Appendix K Traffic Modelling Report

Ashburton-Tinwald Connectivity Indicative Business Case

Transport Modelling Report

PREPARED FOR ASHBURTON DISTRICT COUNCIL | 23 SEPTEMBER 2021

We design with community in mind

Stantec

Quality Statement

All quality requirements including internal check and review processes have been completed in accordance with appropriate Stantec policies and systems.

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1.0 INTRODUCTION

1.1 ASHBURTON TINWALD CONNECTIVITY IBC

The Ashburton-Tinwald Connectivity Indicative Business Case (IBC) is focused on the potential investment case around improving connectivity across the Hakatere (Ashburton) River. The river is crossed by SH1 which runs north / south through the township. Ashburton town lies on the north side of the bridge and Tinwald, which has a mix of land uses including a larger residential component, is south of the river.

A business case is currently being progressed to establish a preferred option (or programme) to address significant connectivity, travel choice, safety, and efficiency issues. This report provides additional detail and analyses relating to the observed data and traffic modelling which has been used to provide key inputs to the IBC. The traffic modelling has used to inform a recommendation for a future second bridge alignment.

1.2 TRANSPORT MODELLING AND DATA ANALYSIS

There are several components to the transport modelling and data analysis aspects which support the IBC. These include:

- **Observed traffic count data**. Three sources – (1) Waka Kotahi TMS link counts on State Highway 1 (SH1); (2) ADC tube link counts; and (3) comprehensive intersection turning movement surveys across the network.
- **Observed travel time data**. Two sources – Google travel time and TomTom.
- **Observed travel pattern data.** Number plate surveys at the southern and northern ends of the town, plus the SH1 bridge.
- **Regional transport modelling**. A TRACKS 3-step model, capable of forecasting traffic growth from provided land-use inputs.
- **Microsimulation modelling**. A Paramics Discovery network model, linked to the TRACKS model, focused on predicting the performance of the traffic network.

The observed data and modelling system developed and described in this report is a robust basis for the elements which have supported the IBC. Additionally, having this transport modelling system in place with this foundation will enable and support future assessment work in Ashburton. For example, future business case stages, economic analyses, intersection upgrade assessments etc.

1.3 KEY OBJECTIVES OF MODELLING AND ANALYSIS

The key purposes of the transport modelling and observed data analyses are as follows:

1. From the observed data **establish key benchmark statistics**, particularly on SH1 in the urban area (50kph zone) through Ashburton. Notably, traffic volumes and northbound / southbound travel times and delays.
2. From the regional transport model (TRACKS) and the observed number plate survey, **establish the existing vehicle travel patterns** through the study area.
3. From the microsimulation model (Paramics) **analyse and assess the performance** of study area movements, key corridors, and key intersections.
4. From provided regional future year land use inputs and external traffic growth trends, using the regional model **establish the traffic growth between 2021 and 2031 and 2041**.
5. From the microsimulation modelling, **assess key performance thresholds** in the Do Minimum scenario (the existing network plus committed upgrades) to determine when the operation of the network reaches a point when a significant traffic upgrade (increase river crossing capacity for vehicle traffic) may be required.
6. From the microsimulation modelling, **assess the relative performance of alternative network options** (alternative new bridge scenarios).

1.4 TYPICAL WEEKDAY ASSESSMENT

The observed data and traffic modelling is based on conditions representing typical weekdays, Monday / Tuesday / Wednesday / Thursday for June / July 2021.

It has been established that Fridays are distinctly different to Monday-to-Thursday's weekdays in Ashburton. On Friday's there is evidence of consistently higher traffic flows and delays through the day, and particularly higher travel times and increased congestion northbound in the afternoon / evening.

Additionally, there are more 'extreme' days, often around long weekend holidays, where volumes and delays can be much more significant and traffic queues on SH1 extend over a long distance.

The traffic modelling and analysis could be extended to examine the performance and outcomes on days where volumes / delays are markedly different (higher) than typical weekdays should this be desired in the future. For example, it is likely to be advisable to consider this aspect in a robust and comprehensive economic assessment.

1.5 DETAIL IN THIS REPORT

This report broadly covers the following key areas:

- The observed data used to support the assessment.
- The data used in the development, calibration, and validation of the transport models.
- The development of the TRACKS regional transport model.
- The development and calibration / validation of the Microsimulation traffic model.
- The inputs / assumptions to the forecasting and calculation of the study area future year transport demands.
- The Do Minimum network assumptions and detailed outputs around the threshold assessment.
- Detailed modelling outputs which provide further detail to the alternative bridge alignment assessments.

2.0 TRANSPORT MODELLING OVERVIEW

2.1 BROAD MODELLING METHODOLOGY

The broad transport modelling approach is to develop two tiers of models which are linked together.

The higher tier, regional TRACKS model, has land use (households, population, employment, external traffic volumes) as input and produces base and future year travel demands from the land use data and trip making principles. The regional model is not fully calibrated / validated but has been broadly checked against the magnitude of current traffic volumes and reproduces the known surveyed origin-destination movements. It is considered as being fit-for-purpose for this project.

Beneath the regional model, a microsimulation model has been developed which focuses on providing key measurements; namely - volumes, travel times, delays, and queues. The regional TRACKS model feeds the microsimulation model, providing base year travel pattern data and future year demand growth. The microsimulation model has been calibrated and validated to observed traffic data in the study area.

2.2 STUDY AREA

The study area is effectively the Ashburton township area, from Fairfield Road / SH1 in the north to Maronan Road / SH1 in the south, and SH77 / Racecourse Road in the west. The area is shown broadly in Figure 2-1.

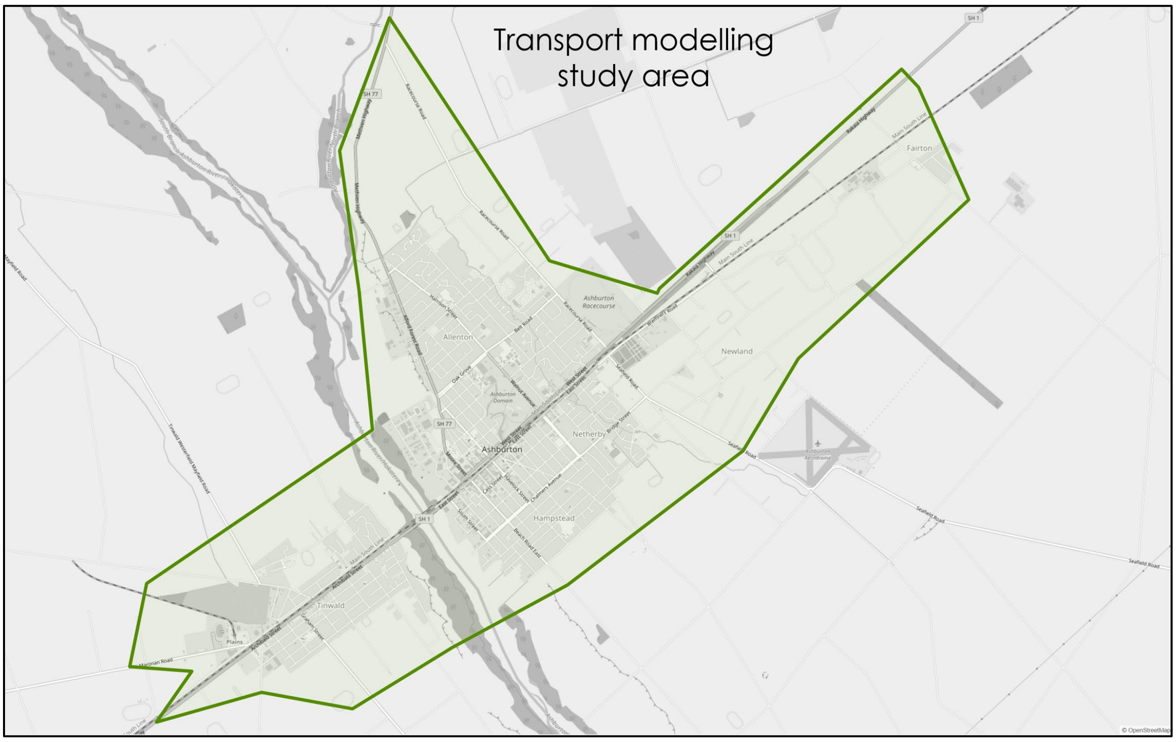


Figure 2-1: Transport Modelling Study Area

2.3 MODELLED TIME PERIODS

As described in Section 1.4, the observed data and basis of the traffic modelling is typical Monday-to-Thursday weekdays. The models and assessment cover the following time periods:

- **AM:** 07:00 – 09:30
- **Inter-peak:** 11:00 – 13:00
- **PM:** 14:30 – 18:00

2.4 TRANSPORT MODELLING SOFTWARE

Both the regional and microsimulation models have been developed in software that has historically been used widely in New Zealand. The software and versions used are as follows:

- Regional transport model: TRACKS, version V7.0
- Microsimulation traffic model: Paramics Discovery, version 24.0.4

3.0 TRANSPORT DATA

3.1 OVERVIEW OF DATA

3.1.1 June / July 2021 Data and School Holidays

There was limited time available to carry out the IBC work and transport modelling assessment. As such, the survey exercise had to be bought forward to meet project timeframes. Weekday data was collected in the week before the July School holidays. The counts were compared with historical TMS trends, this determined that the AM and inter-peak data was similar to typical average weekday flows and the PM data was slightly higher than typical. The survey data was deemed appropriate on this basis.

3.1.2 Town Centre Roadworks

During the traffic survey exercise, roadworks were present on several links within the town centre area. Sections of Burnett Street and Havelock Street were closed. The data was collected with these closures and the associated slow speed limits from the traffic management in place.

The microsimulation base model was calibrated / validated with these closures and slow speeds in place, and they were removed in the Do Minimum scenario.

3.2 TRAFFIC COUNT DATASET

3.2.1 ADC link counts

ADC provided metro count link-count files for link-counts carried out within the last five years. Older counts were discounted and link-counts on routes affected by the city centre roadworks (i.e., carrying higher or lower traffic volumes than typical) were discarded. The result was 43 classified, directional, counts which were processed to produced 15-minute average weekday volumes.

3.2.2 Waka Kotahi TMS link counts

The Waka Kotahi Traffic Management System (TMS) provides link-count data throughout the State Highway system. Sites and data is available for both SH1 and SH77 within the study area.

Due to the Town Centre roadworks, only TMS data south of the Ashburton River and north of the northern East Street / SH1 intersection could be used in the development of the transport models.

3.2.3 July 2021 Intersection Counts

The core traffic count dataset is a series of 22 intersection counts collected on Thursday 8th July 2021, the locations are shown in Figure 3-1.

The data was collected for the following vehicle classifications in 15-minute intervals over the AM, IP, and PM modelled time periods:

- **Light Vehicles:** Cars, 4wds, Vans
- **Medium Weight Goods Vehicles (MGVs):** Rigid Trucks
- **Heavy Weight Goods Vehicles (HGVs):** Semi-Trailers, B-Trains

Figure 3-1: Intersection Turning Movement Survey Locations

3.3 TRAVEL TIME DATA

3.3.1 Google Travel Time Extraction

Stantec has the capability to put a 'watch' on Google's traffic conditions data. This writes Google's estimated travel times between points to an output file. The routes and sections that were 'watched' over a period of several weeks before and after the July 2021 school holidays are shown in the figure below.

Figure 3-2: Google Travel Time Monitoring Routes

3.3.2 TomTom Data Check

Due to the importance of understanding and establishing the current network performance and travel times, a check has been carried out on the Google Travel Time using TomTom travel time data on SH1. This check confirms that the TomTom and Google Travel Times are well aligned (Appendix A2).

Additionally, the TomTom data enables more detailed time / distance analysis to be completed as it provides outputs in shorter distance segments. This analysis is shown in Appendix A1, and key aspects are described in the section below.

3.4 KEY OBSERVATIONS FROM OBSERVED TRAVEL TIME DATA

Time / distance graphs are provided for Monday-to-Thursdays and separately for Fridays for SH1 northbound and southbound through Ashburton in **Appendix B**. The slope of these graphs indicates delay / congestion; a more steeply sloping line indicates slower speeds and delay.

There are a number of important outcomes demonstrated by this observed travel time data:

- Delays on typical Monday / Tuesday / Wednesday / Thursdays remain relatively low.
- Delays in the morning and inter-peak are low across all days.
- Delays southbound across all time periods and all weekdays, including Fridays, are low.
- Northbound during the afternoon (03:00pm to 4:00pm) and evening (4:30pm to 5:30pm) on Monday / Tuesday / Wednesday / Thursdays are around 2-to-3min from north of the Bridge through past Walnut Ave.
- Northbound on a Friday, the above afternoon and evening delays are more significant. Delays increase to 6-to-8 minutes.

3.5 ORIGIN-DESTINATION SURVEY

3.5.1 Overview

A number plate survey was carried out on the same day as the weekday turning movement survey via camera / video. The locations of the survey sites are shown Figure 3-3.

- North of the town.
- At bridge, immediately south of the SH1 Hakatere (Ashburton) River bridge.
- South of the town.

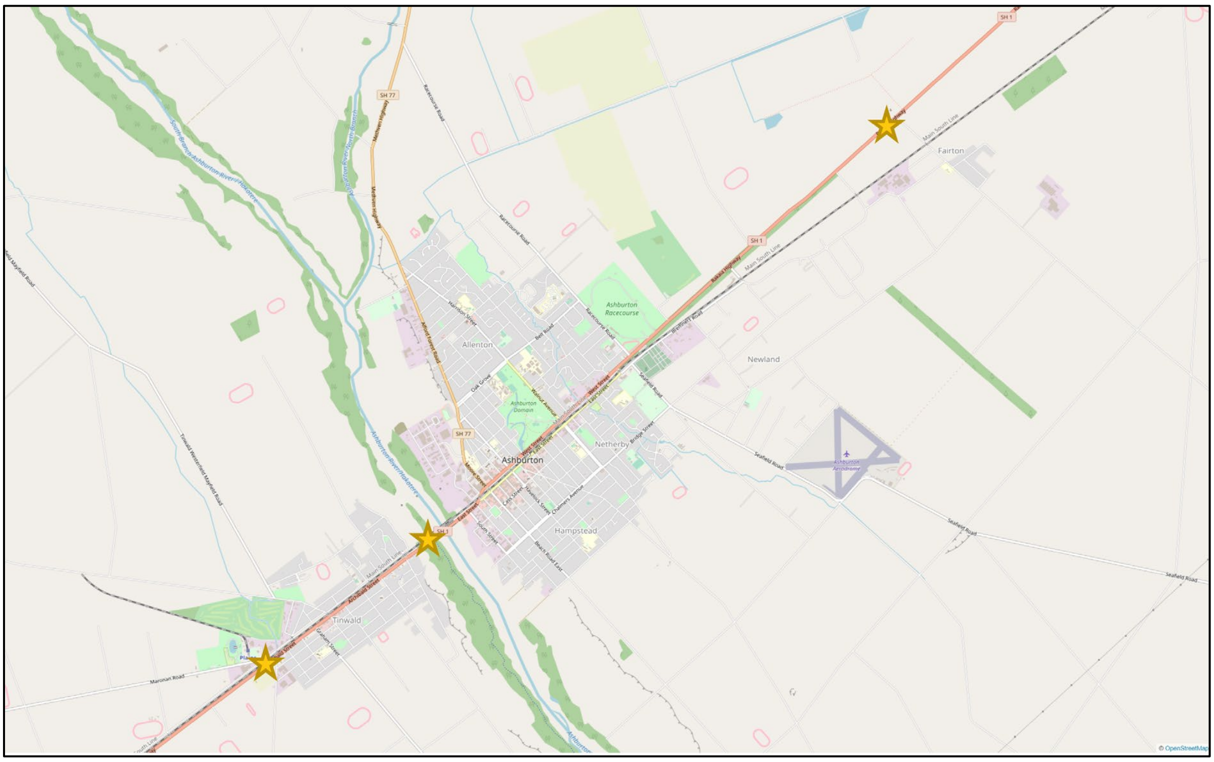


Figure 3-3: OD Survey Locations

3.5.2 Data Provided and Data Issues

Data was provided in 30-minute intervals along with the proportion of matches and the match rates between sites. There were some issues with the OD data matching, the key problems being:

- There were matching issues (low match rates) in both directions in the early part of the AM peak (07:00 to 07:30 and 07:30 to 08:00). However, in the middle two AM periods the data was reasonably robust for key movements (08:00 to 09:00).
- Similar to the above, there were matching issues in the last two PM half hour periods (17:00 to 18:00).
- The data from the southern external to the north is weaker, particularly on the northbound bridge camera (the middle location).
- The data from the northern external shows robust match rates through most of the time periods at all three sites, except for the first / last AM and PM times.

The match rates are shown in Table 3-1. The * indicates which time-slices have been used to estimate proportions on key movements for each of the three time periods.

Table 3-1: OD Data Survey Match Rates, Light Vehicles

Light Vehicles	From Southern External			From Northern External			
	South Nbd	Bridge Nbd	North Nbd	North Sbd	Bridge Sbd	South Sbd	Include
07:00	3%	23%	0%	38%	35%	45%	
07:30	42%	26%	2%	64%	41%	65%	
08:00	100%	51%	43%	89%	84%	83%	*
08:30	96%	20%	95%	80%	87%	93%	*
09:00	96%	0%	100%	96%	78%	75%	
11:00	100%	39%	100%	68%	72%	96%	
11:30	100%	63%	100%	82%	75%	89%	*
12:00	97%	64%	100%	71%	78%	83%	*
12:30	99%	47%	100%	76%	70%	88%	
14:30	90%	75%	93%	60%	75%	77%	*
15:00	94%	70%	92%	76%	63%	71%	*
15:30	92%	66%	89%	78%	73%	83%	*
16:00	91%	70%	70%	60%	69%	79%	*
16:30	94%	57%	34%	83%	67%	81%	
17:00	34%	73%	17%	67%	68%	87%	
17:30	6%	50%	0%	39%	57%	28%	

3.5.3 Key OD Survey Outcomes

Key outcomes form the light vehicle travel patterns from the OD survey are provided in Table 3-2. The red text indicates movements where the matching is weaker, and there is less certainty on the estimated proportion.

Table 3-2: Light Vehicle Travel Patterns from OD Survey

Light Vehicle Travel Patterns		To North	To Central	To Tinwald	To South
AM Period	From North	0%	50%	15%	35%
	From South	57%	19%	19%	0%
Inter-Peak	From North	0%	45%	22%	33%
	From South	54%	25%	21%	0%
PM Period	From North	0%	68%	6%	26%
	From South	42%	25%	33%	0%

At a high level, the key outcomes are:

- From the north, 45 to 70% of traffic is heading into the city centre. In the PM peak, this proportion is highest.
- From the south, the proportion appears lower with roughly 25% to 35% of traffic heading to the city centre and a higher proportion travelling through to the north (40-60%). It is noted that the matching is weaker in the south and this outcome is more uncertain.

4.0 REGIONAL MODEL DEVELOPMENT

4.1 BACKGROUND

To provide the detailed Microsimulation project model with initial trip matrices and forecast group for the three modelled periods, a skeletal TRACKS regional model was developed. This model generated zonal trips to and from each area within the project area based on the provided land use, distributed those trips according to a conventional gravity-type process, assigned the resulting trips onto the skeletal road network and finally iterated the process until the distribution of trips settles into a consistent pattern.

4.2 2021 LAND USE

The 2021 base model splits the Ashburton/Tinwald area into 86 internal zones based on the 2018 Census SA1 areas and which directly relate to the 10 Ashburton Profile.id. projection areas. It also includes three external zones representing the three main SH1 and SH77 external roads.

2018 Census land use was used as the basis for creating the 2021 land use. Occupied private dwellings, usually resident population, available vehicles per household and all employment types grouped into agriculture, retail, office, manufacturing, community, and school were used as inputs into the model.

Agreed council household and employment projections were used to expand the 2018 census data up to those representing the base 2021 situation. In total, the 2021 model represents approximately 10,000 households, 24,800 persons, 18,800 private vehicles, 9,800 jobs and 4,000 school roll.

4.3 TRIP GENERATION

As no home interview survey has been undertaken in the Ashburton area, the trip generation structure and parameters for the generation process was taken directly from a similar existing validated model. The Upper Hutt model was chosen as it was of similar size, had a substantial state highway passing through the area, attracted internal trips to external locations and included all of the trip purpose types that would be useful in this model.

The private trip purposes used in the model are home based work, home based education, home based shopping, serve passenger, home based other and non-home based. Additional non-private trip purposes for light and heavy goods vehicles and external trips were also used. A major advantage of using this trip generation form is that it included all of the private purposes in all three model periods thereby allowing for the production of additional trips in the interpeak period representing the local levels of activity such as going to/from home for lunch. This did however involve factoring the interpeak home based work trips by 1.2.

