Northern Corridor, Cranford Street, and Downstream Effects Management Plan

Detailed Option Assessment, Modelling Report

14/06/2024

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Revision Schedule

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1	05/04/2024	Draft	B. Wilmshurst W. Mukherjee	T. Brewer	C. Rossiter	A. Newman
2	12/04/2024	Final	B. Wilmshurst	T. Brewer	C. Rossiter	A. Newman
3	14/06/2024	Final	B. Wilmshurst		C. Rossiter	A. Newman

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Contents

List of tables

List of figures

1. Introduction

1.1 Waimakariri to Christchurch Corridor

1.1.1 Christchurch Northern Corridor

The Christchurch Northern Corridor (CNC) includes a High Occupancy Vehicle (HOV) T2 lane, a transit lane for vehicles with two or more occupants, for southbound travel towards Christchurch. The current HOV lane extends from Tram Road north of the Waimakariri River to just south of QEII Drive, effectively the end of the NART motorway. The northern Tram Road section operates 24hrs and the main section from the northern end of the NART to QEII Drive operates 6am-9am Monday to Friday.

Currently the HOV lane is not enforced and anecdotal evidence is that Single Occupant Vehicles (SOVs) are using the HOV lanes and not obeying SOV restrictions. Considerations moving forward relating to the HOV lane component of the CNC include the extent (length) of the lane, and right-lane or left-lane operation in sections from Tram Road south.

1.1.2 Cranford Street

Cranford Street, south of Innes Road, is an arterial road on the Christchurch network. Cranford Street links to the southern end of the North Arterial (NART) through to Bealey Avenue and the northern edge of Christchurch Central Business District area.

Cranford Street includes a trial Bus Lane from south of Innes Road through to north of Berwick Street. The trial is due to end and considerations moving forward relate to the form, management, layout, and operation of this section of Cranford Street.

1.1.3 Downstream Effects Management Plan

The Downstream Effects Management Plan (DEMP) area is the area and neighbourhood around the Cranford Street corridor at the southern end of the CNC, from roughly north of Innes Road to south of Berwick Street. The DEMP area includes the neighbouring transport network to the east and west of Cranford Street. Considerations moving forward relate to how the CNC and Cranford Street treatments may influence transport and effect traffic, travel, and the community in the DEMP area.

1.2 Full Study Area Considerations

Waka Kotahi, Christchurch City Council (CCC), and the Community all have interests in the path forward for the transport network along and south of the NART. Overlapping elements include the extent of the HOV lane southwards, the lane arrangements on Cranford Street south of Innes Road, the priorities and efficiencies for certain forms of transport, community accessibility, and impacts / outcomes on safety. Options which consider these individual aspects will interact and affect other aspects.

1.3 CNC, Cranford, and DEMP Analysis

1.3.1 Extended Operational Transport Model

Stantec carried out detailed operational transport network modelling which focused on CNC in 2018-19. Further work has been carried out in 2023/24. This has involved extending the operational transport model, calibrating and validating the model to observed data with a particular focus in the southern region and DEMP areas of the wider study area, and assessing a number of options along the NART and through Cranford Street.

The operational model is linked with the Christchurch Assignment and Simulation Traffic (CAST) model. The base year of the CNC, Cranford, DEMP operational model is 2023 and the CAST model has been used to estimate a 2028 traffic demand forecast scenario.

1.3.2 Operational Model Option Testing

Option testing utilising the operational model has been carried out in several phases. A preliminary phase concentrated on components associated with Cranford Street, including the Cranford Street / Innes Road signal operation. A secondary

detailed phase included an extensive option modelling process considering alternative HOV options through the CNC area and alternative Cranford Street options, in total this included more than 20 option scenarios.

1.3.3 Previous and Complimentary Reporting

The work described broadly above has been carried out in partnership with Waka Kotahi and CCC. Key reports associated with the traffic modelling and analysis include;

- **Historical Modelling and Analysis Review,** CCC**:** Review of the historical transport modelling and analysis evidence / outcomes associated with each of the potential projects and options in the study area, 'Christchurch Northern Corridor, Downstream Effects Management Plan (DEMP), Review of Transport Modelling & Analysis Outcomes', 6 April 2023.
- **Operational Model Development,** CCC & Waka Kotahi**:** Details of the model extension work and calibration / validation outcomes are provided in Stantec memo 'Northern Arterial, High Occupancy Vehicle (HOV) Lane Downstream Effects Management Plan (DEMP), 2023 Microsimulation Base Year Model Calibration / Validation Outcomes' 1 November 2023.
- **High Level Travel Time Outcomes,** Waka Kotahi: Key high-level travel time outcomes for the Reference scenario compared to the extended left-lane T2 (HOV) lane scenario, 'Network Journey Time: Tram Road to Bealey Ave', 14 February 2024.

1.4 Detailed Modelling Option Assessment

CCC has requested Stantec to provide a more detailed modelling assessment of the performance and operation of key options identified through the assessment process. Identifying these options has included weighing pros/cons of key elements (multi-criteria analysis), discussion, feedback, design, engineering etc.. The key options analysed, assessed, and with detailed outcomes presented in this report are;

1. **Reference Scenario with Bus Lane**: Existing situation without HOV enforcement: This is the current NART HOV lane arrangement as it is operating today (without HOV lane enforced), and on Cranford Street south of Innes Road to Berwick Street the current trial Bus Lane is assumed.

2. **Reference Scenario with Bus Lane and Current HOV enforced:** As per 1, with the current HOV lane arrangement on the CNC enforced.

3. **Cranford Street Clearway** (CW)**:** As per 2, but with a clearway (two traffic lanes during peak times) on Cranford Street south of Innes Road through to south of Berwick Street and split phase signal operation at Cranford Street / Innes Road.

4. **Cranford Street HOV left-Lane south of Innes:** As per 2, but with a HOV lane in the left-lane on Cranford Street south of Innes Road through to south of Berwick Street and split phase signal operation.

5. **Extended HOV Left Hand Lane (LHL):** This has the HOV lane in the left lane running from Tram Road through the NART onto Cranford Street through to south of Berwick Street and includes the split phase signal operation.

Scenario 2, the existing arrangement with the HOV lane enforced includes the current signal phasing arrangement at Cranford Street / Innes Road. The three further options all include the split phase signal phasing at this intersection.

For consistency, all scenarios (where relevant) assume that the 2-to-1 merge length on Cranford Street south of Innes Road is extended.

The sections below provide the network wide travel times and distances, followed by sectional travel times, and finally volume changes / flow difference plots.

2. Key Network Outcomes

2.1 AM Peak Waimak to DEMP Travel Times

The transport model has been setup to readily provide travel times results separately for 'Single Occupancy Vehicles' (SOV) and 'High Occupancy Vehicles' (HOV) for trips leaving the Waimakariri area (north of the Waimakariri river) through to locations in the DEMP area (south of Innes Road, including the southern end of Cranford Street).

The tables below provide these travel times for the full 05:00 - 10:00 AM period, the average travel time (**Error! Reference s ource not found.**) and the average maximum travel times (**Error! Reference source not found.**) are provided.

The top section of the table shows the SOV and HOV travel times, and importantly the difference between HOV and SOV times (i.e. if the benefit, or travel time saving, to HOV vehicles compared to SOV vehicles).

The bottom section of the table shows the difference between the most appropriate reference scenario to compare against and the key options scenarios; the 'Base' compared to enforcing the 'NART HOV RHL' and the three core alternative options compared to the reference 'NART HOV RHL'.

The differences between SOV and HOV average travel times and the effects of congestion / delay during peak times will be dampened by averaging over the 5-hour period. In other words, there are times during the full period (before 7:15am and after 9:00am) when delays/congestion are low and SOV vs HOV travel time differences will be minimal - the outcomes from these times will affect the overall 5-hour average.

Table 1: Average Travel Times: Waimak to DEMP SOV vs HOV 2023 and 2028

From Waimak to DEMP Network Travel Times by Veh Type	Avg Time (mins), 2023			Avg Time (mins), 2028		
	SOV	HOV	Diff	SOV	HOV	Diff
Base + Bus Lane	15.61	15.61		16.65	16.65	
NART HOV RHL	16.66	15.60	-1.06	18.33	17.27	-1.06
Cranford St Clearway	16.20	15.20	-1.00	17.33	16.17	-1.15
Cranford St HOV LHL (South of Innes)	16.22	14.99	-1.23	17.42	16.03	-1.40
Extended HOV LHL	17.21	15.56	-1.65	18.97	16.40	-2.57
Travel Time Difference between Scenario & Reference	**SOV**	**HOV**		**SOV**	**HOV**	
NART HOV RHL vs Base	1.05	-0.01		1.68	0.62	
Clearway vs HOV RHL	-0.46	-0.40		-1.00	-1.09	
Cran HOV LHL vs HOV RHL	-0.44	-0.61		-0.90	-1.24	
Xtd HOV LHL vs vs HOV RHL	0.56	-0.04		0.64	-0.87	

The maximum travel time presented in the table below is based on statistical analysis, because there are more SOV vehicles than HOV vehicles there is greater probability of SOVs encountering higher travel times. This leads to higher SOV travel times, even in the existing Base scenario where there HOV lane is not enforced.

Table 2: Average Maximum Travel Times: Waimak to DEMP SOV vs HOV 2023 and 2028

From Waimak to DEMP Network Travel Times by Veh Type	Avg Time (mins), 2023			Avg Time (mins), 2028		
	SOV	HOV	Diff	SOV	HOV	Diff
Base + Bus Lane	17.46	16.38		19.24	17.77	
NART HOV RHL	18.39	16.45	-1.95	21.42	18.61	-2.81
Cranford St Clearway	17.49	15.84	-1.65	19.14	16.99	-2.14
Cranford St HOV LHL (South of Innes)	17.51	15.61	-1.90	19.22	16.81	-2.40
Extended HOV LHL	19.53	16.24	-3.29	22.17	17.24	-4.93
Travel Time Difference between Scenario & Reference	**SOV**	**HOV**		**SOV**	**HOV**	
NART HOV RHL vs Base	0.93	0.07		2.19	0.84	
Clearway vs HOV RHL	-0.91	-0.61		-2.29	-1.62	
Cran HOV LHL vs HOV RHL	-0.88	-0.84		-2.21	-1.80	
Xtd HOV LHL vs vs HOV RHL	1.13	-0.20		0.75	-1.38	

The tables above demonstrate that there is some complexity to the outcomes for SOV and HOVs associated with these options. The following outcomes across the 05:00 – 10:00 model period are noted;

Enforcing Existing T2 Lane, Tram Road & Northern Arterial (NART)

- Enforcing the existing T2 lane configuration increases travel times for SOVs by 1-to-2 minutes compared with the scenario where it is not enforced. This is largely associated with the increased delay to SOV vehicles in the Tram Road area (this is shown in the Time v Distance graphs in Section 3.1).
- Enforcing the existing right-hand-lane T2 lane on the Northern Arterial will produce a 1-to-3 minute benefit for HOV over SOVS.

