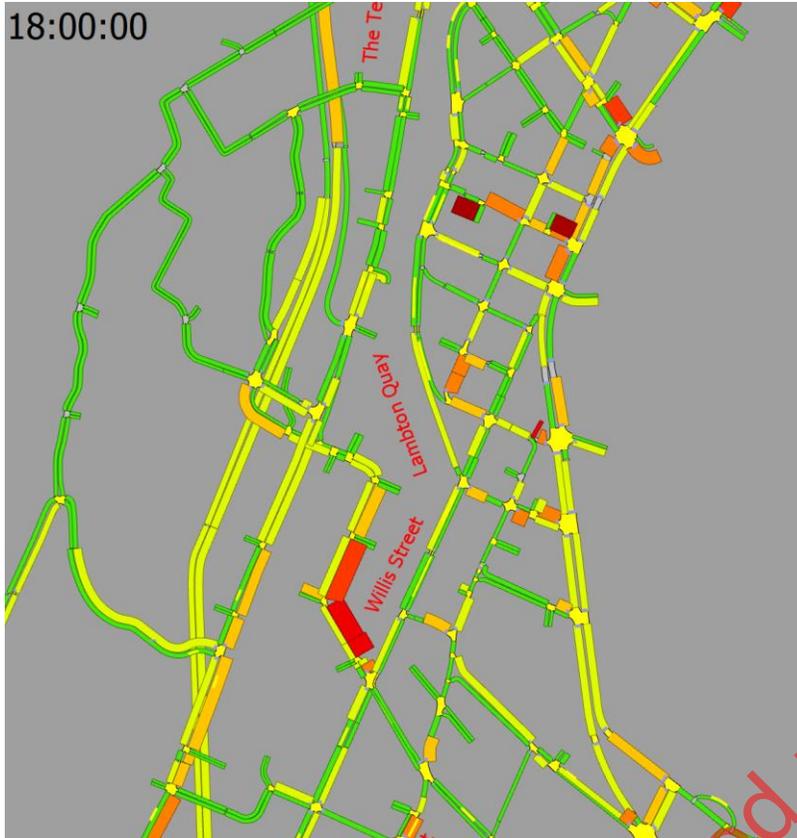
PM (5:00PM to 6:00PM)



Do-Minimum

Consultation Option 1

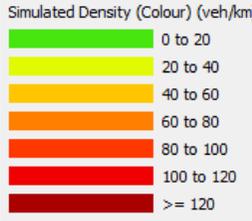
Consultation Option 4



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LGWM – Te Aro Area

PM (5:00PM to 6:00PM)



Do-Minimum

Consultation Option 1

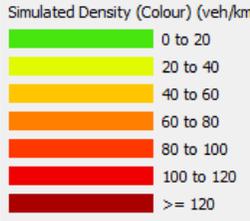
Consultation Option 4



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LGWM – East of Basin

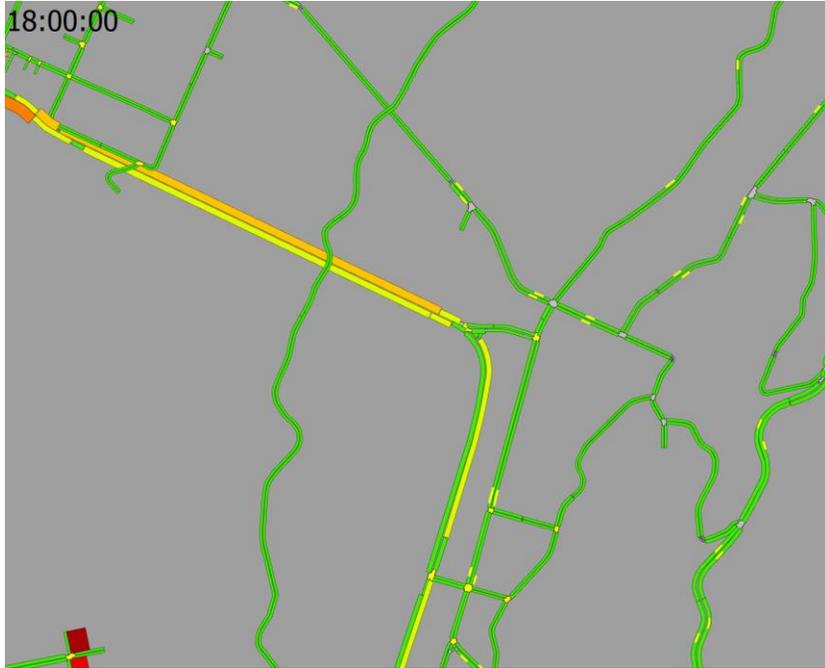
PM (5:00PM to 6:00PM)