4.4 TRIP DISTRIBUTION

Again, as no home interview survey-based distribution data existed for the Ashburton area, the trip distribution structure and parameters for Upper Hutt were used for this model as per the reasons highlighted in the section above. A standard gravity model was used with reasonably flat parameters allowing all trip purposes to distribute evenly throughout the model. External traffic volumes were given a lower gravity coefficient to allow for trips to travel further through the model.

Through trips for each period were detailed directly from the O-D surveys undertaken for the model and therefore were not included in the distribution process.

4.5 TRIP ASSIGNMENT

To allow the model to produce a realistic distribution of trips, the trip matrices produced by the generation / distribution processes need to be assigned to a road network. The network used in the regional model contains most of the main roads in the area and intersections coded as they exist in 2021. The network included enough roads to ensure that the zonal trips could be loaded appropriately and allowed for appropriate routes to taken so that realistic zone to zone “costs of travel” could be calculated. These costs are important in that they allow the model to determine where trips from each zone should go based on how easy it is to get to each other zone.

4.6 OUTPUTS

Once trips are assigned to the network the outputs of the assignment are feed back into the distribution process so that it can have an updated understanding where it should distribute trips. This feedback loop continues until there is no appreciable change in process from one loop to another.

The resulting light and heavy vehicle matrices are compared to the overall surveyed origin-destination survey results to ensure that the model is replicating them in a reasonable fashion. This process produces a regional model that is not truly fully calibrated / validated model and as such the representation of traffic volumes is less robust than the microsimulation model.

5.0 MICROSIMULATION MODEL DEVELOPMENT

5.1 MODEL CONSTRUCTION AND INPUTS

The Paramics model has been constructed from scaled digital aerial photo tiles downloaded from Linz. Signal timings were also input to the base model as per SCATS history phase times provided by Waka Kotahi.

5.2 MODELLED ROAD HIERARCHY

The road hierarchy has been developed from the posted speed limits and drivers perceived attractiveness of routes through the network. The road hierarchy in Paramics is related to the assignment settings and is refined and adjusted relative to the classified road hierarchy. The figure below shows the road hierarchy and settings.

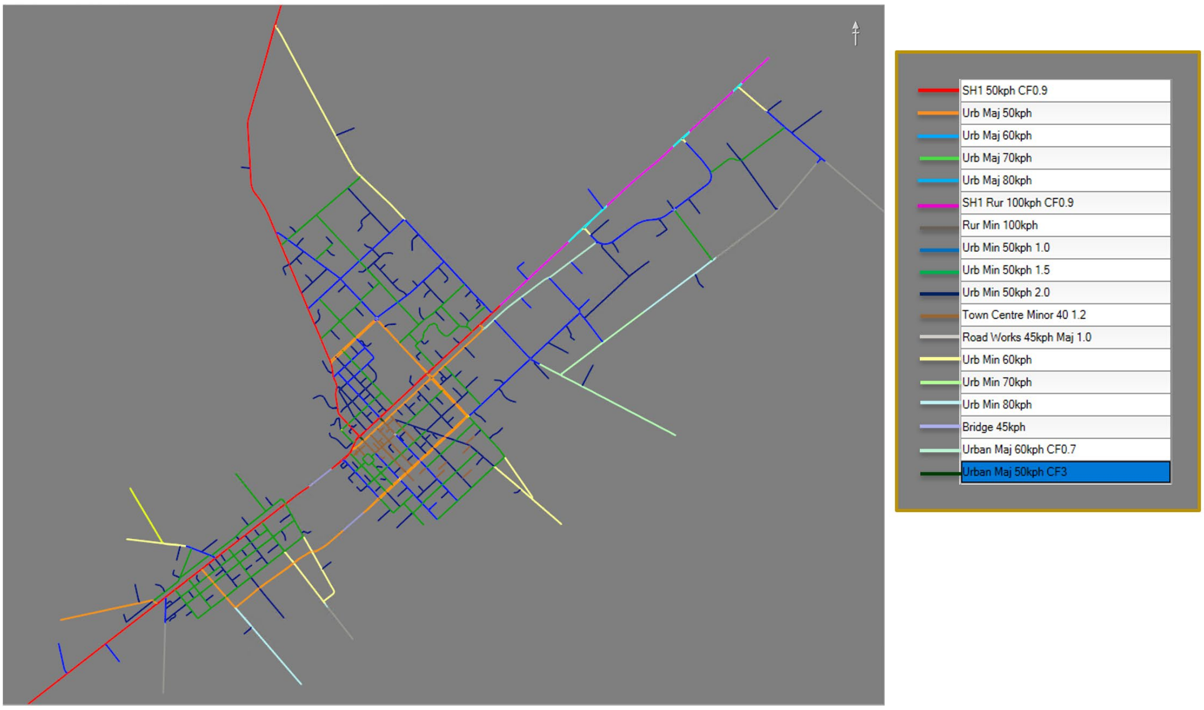


Figure 5-1: Microsimulation Modelled Network and Road Hierarchy

5.3 TARGET SPEED ADJUSTMENT BY LINK CATEGORY

During the comparison between observed and modelled travel times it became apparent that the modelled average speeds were higher than observed in links / locations some distance from intersections where there are no obvious or apparent reasons for vehicle movement to be impeded. A particular location where this was evident is the stretch of SH1 through Tinwald, from south of the Bridge to/from the edge of Ashburton.

Based on this comparison with observed data, the vehicle target speed distribution settings were reduced for each vehicle type using the link category settings.

These speed settings effect a distribution of target speeds for vehicles as they travel through the network. As with reality, vehicles can and still do exceed the posted speed limits and modelled average link speeds can be higher than these settings in locations where vehicles (notably light vehicles) move freely along links. As an example of the magnitude of this adjustment, the SH1 50kph link category speed distributions have been reduced for the modelled vehicle types as follows:

- Light vehicles - 47kph
- Rigid trucks - 43kph
- Articulated trucks - 40kph

5.4 ZONE SYSTEM

The zone system was matched directly with the TRACKS model.

5.5 GLOBAL MODEL SETTINGS AND PARAMETERS

5.5.1 Global Parameters

The UK-based settings (default in Paramics) for the signal inter-green timings have been adjusted to correspond with inter-green timings used in New Zealand and have been set to:

- 0 seconds red-to-green amber time (New Zealand does not have amber before the green); and
- 4 seconds green-to-red amber time (reflecting standard New Zealand signal inter-green).

5.5.2 Route Choice Settings

The following route choice settings have been used for the development of the model:

- Generalised Cost Equation for all Vehicle Types: 1*Time + 0.7*Distance
- Familiarity:
  - Light Vehicles 60%
  - Medium Weight Goods Vehicles 0%
  - Heavy Weight Goods Vehicles 0%
- Perturbation:
  - Light Vehicles 5%
  - Medium Weight Goods Vehicles 0%
  - Heavy Weight Goods Vehicles 0%
- Feedback Interval: 2-minute
- Feedback Factor: 0.45

Familiarity is a behavioural parameter; it reflects the proportion of drivers in a network who are more likely to 'rat-run' through minor routes (residential streets and similar) and who are more likely to respond to delays and reroute as traffic conditions change in the network. For light vehicles, familiarity ranges of 40-60% are typically used and for heavy vehicles 0-30%.

Perturbation is the Paramics stochastic route choice setting. It applies a 'spread' of routes between trip start and end points based on the trip cost. In an assignment network, perturbation values of 5-10% are typically used for light vehicles and 0-5% for heavy vehicles.

It is a little unusual for the medium weight vehicles to have 0% familiarity and 0% perturbation. The reason for this is that it is not anticipated that these vehicles will rat-run and re-route due to delays in Ashburton - i.e., they are more likely to stay on arterial routes.

The Feedback Interval updates the familiar vehicle's knowledge of network conditions at regular intervals. The information that is updated is the time (delay) component of the generalised cost. This gives familiar vehicles the opportunity to re-route during their journeys and when they load onto the network if a more attractive route to their destination is found. Feedback intervals are typically set between two and five minutes. Two minutes has been used in this network, which is reasonable typical for a town-style network with a relatively dense roading network.

The Feedback Factor regulates the re-routeing response to updated delays each feedback interval. Rather than simply using the 'raw' change in travel time from the previous 2-minute interval to reassess route choice (this can lead to higher levels of model fluctuation), familiar vehicles will use 45% (factor of 0.45) of the delays from all previous feedback intervals (method of successive averages) which dampens the response to delay changes. Feedback factors of 0.4 to 0.6 are typically used.

5.5.3 Local Link Settings and Parameters

Link parameters have been applied consistently throughout the model to allow for the same approach and parameters to be applied to all intersections and network features in future test scenarios. The following localised link parameter adjustments have been applied:

- **Visibility**: a 20m visibility distance has been applied on lower priority movements at roundabouts and right turn movements from the main road turning into side streets. Zero or no visibility has been applied to vehicles turning out of a side street because they typically will need to stop at the intersection and look both ways to check for on-coming traffic.
- **Headway Factor**: a 1.5 headway factor has been applied on links across the central span of the existing SH1 bridge to replicate the environment (narrower lanes, enclosure with bridge railings etc.). This factor increases the following distances for vehicles as they cross the bridge, in turn reducing the capacity of this link. This has been carried out based on local / anecdotal observation of behaviour in this location and is a common adjustment to reflect enclosed environments with narrower lanes such as bridges and tunnels.

5.6 DEMAND DEVELOPMENT PROCESS

5.6.1 TRACKS Demand Inputs

A proportion of the Inter-Peak TRACKS matrices was used in combination with the AM and PM to create input starter matrices (prior matrices) for further refinement in the microsimulation model. This approach ensured that the overall demand totals in each time were reasonably well aligned with the observed volumes and no global factoring of the prior matrices was required.

5.6.2 Application of Matrix Estimation

A carefully restricted and controlled use of Matrix Estimation (ME) was carried out to make minor improvements and refinements to the prior Origin-Destination matrices. ME was largely used as an error checking and correction tool, i.e., to identify and update/refine issues with the traffic count data, the model description, and input (prior) matrices.

The robust ADC link counts and TMS counts not effected by the city centre roadworks were used as survey targets alongside the intersection turning movement survey data in the ME process.

ME was carried out separately for the Light and Heavy vehicle matrices.

The most straightforward, and generally effective, method of limiting the effect ME can have on the prior matrix travel patterns is to limit the number of iterations of the ME process. For light vehicles, 5 iterations were used, and for heavy vehicles, 2-3 iterations were used. For heavy vehicles, it was deemed particularly important to maintain the wider network travel patterns and longer trip distance movements.

5.6.3 Matrix Totals and ME Checks

Table 5-1 provides the total demands (OD matrix totals) for three matrices, the ‘raw’ TRACKS input matrices, adjusted Prior matrix which reflects more obvious improvements and refinements identified in the ME process, and the final microsimulation base year demands (output from ME).

Table 5-1: Base Year Demand Totals Through ME Process

	AM Period		IP Period		PM Period	
	Light	Heavy	Light	Heavy	Light	Heavy
TRACKS Raw	16,081	1,823	16,367	1,100	33,975	1,560
Developed Prior	16,045	1,797	16,367	1,100	33,287	1,464
Final Demands	14,078	1,096	14,257	848	29,251	1,251
Diff to TRACKS	*-2,003*	*-728*	*-2,110*	*-252*	*-4,724*	*-309*
	-12%	*-40%*	*-13%*	*-23%*	*-14%*	*-20%*

The table above indicates that the ‘raw’ TRACKS matrices appear to overestimate the base year demands, the adjustments to the prior matrix in the AM and PM periods were made to partially account for this and ME reduced the overall demands further.

Trip Length Distribution graphs are provided in **Appendix B**. While there are some minor travel pattern changes in certain bins associated with refinements to the matrices (e.g., increases in heavy trips to the central industrial area, west of the town centre), important the longest distance trips are maintained and, in many cases, increased in the ME process.

Comparisons between the observed OD data and modelled travel patterns for the key surveyed movements are also provided in **Appendix B**. It is difficult to draw direct conclusions from this analysis due to issues with the observed data and the limited number of movements surveyed. However, the comparison does indicate that the Matrix Estimation process is maintaining and often improving the comparison with the observed travel patterns on key movements.

6.0 MICROSIM MODEL CALIBRATION / VALIDATION

6.1 OVERVIEW AND TARGETS

Two main calibration and validation checks have been carried out and reporting on for the Ashburton Paramics microsimulation model for all time periods (AM, IP, PM):

- Turn and Link Movement Calibration: hourly calibration checks of all intersection turning and link movements in the network.
- Travel Time Validation: travel time comparisons between observed and modelled data on key routes within the network for the peak hour.

Calibration and validation targets are based on model category Type D: Waka Kotahi Project model application as described in the Transport Model Development Guidelines by Waka Kotahi.

6.2 TRAFFIC COUNT CALIBRATION OUTCOMES

The tables below provide a summary of the GEH comparison for each modelled hour in each time period.

GEH is a statistic that is used to compare observed and modelled counts, a lower GEH value indicates a closer match between observed and modelled values.

Table 6-1: AM Period GEH Summary

Individual Turning Movements and/or Directional Link Counts	% of Comparisons Achieving Target		
	07:30 - 08:30	08:30 - 09:30	TARGET (D: Waka Kotahi Project)
GEH <5.0	89%	88%	>82.5%
GEH <7.5	97%	97%	>87.5%
GEH <10.0	100%	99%	>92.5%
Number of Comparisons	194	194	

Table 6-2: IP Period GEH Summary

Individual Turning Movements and/or Directional Link Counts	% of Comparisons Achieving Target		
	11:00 - 12:00	12:00 - 13:00	TARGET (D: Waka Kotahi Project)
GEH <5.0	93%	89%	>82.5%
GEH <7.5	100%	98%	>87.5%
GEH <10.0	100%	100%	>92.5%
Number of Comparisons	192	192	

Table 6-3: PM Period GEH Summary

Individual Turning Movements and/or Directional Link Counts	% of Comparisons Achieving Target			
	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TARGET (D: Waka Kotahi Project)
GEH <5.0	87%	86%	82%	82.5%
GEH <7.5	97%	97%	96%	87.5%
GEH <10.0	99%	100%	98%	92.5%
Number of Comparisons	194	194	194	

The tables above indicate that the modelled hours are meeting and, in most cases, comfortable exceeding the guideline targets. There is one exception, the 17:00-18:00 hour in the PM period where the actual percent of matches is 82.47% (target 82.5%), this not considered an issue especially as the <7.5 GEH target is comfortably exceeded.

XY Scatter plots of observed and modelled counts are provided in **Appendix C**. In the AM and IP periods, the XY plots indicate a tendency for the modelled values to be low in the first modelled hour, and robust in the second modelled hour. This is not considered to be an issue as detailed analysis of model outputs - e.g., delays and time vs. distance travel time on SH1, is concentrated on the later hours in the modelled time periods. In the PM period the modelled flows are robust across all modelled hours.

6.3 TRAVEL TIME VALIDATION

The model has been validated to the Google observed travel times on the routes through the network as described in Section 3.3.1. The tables below provide a summary of the travel time validation comparisons, the tighter guideline threshold (threshold 1) is to be within 1-minute or 15% of observed.

Table 6-4: Travel Time Validation Summary, AM Peak

Route		Description	Observed	Modelled	Difference		Pass? (threshold 1)
			Avg	Avg	Abs	%	
Route 1	NB	SH1-NEB	8.3	8.4	0.1	1%	Yes
	SB	SH1-SWB	8.0	7.6	-0.4	-5%	Yes
Route 2	SB	SH77-NWB	3.8	3.5	-0.4	-9%	Yes
	NB	SH77-SEB	4.3	3.8	-0.5	-11%	Yes
Route 3	WB	EastSt-NEB	2.1	1.6	-0.5	-23%	Yes
	EB	EastSt-SWB	2.3	1.7	-0.6	-25%	Yes
Route 4	NEB	ChalmersAve-NEB	2.2	2.1	-0.1	-5%	Yes
	SWB	ChalmersAve-SWB	2.2	2.1	-0.1	-6%	Yes
Route 5	SB	SouthSt-NWB	1.3	1.6	0.2	15%	Yes
	NB	SouthSt-SEB	1.2	1.0	-0.3	-20%	Yes
Route 6	NWB	MooreSt-NWB	1.9	1.7	-0.2	-11%	Yes
	SEB	MooreSt-SEB	1.5	1.2	-0.3	-22%	Yes
Route 7	NB	WalnutAve-NWB	4.4	3.7	-0.8	-18%	Yes
	SEB	WalnutAve-SEB	4.5	3.6	-0.9	-20%	Yes

Table 6-5: Travel Time Validation Summary, Inter-Peak

Route		Description	Observed	Modelled	Difference		Pass? (threshold 1)
			Avg	Avg	Abs	%	
Route 1	NB	SH1-NEB	8.4	8.1	-0.3	-3%	Yes
	SB	SH1-SWB	8.0	8.1	0.0	0%	Yes
Route 2	SB	SH77-NWB	4.0	3.5	-0.5	-14%	Yes
	NB	SH77-SEB	4.4	3.8	-0.5	-12%	Yes
Route 3	WB	EastSt-NEB	2.5	1.6	-0.8	-34%	Yes
	EB	EastSt-SWB	3.0	2.1	-0.9	-29%	Yes
Route 4	NEB	ChalmersAve-NEB	2.3	2.1	-0.2	-7%	Yes
	SWB	ChalmersAve-SWB	2.3	2.1	-0.2	-8%	Yes
Route 5	SB	SouthSt-NWB	1.5	1.3	-0.1	-8%	Yes
	NB	SouthSt-SEB	1.3	1.0	-0.3	-24%	Yes
Route 6	NWB	MooreSt-NWB	2.2	1.7	-0.4	-20%	Yes
	SEB	MooreSt-SEB	1.8	1.2	-0.6	-34%	Yes
Route 7	NB	WalnutAve-NWB	4.4	3.7	-0.7	-15%	Yes
	SEB	WalnutAve-SEB	4.0	3.7	-0.3	-8%	Yes

Table 6-6: Travel Time Validation Summary, PM Peak

Route		Description	Observed	Modelled	Difference		Pass?
			Avg	Avg	Abs	%	(threshold 1)
Route 1	NB	SH1-NEB	9.5	8.4	-1.0	-11%	Yes
	SB	SH1-SWB	8.3	7.8	-0.5	-6%	Yes
Route 2	SB	SH77-NWB	3.8	3.5	-0.4	-9%	Yes
	NB	SH77-SEB	4.6	4.1	-0.5	-10%	Yes
Route 3	WB	EastSt-NEB	2.1	1.8	-0.3	-16%	Yes
	EB	EastSt-SWB	2.6	2.2	-0.4	-15%	Yes
Route 4	NEB	ChalmersAve-NEB	2.2	2.1	-0.1	-3%	Yes
	SWB	ChalmersAve-SWB	2.2	2.1	-0.1	-5%	Yes
Route 5	SB	SouthSt-NWB	1.4	1.5	0.1	4%	Yes
	NB	SouthSt-SEB	1.2	1.0	-0.3	-23%	Yes
Route 6	NWB	MooreSt-NWB	2.1	1.8	-0.3	-14%	Yes
	SEB	MooreSt-SEB	1.5	1.2	-0.3	-22%	Yes
Route 7	NB	WalnutAve-NWB	4.2	3.9	-0.3	-7%	Yes
	SEB	WalnutAve-SEB	4.0	3.7	-0.3	-7%	Yes

The tables above demonstrate that the modelled travel times meet the thresholds on all routes, in all directions, in all time periods.

There is a tendency for the average modelled travel times to be lower than the average observed travel times in the above tables. The time vs. distance plots in **Appendix C** demonstrate a strong correlation between the observed and modelled travel times, particularly the between the modelled and observed range of travel times. The maximum modelled travel times are well aligned with the maximum observed travel times, any underestimation of average vales is not considered a significant issue based on the time vs. distance comparisons.

7.0 FORECASTING INPUTS AND DEVELOPMENT

7.1 REGIONAL MODEL FORECASTS

7.1.1 Land Use Inputs

As indicated in Chapter 4, the land use for the future years of 2031 and 2041 are based on agreed projections provided by ADC. Household related projections were provided at an area level of detail by the land use planning site Profile.id. for the entire ADC area. These projections detailed the expected number of households and population for each area but not the distribution of that data within each area. Several assumptions were made in distributing the household data:

1. Where no specific housing development could be identified within any of the 10 model planning areas, the increase in households and population was distributed pro-rata over every zone within the relevant area.
2. The main housing development of Lake Hood, within the Hinds North planning area, specifically received housing at a historic rate of 20 households/year with the remaining housing growth within the Hinds North area being distributed pro-rata over the rest of the area. Growth in Lake Hood households continued until a total of 500 households existed.