Cranford Street Clearway (HOV enforced at Tram Rd & NART)

- The Cranford Street Clearway reduces SOV travel times by 1-to-2 minutes compared to the comparable HOV NART RHL scenario over the fuller Waimak to South trip and 5-hour am period.
- The Clearway reduces the HOV vs SOV benefits, because SOVs travel times decrease the differential benefits of the current HOV lane are reduced and HOV benefits are only 1-to-2 minutes compared to SOVs.

Cranford Street HOV Left-Lane (HOV enforced at Tram Rd & NART)

- The addition of the T2 lane on Cranford Street from south of Innes Road to Berwick Street also produces a 1-to-3 minute benefit for HOVs over SOVs. The benefits are more consistent / reliable, the average travel time benefit is 15-30% greater than with the HOV lane enforced on the NART only.
- The Cranford Street T2 lane south of Innes has little-to-no impact on SOV travels and delays. The SOV travel times are similar to the Clearway option. This indicates that the additional vehicle capacity provided through the Innes Road signals and through the southbound two-to-one lane merge by the T2 lane is benefitting all vehicles, both SOVs and HOVs.

Extended Tram Road to Berwick Street southbound T2 Left-Lane

- The extended T2 left-lane from Tram Road, along the NART, southbound on Cranford Street through Berwick Street shows the most significant benefit to HOV vs. SOV travel times. Across the 5-hour period HOVs travel 2-to-5 minutes quicker than SOVs.
- SOV travel times increase in this scenario. Compared to the T2 lane on the NART, SOV travel times increase by around 1-minute and compared to other scenarios by 1-to-3 minutes. This scenario has the highest overall SOV travel times indicating an increase in delay / congestions with the addition of the extended T2 left-lane.

2.2 AM Period Waimak to DEMP Bus Travel Times

The table below provides bus travel times from north of Tram Road through to the southern end of Cranford Street. These bus travel times are only loosely comparable to the vehicle travel times above; the vehicle times are based on zone-to-zone trips which include time spent getting to/from the zones along with travel along the corridors, whereas the bus travel times below is just the time for bus vehicles along the corridor itself.

Table 3: Bus Travel Times, north of Tram Road to southern end of Cranford Street

From Waimak to DEMP Corridor Bus Travel Times	Travel Time (mins), 2023		Travel Time (mins), 2028	
	Avg	Max	Avg	Max
Base + Bus Lane	14.2	15.4	14.6	15.8
NART HOV RHL	13.9	15.1	14.4	15.7
Cranford St Clearway	14.2	15.4	14.3	15.6
Cranford St HOV LHL (South of Innes)	14.1	15.4	14.3	15.6
Extended HOV LHL	14.6	15.7	14.7	15.9
Travel Time Difference between Scenario & Reference	**Avg**	**Max**	**Avg**	**Max**
NART HOV RHL vs Base	-2%	-2%	-1%	-1%
Clearway vs HOV RHL	2%	2%	-1%	-1%
Cran HOV LHL vs HOV RHL	2%	2%	-1%	-1%
Xtd HOV LHL vs vs HOV RHL	5%	4%	2%	1%

The results above show that the options have a very minimal effect on bus travel times. The change in bus travel times between options is only in the range of -2% to 5%. Considering this, the notes below discuss some of the differences but these differences are outcomes are marginal.

The 2023 results show the effect of introducing the split phase signal settings at the Cranford Street / Innes Road intersection. This reduces delays in the NART HOV right-hand-lane scenario compared to the base scenario which does not have these settings.

In 2028 the Cranford Street clearway and left-lane HOV lane south of Innes Road both provide benefits to bus travel times due to the general improvement to traffic flow that these scenarios provide.

The HOV extended lane has higher overall bus travel times compared to the other options. This increase in travel time occurs along the NART sections of the corridor. It is difficult to be absolutely certain why this increase in bus travel times occurs, one reason may be that the buses in the HOV left-lane along the NART are interacting with more vehicles and the on/off-ramps in this scenario (vehicle volumes in the corridor sections are explored further in section 4). It is reiterated that this change is very minimal, 20-30 seconds at most.

More detailed bus travel times, in the section from the Cranford Street roundabout to Berwick Street, are provided in Section 3.3.

2.3 AM Peak Waimak to DEMP Distances

The table below provides the average travel distance for trips from the Waimakariri area through the locations in the DEMP area and further south for SOV and HOV vehicle types. An increase in distance above the reference scenario indicates a higher level of rerouting to avoid delays / congestion, as SOVs generally experience more delay / congestion than HOVs in the option scenarios, this effect is demonstrated by increasing SOV travel distances.

Table 4: Average Travel Distances: Waimak to DEMP SOV vs HOV 2023 and 2028

From Waimak to DEMP Network Distances by Veh Type	Avg Dis (kms), 2023			Avg Dis (kms), 2028		
	SOV	HOV	Diff	SOV	HOV	Diff
Base + Bus Lane	17.19	17.20		17.31	17.33	
NART HOV RHL	17.20	17.17	-0.03	17.37	17.39	0.02
Cranford St Clearway	17.17	17.15	-0.02	17.24	17.23	-0.01
Cranford St HOV LHL (South of Innes)	17.17	17.14	-0.03	17.25	17.23	-0.02
Extended HOV LHL	17.42	17.17	-0.24	17.66	17.26	-0.41
Distance Difference between Scenario & Reference	**SOV Distance Inc.**			**SOV Distance Inc.**		
NART HOV RHL	0.01	0.1%		0.06	0.4%	
Cranford St Clearway	-0.03	-0.2%		-0.13	-0.7%	
Cranford St HOV LHL (South of Innes)	-0.03	-0.2%		-0.12	-0.7%	
Extended HOV LHL	0.22	1.3%		0.29	1.7%	

The table above demonstrates that SOV distances increase in the NART right-lane option marginally. SOV distances increase more significantly in the extended HOV left-lane option. This indicates that the increasing SOV delays in these scenarios (demonstrated by the travel time tables in the section above) are leading to SOV vehicles re-routeing and taking mildly longer journeys on average. Section 4 provides more information on volumes and flow differences.

3. Detailed Section Travel Times

3.1 07:00 to 09:00 Time vs. Distance Plots

The graphs below show time distance plots for travel from Tram Road through to south of Berwick Street. The first section (zero distance, left-hand end of the graph) is the motorway north of the Tram Road interchange, followed by the two sections from the west and northeast which capture local road traffic travelling to the Tram Road interchange and onto the southbound on ramp, from there the sections follow the motorway, northern arterial (NART), and Cranford Street (Cran) ending at Edgeware Road (19km, right-hand end of the graph).

The top two graphs show 2023 results, average travel times on the left and average maximum travel times on the right and the bottom two graphs show 2028 results. The HOV and SOV travel time outcomes are separated for the options where there is a material difference between the times for these vehicles. The travel time scale (y axis) varies on the graphs below so that differences / changes can be more easily identified between scenarios and HOVs / SOVs outcomes.

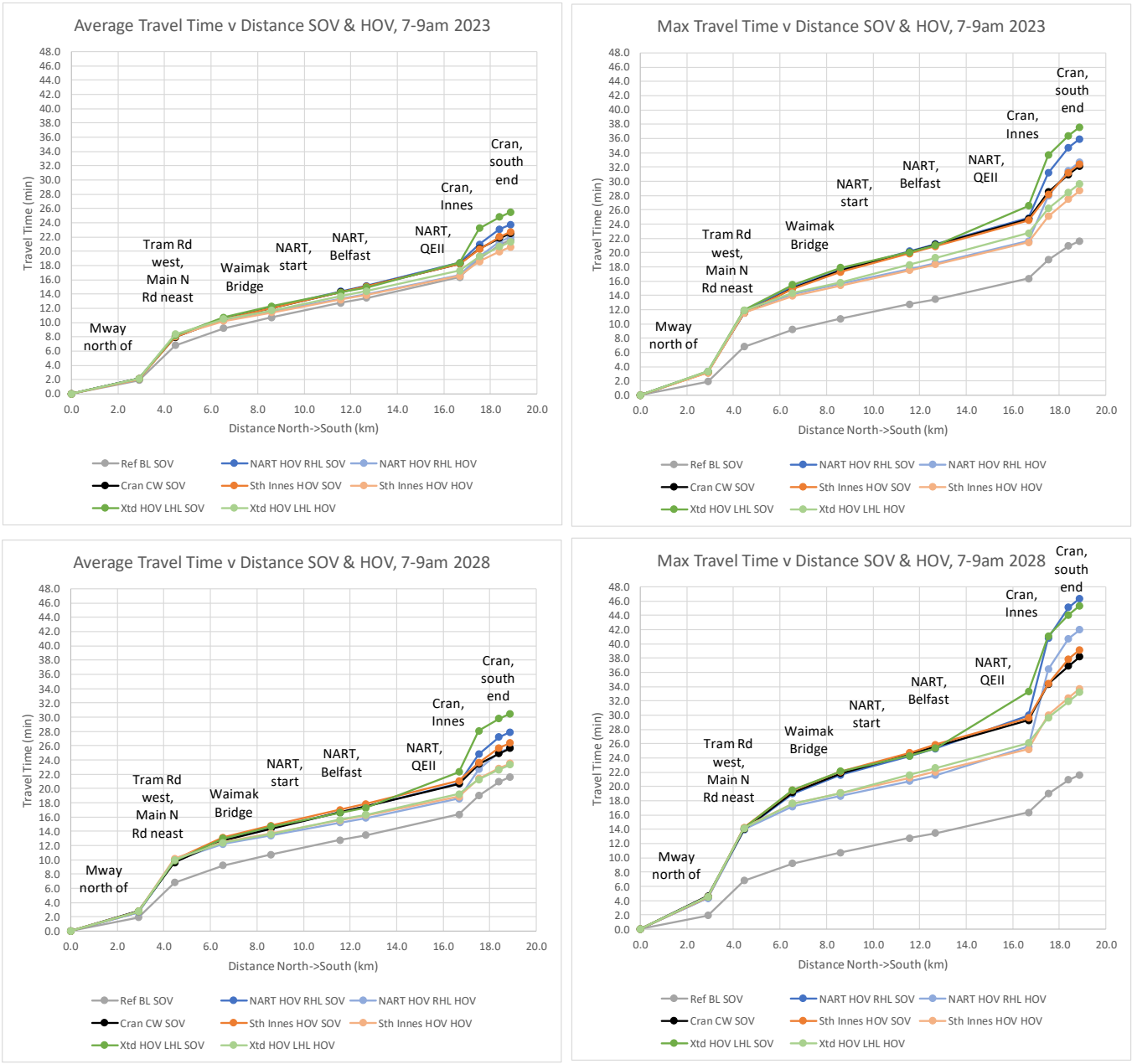

Figure 1: Travel Time vs. Distance, Tram Rd to South of Berwick, 7-9am

The figures above show the following key outcomes.