Do-Minimum

Consultation Option 1

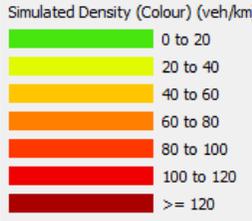
Consultation Option 4



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LGWM – Kilbirnie/Hataitai

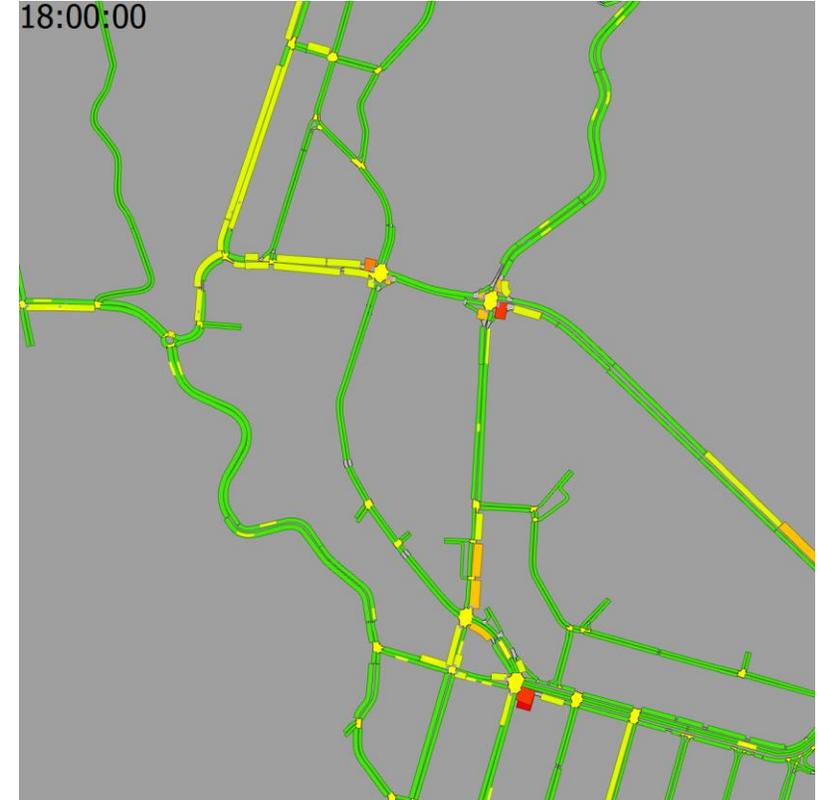
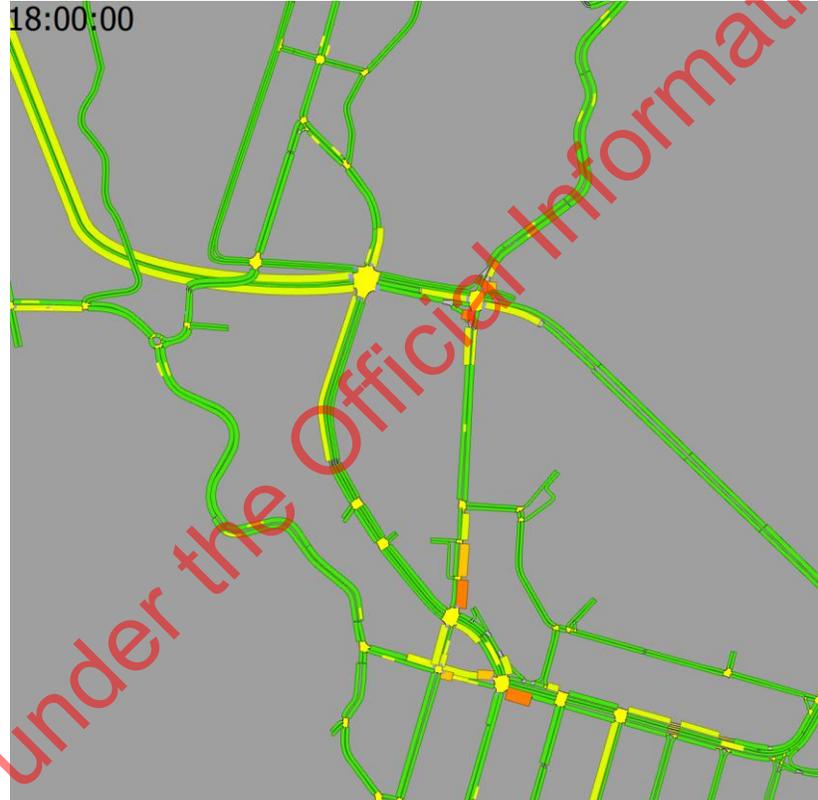
PM (5:00PM to 6:00PM)