The area household growth used in the model is shown in Table 7-1.

Table 7-1: Area Household Growth Used for Each Future Model Year

Area	2021		2031		2041	
	Households	Population	Households	Population	Households	Population
Allenton East	1,871	4,591	1,987	4,873	2,089	5,049
Allenton West	879	2,258	924	2,333	963	2,405
Ashburton Central	1,413	3,105	1,501	3,299	1,588	3,458
Chertsey	1,059	2,735	1,124	2,837	1,193	2,980
Fairton-Ashburton Northwest	735	1,909	939	2,350	1,123	2,772
Hampstead	1,237	3,018	1,285	3,114	1,335	3,202
Hinds North	1,043	2,808	957	2,526	986	2,602
Lake Hood	234	630	434	1,145	500	1,319
Netherby	874	2,316	1,014	2,678	1,140	2,994
Tinwald-Plains Railway	1,680	4,122	1,815	4,376	1,943	4,680
Total	11,025	27,492	11,980	29,533	12,860	31,461
Growth from 2021			**0.87% pa**	**0.74% pa**	**0.83% pa**	**0.72% pa**

7.1.2 External Growth Rates

To determine the growth in external flows into and out of the model area, the historic growth in external SH1 and SH77 flows were used and extrapolated for each future year. Waka Kotahi permanent count sites were used to determine the historic growth at each site. This indicated that the annual growth at each site was 2.4%pa for SH1 north of the area, 3.1%pa for SH1 south of Tinwald and 2.0%pa for SH77 to the west of the area.

7.2 MICROSIMULATION MODEL FUTURE YEAR DEMANDS

7.2.1 Demand Development Process

To ensure the refinements to the base year demands and calibration of the microsimulation model to the observed traffic volumes are carried through into the future year demands, the process to develop the microsimulation model involves adding the TRACKS growth to the base year microsimulation model. This is a standard industry practice, described in Appendix 1 of the Monetised Benefit and Cost Manual, section "Project models fed by regional models" and "OD Additive Growth Method".

The forecasts for the microsimulation model have been developed by taking the difference between the TRACKS 2021 and TRACKS future years demands and adding this to the finalised 2021 base year microsimulation model matrices. The TRACKS matrices used had the same time period adjustments/additions as noted for the base year demands.

7.2.2 Final Demand Totals and Growth

The table below shows the full period demand totals for each time period the resulting absolute and percentage growth from the base year, and the annual growth rate from the base year.

Table 7-2: AM, IP, and PM Full Period Demand Totals and Resulting Growth

AM Demands	2021			2031			2041		
	Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
OD Demand Totals	14,078	1,096	**15,174**	16,058	1,286	**17,343**	17,798	1,466	**19,264**
Growth from Base Year				1,980	190	**2,170**	3,720	371	**4,091**
% Growth from Base Year				14%	17%	**14%**	26%	34%	**27%**
% p.a.				1.4%	1.7%	**1.4%**	1.3%	1.7%	**1.3%**

IP Demands	2021			2031			2041		
	Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
OD Demand Totals	14,257	848	**15,105**	16,300	1,032	**17,332**	18,105	1,212	**19,316**
Growth from Base Year				2,043	184	**2,227**	3,848	364	**4,211**
% Growth from Base Year				14%	22%	**15%**	27%	43%	**28%**
% p.a.				1.4%	2.2%	**1.5%**	1.3%	2.1%	**1.4%**

PM Demands	2021			2031			2041		
	Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
OD Demand Totals	29,251	1,251	**30,502**	33,605	1,518	**35,123**	37,413	1,780	**39,193**
Growth from Base Year				4,354	267	**4,621**	8,162	529	**8,691**
% Growth from Base Year				15%	21%	**15%**	28%	42%	**28%**
% p.a.				1.5%	2.1%	**1.5%**	1.4%	2.1%	**1.4%**

8.0 DO MINIMUM AND THRESHOLD ASSESSMENT

8.1 DO MINIMUM ASSUMPTIONS

The Do Minimum refers to the network scenario without any additional river crossing capacity and with the committed transport projects in the area. There are three alternations to the Do Minimum network compared to the Base model scenario:

- Removal of the road works in the town centre area, i.e., slower speed limits and road closures.
- Addition of signalised intersection at Lagmhor Road / Agnes Street / SH1, as per design layout indicated on Waka Kotahi project website.
- Addition of signalised intersection at Walnut Ave / SH1, as per design layout indicated on Waka Kotahi project website.

8.2 FUTURE YEAR SH1 TRAFFIC VOLUMES

The table below provides the peak hour volumes on SH1 in the south, north, and on the existing bridge.

Table 8-1: SH1 Do Minimum Peak Hour Volumes in Key Locations

Peak Hour Flows (vph)		2021			2031					2041				
		Nbd	Sbd	Tot	Nbd	Sbd	Tot	Diff to 2021		Nbd	Sbd	Tot	Diff to 2021	
SH1 (Bridge)	AM	1,110	750	**1,860**	1,320	890	**2,210**	350	19%	1,460	1,000	**2,460**	600	32%
	IP	860	980	**1,840**	1,060	1,180	**2,240**	400	22%	1,210	1,340	**2,550**	710	39%
	PM	980	1,190	**2,170**	1,210	1,440	**2,650**	480	22%	1,350	1,580	**2,930**	760	35%
SH1 North (Racecourse Rd)	AM	420	500	**920**	490	600	**1,090**	170	18%	580	690	**1,270**	350	38%
	IP	580	620	**1,200**	680	740	**1,420**	220	18%	760	850	**1,610**	410	34%
	PM	670	580	**1,250**	780	740	**1,520**	270	22%	880	890	**1,770**	520	42%
SH1 South (Maronan Rd)	AM	420	400	**820**	520	490	**1,010**	190	23%	630	590	**1,220**	400	49%
	IP	550	490	**1,040**	690	620	**1,310**	270	26%	830	750	**1,580**	540	52%
	PM	520	550	**1,070**	680	710	**1,390**	320	30%	810	860	**1,670**	600	56%

8.3 BRIDGE CAPACITY THRESHOLD TIMING ANALYSIS

8.3.1 Assessment Approach, Key Movements and Baseline Travel Times

The 2021, 2031, and 2041 Do Minimum models have been used to assess the network operation and performance into the future. This has been used to estimate the approximate year in the future when additional river crossing vehicle capacity may be needed, based on the average Monday-to-Thursday weekday modelling.

The approach to this threshold assessment was discussed and agreed with the Client Group. The method agreed was to consider key movements between important areas (sectors) of the network, and a level of additional travel time above 'free-flow' times (delay) which is considered unacceptable. The figure below shows the important areas (sectors).

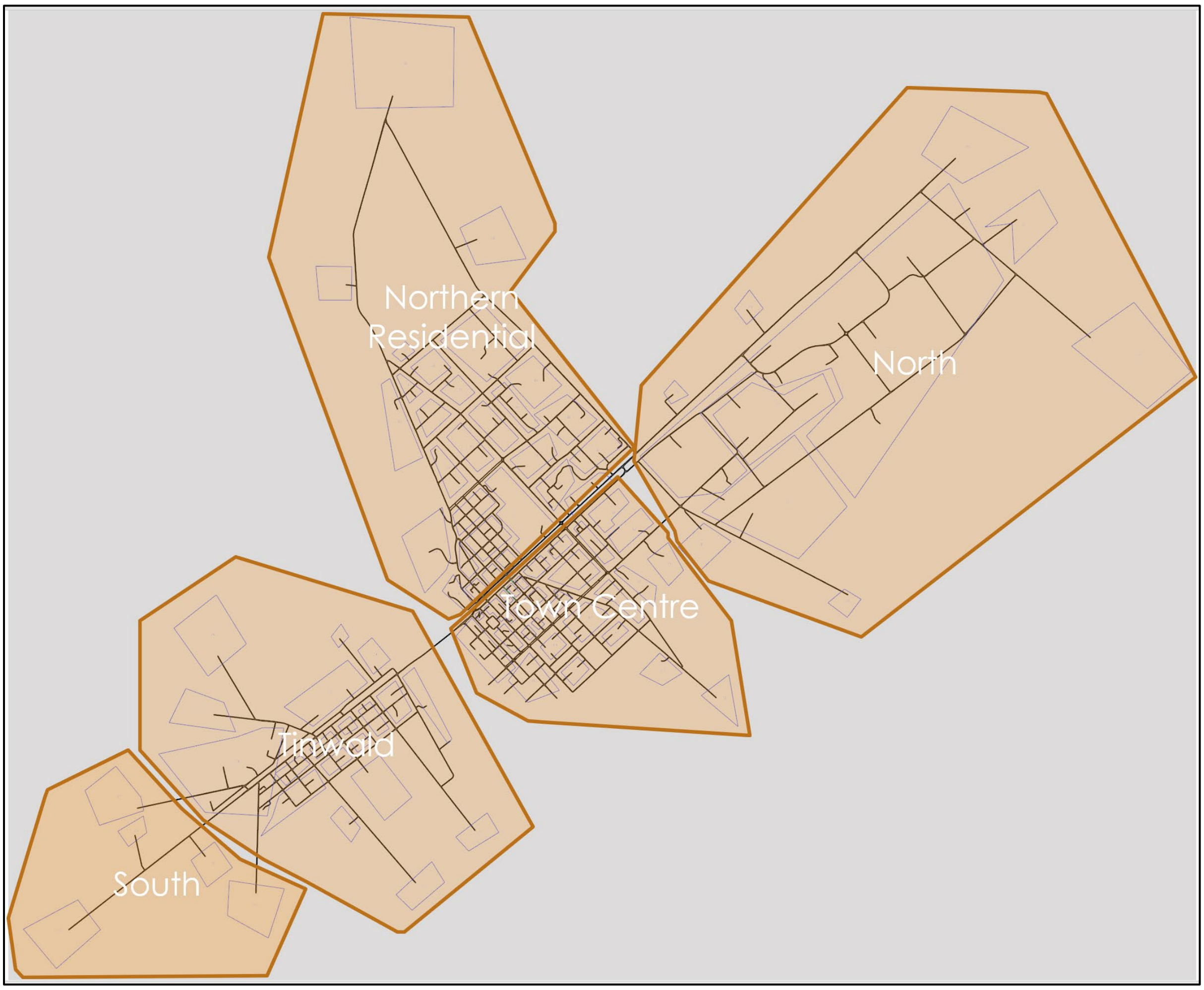


Figure 8-1: Sectors for Threshold Analysis

The movements determined to be the more critical and the baseline (free flow) travel time in minutes for each movement are shown in Table 8-2.

Table 8-2: Key Movements and Free-Flow Travel Times

	Baseline (freeflow) travel time (mins)
North to South	14.00
South to North	14.00
Tinwald to Town Centre	5.00
Town Centre to Tinwald	5.00
Northern Residential to Town Centre	4.00
Town Centre to Northern Residential	4.00
Within Town Centre	2.25
North to Town Centre	6.00
Town Centre to North	6.00
Tinwald (trips within Tinwald area)	2.25

8.3.2 Bridge Threshold Timing Assessment

The tables below provide the 85th percentile delay (travel time additional to free flow as provided in table above) along with the thresholds agreed with the Client Group.

Table 8-3: AM Period 85%ile Delays Compared with Thresholds

AM 85%ile Delay (additional travel time) Outcomes	Threshold	Do Min 2021	Do Min 2031	Do Min 2041
North to South	5-mins +	1.41	1.64	1.91
South to North	5-mins +	1.05	1.38	1.63
Tinwald to Town Centre	3-4mins +	0.58	1.26	2.21
Town Centre to Tinwald	3-4mins +	1.14	1.28	1.48
Northern Residential to Town Centre	2-3mins +	0.58	0.70	0.77
Town Centre to Northern Residential	2-3mins +	0.61	0.71	0.84
Within Town Centre	1-2mins +	0.36	0.40	0.44
North to Town Centre	3-4mins +	0.58	0.67	0.73
Town Centre to North	3-4mins +	0.42	0.36	0.41
Tinwald	1min +	0.48	0.57	0.85

Table 8-4: IP Period 85%ile Delays Compared with Thresholds

IP 85%ile Delay (additional travel time) Outcomes	Threshold	Do Min 2021	Do Min 2031	Do Min 2041
North to South	5-mins +	1.84	2.24	2.99
South to North	5-mins +	1.39	1.72	2.11
Tinwald to Town Centre	3-4mins +	0.76	1.10	1.64
Town Centre to Tinwald	3-4mins +	0.81	1.18	2.05
Northern Residential to Town Centre	2-3mins +	0.32	0.44	0.72
Town Centre to Northern Residential	2-3mins +	0.39	0.52	0.78
Within Town Centre	1-2mins +	0.31	0.38	0.49
North to Town Centre	3-4mins +	1.07	1.02	1.08
Town Centre to North	3-4mins +	1.30	1.48	1.66
Tinwald	1min +	0.38	0.50	0.69

Table 8-5: PM Period 85%ile Delays Compared with Thresholds

PM 85%ile Delay (additional travel time) Outcomes	Threshold	Do Min 2021	Do Min 2031	Do Min 2041
North to South	5-mins +	1.64	2.41	6.71
South to North	5-mins +	1.50	2.09	3.39
Tinwald to Town Centre	3-4mins +	1.08	2.72	5.32
Town Centre to Tinwald	3-4mins +	0.96	1.89	5.08
Northern Residential to Town Centre	2-3mins +	0.66	1.09	2.67
Town Centre to Northern Residential	2-3mins +	0.73	1.09	2.70
Within Town Centre	1-2mins +	0.40	0.53	1.87
North to Town Centre	3-4mins +	0.57	0.75	2.71
Town Centre to North	3-4mins +	0.81	1.15	2.05
Tinwald	1min +	0.44	0.70	0.77

The tables above indicate that the thresholds are being exceeded in 2041 but are not exceeded in 2031.

This indicates that, based on the Monday-to-Thursday modelling assessment, new vehicle bridge capacity would be required between 2031 and 2041.

9.0 ALTERNATIVE BRIDGE OPTION COMPARISON

9.1 OVERVIEW

The sections below present outputs from the microsimulation model comparing three scenarios:

- **Do Minimum network**: As described in Section 8.1, includes new signals at SH1 / Walnut Ave and SH1 / Lagmhor Road / Agnes Street
- **SH1 Bridge Duplication:** Additional bridge immediately adjacent to existing SH1 Bridge. Assumed to include 4-lanes from south of bridge through to north of SH1 / Moore Street signals, SH1 / Moore Street SH1 through lane capacity increased (left slip to SH77 removed), Left-In Left-Out (LILO) at Dobson Street / SH1, East Street / SH1 right turn in provided with turn bay accommodated, LILO at Kermode Street / SH1.
- **Chalmers Alignment Bridge:** 60kph assumed from roughly 200/250m south of Chalmers Ave / South Street, through to Chalmers Extension / Grahams Road, higher level in road hierarchy to connect to/from the Chalmers Bridge and Chalmers Extension; Grahams Road, Wilkin Street, and South Street.

9.2 TRAFFIC VOLUME OUTCOMES

9.2.1 Traffic Pattern Changes

9.2.1.1 Existing and Future SH1 Duplication Traffic Flow Patterns

The images below show the AM, inter and PM peak hour volumes from the 2021 Do Minimum scenario followed by the 2041 SH1 Bridge Duplication scenario. The scale is the same in all images (100 to 1,800vph) so the current travel patterns and flow increases can be identified.

Figure 9-1: AM Peak Hour, 2021 Do Minimum

Figure 9-2: AM Peak Hour, 2041 SH1 Bridge Duplication

Figure 9-3: Inter-Peak Hour, 2021 Do Minimum

Figure 9-4: Inter-Peak Hour, 2041 SH1 Bridge Duplication

Figure 9-5: PM Peak Hour, 2021 Do Minimum

Figure 9-6: PM Peak Hour, 2041 SH1 Bridge Duplication

9.2.2 Chalmers Alignment Flow Changes

The figures below show the peak hour difference between the SH1 Duplication and the Chalmers Bridge alignment scenario for the AM, IP, and PM 2041 scenarios.

The plot can only be completed for links which are common to both models, therefore unfortunately the two bridges do not show any differences and changes can be identified from the links each side of the bridges.

A reduction in the Chalmers Alignment scenario is shown in blue with a maximum scale of -200vph.

An increase in the Chalmers Alignment scenario is shown in yellow-to-orange with a maximum scale of 200vph.

Figure 9-7: AM Peak Hour 2041 Flow Difference, Chalmers vs SH1 Duplication

Figure 9-8: IP Peak Hour 2041 Flow Difference, Chalmers vs SH1 Duplication

Figure 9-9: PM Peak Hour 2041 Flow Difference, Chalmers vs SH1 Duplication

9.2.3 Comparison of Bridge Volumes

The table below provides the peak hour volumes crossing the Hakatere River (Ashburton River) in the three scenarios. Note, in the table below in the Chalmers Bridge Alignment scenario the flows are split on SH1, and the Chalmers Ave bridge the volumes on each link and the totals are provided.

Table 9-1: Ashburton River Peak Hour Crossing Volumes, Bridge Scenarios

Peak Hour Flows		NBD					SBD				
		Do Min	Chalmers Bridge Alignment			SH1 Bridge Alignment	Do Min	Chalmers Bridge Alignment			SH1 Bridge Alignment
			SH1	Chalmers	Total			SH1	Chalmers	Total	
2021	AM	750	630	140	760	770	450	380	80	450	470
	IP	820	740	140	890	850	900	750	170	920	920
	PM	1,010	830	190	1,020	990	1,070	820	210	1,030	1,030
2031	AM	920	750	170	920	930	560	450	100	550	540
	IP	1,040	860	180	1,040	1,050	1,110	890	210	1,100	1,120
	PM	1,230	1,000	230	1,230	1,230	1,310	1,030	260	1,290	1,280
2041	AM	1,050	830	190	1,010	1,030	620	490	90	580	610
	IP	1,210	990	220	1,210	1,180	1,250	1,010	250	1,260	1,300
	PM	1,360	1,130	250	1,390	1,340	1,460	1,150	340	1,490	1,490

9.2.4 Right Turn Volume Changes, Chalmers Bridge Scenario

Table 9-1 shows the volume changes from two key right turn movements onto SH1. The Chalmers Bridge alignment option is predicted to reduce these volumes, providing an improved safety outcome.

Table 9-2: Key Right Turn Movement Volume Changes

Peak Hour Flows		DoMin 2041	SH1 Duplication 2041	Chalmers Align 2041	Change, Chalmers vs SH1 Duplication
Graham Road, RT onto SH1	AM	155	147	89	-57
	PM	83	79	50	-29
Agnes Street, RT onto SH1	AM	97	95	93	-2
	PM	94	92	88	-4

9.3 OVERALL NETWORK WIDE OUTCOMES

9.3.1 Overall Network Wide Average Travel Time and Distance

The tables below provide the overall average network-wide travel times and distances. The values are calculated from all completed origin-destination trips in the simulation period and the outputs weighted by the number of vehicles making each trip. These are important outputs and would provide the basis for Value of Time and Vehicle Operating Cost inputs to a future economic assessment.