Tram Road top of NART

The Tram Road sections which access the northern motorway exhibit high delays. This can be seen in the second section of the time vs. distance graphs, between roughly 2.5km and 4.5km. Key outcomes associated with the options in this section include;

- Implementing the T2 enforcement slows SOV and HOV travel times in this area. Without the enforcement, SOVs are able to avoid significant delays (4-to-8 minutes). This has a knock-on effect through the rest of the corridor, this 6-to-8 minute saving in the Tram Road area translates into quicker overall corridor travel times in the Reference Bus Lane (ref BL scenario).
- The remaining options all implement the same, or very similar, enforced T2 lane and perform similarly in this section.

NART, **Northern end to south of QEII Interchange**

The full length of the NART is relatively uncongested, the gradient of the time vs. distance line remains low and doesn't show any increases/sharpness between 4.5km to 16km distances. Key outcomes associated with the options in this section include;

- HOV and SOV travel times begin to separate in this section of the network (i.e. HOVs becoming quicker than SOVs). This is shown by the lighter coloured lines separating, and being lower, than the darker coloured lines.
- The right-lane HOV options provide better HOV benefits (NART HOV RHL and Sth Innes HOV) than the left-lane option (Xtd HOV LHL) along the NART. This difference is marginal, 0.5 to 1.0 minutes. The benefit comes from the HOV lane being in the right-hand 'fast lane' and avoiding merging / weaving traffic associated with on and off ramps.
- In 2028 and in the 2023 average maximum times, SOV delay / congestion can be seen to wash back onto the southern end of the NART in the Extended HOV LHL scenario (solid green line travel times increasing in the 13km to 16km section).

Cranford Street, from end NART to Innes Road

This section of the network with has high delays / level of congestion. This can be identified by the steepness of the time vs. distance lines between the 16km and 18km distances. Key outcomes associated with the options in this section include;

- The scenario which provides the greatest separation of SOV vs. HOV benefits in this area is the Extended HOV lane. The travel times in this particular section are 4-to-9 minutes quicker for HOVs than SOVs. SOV congestion in this section in this scenario increases due to SOVs (modelled as 85% of vehicle traffic volume) being forced into a single lane for a long section the north approach to the Cranford Street / Innes Road signalised intersection.
- The benefits of the split phasing signal arrangement at Cranford Street / Innes Road can also be identified in the results in this section. The HOV and SOV travel times for the HOV RHL option, which doesn't include the split phasing, show higher levels of congestion in this area than the other options.

Cranford Street, south of Innes Road

Some level of delay is experienced in this section and key outcomes associated with the options in this section include;

- The clearway produces some SOV travel time benefits in this section, although it is noted that these are not significant and potentially this is associated with additional traffic being attracted to Cranford Street in this scenario which erodes travel time savings.
- The Extended HOV left-lane and HOV left-lane south of Innes Road options both maintain and deliver HOV travel time benefits in this section. This ranges from around 0.5 to 1.0 minutes.

3.2 30-minute Travel Times

The graphs below show similar information as above, presented in each section in 30-minute intervals through the AM period to identify the benefits at peak times. In addition to the travel times in the key sections along the NART and Cranford Street, travel times are included on the parallel and intersecting routes (Marshland Road, Main North Road, and QEII Drive). The NART / Cranford Street travel times include SOV and HOV times, whereas the other routes are travel times for all vehicles.

Average travel times are presented on the graphs on the left and average maximum travel times on the right. The 2023 results are presented first, followed by the 2028 results.

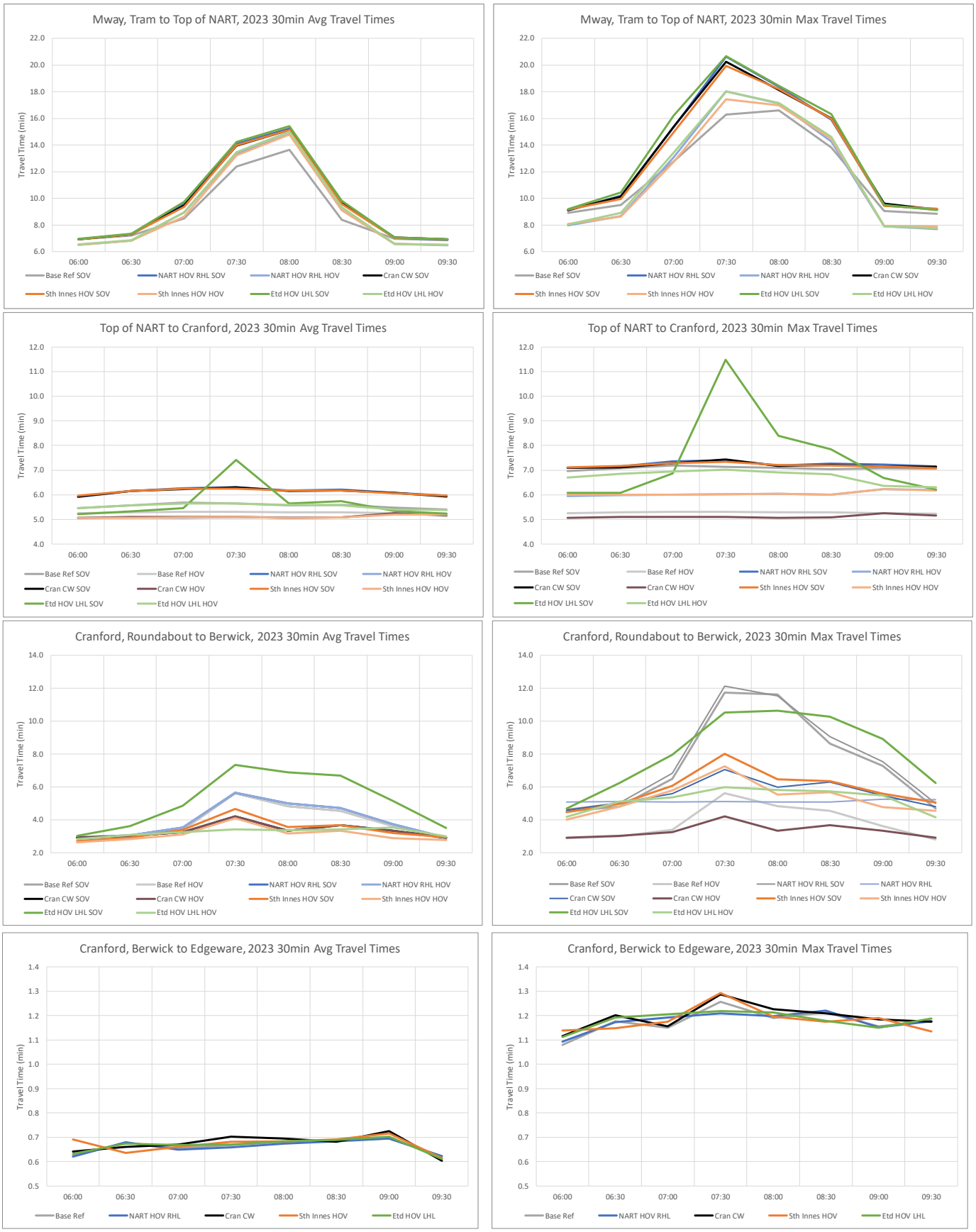

Figure 2: 2023 30-Minute Travel Times along NART and Cranford Street

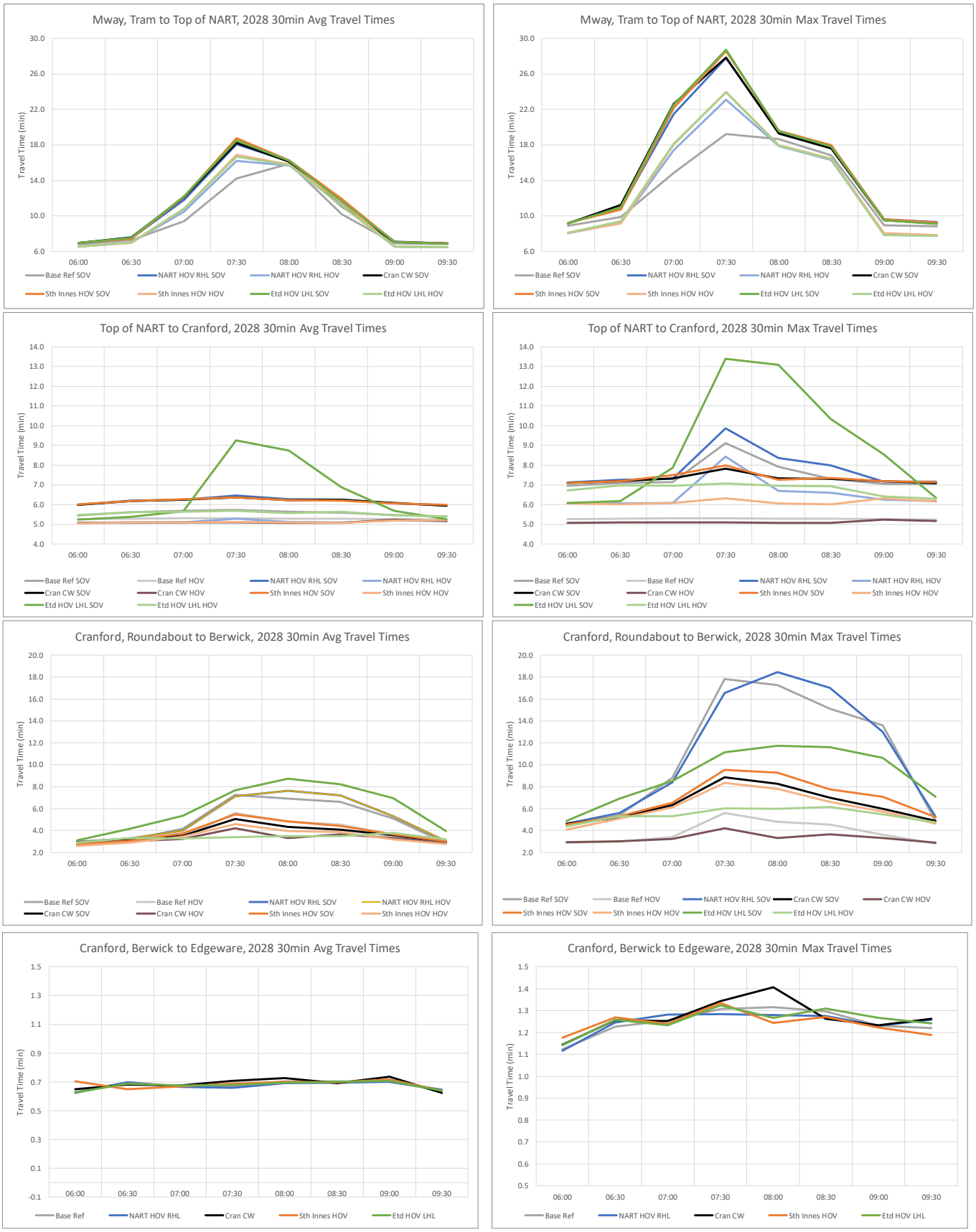

Figure 3: 2028 30-Minute Travel Times along NART and Cranford Street

The graphs above show the following key outcomes in each section.