Do-Minimum

Consultation Option 1

Consultation Option 4



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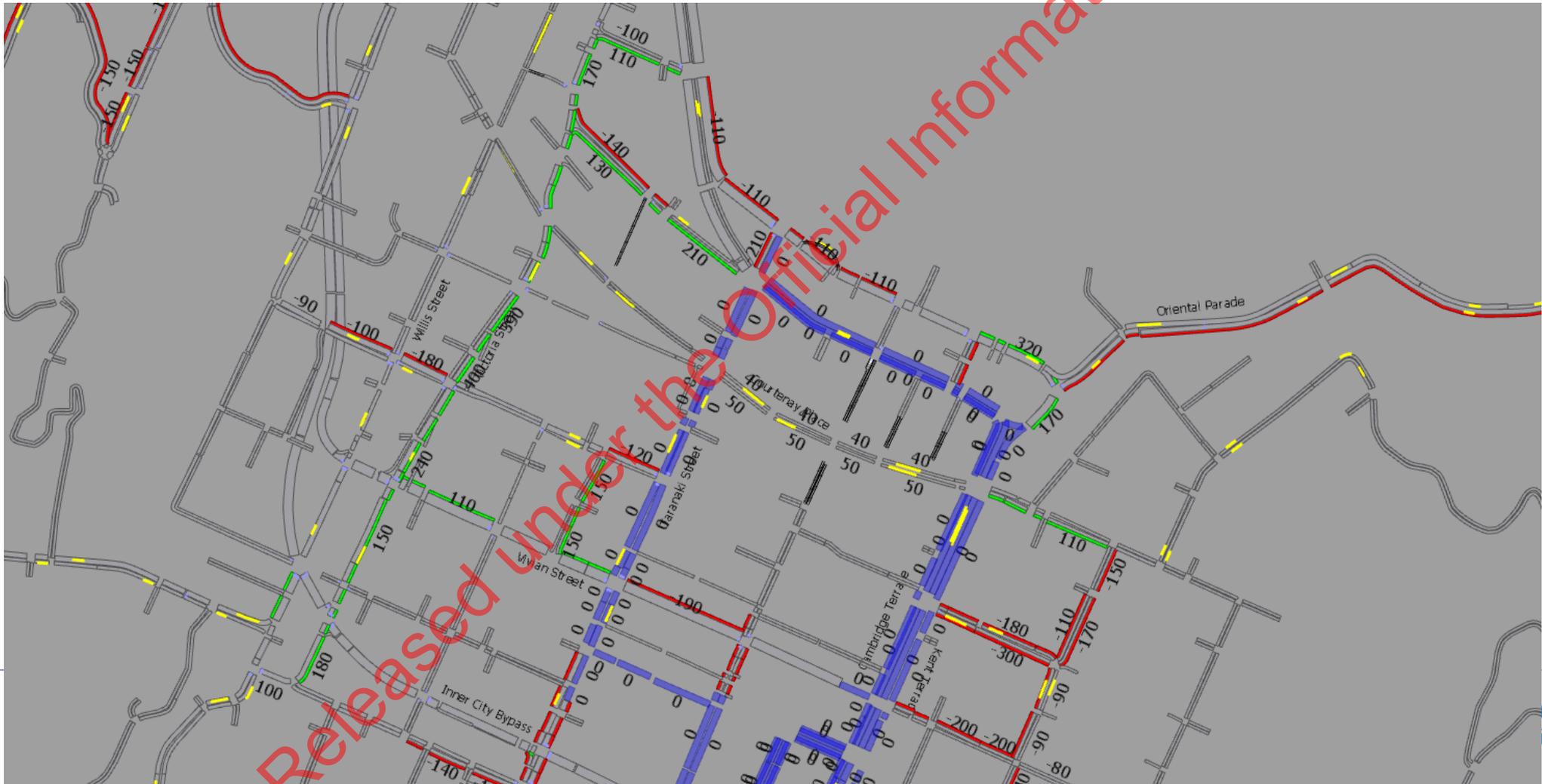
Traffic Demand Comparison