Table 9-3: AM Light Vehicle Network Average Travel Time and Distance

Network Wide Statistics (AM) Light Vehicles		2021			2031			2041		
	Base 2021	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.
Average travel time (min)	5.2	5.3	5.2	5.3	5.5	5.4	5.5	5.8	5.6	5.7
Average travel distance (m)	3,943	3,936	3,932	3,935	4,074	4,073	4,079	4,187	4,185	4,191
Bridge Option vs. Do Min Time diff			-0.1	0.0		-0.1	0.0		-0.2	0.0
			-1.4%	-0.2%		-1.8%	0.0%		-2.9%	-0.3%
Bridge Option vs. Do Min Dis diff			-4	3		-1	6		-2	6
			-0.1%	0.1%		0.0%	0.1%		-0.1%	0.1%

Table 9-4: AM Heavy Vehicle Network Average Travel Time and Distance

Network Wide Statistics (AM) Heavy Vehicles		2021			2031			2041		
	Base 2021	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.
Average travel time (min)	7.3	7.4	7.3	7.3	7.7	7.6	7.7	8.0	7.8	7.9
Average travel distance (m)	5,352	5,381	5,308	5,294	5,490	5,473	5,531	5,639	5,612	5,630
Bridge Option vs. Do Min Time diff			-0.1	-0.1		-0.1	0.0		-0.2	0.0
			-1.7%	-1.4%		-1.2%	0.5%		-1.9%	-0.3%
Bridge Option vs. Do Min Dis diff			-73	-13		-18	58		-28	18
			-1.4%	-0.2%		-0.3%	1.1%		-0.5%	0.3%

Table 9-5: IP Light Vehicle Network Average Travel Time and Distance

Network Wide Statistics (IP) Light Vehicles		2021			2031			2041		
	Base 2021	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.
Average travel time (min)	5.3	5.3	5.3	5.3	5.7	5.6	5.6	6.0	5.9	5.9
Average travel distance (km)	3,953	3,922	3,927	3,923	4,071	4,077	4,068	4,185	4,189	4,186
Bridge Option vs. Do Min Time diff			-0.1	0.0		-0.1	0.0		-0.1	0.0
			-1.0%	-0.2%		-1.5%	-0.6%		-2.1%	-0.8%
Bridge Option vs. Do Min Dis diff			5	-4		6	-9		4	-3
			0.1%	-0.1%		0.1%	-0.2%		0.1%	-0.1%

Table 9-6: IP Heavy Vehicle Network Average Travel Time and Distance

Network Wide Statistics (IP) Heavy Vehicles	2021				2031			2041		
	Base 2021	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.
Average travel time (min)	7.5	7.6	7.5	7.6	7.9	7.7	7.8	8.2	8.1	8.1
Average travel distance (km)	5,407	5,395	5,377	5,381	5,486	5,472	5,500	5,559	5,599	5,575
Bridge Option vs. Do Min Time diff			-0.1	0.0		-0.1	0.0		-0.1	0.0
			-0.9%	-0.2%		-1.5%	-0.3%		-0.7%	-0.3%
Bridge Option vs. Do Min Dis diff			-18	5		-14	28		41	-25
			-0.3%	0.1%		-0.2%	0.5%		0.7%	-0.4%

Table 9-7: PM Light Vehicle Network Average Travel Time and Distance

Network Wide Statistics (PM) Light Vehicles	2021				2031			2041		
	Base 2021	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.
Average travel time (min)	5.3	5.4	5.4	5.4	5.9	5.7	5.9	7.0	6.3	6.6
Average travel distance (km)	3,946	3,946	3,947	3,945	4,128	4,128	4,128	4,263	4,254	4,256
Bridge Option vs. Do Min Time diff			-0.1	0.0		-0.2	0.0		-0.7	-0.3
			-1.3%	0.1%		-3.0%	-0.8%		-9.9%	-4.7%
Bridge Option vs. Do Min Dis diff			1	-3		0	0		-9	2
			0.0%	-0.1%		0.0%	0.0%		-0.2%	0.0%

Table 9-8: PM Heavy Vehicle Network Average Travel Time and Distance

Network Wide Statistics (PM) Heavy Vehicles	2021				2031			2041		
	Base 2021	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.	Do Min	Chalm. Align	SH1 Dupl.
Average travel time (min)	7.6	7.7	7.6	7.6	8.1	8.0	8.1	9.4	8.6	9.3
Average travel distance (km)	5,448	5,423	5,434	5,406	5,575	5,598	5,586	5,640	5,640	5,630
Bridge Option vs. Do Min Time diff			-0.1	0.0		-0.2	0.0		-0.7	-0.1
			-1.0%	-0.3%		-1.9%	-0.6%		-7.9%	-1.2%
Bridge Option vs. Do Min Dis diff			11	-28		23	-12		1	-11
			0.2%	-0.5%		0.4%	-0.2%		0.0%	-0.2%

The tables above indicate that both bridge options provide overall network-wide benefits in nearly all time periods and modelled years. The benefits of the Chalmers Bridge Alignment option are greater than the SH1 Duplication, becoming reasonably significant in the 2041 PM peak period.

Appendix E provides 15-min network-wide travel times. This demonstrates that there are consistent benefits to the Chalmers Bridge Alignment throughout the modelled time periods.

9.3.2 Sector-to-Sector Changes

The tables below show the change in the key sector-to-sector delays between the two bridge alignment options and the Do Minimum scenario.

Table 9-9: AM Period, Sector-to-Sector 85%ile Delay Differences

AM 85th %ile Delay Diff		2021					2031					2041				
			Chalmers Alnmt		SH1 Alnmt			Chalmers Alnmt		SH1 Alnmt			Chalmers Alnmt		SH1 Alnmt	
From Sector	To Sector	DoMin	Delay	Diff to DM	Delay	Diff to DM	DoMin	Delay	Diff to DM	Delay	Diff to DM	DoMin	Delay	Diff to DM	Delay	Diff to DM
North	South	1.41	1.43	0.03	1.29	-0.12	1.64	1.59	-0.05	1.54	-0.10	1.91	1.92	0.01	1.79	-0.12
South	North	1.05	1.01	-0.05	0.87	-0.19	1.38	1.25	-0.14	1.14	-0.25	1.63	1.45	-0.19	1.36	-0.28
Tinwald	Town Centre	0.58	-0.20	-0.78	0.58	0.00	1.26	-0.03	-1.29	1.24	-0.02	2.21	0.08	-2.13	1.99	-0.23
Town Centre	Tinwald	1.14	0.63	-0.51	1.19	0.05	1.28	0.75	-0.53	1.27	-0.01	1.48	0.88	-0.59	1.49	0.01
Northern Residential	Town Centre	0.58	0.59	0.02	0.58	0.00	0.70	0.71	0.01	0.75	0.05	0.77	0.80	0.03	0.84	0.08
Town Centre	Northern Residential	0.61	0.68	0.07	0.62	0.01	0.71	0.74	0.03	0.72	0.02	0.84	0.87	0.03	0.89	0.05
Town Centre	Town Centre	0.36	0.42	0.06	0.37	0.01	0.40	0.45	0.05	0.40	-0.01	0.44	0.51	0.07	0.44	0.00
North	Town Centre	0.58	0.54	-0.04	0.57	0.00	0.67	0.59	-0.09	0.63	-0.04	0.73	0.70	-0.03	0.72	0.00
Town Centre	North	0.42	0.41	-0.01	0.46	0.04	0.36	0.46	0.11	0.40	0.05	0.41	0.38	-0.02	0.40	0.00
Tinwald	Tinwald	0.48	0.50	0.02	0.48	0.00	0.57	0.51	-0.06	0.62	0.05	0.85	0.57	-0.28	0.79	-0.06

Table 9-10: IP Period, Sector-to-Sector 85%ile Delay Differences

IP 85th %ile Delay Diff		2021					2031					2041				
			Chalmers Alnmt		SH1 Alnmt			Chalmers Alnmt		SH1 Alnmt			Chalmers Alnmt		SH1 Alnmt	
From Sector	To Sector	DoMin	Delay	Diff to DM	Delay	Diff to DM	DoMin	Delay	Diff to DM	Delay	Diff to DM	DoMin	Delay	Diff to DM	Delay	Diff to DM
North	South	1.84	1.64	-0.21	1.66	-0.18	2.24	2.08	-0.16	2.02	-0.23	2.99	2.42	-0.56	2.65	-0.34
South	North	1.39	1.28	-0.11	1.16	-0.23	1.72	1.57	-0.15	1.50	-0.22	2.11	1.92	-0.19	1.80	-0.31
Tinwald	Town Centre	0.76	0.15	-0.61	0.69	-0.07	1.10	0.23	-0.87	0.95	-0.15	1.64	0.48	-1.16	1.54	-0.10
Town Centre	Tinwald	0.81	0.33	-0.47	0.82	0.02	1.18	0.49	-0.69	1.11	-0.08	2.05	0.85	-1.20	1.54	-0.51
Northern Residential	Town Centre	0.32	0.36	0.04	0.34	0.02	0.44	0.51	0.07	0.50	0.06	0.72	0.79	0.07	0.69	-0.03
Town Centre	Northern Residential	0.39	0.43	0.04	0.39	0.01	0.52	0.50	-0.02	0.52	0.00	0.78	0.81	0.03	0.78	0.00
Town Centre	Town Centre	0.31	0.34	0.03	0.32	0.01	0.38	0.42	0.05	0.38	0.00	0.49	0.55	0.06	0.48	-0.01
North	Town Centre	1.07	1.02	-0.06	1.04	-0.04	1.02	1.04	0.02	1.02	0.01	1.08	1.23	0.16	1.20	0.12
Town Centre	North	1.30	1.46	0.16	1.44	0.14	1.48	1.52	0.04	1.47	-0.02	1.66	1.66	0.00	1.61	-0.05
Tinwald	Tinwald	0.38	0.39	0.00	0.38	-0.01	0.50	0.43	-0.07	0.43	-0.07	0.69	0.46	-0.22	0.60	-0.09

Table 9-11: PM Period, Sector-to-Sector 85%ile Delay Differences

PM 85th %ile Delay Diff		2021					2031					2041				
			Chalmers Alnmt		SH1 Alnmt			Chalmers Alnmt		SH1 Alnmt			Chalmers Alnmt		SH1 Alnmt	
From Sector	To Sector	DoMin	Delay	Diff to DM	Delay	Diff to DM	DoMin	Delay	Diff to DM	Delay	Diff to DM	DoMin	Delay	Diff to DM	Delay	Diff to DM
North	South	1.64	1.46	-0.19	1.55	-0.09	2.41	1.99	-0.42	2.12	-0.29	6.71	3.67	-3.04	4.99	-1.72
South	North	1.50	1.35	-0.15	1.30	-0.20	2.09	1.77	-0.31	1.63	-0.46	3.39	2.21	-1.19	2.33	-1.06
Tinwald	Town Centre	1.08	0.21	-0.88	0.95	-0.13	2.72	0.41	-2.31	1.74	-0.98	5.32	0.66	-4.66	3.60	-1.72
Town Centre	Tinwald	0.96	0.45	-0.51	1.09	0.13	1.89	0.78	-1.11	1.88	-0.01	5.08	1.50	-3.58	3.20	-1.88
Northern Residential	Town Centre	0.66	0.79	0.13	0.77	0.11	1.09	1.21	0.12	1.14	0.05	2.67	1.63	-1.05	1.45	-1.22
Town Centre	Northern Residential	0.73	0.74	0.01	0.77	0.04	1.09	0.96	-0.13	1.01	-0.08	2.70	1.54	-1.16	1.46	-1.24
Town Centre	Town Centre	0.40	0.46	0.06	0.43	0.03	0.53	0.58	0.05	0.55	0.02	1.87	0.79	-1.09	0.69	-1.18
North	Town Centre	0.57	0.56	0.00	0.59	0.03	0.75	0.69	-0.06	0.64	-0.11	2.71	2.43	-0.29	3.14	0.43
Town Centre	North	0.81	0.82	0.01	0.88	0.08	1.15	1.07	-0.08	1.12	-0.04	2.05	1.71	-0.34	1.74	-0.31
Tinwald	Tinwald	0.44	0.43	-0.01	0.42	-0.02	0.70	0.53	-0.17	0.74	0.04	0.77	0.77	0.00	0.77	0.00

The tables above indicate that there are reductions in delays on key movements for both bridge alignment options. The most significant improvement is the Chalmers Ave bridge alignment in the PM period.

The Chalmers Bridge offers particular improvements for the Tinwald to/from Town Centre movements, but also reduces delays on the north to south and south to north movements through Ashburton more effectively that the SH1 bridge alignment.

9.4 SH1 TRAVEL TIME RELIABILITY

Time vs. distance graphs for SH1 through Ashburton are provided in the graphs below for each modelled year for the AM and PM peaks. The minimum, average, and maximum times are included to provide an indication of the change in travel time reliability along this route for each of the three scenarios.

Figure 9-10: 2021 SH1 Time vs. Distance Graphs

Figure 9-11: 2031 SH1 Time vs Distance Graphs

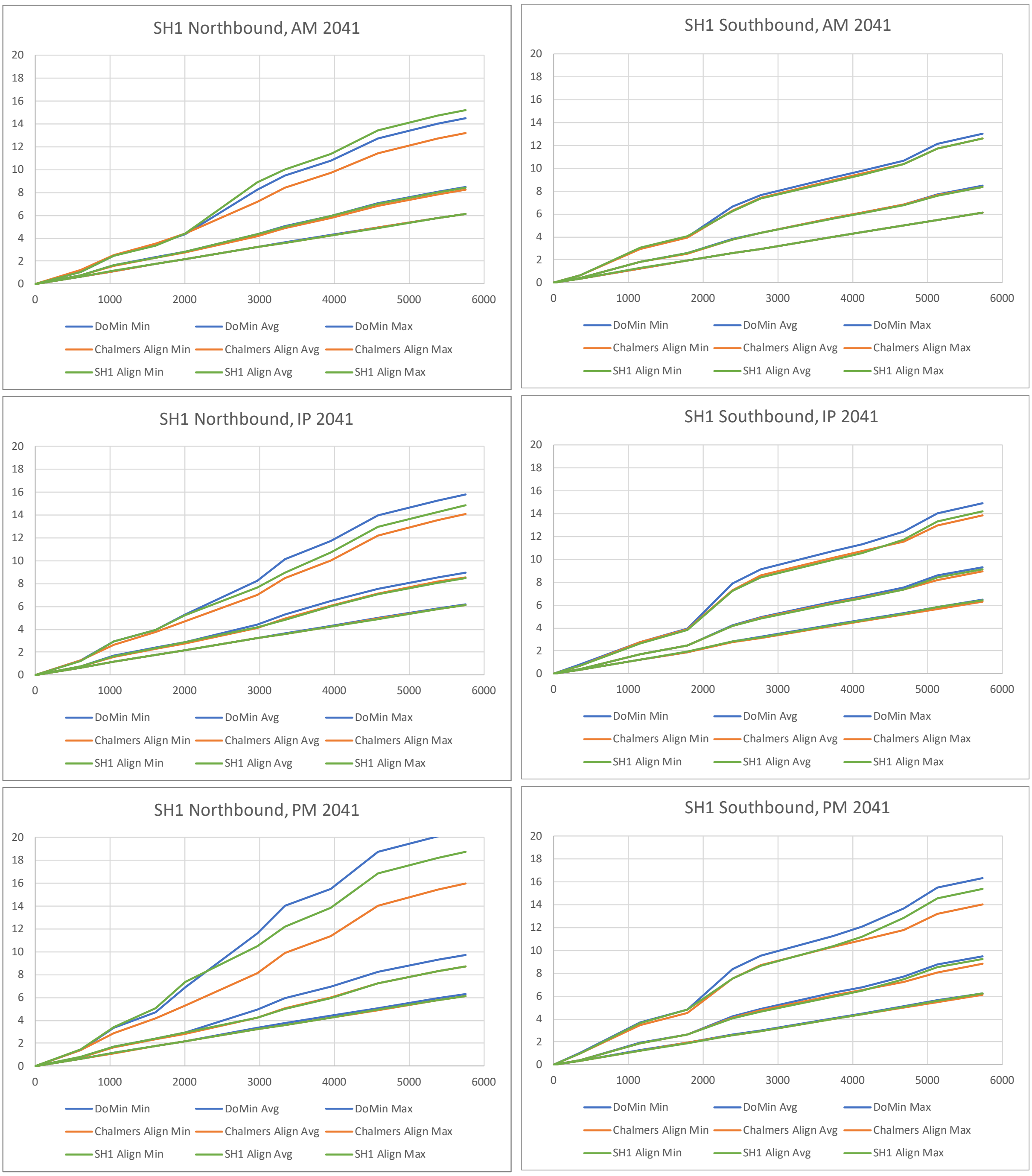


Figure 9-12: 2041 SH1 Time vs Distance Graphs

The figures above indicate that there are consistent reliability improvements in the northbound direction for both Bridge options, but particularly the Chalmers Alignment in 2041 and again in the PM period.

In the southbound direction there is little difference between the Do Minimum and options until 2041 where both options begin to show reliability improvements, with the Chalmers Alignment again showing greater improvement.

10.0 SUMMARY

10.1 ASHBURTON TINWALD CONNECTIVITY IBC

The Ashburton-Tinwald Connectivity Indicative Business Case (IBC) is focussed on connectivity across the Hakatere (Ashburton) River. SH1 crosses the river and runs north / south through Ashburton, with Tinwald on the south side of the river and Ashburton Town Centre on the north side.

10.2 TRANSPORT DATA

A robust set of observed count and travel time has been collated and analysed for this study. The travel time data identifies some delays on SH1, notably northbound in the afternoon / evening peak period.

Analysis and assessment has been completed using average Monday-to-Thursday traffic counts and conditions.

The travel time data clearly identifies Friday afternoon / evenings experience higher delays than typical Monday-to-Thursdays and count data shows that volumes on Fridays are around 10% higher than on other days.

10.3 TRANSPORT MODELLING SYSTEM

A transport modelling system has been developed utilising a TRACKS regional model which estimates traffic volumes from land-use inputs and a Microsimulation model which is focussed on providing measurements and outputs relating to the performance and operation of the various scenarios. The two models have the same zoning system and the TRACKS model feeds base year travel patterns and forecast growth to the microsimulation model.

The TRACKS model has only undergone a straightforward check of modelled and observed traffic volumes.

The microsimulation model has been fully calibrated and validated to observed data. The model calibration / validation levels reached meet the targets in the NZ Transport Model Development guidelines for a project of this nature and purpose.

10.4 FORECASTING, DO MINIMUM AND THRESHOLD ASSESSMENT

Agreed future year land use data for the region has been input to the TRACKS model and, along with external growth rates, forecast traffic volumes estimated. The growth between the base and future years has been added to the base year microsimulation model demands to develop future year demand scenarios for the assessment.

The microsimulation model Do Minimum network includes in the two committed signal upgrades on SH1; Walnut Ave and Lagmhor Road / Agnes Street.

A threshold assessment has been carried out on key movements in the study area from the 2021, 2031, and 2041 Do Minimum microsimulation model outputs. Based on this assessment of typical Monday-to-Thursday's, additional river crossing capacity would be required between 2031 and 2041.

10.5 ASSESSMENT OF BRIDGE ALIGNMENT SCENARIOS

The microsimulation model has been applied to look at several measures and outputs. This has compared three scenarios; the Do Minimum, an SH1 Duplication Bridge alignment, and a Chalmers Ave Bridge alignment.

The results from this assessment are provided in Section 9 of this report

10.6 FUTURE ASSESSMENT WORK

The transport modelling system described in this port is a robust foundation for future transport work in Ashburton – e.g., future business case stages, economic analyses, intersection upgrade assessments etc.

Appendices

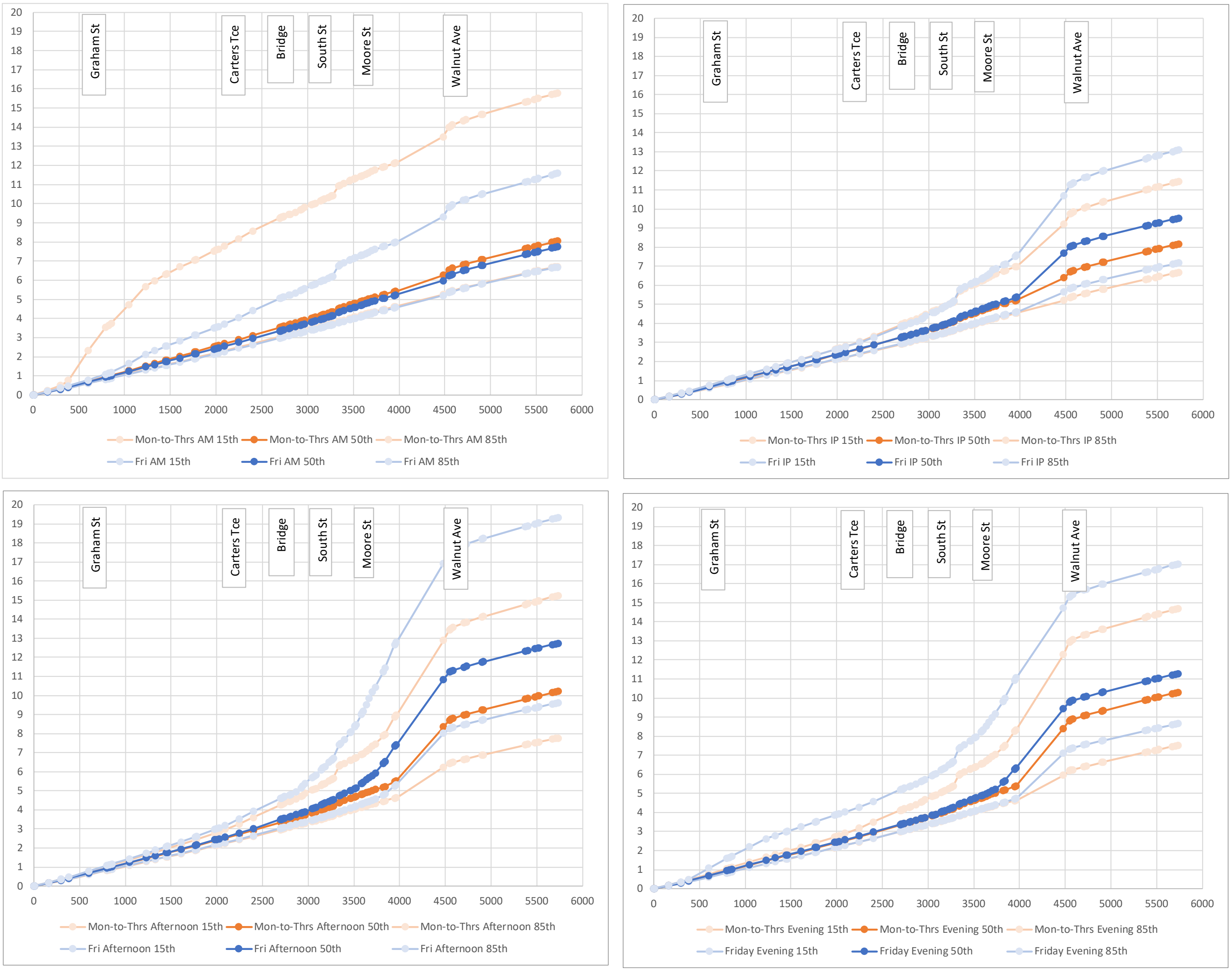
We design with community in mind

Appendix A   OBSERVED TRAVEL TIME DATA

TOMTOM MON-TO-THURS AND FRIDAY TRAVEL TIMES

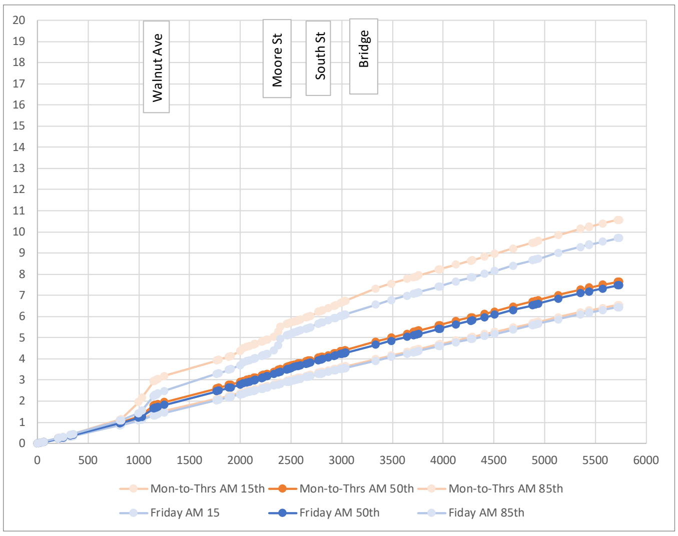
The graphs below show time / distance plots for Monday-to-Thursdays and Fridays through non-holiday weekdays in June and July 2021.