Tram Road top of NART

- The enforcement of the HOV lane increases travel times for both SOVs and HOVs in this area. In terms of travel time reliability (demonstrated through the maximum travel times), enforcing the HOV lane does provide some reliability benefits to HOVs.

NART, **Northern end to south of QEII Interchange**

- In the peak hour, the extended left-lane HOV scenario results in congestion / delays which affects SOV travel times at the southern end of the NART. In 2028 the increase to SOV travel times in this section is 4-to-7 minutes while HOVs travel times remain unaffected. As HOVs are not delayed, the increase in SOV travel times translates to a benefit to HOVs.
- The enforcement of the existing HOV right-lane along the NART produces HOV benefits of around 2 minutes along the NART. This is demonstrated in both the NART HOV RHL and South of Innes HOV options.
- The 2028 maximum travel times show the effect of not deploying the Cranford Street / Innes Road split phase signal operation in the NART HOV right-lane option. In this scenario, congestion / delays from these signals can affect the southern end of the NART.

Cranford Street, from end NART to Berwick Street

- All options demonstrate levels of delay and congestion along Cranford Street between the roundabout south of the NART through to south of Berwick Street.
- The HOV left-lane south of Innes Street produces HOV benefits of around 2-minutes. Of interest, this option also has some benefit to SOV travel times and produces travel time / delay outcomes similar to the clearway option - this is due to 15% (HOV split) of the traffic volume not needing to merge to 1-lane south of Innes Road.
- In the extended left-lane HOV scenario, the combination of the two sections above (NART section and Cranford section) leads to peak HOV travel times which are around 10-to-15 minutes faster than SOVs.

Cranford Street, south of Berwick Street

- No change in travel times / congestion is anticipated in any of the scenarios in the modelled section from south of Berwick Street to Edgeware Road.

The graphs below show travel times on the parallel and intersecting routes (Marshland Road, Main North Road, and QEII Drive) for all vehicles the majority of which are SOVs. Average travel times are presented on the graphs on the left and average maximum travel times on the right. The 2023 results are presented first, followed by the 2028 results.

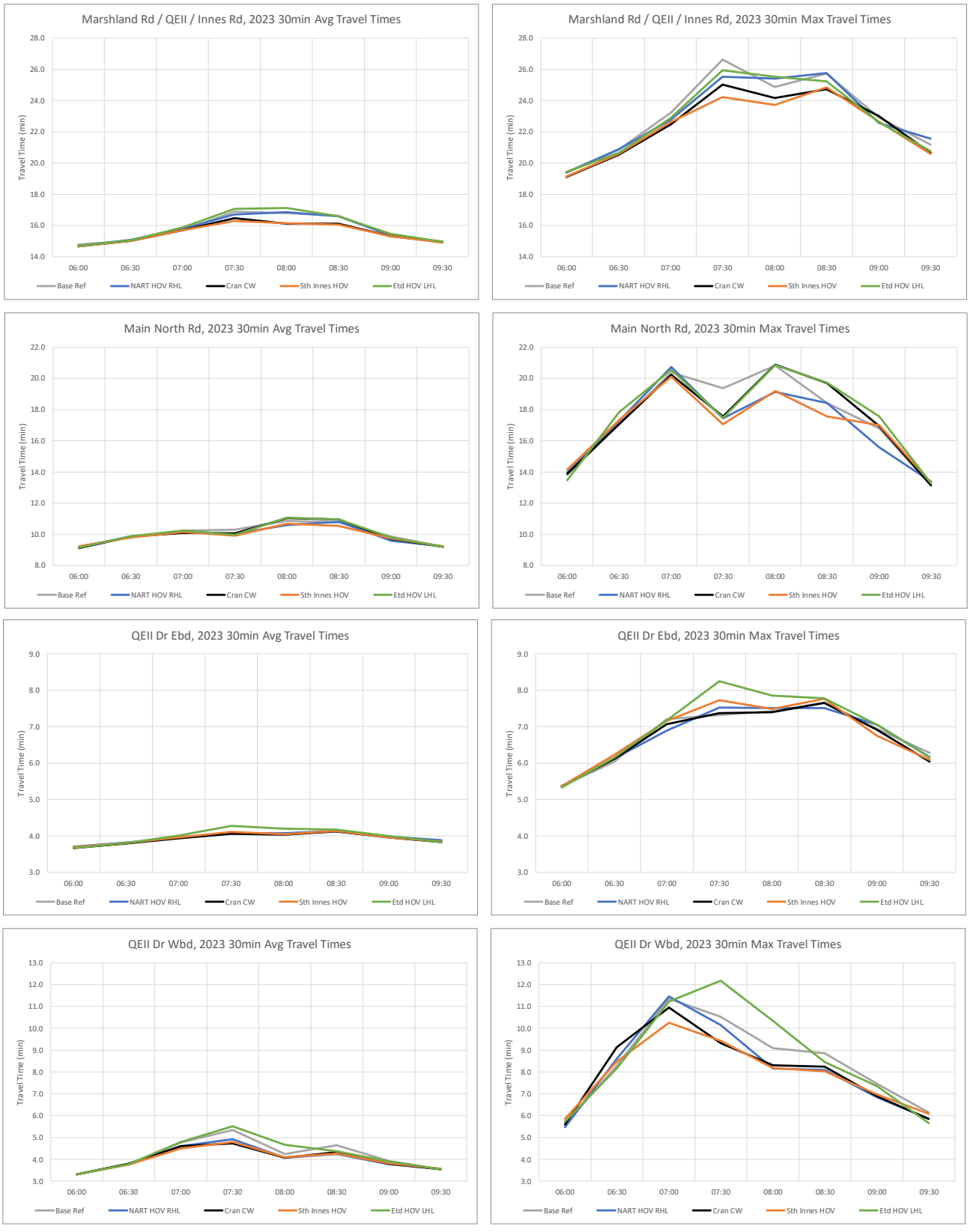

Figure 4: 2023 30-Minute Travel Times Parallel and Crossing Routes

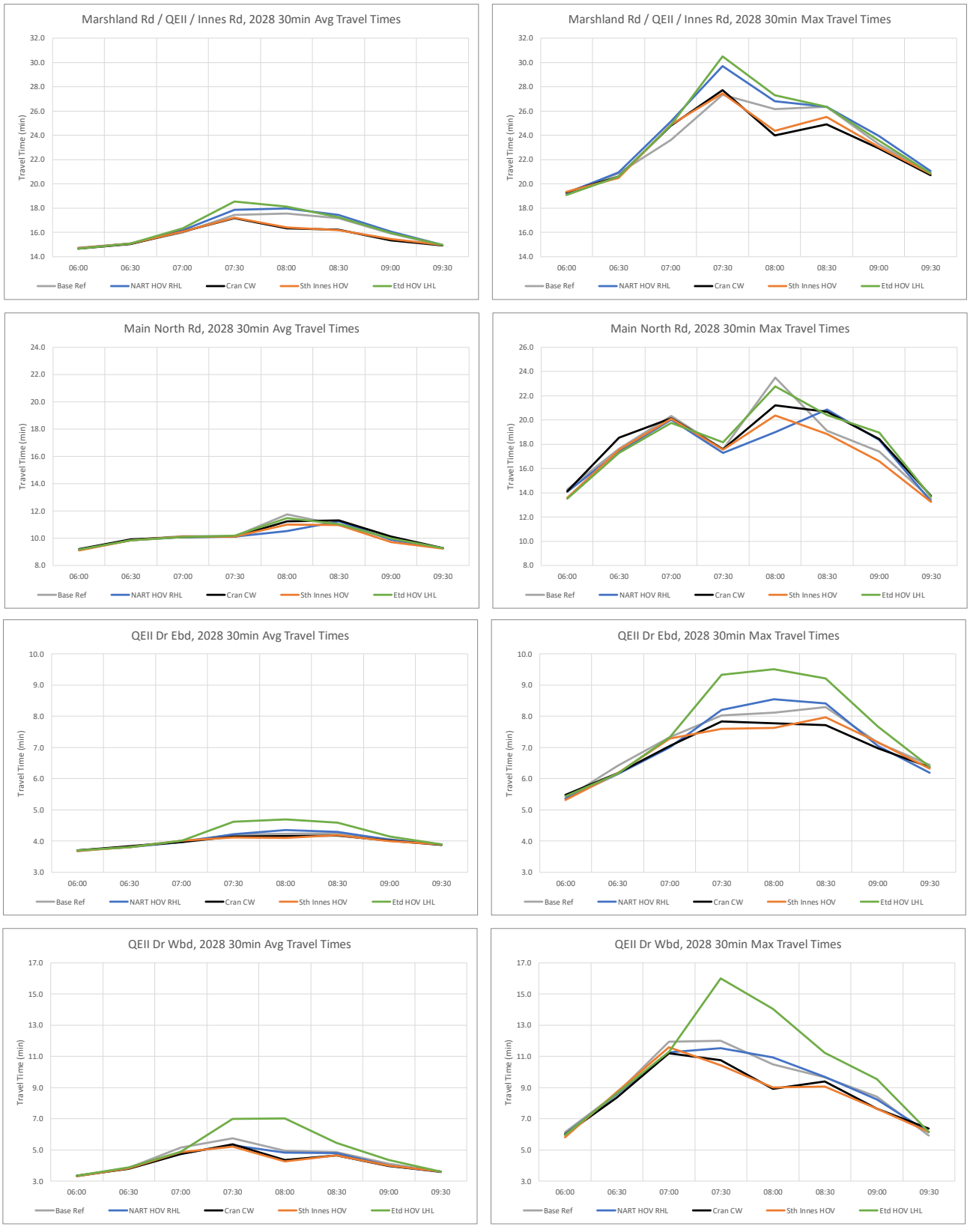

Figure 5: 2028 30-Minute Travel Times Parallel and Crossing Routes

The figures above show the following key outcomes on the parallel and connecting routes.