- Option 1 vs Option 4

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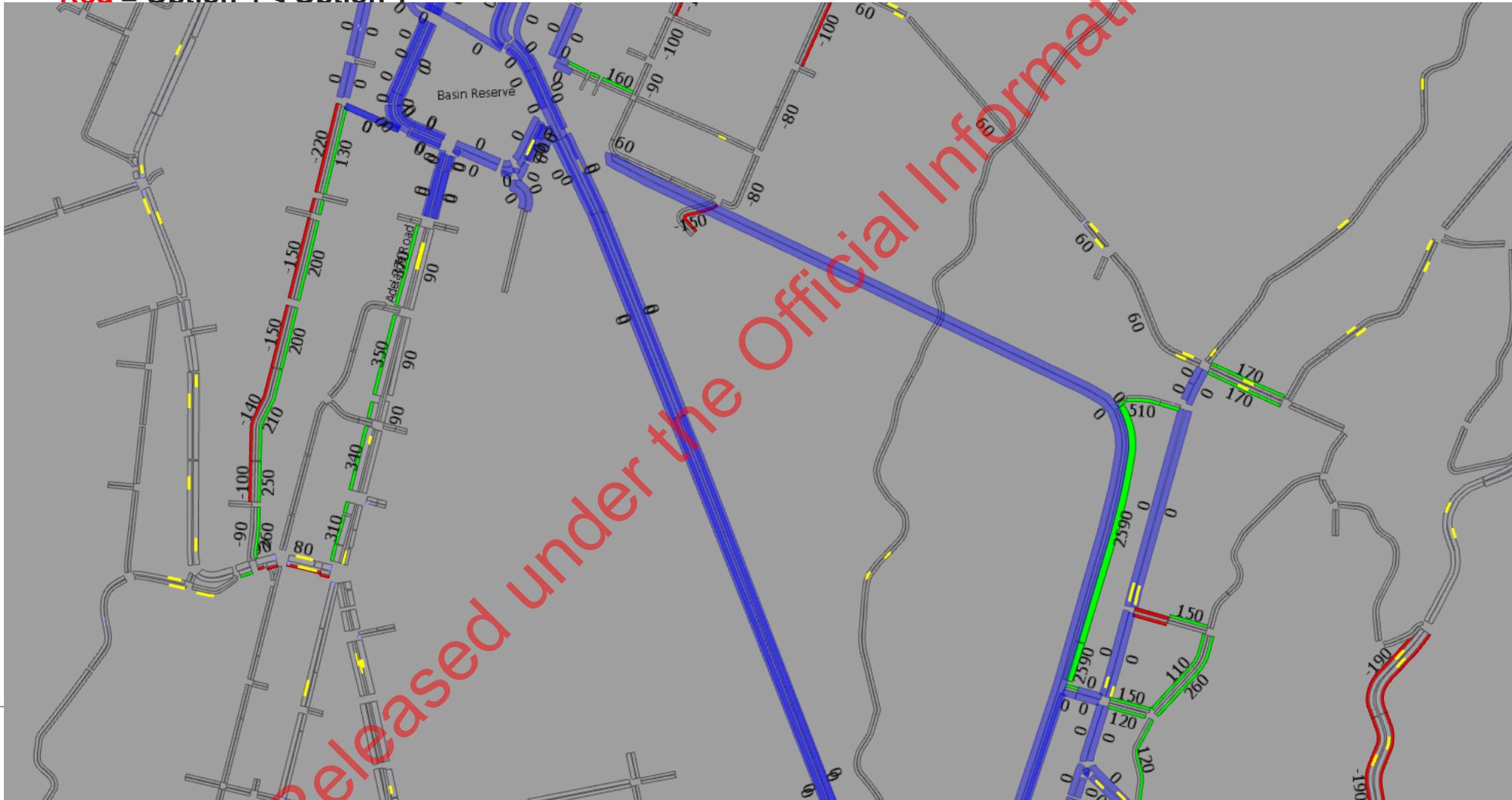
LGWM – Te Aro – AM Peak (Aggregated 7:00-9:00)