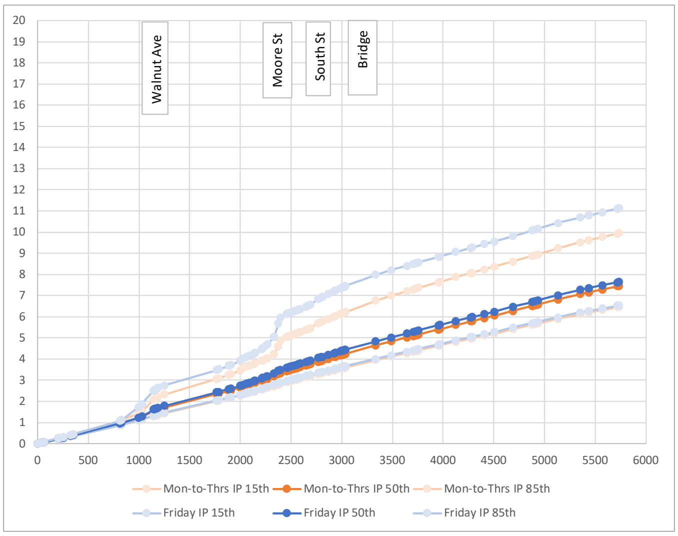
Key streets / network features are noted on the graphs below. The slope of the graph indicates delay, the steeper the slope the greater the delay. Increasing slope *before* a street / feature indicates that this feature may generating the delays.

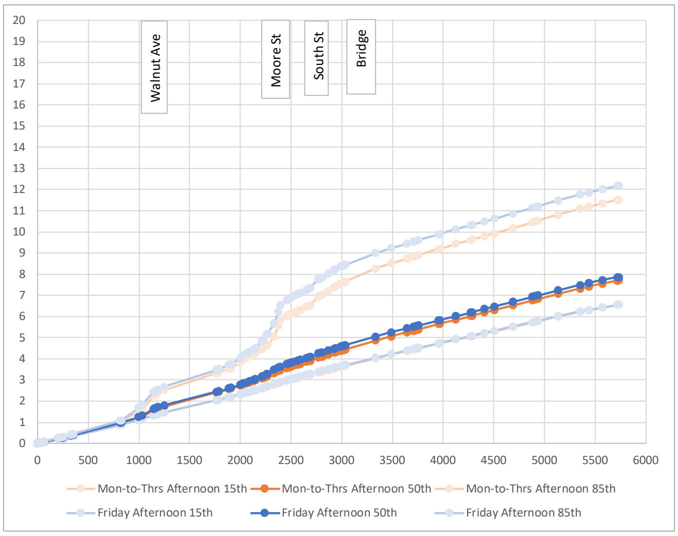


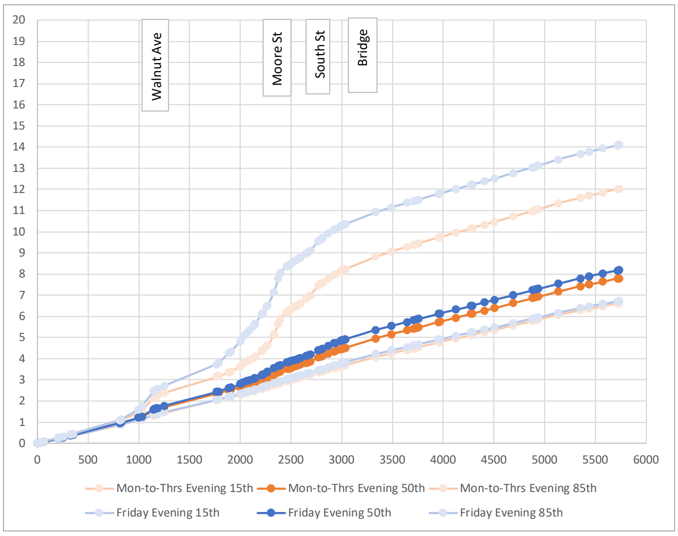
Northbound TomTom Mon-to-Thurs and Friday Travel Times

Appendix A Observed Travel Time Data







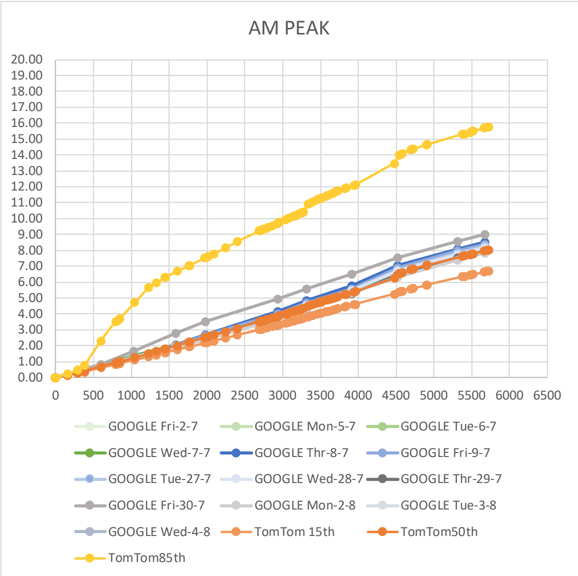


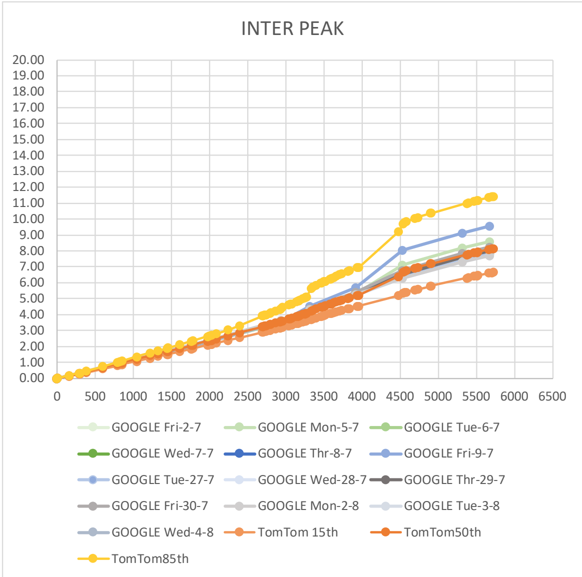
Southbound TomTom Mon-to-Thurs and Friday Travel Times

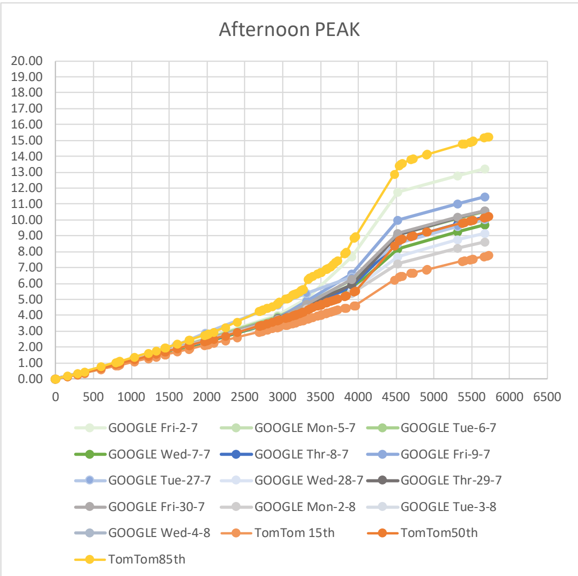
Appendix A Observed Travel Time Data

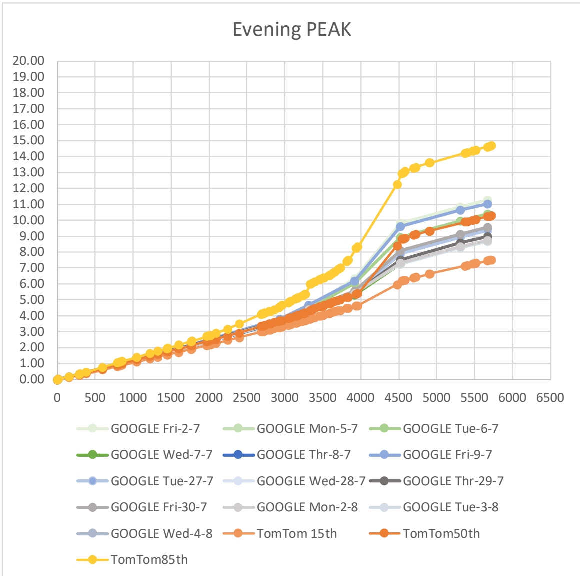
TOMTOM AND GOOGLE TRAVEL TIME CHECK

The graphs below show time / distance plots comparing the TomTom and Google travel time data on SH1 through Ashburton for June and July 2021.



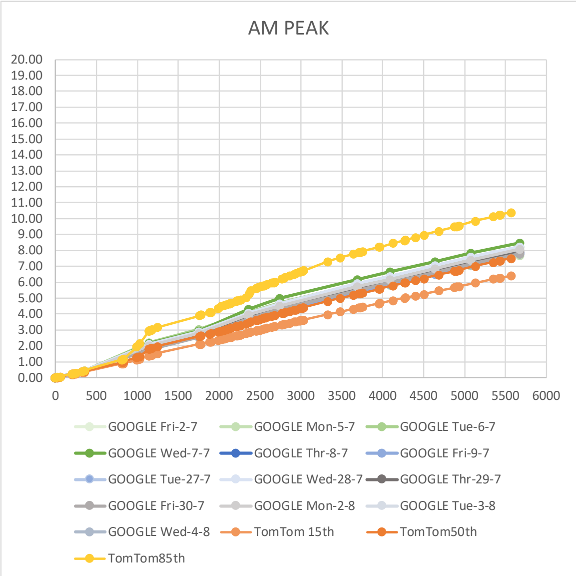


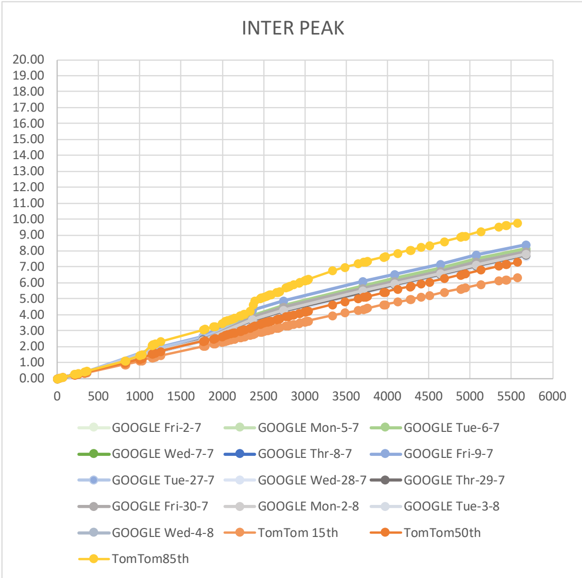


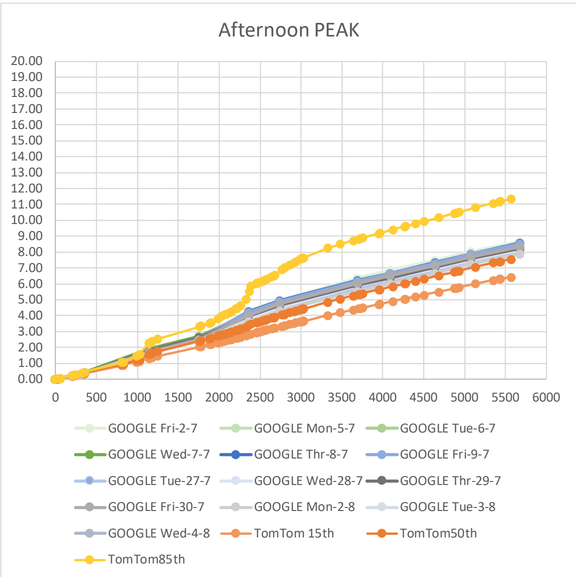


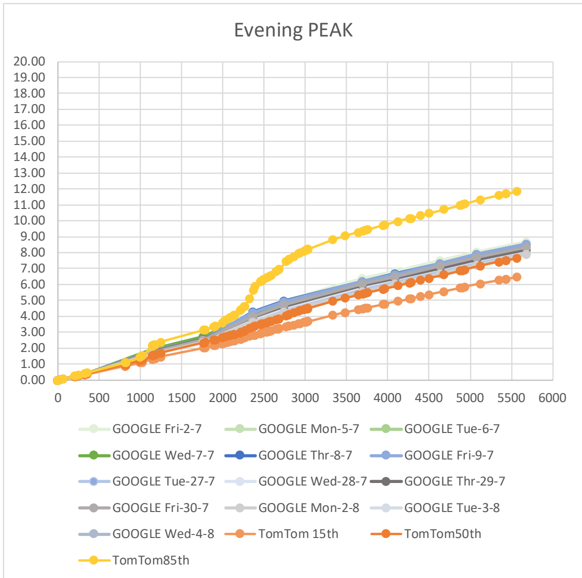
Northbound check of Google and TomTom Travel Time Data

Appendix A Observed Travel Time Data









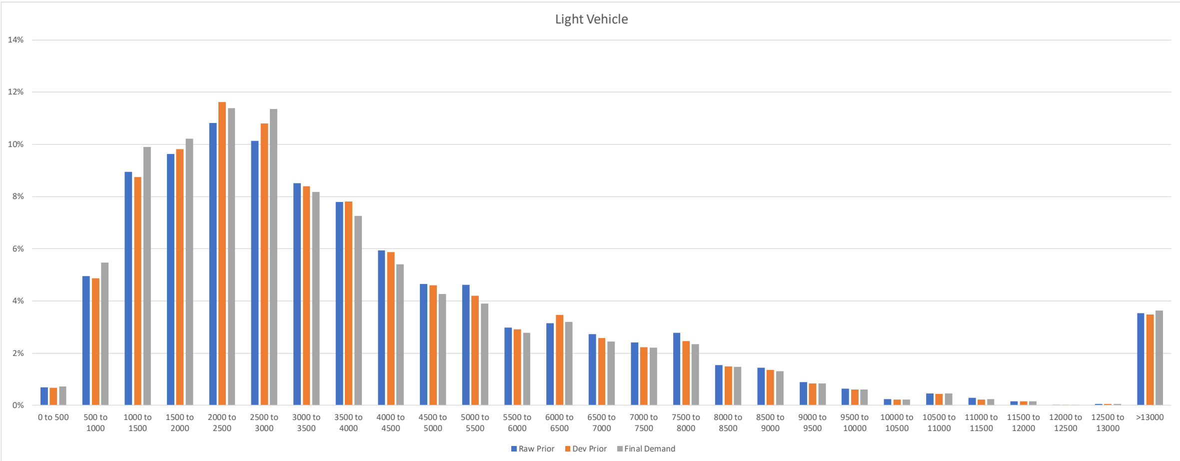
Southbound check of Google and TomTom Travel Time Data

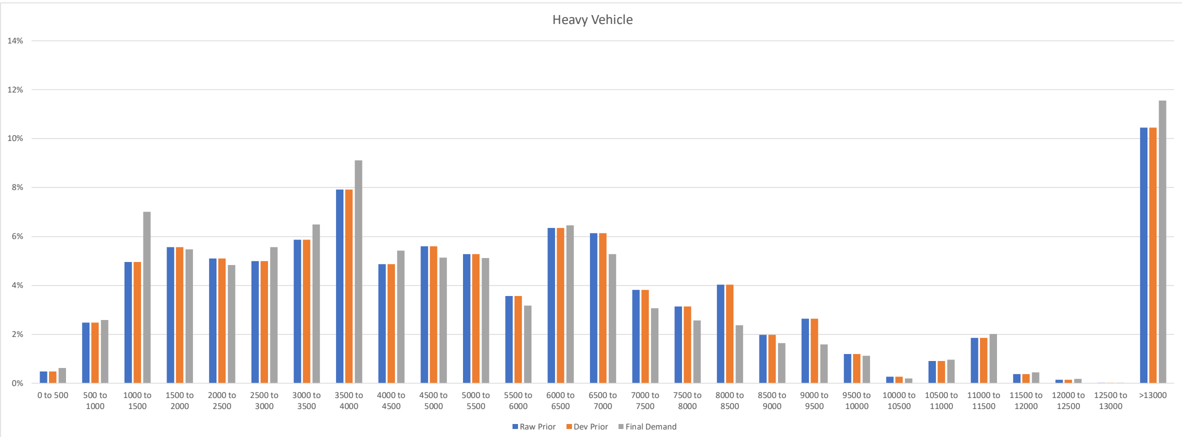
Appendix B MATRIX ESTIMATION OUTCOMES

The figures below provide checks on key travel patterns following application of Matrix Estimation to refine the base year matrices in the microsimulation model.

TRIP LENGTH DISTRIBUTION

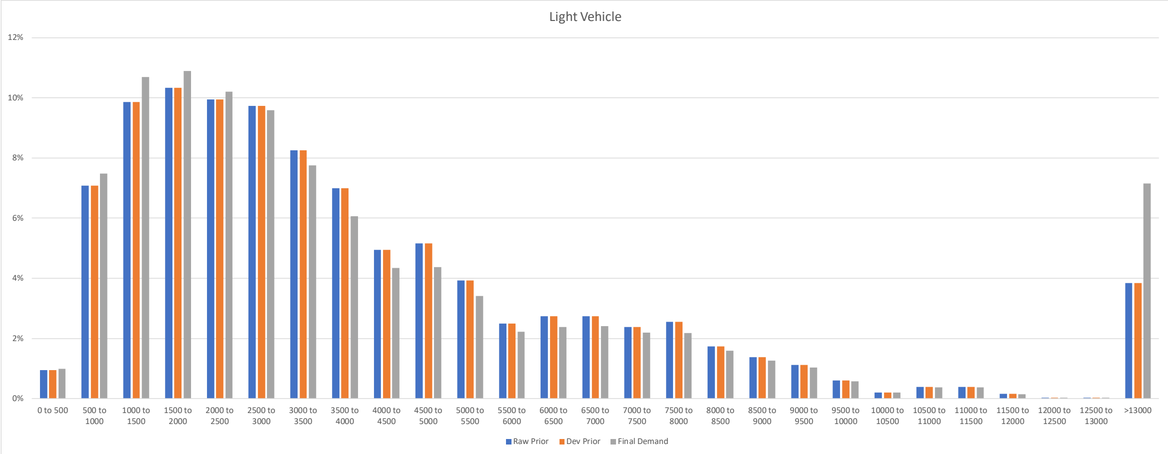
The figures below show trip length distributions for Light and Heavy matrices for the AM, IP and PM periods.