Marshland Road, QEII Drive, Innes Road

- An alternative route to the motorway corridor to travel to Cranford Street south is via Marshland Road, QEII Drive, and Innes Road.
- Along this route travel times increase in the Base, NART RHL (no signal split phase), and extended-HOV lane scenario. This indicates that vehicles have rerouted onto these routes and the increased volume has increased travel times. This is most significant in the extended HOV left-lane option where travel times increase by 1-to-2 minutes.
- In the Clearway and HOV left-lane south of Innes scenarios, travel times decrease on this route indicating that volumes / rerouting has decreased, i.e. in these options more traffic stays on the core NART and Cranford Street corridor.

Main North Road

- Main North Road is another alternative route to reach Cranford Street. Travel times along this route are largely unchanged between the options indicating that rerouting to Main North Road isn't predicted to be a significant issue.

QEII Drive Eastbound and Westbound

- QEII Drive provides a connecting route between Innes Road and Cranford Street and this may be an option to avoid congestion along the northern end of Cranford Street.
- The extended left-lane scenario shows distinct increases in travel times along QEII Drive (1-to-2 minutes). This is associated with predicted rerouting, using QEII Drive as a connection to avoid delays along the northern end of Cranford Street.
- Rerouting and changes in volumes are explored further in the section below.

3.3 Motorway to Berwick Street, Bus and Vehicle Times

3.3.1 Bus, SOV, and HOV Vehicle Travel Times

The table below provides the peak 2-hour (07:00-09:00) average bus, SOV, and HOV vehicle travel times from the top of the Northern Arterial (NART) through to Berwick Street for trips travelling on the NART and Cranford Street. The section that follows provides more detailed bus travel times and SOV, HOV travel times along Cranford Street, from the roundabout to Berwick Street.

Table 5: 2023 Average 07:00-09:00 Vehicle Travel Times, NART to Berwick Street

NART to Berwick Travel Times, 2023	Avg Travel Time Mins		
	SOV	HOV	Bus
Base + Bus Lane	10.2	9.9	9.4
NART HOV RHL	11.0	9.8	9.1
Canford St Clearway	9.8	8.7	9.4
Cranford St HOV LHL (sth of Innes)	10.0	8.5	9.3
Extended HOV LHL	12.5	9.0	9.6

Table 6: 2028 Average 07:00-09:00 Vehicle Travel Times, NART to Berwick Street

NART to Berwick Travel Times, 2028	Avg Travel Time Mins		
	SOV	HOV	Bus
Base + Bus Lane	11.9	11.6	9.8
NART HOV RHL	12.8	11.7	9.6
Canford St Clearway	10.5	9.3	9.7
Cranford St HOV LHL (sth of Innes)	10.9	9.1	9.6
Extended HOV LHL	15.1	9.0	9.6

The tables above demonstrate that the following key outcomes;

- Over the fuller journey from north-to-south, the options have minimal effect on bus travel times. This reiterates the earlier finding in Section 2.2 that changes in bus travel times are minimal between options over fuller trips from Waimakariri south, there are benefits in the southern Cranford Street described in the section that follows.
- Implementing the right-hand T2 (HOV) lane on the NART creates a roughly 1-minute benefit to HOVs compared to SOVs and provides some small benefit to buses.
- The Cranford Street clearway option reduces travel times for all vehicles, and slightly slows bus travel times due to the increased vehicle traffic on the corridor.
- The T2 (HOV) lane south of Innes Road performs well, it provides around 2-minute benefit to HOV (and good HOV travel times compared to other options) along with maintaining bus travel times.
- The Extended HOV lane provides similar HOV and Bus Travel times to the lane south of Innes Road, but creates are more significant difference in SOV and HOV travel times in 2028 – a difference on average between 07:00 and 09:00 of around 6-minutes.

3.4 Cranford Street Bus and Vehicle Type Travel Times

3.4.1 Bus Travel Times

The graphs below provide the 30-minute average and maximum bus travel times along Cranford Street from the Cranford Street roundabout through to Berwick Street for 2023 and 2028. Below this, comparison of bus travel times to SOV and HOV vehicles are provided for the same section.

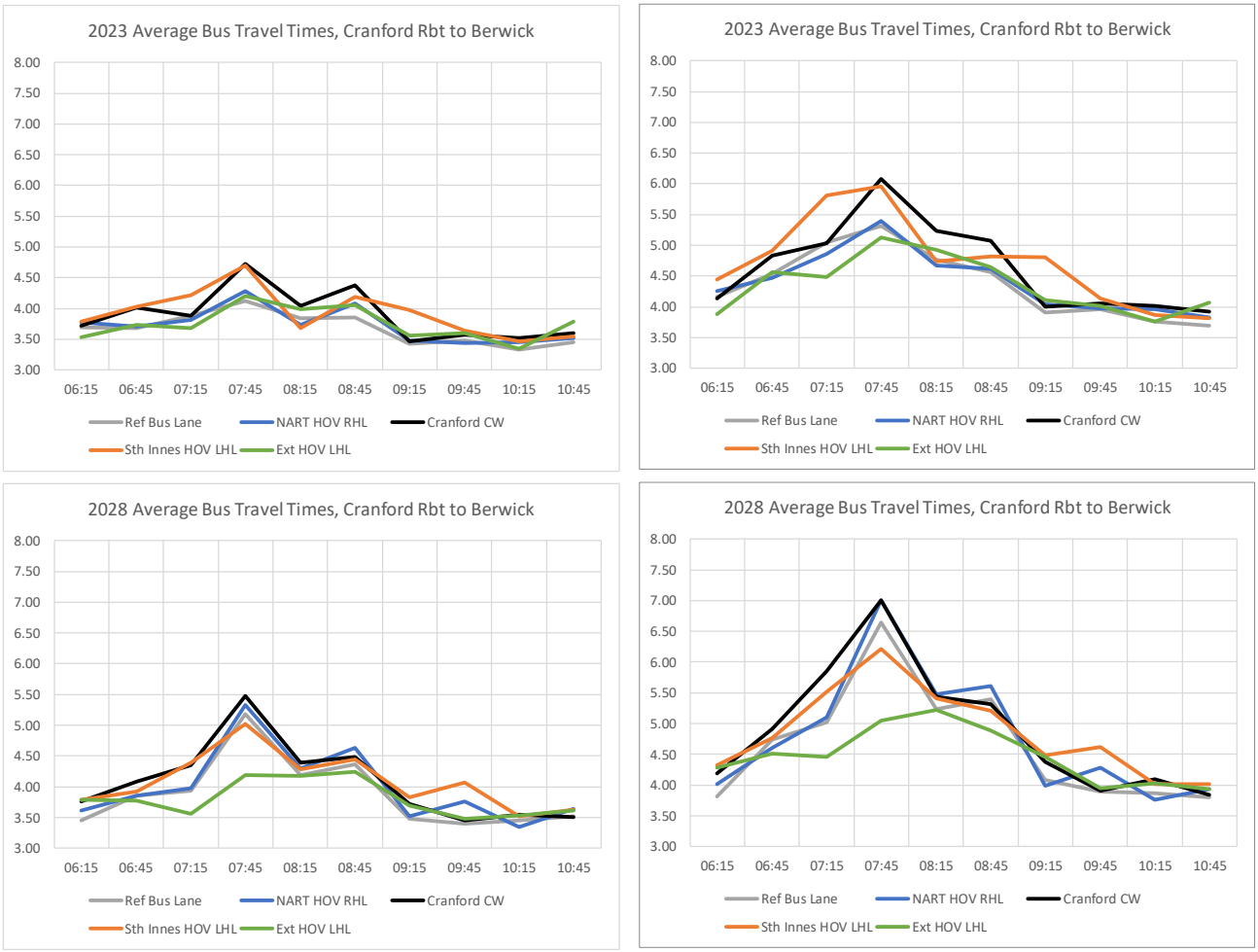

Figure 6: Bus Average and Maximum Travel Times (Cranford Roundabout to Berwick Street)

Of importance, the 'Reference Bus Lane' and the 'NART HOV RHL' scenarios do not include the split-phase signal strategy at the Cranford Street / Innes Road intersection. This provides travel time benefits and delay reductions in the other options, but not in the 'Reference Bus Lane' or 'NART HOV RHL' scenarios. This is most evident in the 2028 maximum bus travel times where these scenarios shows a higher spike in delays without the split-phase signal timings.

The graphs above demonstrate that the Extended T2 Left-Lane option provides the greatest benefit to bus travel times, *in this specific section of the network*. However, the earlier results which examined a fuller bus travel time from the Tram Road area demonstrated that this option had slower overall bus travel times - influenced most significantly by slower times along the NART.

The HOV lane south of Innes provides some benefits to reducing maximum bus travel times in 2028 and the Cranford Clearway and NART T2 Right-Lane options generate mildly higher bus travel times in 2028 in this section of the corridor.

With the exception of the extended HOV lane scenario, there is little difference between average bus travel times in the options which reiterates the earlier finding in Section 2.2 that changes in bus travel times are minimal between options.

3.4.2 Bus, SOV, and HOV Vehicle Travel Times

The table below provides the peak 2-hour (07:00-09:00) average bus, SOV, and HOV vehicle travel times along Cranford Street from the Cranford Street Roundabout to Berwick Street.

Table 7: 2023 Average 07:00-09:00 Vehicle Travel Times, Cranford Street Roundabout to Berwick Street

Cranford Street Travel Times, 2023	Avg Travel Time Mins		
	SOV	HOV	Bus
Base + Bus Lane	4.6	4.6	3.9
NART HOV RHL	4.7	4.7	4.0
Canford St Clearway	3.6	3.6	4.3
Cranford St HOV LHL (sth of Innes)	3.8	3.4	4.2
Extended HOV LHL	6.4	3.4	4.0

Table 8: 2028 Average 07:00-09:00 Vehicle Travel Times, Cranford Street Roundabout to Berwick Street

Cranford Street Travel Times, 2028	Avg Travel Time Mins		
	SOV	HOV	Bus
Base + Bus Lane	6.1	6.1	4.3
NART HOV RHL	6.5	6.5	4.4
Canford St Clearway	4.3	4.3	4.6
Cranford St HOV LHL (sth of Innes)	4.6	4.0	4.4
Extended HOV LHL	7.5	3.4	3.9

The tables above demonstrate the following key outcomes in this particular section of the network;

- The bus lane (present in the Base and NART HOV RHL options) provides benefit to buses over vehicles by around 0.5 to 2.0 minutes.
- Although the Clearway improves vehicle travel times, it slows buses and this creates a greater disparity between bus and vehicle travel times.
- The HOV lane south of Innes provides good outcomes for HOV vehicles in this scenario, moderate outcomes for buses (similar to average bus travel times with the bus lane in 2028), and some differential between SOV and HOV travel times in this section.
- The extended HOV lane results in a more significant increase in SOV travel times and provides the most benefit to HOVs and buses. Again it is noted that the bus travel time benefits of extended HOV lane option are greatest in this section, but the bus trips from Tram Road south are slowed along the NART sections leading to longer overall bus travel times in this option.