- **Green** = Option 4 > Option 1
- **Red** = Option 4 < Option 1



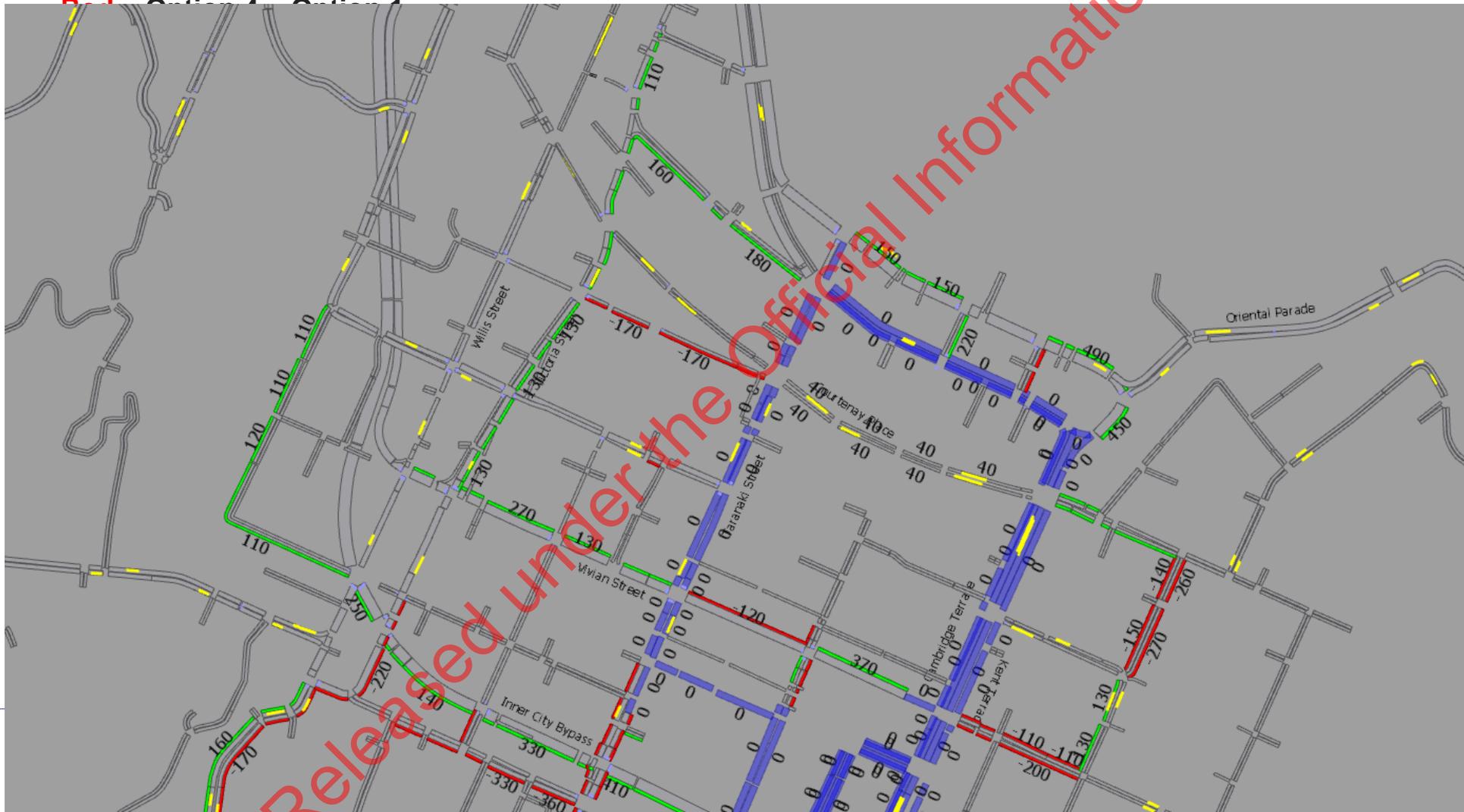
LGWM – Newtown/Hataitai– AM Peak (Aggregated 7:00-9:00)

- **Green** = Option 4 > Option 1
- **Red** = Option 4 < Option 1



LGWM – North CBD & Waterfront – PM Peak (Aggregated 16:00-18:00)

- Green = Option 4 > Option 1



LGWM – North CBD & Waterfront – PM Peak (Aggregated 16:00-18:00)

- Green = Option 4 > Option 1