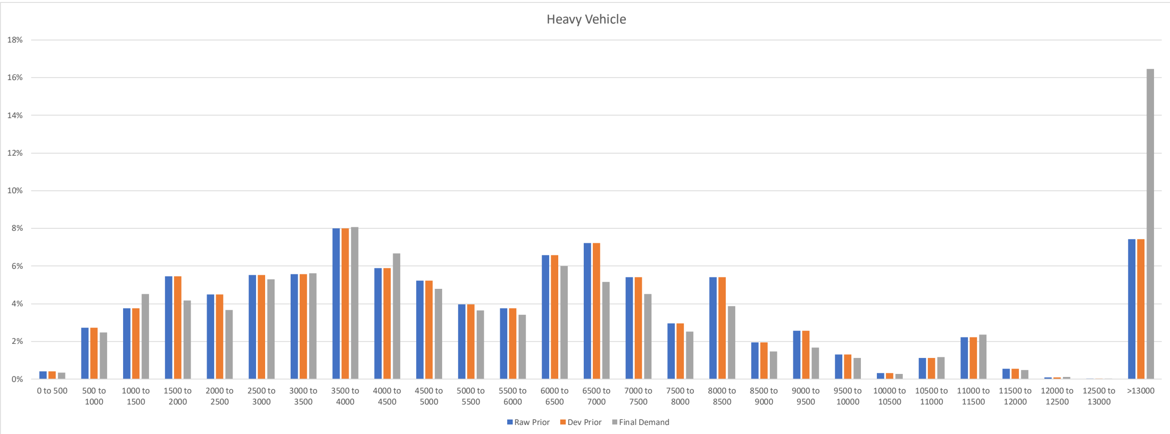




AM Period Trip Length Distributions

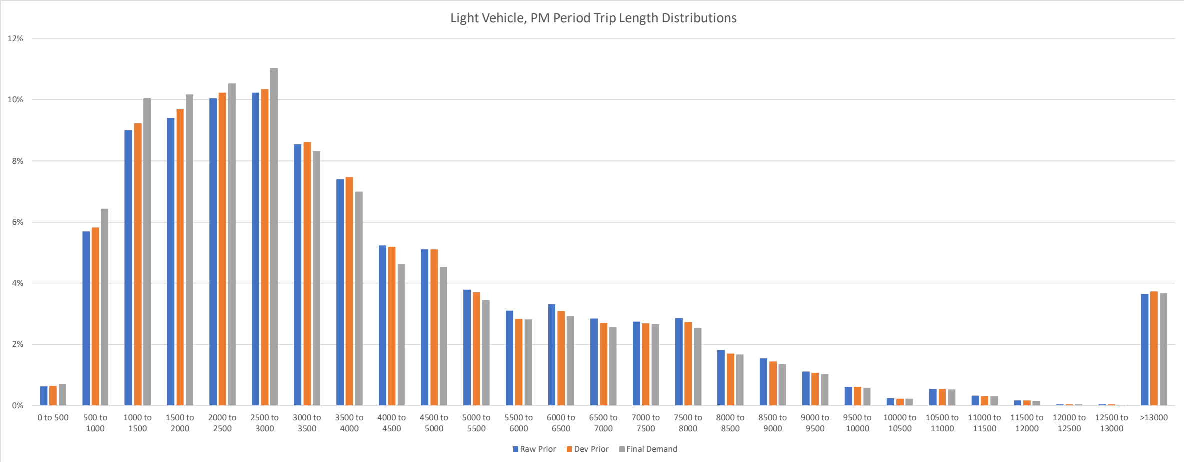
Appendix B Matrix Estimation Outcomes

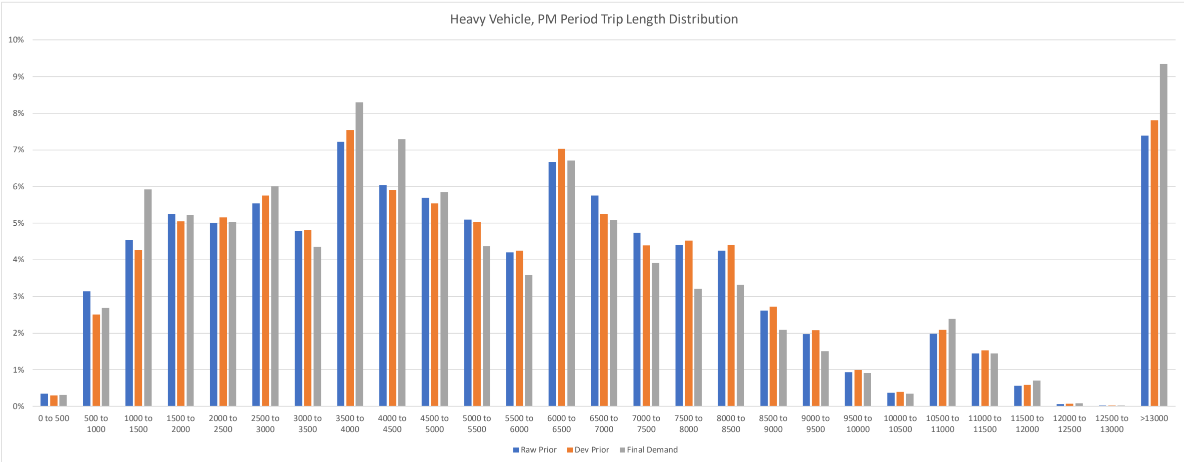




IP Period Trip Length Distributions

Appendix B Matrix Estimation Outcomes

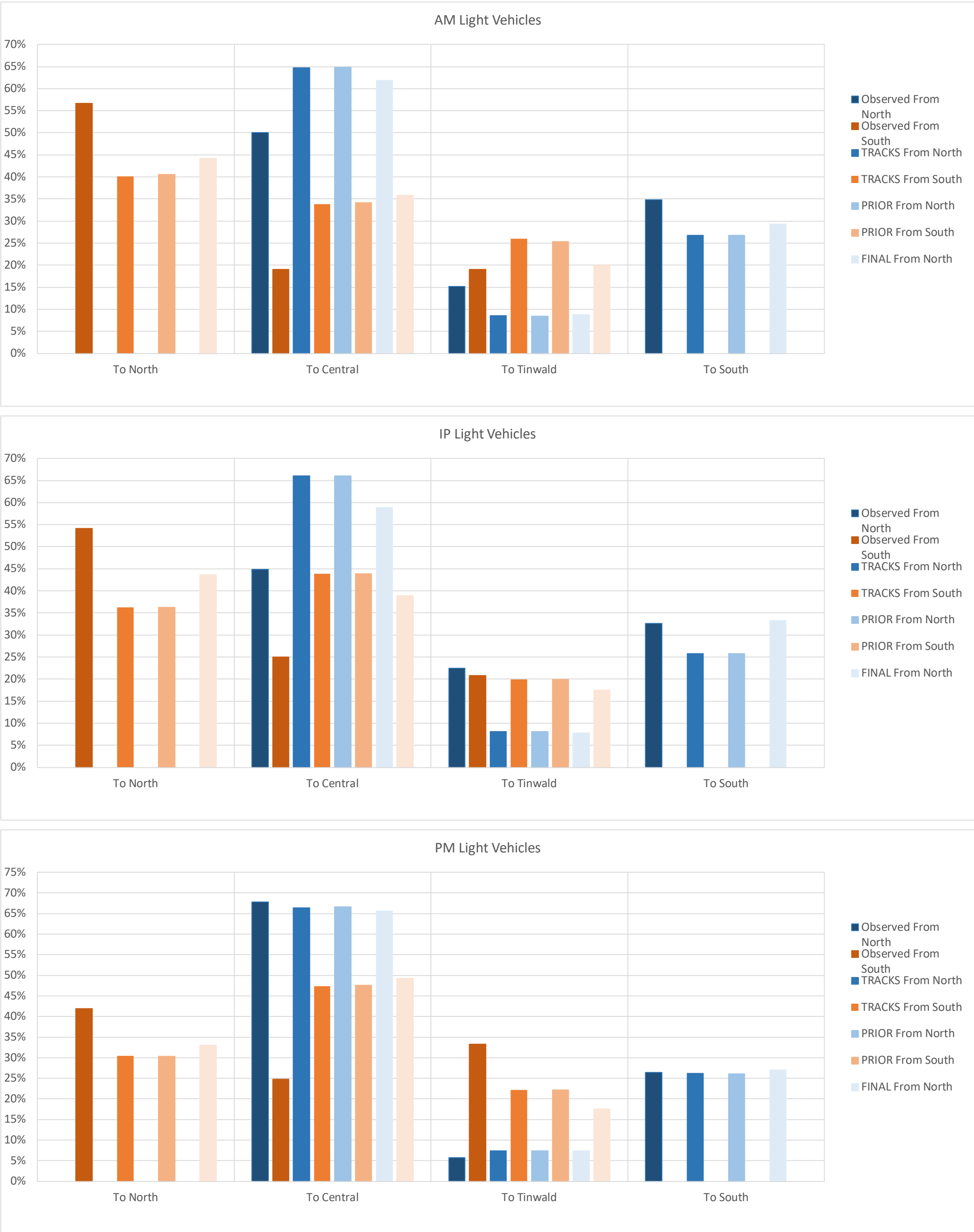




PM Period Trip Length Distributions

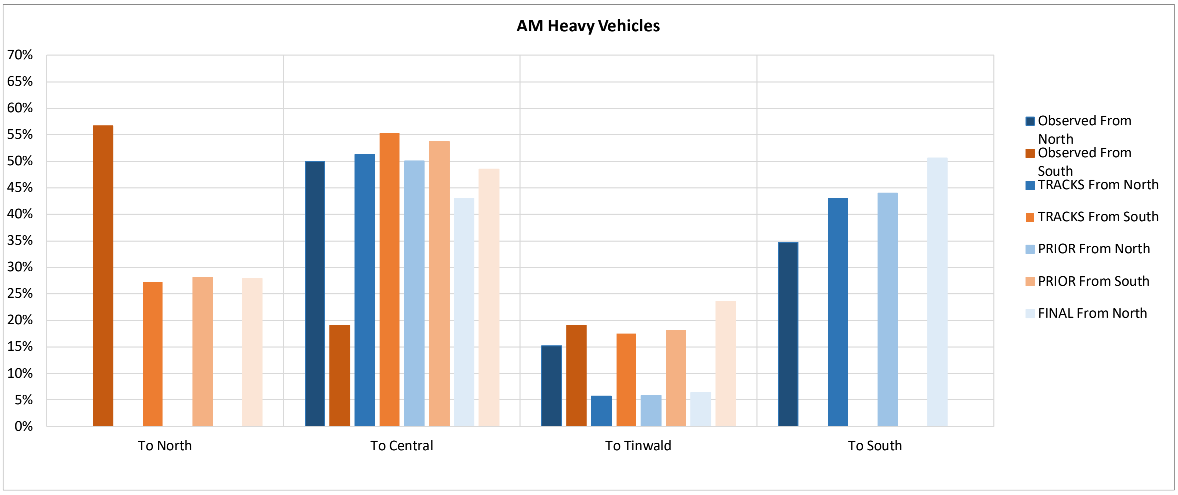
COMPARISONS WITH OD SURVEY

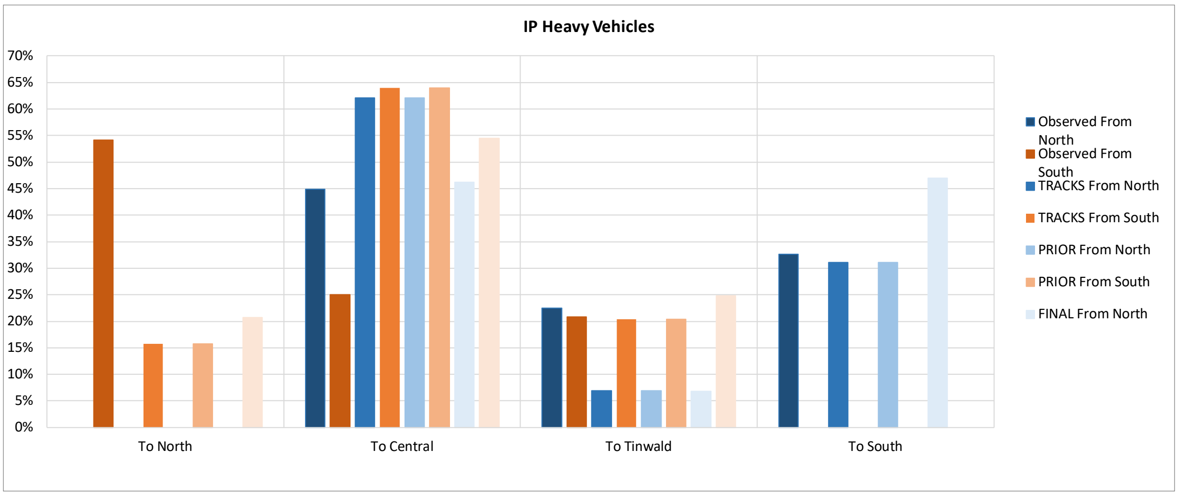
The graphs below show the key OD travel patterns through the network, compared with observed data from the number plate survey.

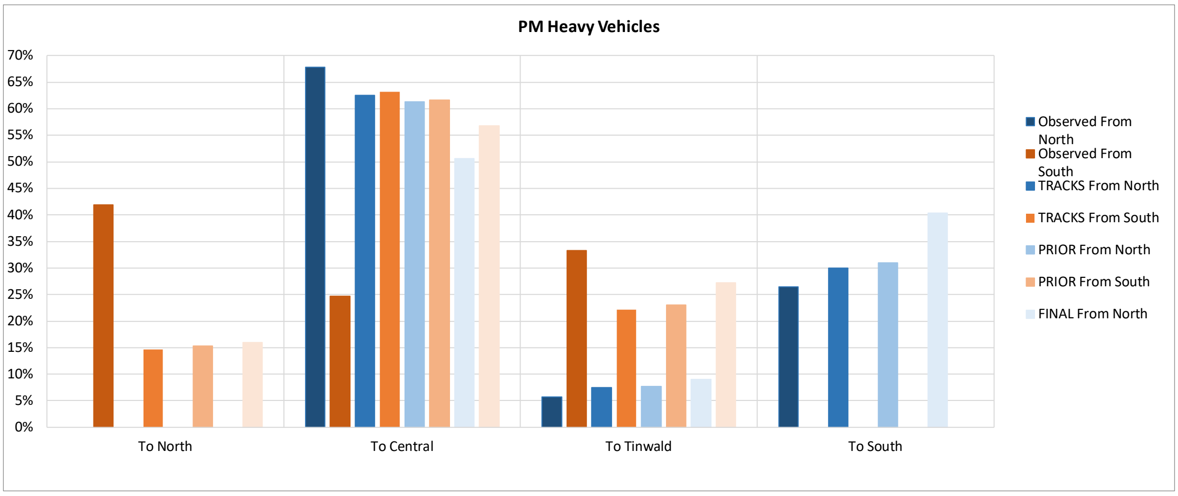


Light Vehicle OD Travel Patterns, Comparison with Number Plate Survey

Appendix B Matrix Estimation Outcomes



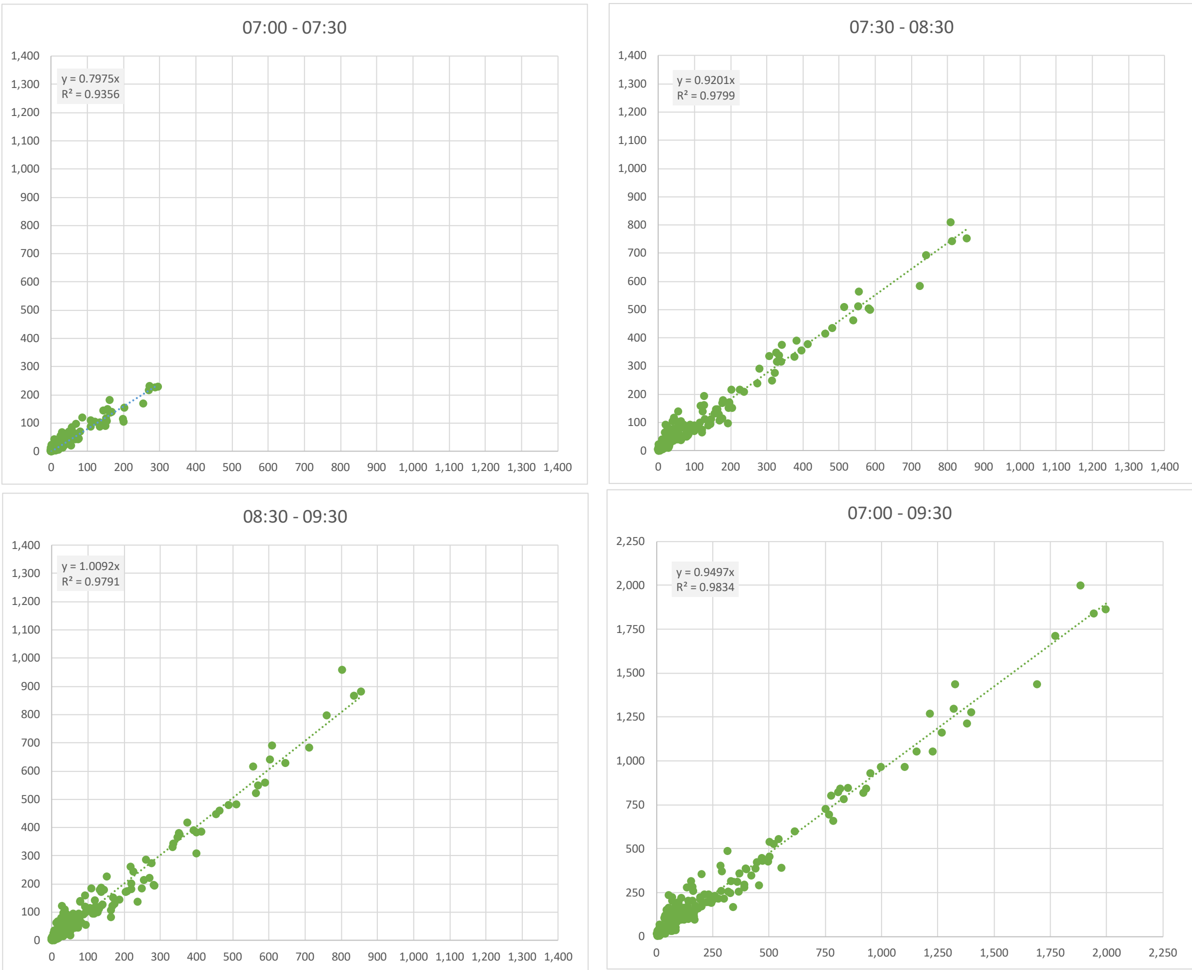




Heavy Vehicle OD Travel Patterns, Comparison with Number Plate Survey

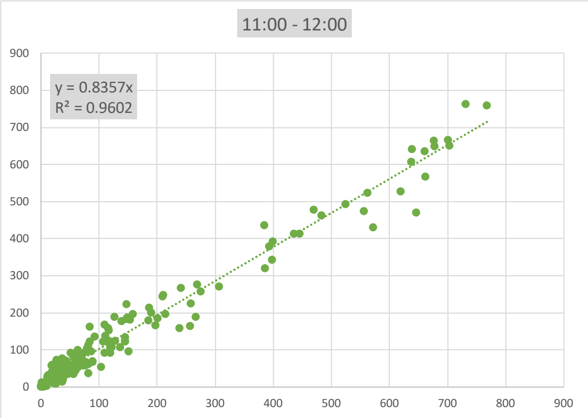
Appendix C COUNT CALIBRATION XY SCATTERS