There is a difference in SOV and HOV travel times in the Base + Bus Lane scenario compared to the NART HOV RHL scenario. The only difference between these two scenarios is that in the 'NART HOV RHL', the HOV lane is enforced (in the 'Base + Bus Lane' scenario the HOV lane is not enforced allowing for 2-lanes southbound on the NART for all vehicle types). Although the section of the network from the Cranford Street roundabout south to Berwick Street is identical in both scenarios, the NART HOV RHL demonstrates a roughly 20-second slower travel time in 2028 compared to the Base + Bus Lane. This is associated with changes and differences in the northern section of the corridor which affect the south. A small proportion of SOV vehicles use an alternative route to the NART when the HOV lane is enforced, particularly Marshland Road, QEII, and Innes Road. This traffic then navigates through the network in the DEMP area and rejoins Cranford Street at points south of Innes Road. The joining traffic slows traffic a little on Cranford Street, compared to the scenario where more traffic chooses to stay on the main NART / Cranford Street corridor. This pattern of traffic leaving the corridor in the north and rejoining in the south is not significant, the pattern and peak hour volumes can be seen in Table 10 and Table 12 in the following section.

4. Volumes, No. of Users, and Rerouteing

4.1 Number of Vehicle Trips and Users Affected

Across the wider network a number of vehicle trips and users (people travelling in vehicles) will be affected by different degrees by elements of each of the scenario. E.g. a traveller from north of Tram Road through to Bealey Ave is likely to be affected by all elements of each scenario, whereas a traveller from the Belfast area to Northcote who uses the NART will only be affected by the HOV elements on this section of the NART. It is therefore difficult to estimate the total vehicles and users affected by the scenarios throughout the wider the study area.

The table below provides a high-level estimate of the vehicle trips and users travelling through the study area which may be influenced by the scenarios between Tram Road and Berwick Street. This includes trips which are likely to use the corridor in the study area but may not, and may pass across the corridor or along a parallel route. These trips will be affected by the corridor scenarios by some degree. HOV lane users include HOV light vehicles[1], buses, and freight.

Table 9: Number of Vehicle Trips and Users on Corridors and Connecting to Corridor, 5am-10am

Study Area Trips to DEMP Location	NART Peak Traffic Volumes (5am-10am)	
	2023	2028
SOV Cars	25,300	26,500
Users	25,300	26,500
HOV Lane Vehs	6,100	6,400
HOV Lane Users	11,700	12,300
% of HOV Users	32%	32%

The table above indicates that a reasonably high number of users / travellers would be benefited by a T2 (HOV) lane scenario which provides HOV vehicle travel time benefits – in total around 12,000 users across the AM period or around 30% of vehicle travellers in the study area.

4.2 Corridor Vehicle Volumes by Section

The tables below provides SOV lane and HOV lane southbound vehicle counts and HOV vehicle percentage by sections through the corridor, from the end of the northern motorway through the NART to the southern end of Cranford Street. Unlike the table in the section above, these numbers are just vehicle counts and not an estimate of users.

[1] HOV vehicle occupancy as surveyed is 2.19 people per vehicle.

Table 10: 2023 HOV and SOV AM Peak Hour Vehicle Southbound Counts through Core Corridor

Peak Hour Volumes	Base + Bus Lane	NART HOV RHL		Cranford Clearway		Cranford HOV (sth of Innes)		Xtd HOV LHL	
	SOV	SOV	Dif to Base	SOV	Dif to RHL	SOV	Dif to RHL	SOV	Dif to RHL
Mway, south of Tram	3,284	3,312	27	3,311	-1	3,284	-28	3,298	-13
NART, south of Mway	1,494	1,464	-30	1,466	2	1,452	-12	1,497	33
NART, south of Belfast	1,651	1,599	-51	1,615	16	1,599	0	1,635	36
NART, south of QEII off-ramp	989	999	11	1,018	18	1,009	10	717	-282
NART, south fo QEII on-ramp	1,074	1,080	6	1,100	21	1,090	11	766	-314
Cranford, south of roundabout	1,398	1,406	9	1,435	29	1,426	20	1,046	-361
Cranford, north of Innes	1,135	1,148	13	1,317	169	1,288	140	837	-312
Cranford, south of Innes	772	778	6	942	165	894	116	589	-188
Cranford, north of Westminster	876	857	-19	1,028	171	962	105	877	20
Cranford, south of Westminster	974	958	-16	1,094	136	1,036	78	952	-6
Cranford, south of Berwick	875	870	-5	890	20	890	20	875	5
Cranford, south of Edgeware	820	825	5	832	6	835	9	830	4
	HOV	HOV	Dif to Base	HOV	Dif to RHL	HOV	Dif to RHL	HOV	Dif to RHL
Mway, south of Tram	538	547	9	538	-8	558	12	557	10
NART, south of Mway	261	249	-12	240	-9	257	8	261	12
NART, south of Belfast	283	273	-10	263	-10	282	9	282	9
NART, south of QEII off-ramp	175	171	-3	163	-8	177	5	170	-2
NART, south fo QEII on-ramp	191	185	-6	177	-8	190	5	184	-1
Cranford, south of roundabout	255	246	-9	243	-3	254	8	245	-1
Cranford, north of Innes	207	200	-7	226	26	230	30	227	27
Cranford, south of Innes	139	135	-4	164	29	155	20	154	19
Cranford, north of Westminster	159	151	-8	178	27	166	15	170	20
Cranford, south of Westminster	176	169	-7	190	21	176	7	179	9
Cranford, south of Berwick	159	156	-3	156	0	154	-2	154	-2
Cranford, south of Edgeware	149	148	0	144	-5	145	-3	143	-5

Table 11: 2023 HOV Vehicle % AM Peak Hour Southbound Through Corridor Sections

% HOV Vehicles	Base + Bus Lane	NART HOV RHL	Cranford Clearway	Cranford HOV sth of Innes	Xtd HOV LHL
	% HOV	% HOV	% HOV	% HOV	% HOV
Mway, south of Tram	14.1%	14.2%	14.0%	14.5%	14.4%
NART, south of Mway	14.9%	14.5%	14.1%	15.0%	14.8%
NART, south of Belfast	14.6%	14.6%	14.0%	15.0%	14.7%
NART, south of QEII off-ramp	15.0%	14.6%	13.8%	14.9%	19.2%
NART, south fo QEII on-ramp	15.1%	14.6%	13.8%	14.8%	19.3%
Cranford, south of roundabout	15.4%	14.9%	14.5%	15.1%	19.0%
Cranford, north of Innes	15.4%	14.8%	14.7%	15.1%	21.4%
Cranford, south of Innes	15.3%	14.8%	14.8%	14.8%	20.7%
Cranford, north of Westminster	15.3%	15.0%	14.8%	14.7%	16.3%
Cranford, south of Westminster	15.3%	15.0%	14.8%	14.5%	15.8%
Cranford, south of Berwick	15.4%	15.2%	14.9%	14.8%	14.9%
Cranford, south of Edgeware	15.3%	15.2%	14.7%	14.8%	14.7%

The tables above show that the both the Clearway and HOV lane south of Innes attract SOV and HOV traffic to Cranford St, i.e. in both these scenarios the Cranford Street corridor capacity is increased, vehicle travel times are benefited, and traffic volumes increase on Cranford Street.

In contrast, in the extended T2 (HOV) left-lane scenario SOV volumes decrease on the on the NART south of QEII Drive through to Westminster Street. This is due to the increase in SOV delay from QEII Drive interchange southwards, this rerouteing effect is examined further in the following section.

The decrease in SOV volumes and corresponding mild increase in HOV volumes can be seen in the percentage split table, north of Innes Road in the extended HOV left-lane scenario the proportion of HOV vehicles on the corridor becomes greater (over 20%) as the SOV vehicles have rerouted away from this area.

Table 12: 2028 HOV and SOV AM Peak Hour Vehicle Southbound Counts through Core Corridor

Peak Hour Volumes	Base + Bus Lane	NART HOV RHL		Cranford Clearway		Cranford HOV (sth of Innes)		Xtd HOV LHL	
	SOV	SOV	Dif to Base	SOV	Dif to RHL	SOV	Dif to RHL	SOV	Dif to RHL
Mway, south of Tram	3,476	3,523	47	3,533	10	3,527	4	3,540	17
NART, south of Mway	1,611	1,573	-38	1,591	18	1,582	9	1,616	43
NART, south of Belfast	1,805	1,754	-51	1,777	23	1,773	19	1,800	46
NART, south of QEII off-ramp	976	976	0	1,133	157	1,140	164	603	-373
NART, south fo QEII on-ramp	1,066	1,060	-6	1,224	163	1,242	182	642	-418
Cranford, south of roundabout	1,407	1,396	-11	1,600	204	1,625	229	947	-449
Cranford, north of Innes	1,115	1,119	4	1,355	235	1,338	219	811	-308
Cranford, south of Innes	743	748	6	956	207	882	134	598	-150
Cranford, north of Westminster	867	851	-16	1,127	276	1,015	164	912	60
Cranford, south of Westminster	991	974	-17	1,201	227	1,118	144	989	15
Cranford, south of Berwick	922	921	-1	1,002	81	988	67	938	16
Cranford, south of Edgeware	854	871	17	884	13	889	18	856	-15
	HOV	HOV	Dif to Base	HOV	Dif to RHL	HOV	Dif to RHL	HOV	Dif to RHL
Mway, south of Tram	569	577	8	571	-6	578	1	576	-1
NART, south of Mway	276	267	-9	271	4	271	4	276	10
NART, south of Belfast	308	296	-12	299	3	298	2	309	13
NART, south of QEII off-ramp	172	165	-8	191	26	192	28	195	30
NART, south fo QEII on-ramp	187	179	-8	207	28	211	31	215	36
Cranford, south of roundabout	254	247	-7	281	33	281	34	284	37
Cranford, north of Innes	201	204	2	239	35	232	29	269	66
Cranford, south of Innes	137	135	-2	167	33	152	17	185	50
Cranford, north of Westminster	158	151	-7	201	50	175	24	200	50
Cranford, south of Westminster	181	172	-9	214	42	191	18	207	35
Cranford, south of Berwick	172	164	-7	180	16	171	7	173	9
Cranford, south of Edgeware	157	152	-4	157	5	156	4	150	-3