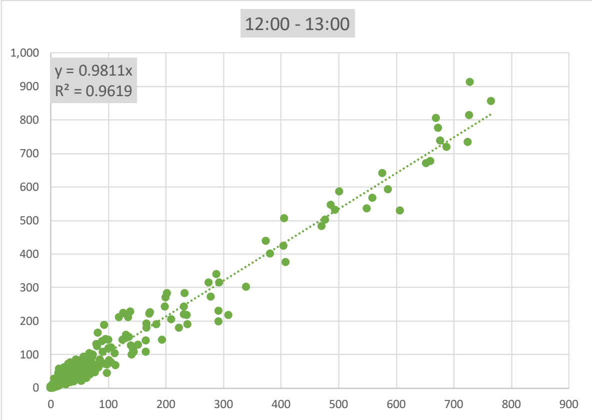
XY SCATTER PLOTS

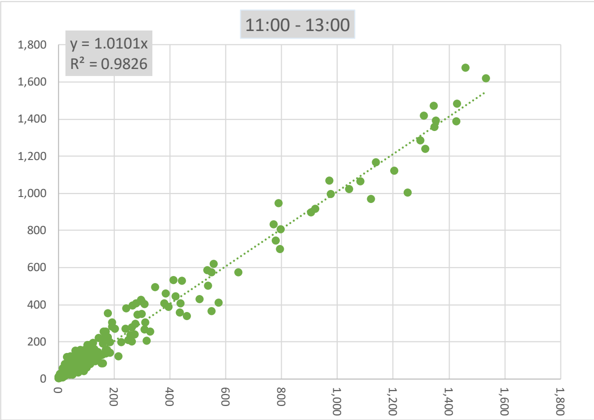


AM Period XY Observed vs Modelled Count Scatter Plots

Appendix C Count Calibration XY Scatters

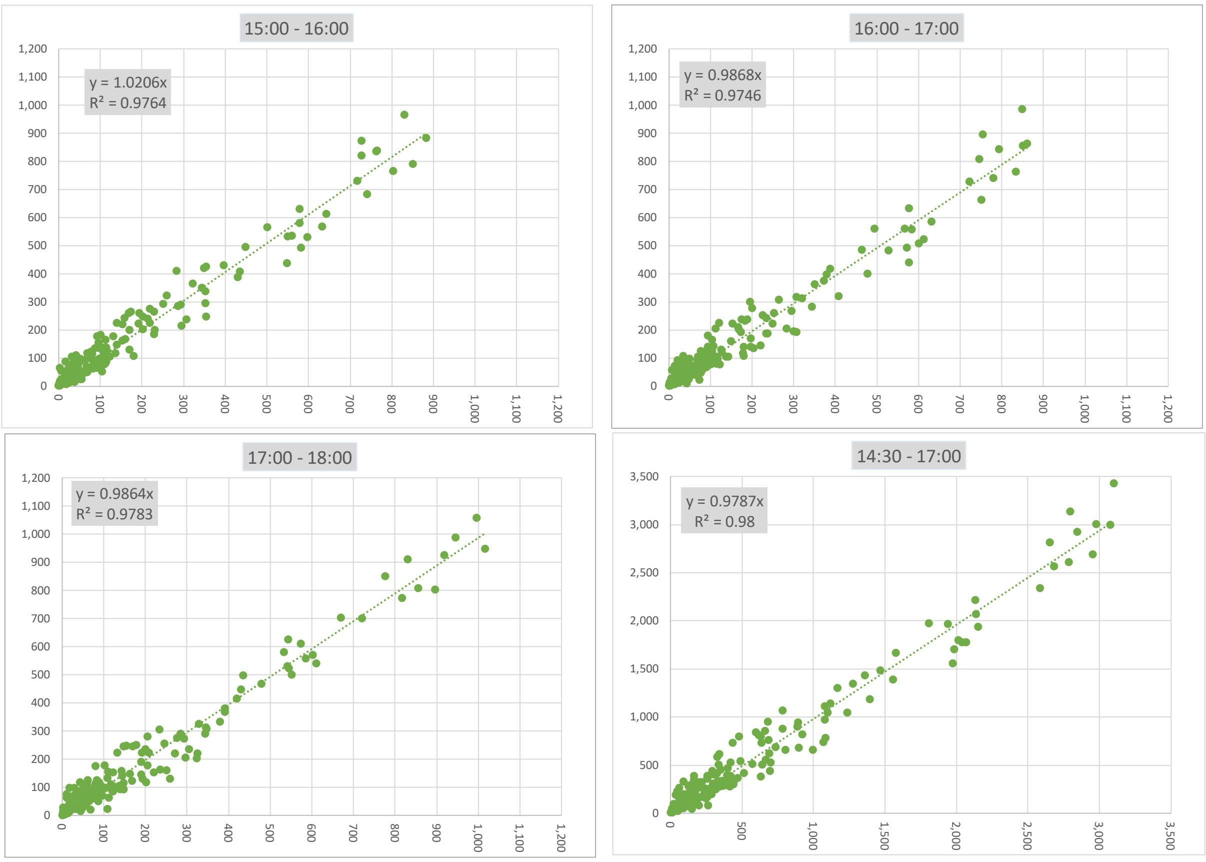






IP Period XY Observed vs Modelled Count Scatter Plots

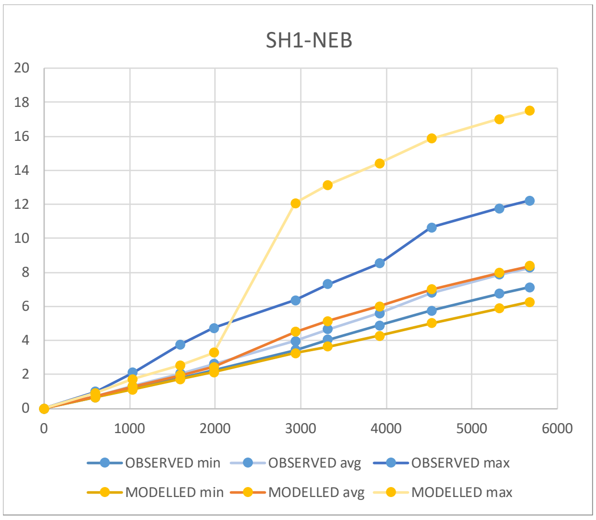
Appendix C Count Calibration XY Scatters

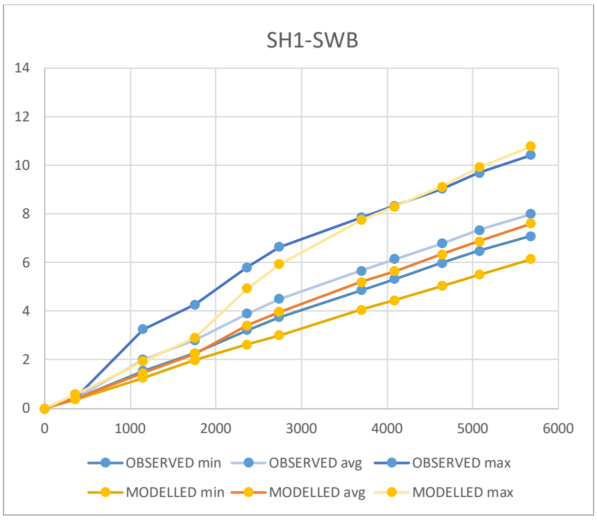


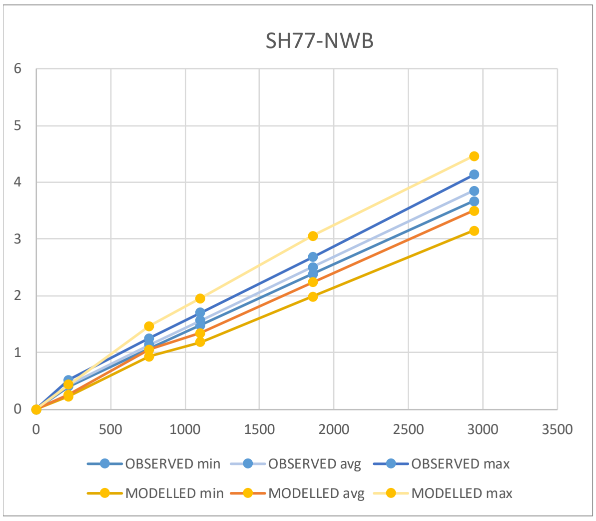
PM Period XY Observed vs Modelled Count Scatter Plots

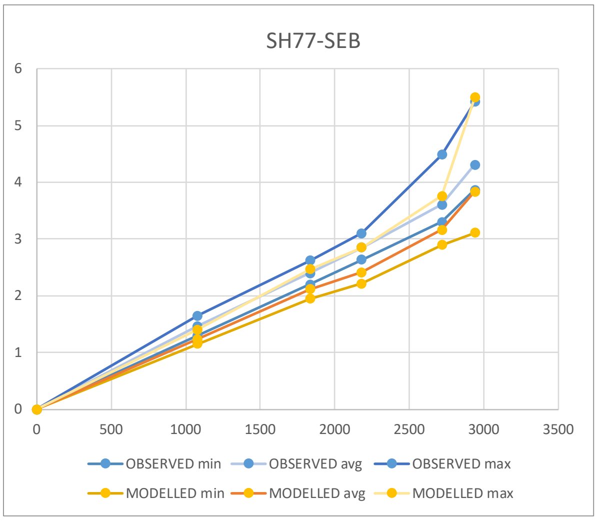
Appendix D TRAVEL TIME VALIDATION GRAPHS

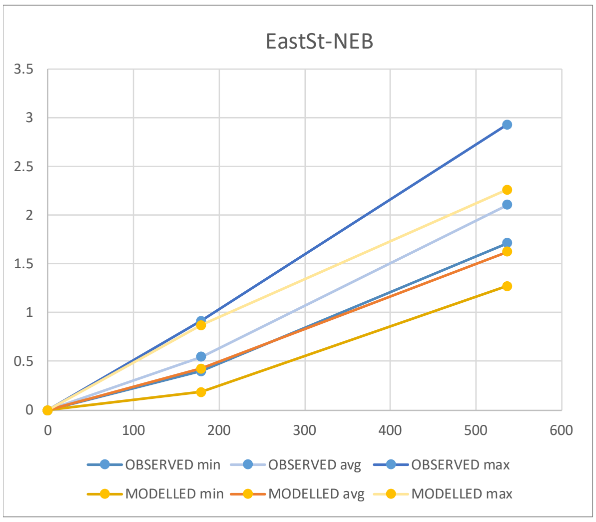
AM PERIOD TIME VS DISTANCE VALIDATION GRAPHS



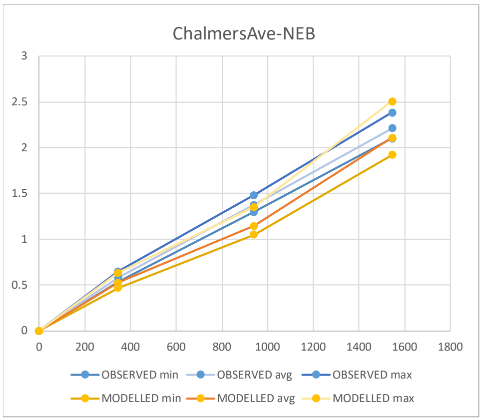


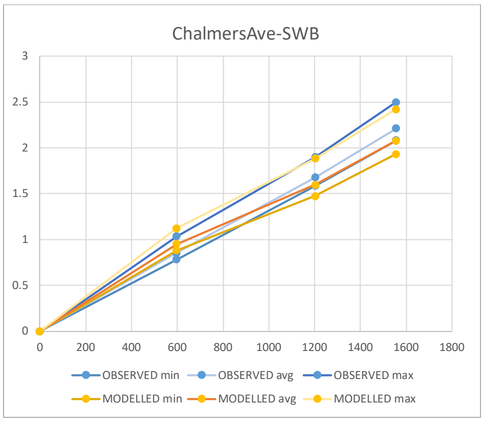


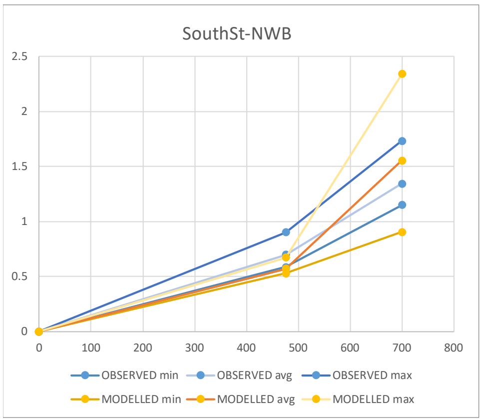


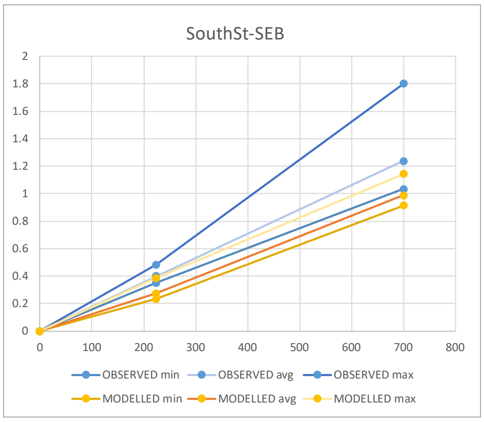


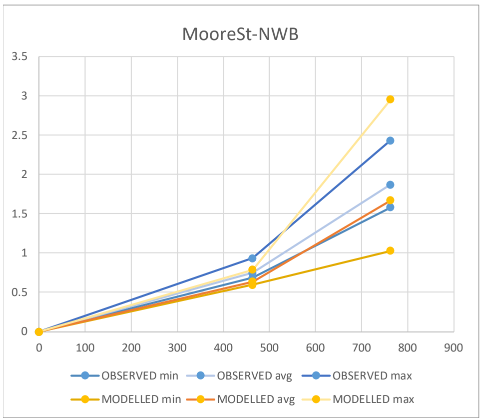
Appendix D Travel Time Validation Graphs

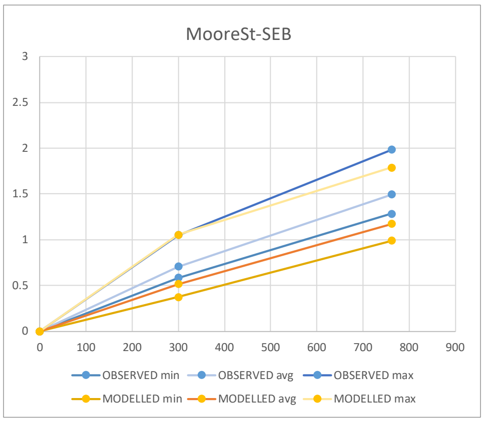


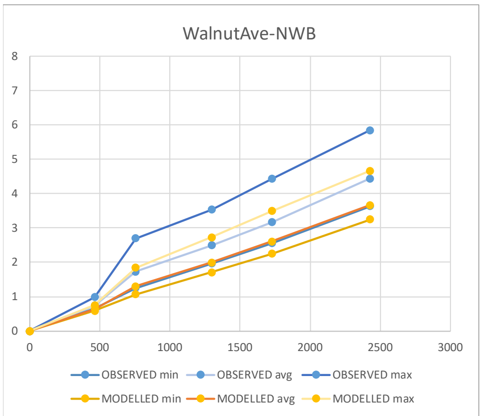


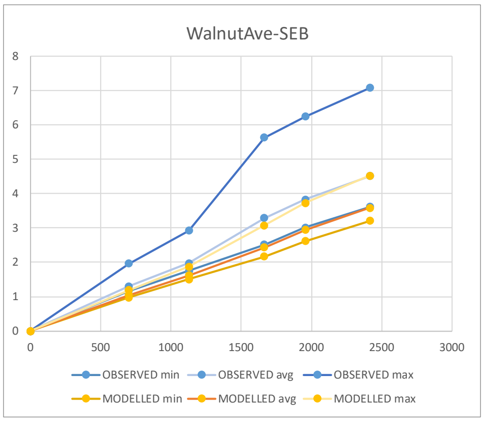




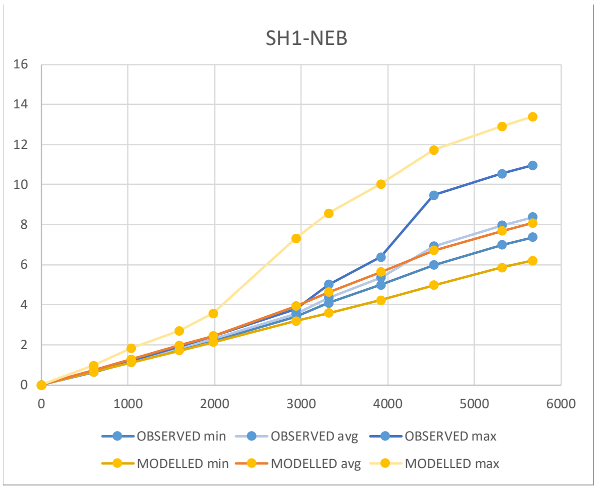


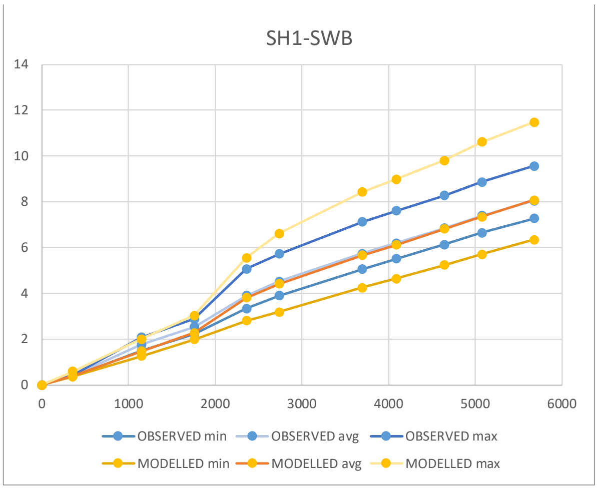


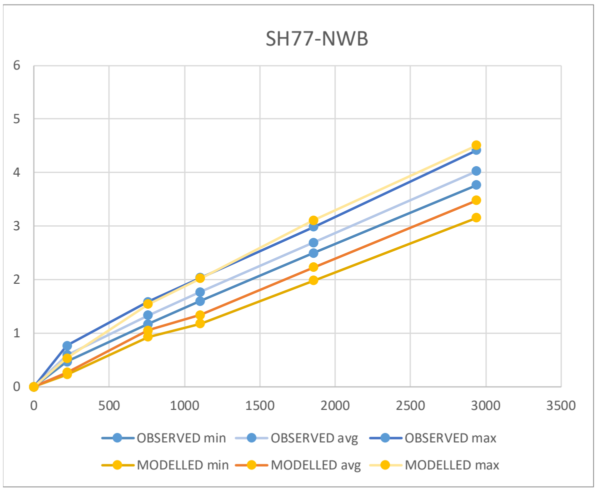


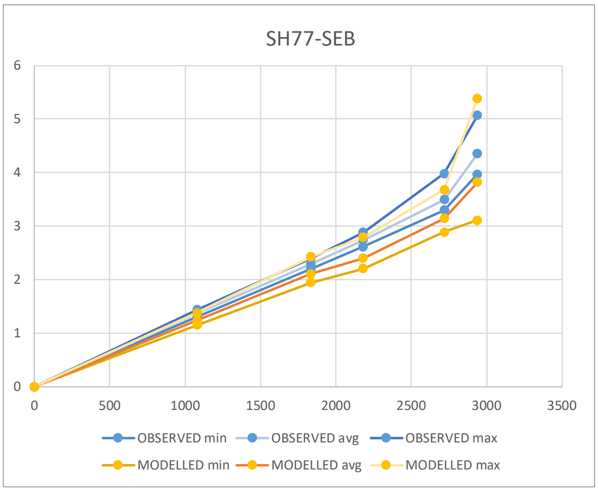


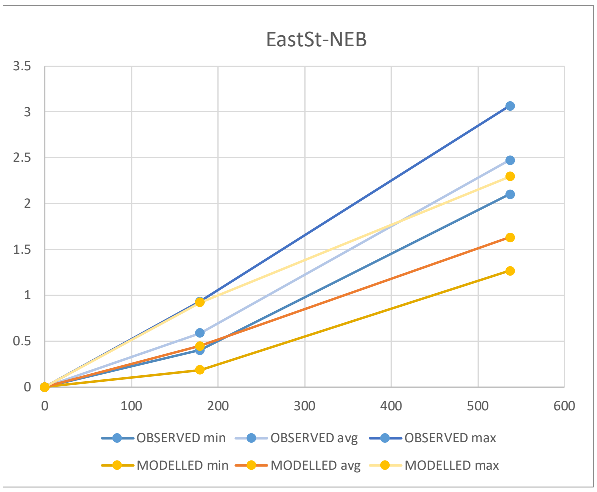
IP PERIOD TIME VS DISTANCE VALIDATION GRAPHS