Table 13: 2028 HOV Vehicle % AM Peak Hour Southbound Through Corridor Sections

% HOV Vehicles	Base + Bus Lane	NART HOV RHL	Cranford Clearway	Cranford HOV sth of Innes	Xtd HOV LHL
	% HOV	% HOV	% HOV	% HOV	% HOV
Mway, south of Tram	14.1%	14.1%	13.9%	14.1%	14.0%
NART, south of Mway	14.6%	14.5%	14.5%	14.6%	14.6%
NART, south of Belfast	14.6%	14.4%	14.4%	14.4%	14.6%
NART, south of QEII off-ramp	15.0%	14.4%	14.4%	14.4%	24.4%
NART, south fo QEII on-ramp	14.9%	14.4%	14.5%	14.5%	25.1%
Cranford, south of roundabout	15.3%	15.0%	14.9%	14.7%	23.1%
Cranford, north of Innes	15.3%	15.4%	15.0%	14.8%	24.9%
Cranford, south of Innes	15.6%	15.2%	14.9%	14.7%	23.6%
Cranford, north of Westminster	15.4%	15.0%	15.1%	14.7%	18.0%
Cranford, south of Westminster	15.4%	15.0%	15.1%	14.6%	17.3%
Cranford, south of Berwick	15.7%	15.1%	15.2%	14.8%	15.6%
Cranford, south of Edgeware	15.5%	14.9%	15.1%	15.0%	14.9%

The 2028 tables above show the same effects as the 2023 scenarios, but at greater magnitude. More traffic is attracted to Cranford Street in the Clearway and HOV South of Innes scenarios and more traffic routes away from Cranford Street south of QEII in the extended HOV lane scenario.

4.3 Flow Difference Plots

The figures below show the peak hour 2028 flow difference plots between the current HOV lane arrangement on the NART (enforced), and the three significant alternative scenarios – Cranford Street Clearway, Cranford Street left-lane T2 (HOV) south of Innes Road, and the Extended Left-Lane T2 (HOV) lane.

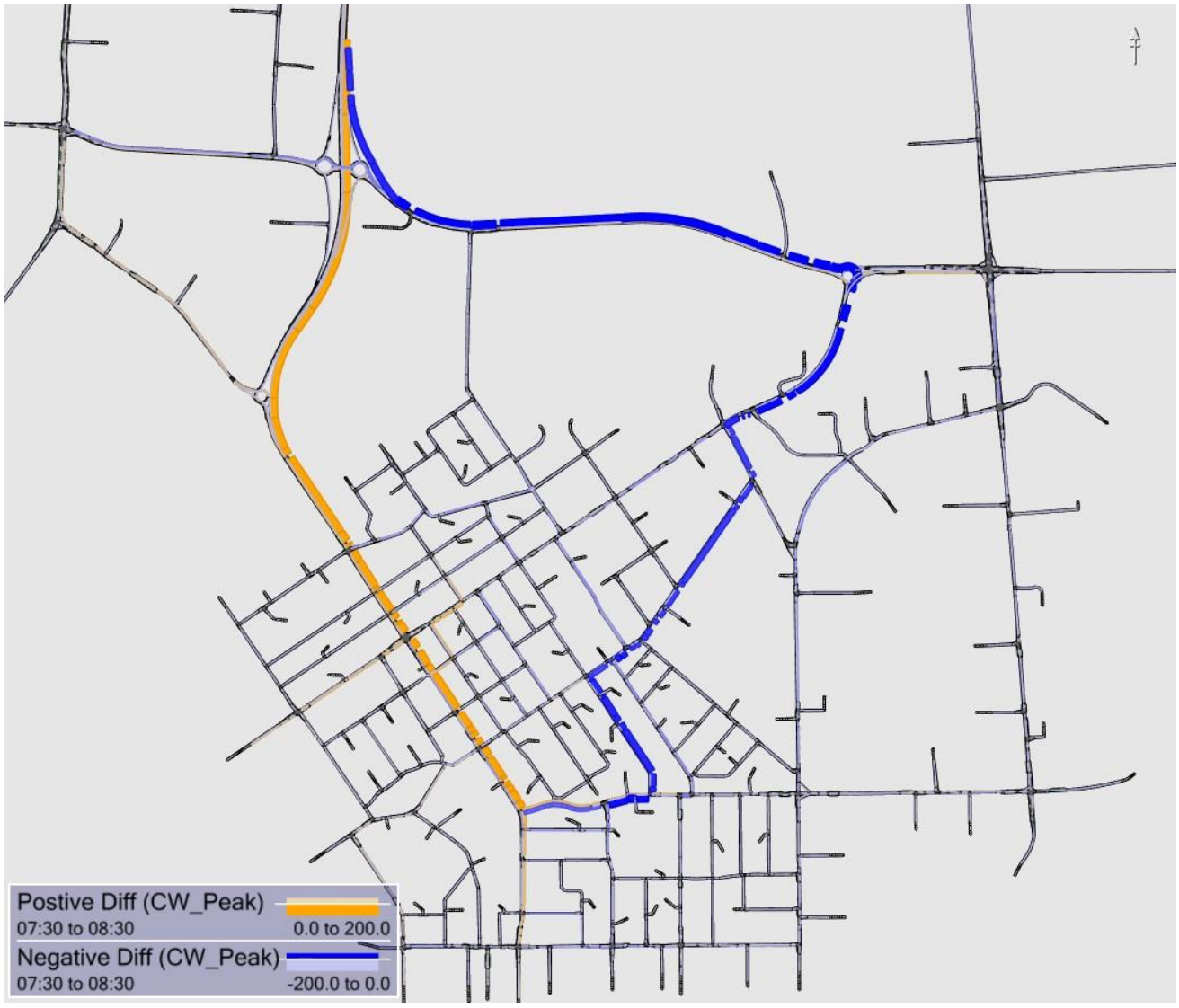

Figure 7: Pk Hr Flow Difference Plot, Cranford Street Clearway vs. NART HOV Reference 2028

The figure above shows that compared to the reference scenario with the NART HOV lane enforced and no split-phase signal operation at the Cranford Street / Innes Intersection, the Cranford Street Clearway option is predicted to reduce rerouting via QEII Drive, through Westminster Street and Francis Ave – reducing traffic volumes on these routes. More traffic is anticipated to remain on the Cranford Street corridor. The reduction estimated on Francis Street in 2028 is around 160vph.

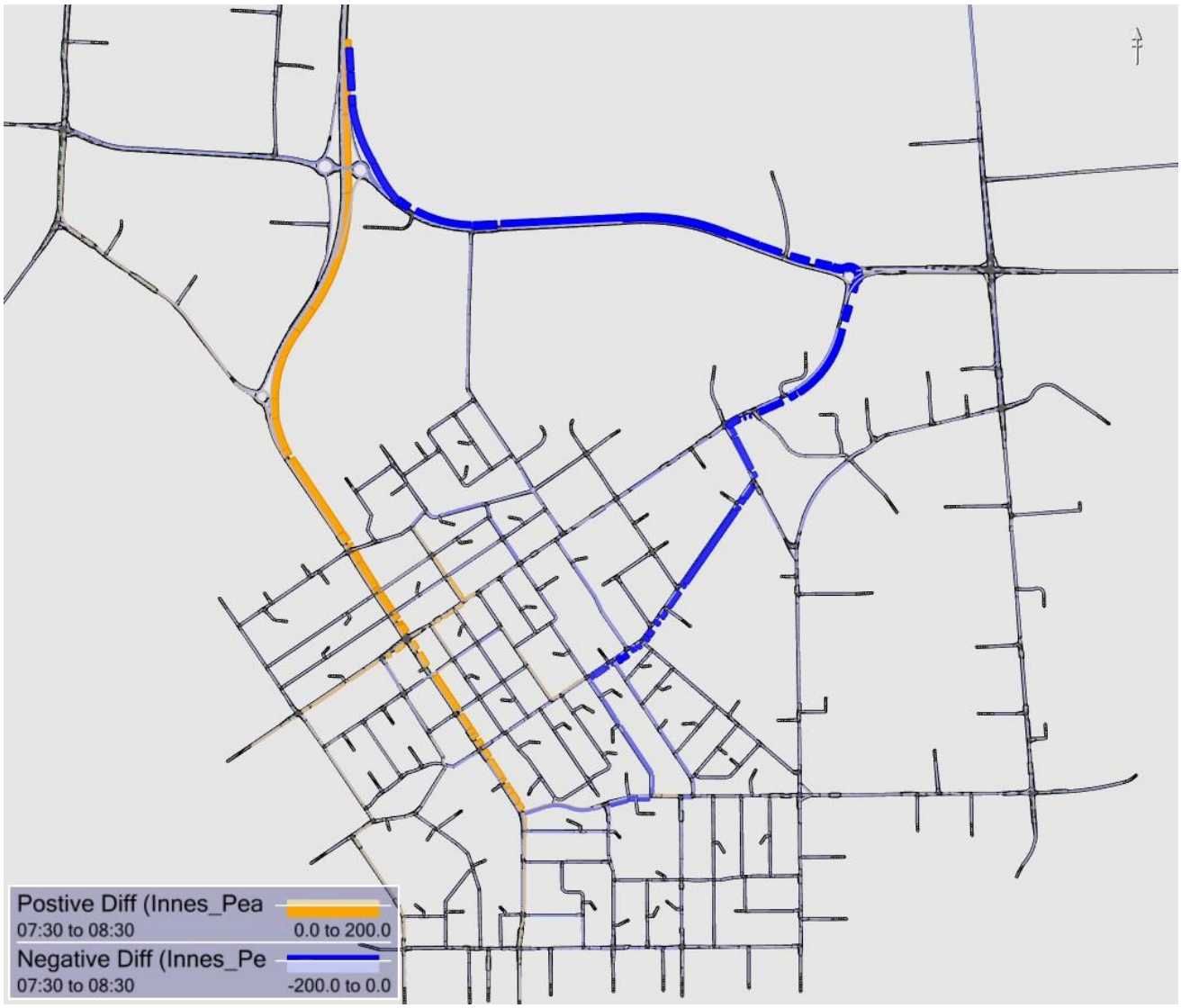

Figure 8: Pk Hr Flow Difference Plot, Cranford Street Left-Lane South of Innes Road HOV vs. NART HOV Ref 2028

In the HOV left-lane on Cranford Street scenario, the reduced rerouting effect is similar to the Cranford Street Clearway option. This is because both options feature the Cranford / Innes signal split phasing and the left-lane HOV option takes 15% out of the 2-to-1 merge south of Innes Road and through the 1-lane at the Westminster / Cranford signals – i.e. the T2 lane is providing some degree of additional capacity to corridor.

This reductions on the alternative routes and local roads are significant as the Clearway option, the reduced volume southbound on Francis Street is around 75vph in the T2 South of Innes Scenario compared with around 160vph in the Clearway scenario.

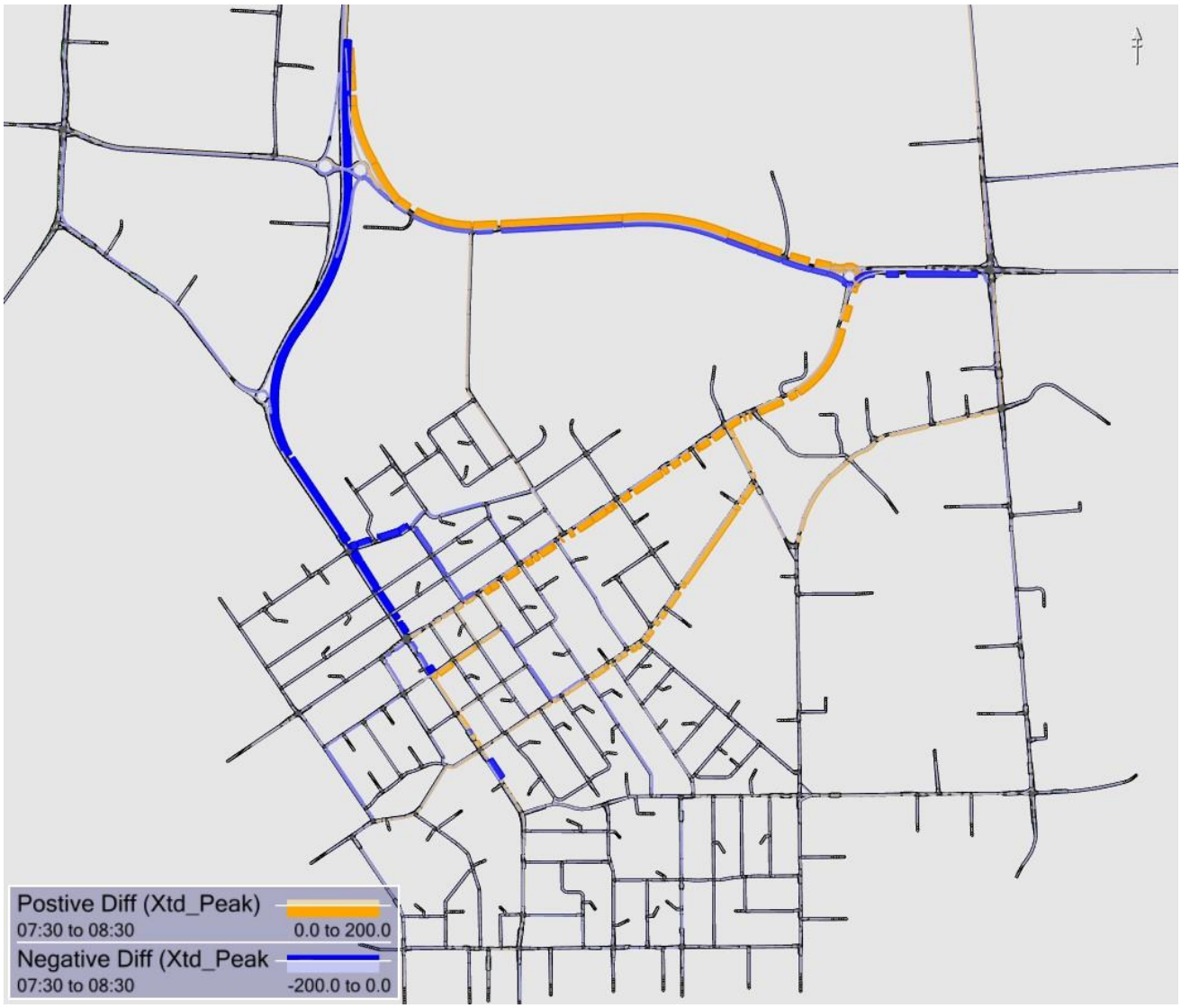

Figure 9: Pk Hr Flow Difference Plot, Cranford Street Extended Left-Lane HOV vs. NART HOV Reference 2028

The figure above shows the opposite effect to Clearway and T2 South of Innes scenarios. Traffic is predicted to increase along the alternative route via QEII Drive, Innes Road, and Westminster Street – rejoining Cranford Street at various locations south of Innes Road. Some increased traffic volumes are anticipated on local roads in the DEMP area in this scenario, at most this is estimated to be 125-to-150vph on local roads.

As described in the travel time analysis above, in this scenario the SOV delays increase on the southern end of the NART and along Cranford Street (from SOV congestion on the north approach to the Innes Road / Cranford Street signals). Although the figures above show flow differences for all vehicle types (SOVs and HOVs combined), HOV delays in this scenario are significantly less than SOVs - therefore the rerouted traffic is almost entirely SOV vehicles.

5. Summary of Key Outcomes

5.1 CNC, Cranford Street, and DEMP

Waka Kotahi, Christchurch City Council (CCC), and the Community all have interests in solutions and treatments relating to the key transport corridor from north of the Waimakariri River through to the southern end of Cranford Street towards central Christchurch.

Key features in this study area include a High Occupancy Vehicle (HOV) T2 lane on the Christchurch Northern Corridor (CNC) motorway, which is not currently enforced, the Cranford Street arterial route at the southern end of the Northern Arterial (NART) motorway, and the area and neighbourhood surrounding Cranford Street.

Important elements which are being considered moving forward include the extent of the HOV lane southwards, the lane arrangements on Cranford Street south of Innes Road, the priorities and efficiencies for certain forms of transport, community accessibility, and impacts / outcomes on safety. Options which consider these individual aspects will interact and affect other aspects and outcomes throughout the wider study area.

5.2 Operational Transport Modelling

Stantec has developed and applied an operational microsimulation model covering the CNC Corridor, Cranford Street, and the detailed transport network in the DEMP area. The model has been calibrated and validated against observed data, with some emphasis in this phase of work on 2023 data and the robustness of the model in the Cranford Street and DEMP areas.

This form of operational modelling is particularly effective at examining the interactions, affects, and outcomes from the overlapping and interrelating elements described above. There is some complexity to the study area, the CNC, Cranford, DEMP Operational model is ideally suited to examining and understanding the scenarios, and the elements in each scenario and how they interact.

5.3 Option Assessment

Several phases of analysis and assessment have been carried out using the operational model to examine the outcomes and performance of a number of options through the study area. CCC has requested that detailed analysis be carried out on five scenarios as outlined below;

1. **Reference Scenario with Bus Lane**: Existing situation without HOV enforcement

2. **Reference Scenario with Bus Lane and Current HOV enforced:** As per 1, with the current HOV lane arrangement on the CNC enforced.

3. **Cranford Street Clearway** (CW)**:** As per 2, but with a clearway (two traffic lanes during peak times) on Cranford Street south of Innes Road through to south of Berwick Street.

4. **Cranford Street HOV left-Lane south of Innes:** As per 2, but with a HOV lane in the left-lane on Cranford Street south of Innes Road through to south of Berwick Street.

5. **Extended HOV Left Hand Lane (LHL):** This has the HOV lane in the left lane running from Tram Road through the NART onto Cranford Street through to south of Berwick Street.

The detailed option analysis presented in this report has considered the high-level travel time and distance outcomes, section-by-section performance and section-by-section peak travel times, and flow difference plots for key scenarios.

5.4 Key Outcomes from Detailed Analysis

Bus travel times are not significantly effected by any of the options across the fuller length of bus journeys from Tram Road to the south. The key outcomes from the detailed analysis are summarised for the three key option scenarios below.

Enforcing Existing Right-Lane HOV Lane on Northern Arterial

Key points relating to this option identified in this analysis include;

- Enforcing the current HOV lane arrangement around the Tram Road area reduces travel times in this area for both HOVs and SOVs, although HOV travel time reliability is better than SOV.
- The existing HOV arrangement produces an average (full time period) travel time saving of around 1-to-3 minutes compared to SOV travel times.
- These savings occur around Tram Road and along the NART, at peak times they reach around 5-minutes in the 2028 short-term forecast.

Cranford Street Clearway

Key points relating to this option identified in this analysis include;

- SOV travel times in this scenario are reduced by around 1-to-2 minutes compared to the reference scenario across the full morning period.
- This option reduces the HOV benefits because SOV travel times reduce and the margin (difference) between HOV and SOV times becomes smaller.
- Additional traffic is attracted to Cranford Street and rerouting and local road traffic in the DEMP area is predicted to reduce in this scenario.
- Potentially because of the increased traffic on Cranford Street, the travel time savings along the corridor in this scenario are not significant over the full Waimak to DEMP area trips, around 1-to-2 minutes.

Left-Lane T2 (HOV) Lane on Cranford Street, South of Innes Road

Key points relating to this option identified in this analysis include;

- Broadly this option performs similarly to the Clearway. It reduces rerouting and local road traffic (although by a smaller amount than the Clearway) and benefits both SOV and HOV travel times.
- This option provides more of a distinct HOV travel time benefit compared to SOVs. Although the average benefits are similar to the HOV NART only scenario (1-to-3 minutes) the benefits are more consistent / reliable and the average travel time benefit is 15-30% greater than with the HOV lane enforced on the NART only.
- There are distinct peak HOV travel time benefits on both the Tram / NART sections of HOV lane, and the section of HOV lane south of Innes Road.

Extended Left-Lane T2 (HOV) Lane, Tram Road to Berwick Street

Key points relating to this option identified in this analysis include;

- This option provides the most significant HOV vs. SOV travel time saving. On average across the full peak period the benefits are 2-to-5 minutes and during the peak times, in the section from the southern end of the NART through to Berwick Street the benefits are 10-to-15 minutes.
- A reasonably large proportion of the HOV benefit noted above is due to increased SOV delay/congestion. SOV travel times increase on average by around 5 minutes on average and during peak times by around 8-to-10 minutes.
- This increase in SOV delay / congestion occurs largely on the north approach the Innes Road / Cranford Street signals and leads to SOV vehicles rerouting to avoid this delay.

- Travel times are predicted to increase on parallel and connecting routes, although this is only apparent during peak times and the increase is not significant, only by around 1-to-2 minutes.
- SOV volumes are predicated to increase on some routes through the local road area due to the increased delay and congestion along Cranford Street from QEII Drive to Innes Road.

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