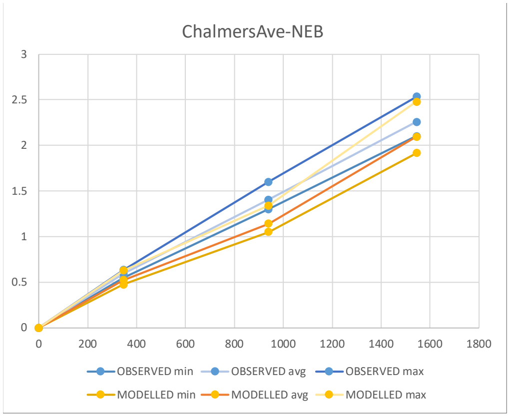


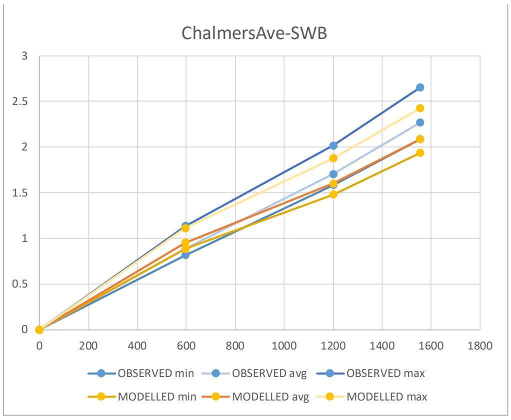


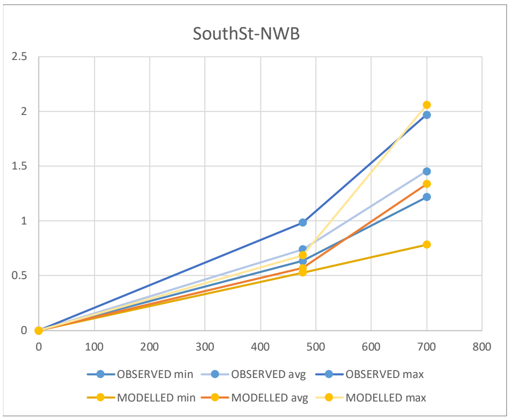


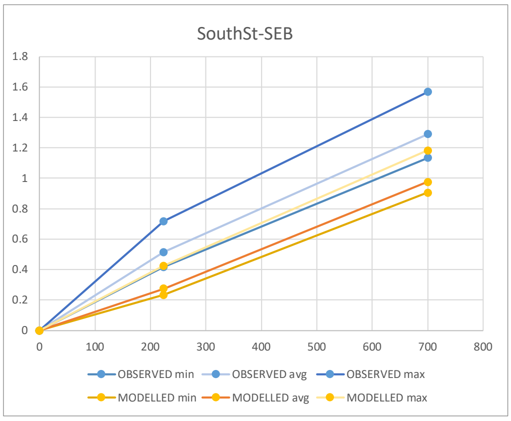


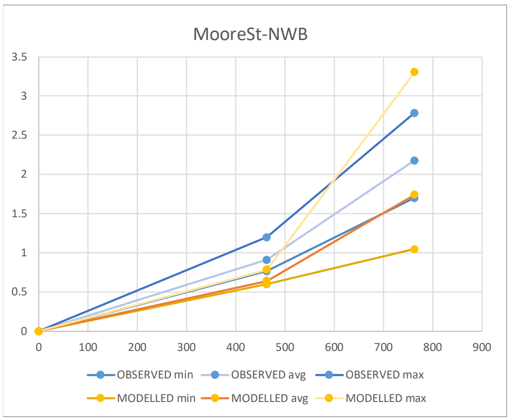
Appendix D Travel Time Validation Graphs

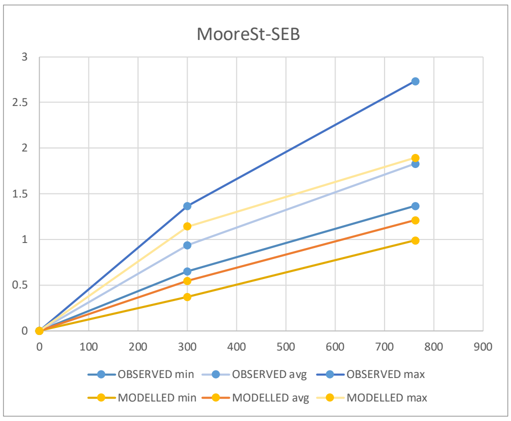


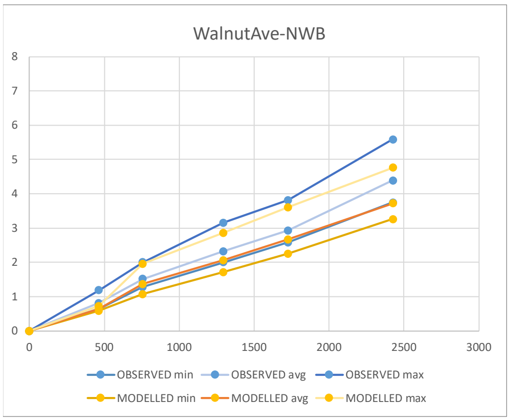


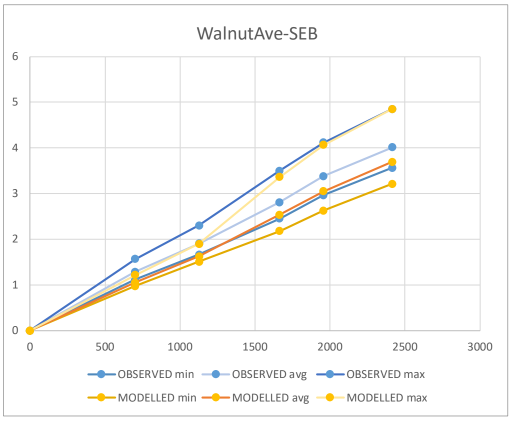




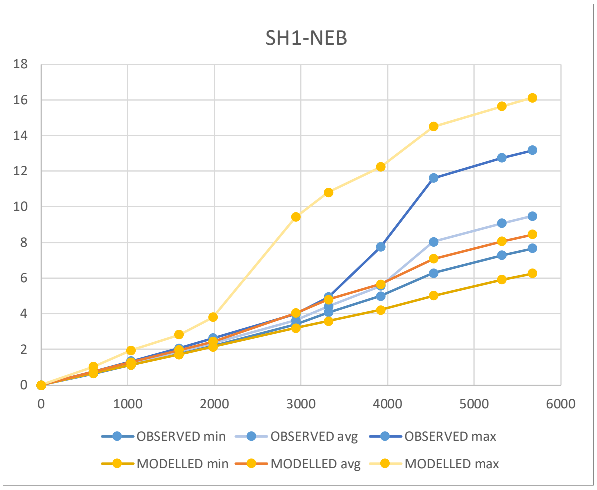


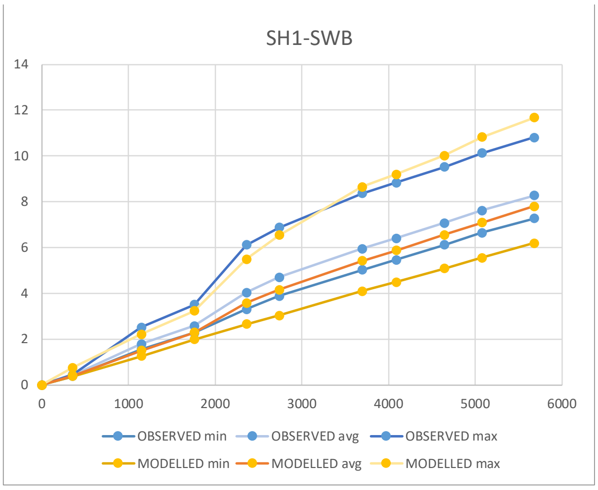


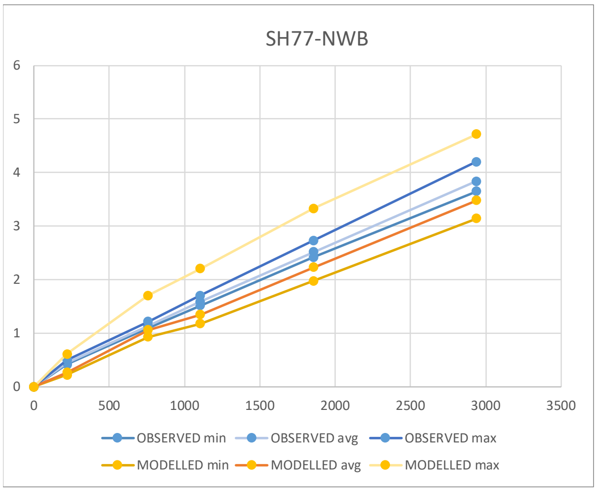


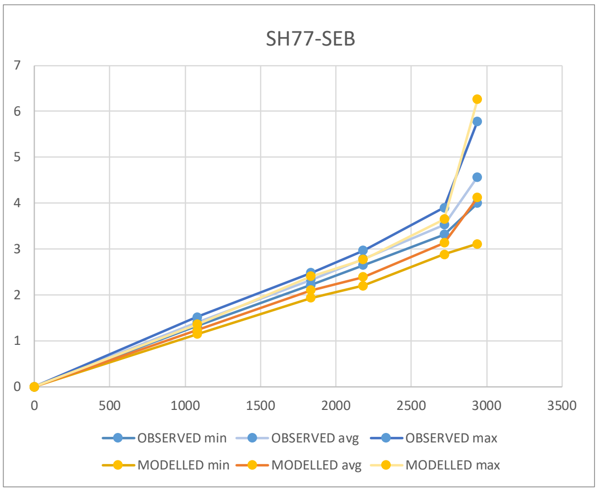


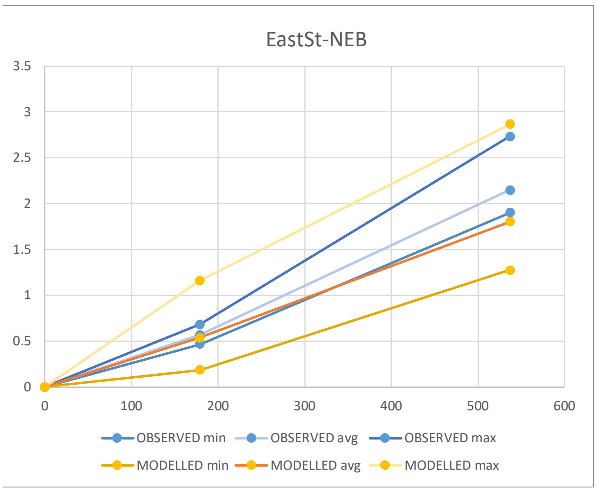
PM PERIOD TIME VS DISTANCE VALIDATION GRAPHS



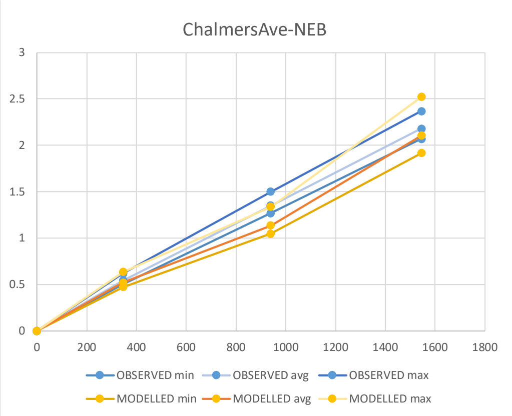


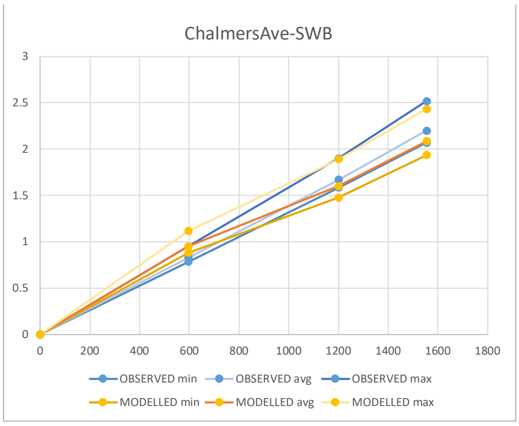


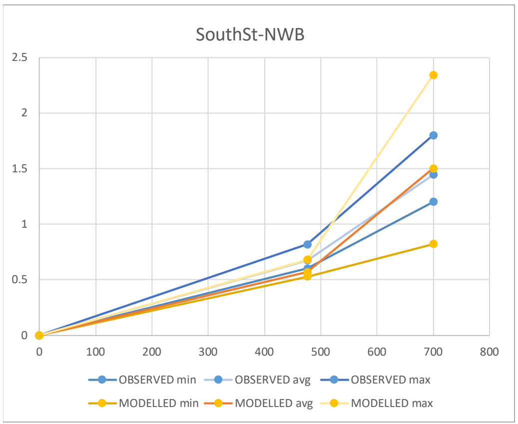


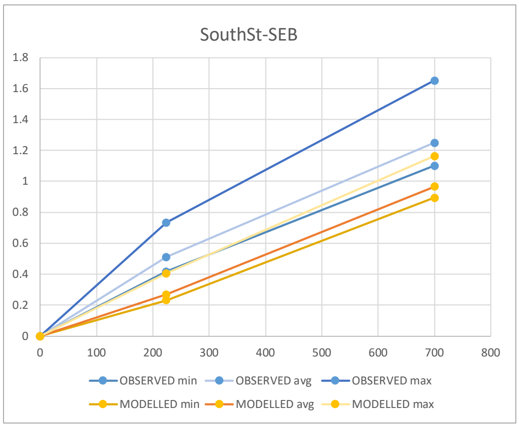


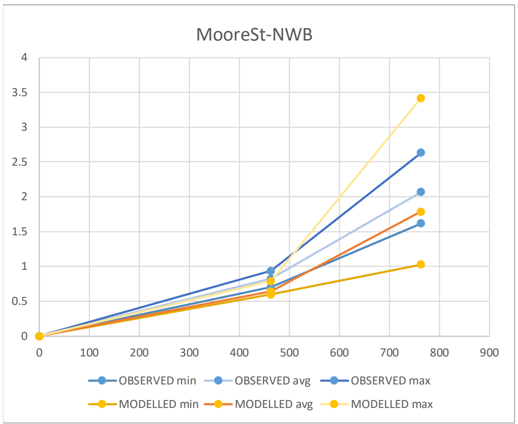
Appendix D Travel Time Validation Graphs

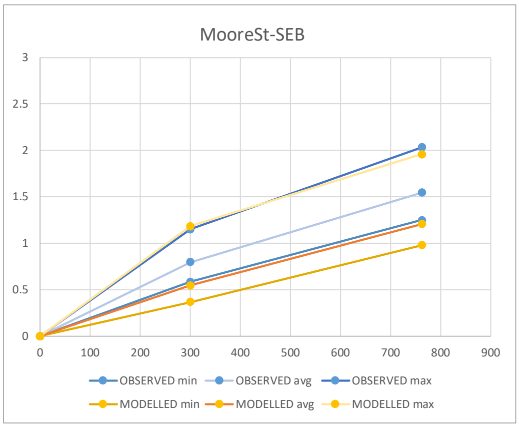


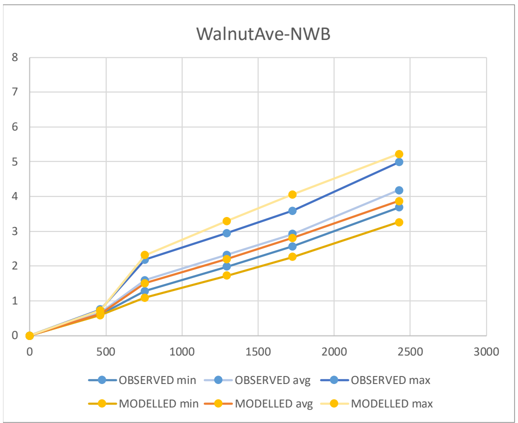


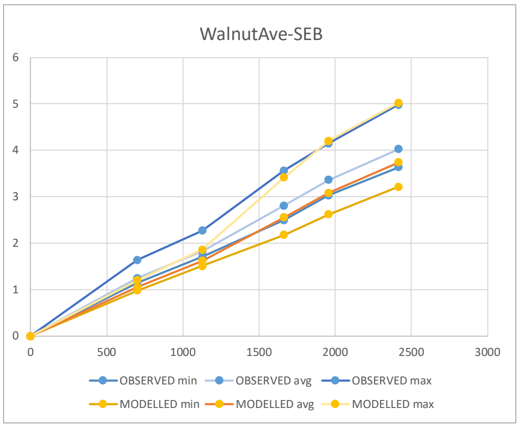






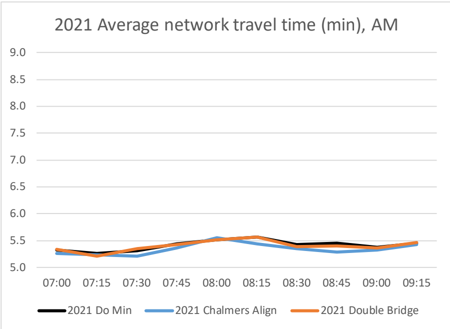


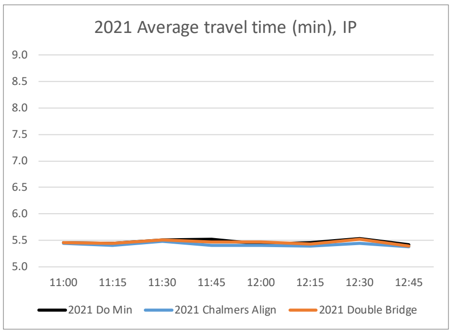


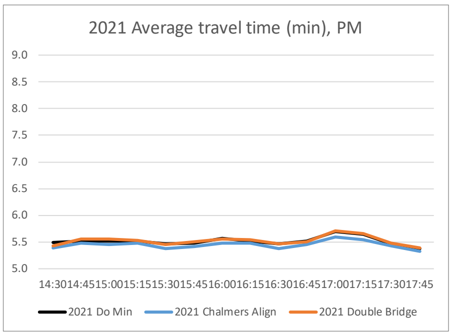


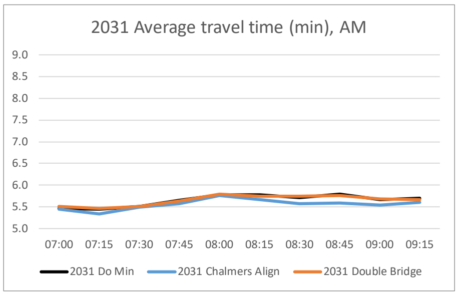
Appendix E 15 MINUTE NETWORK WIDE TRAVEL TIMES

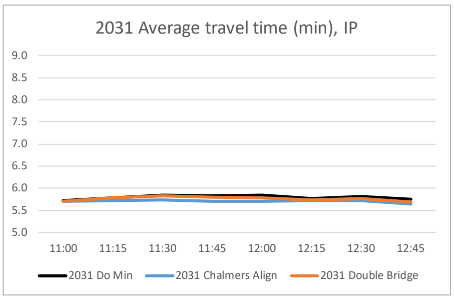
The graphs below show 15-minute weighted network average travel times for each modelled period and year.

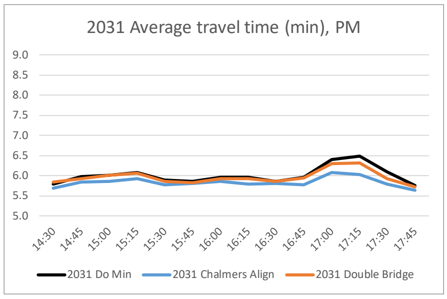


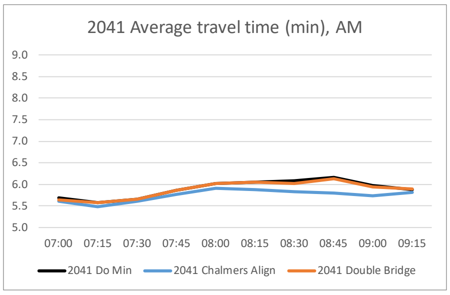


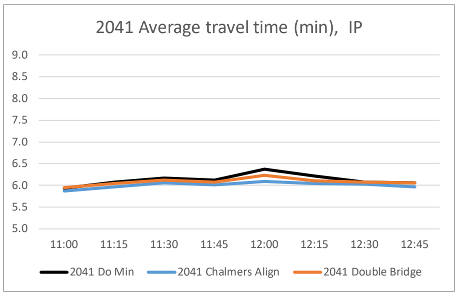


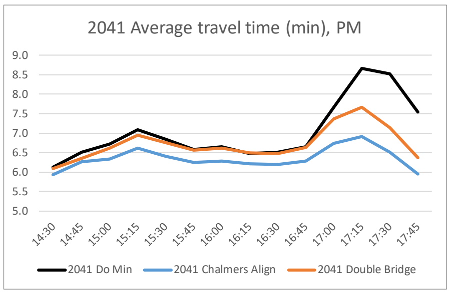












CREATING COMMUNITIES

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of belonging. That's why at Stantec, we always **design with community in mind**.

We care about the communities we serve—because they're our communities too. We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

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