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Redcliffe Area Traffic Study

Calibration and Validation

Transport Report

PREPARED FOR:
City of Belmont

March 2025

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1.1 Introduction

Transcore has been commissioned by the City of Belmont (The City) to undertake microsimulation traffic modelling and analysis for the Redcliffe area, focusing on existing conditions (2024), short-term scenarios (2032), and long-term scenarios (2041).

As part of this project, Transcore has conducted extensive data collection and site observations in collaboration with The City and Perth Airport. A comprehensive Traffic Report has been prepared for the "Existing Situation," documenting the collected data, details of the existing road network, and other relevant information that serves as inputs for the microsimulation models.

Transcore prepared three different traffic reports for this study:

- Existing Situation Report;
- **Calibration and Validation Report**; and,
- Traffic Analysis Report.

This traffic report details the outcomes of the calibration and validation process, ensuring that the models accurately reflect real-world conditions.

1.2 Project Details

The primary objective of this project is to identify preferred network improvements that will enhance connectivity to the wider Belmont area and the regional road network, while also establishing necessary safety and amenity improvements to better serve the community.

Accordingly, Transcore developed microsimulation transport models for this study using VISSIM[1] software. This advanced modelling technique enables detailed analysis of traffic patterns and behaviours under various conditions, allowing for accurate predictions on how land use and changes in the network might influence overall traffic flow.

Figure 1 shows the modelling study area. As evident, the modelling study area including multiple long corridors with various routes between origin and destination zones would be classified as Model Category 3 in accordance with Main Roads WA Operation Guidelines.

[1] Verkehr In Städten - SIMulations modell (German for "Traffic in cities - simulation model")

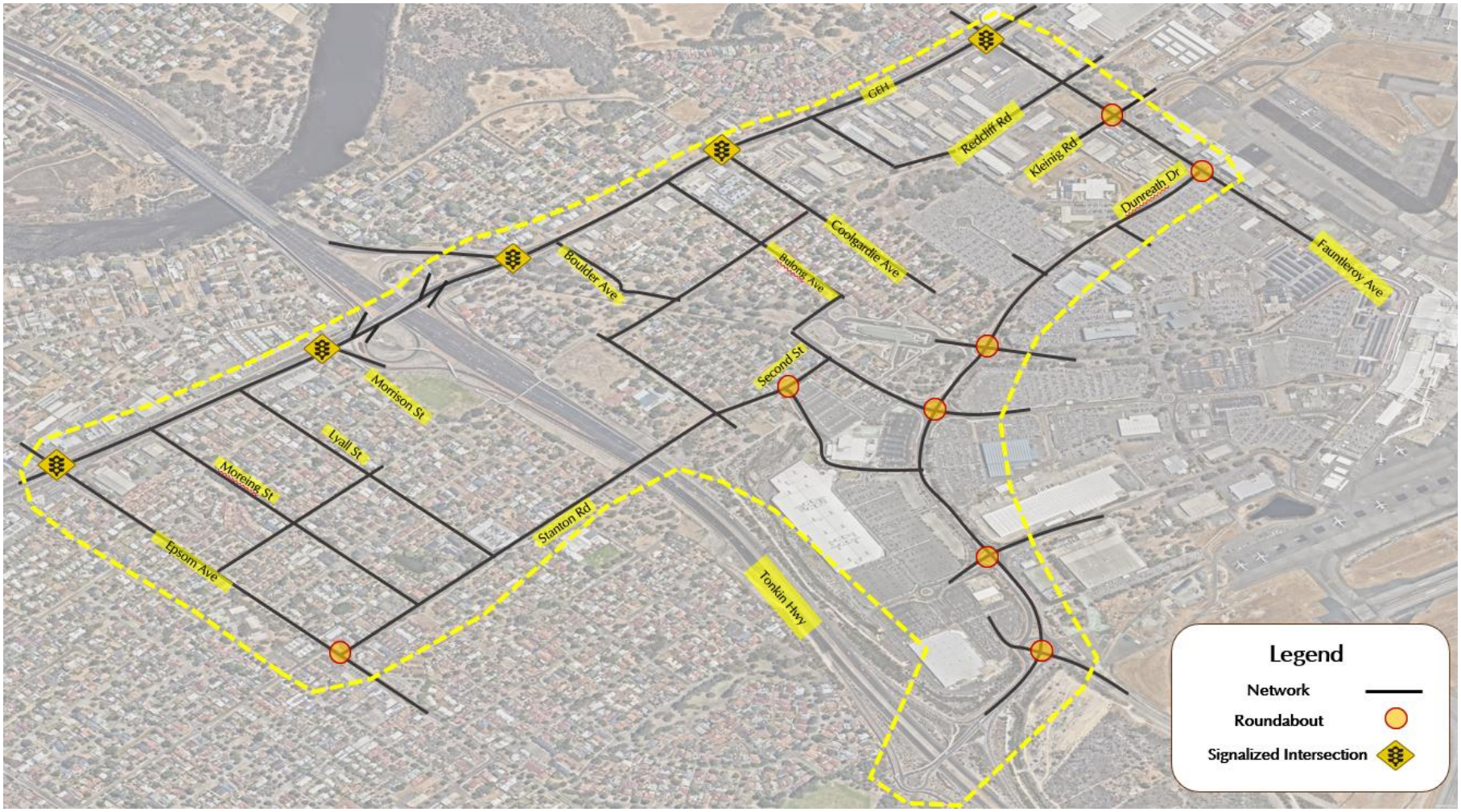


Figure 1: Modelling study area

2 Data Collection

2.1 Traffic counts

As part of the Redcliffe Area Traffic Study, video traffic counts were organised by The City and Perth Airport on Thursday, 23 May 2024. These video counts focused on key intersections within the modelling study area, providing valuable data for traffic analysis. Additionally, The City supplied the latest Sydney Coordinated Adaptive Traffic System (SCATS) data (sourced from Main Roads WA) for all signalised intersections within the modelling area, also corresponding to the same date.

Figure 2 illustrates the locations of the traffic counts. Transcore conducted a thorough review of the collected traffic counts and prepared detailed turning movement counts at these key intersections. The analysis covered two critical peak periods:

- Morning Peak: 8:00 AM to 9:00 AM
- Afternoon Peak: 4:00 PM to 5:00 PM

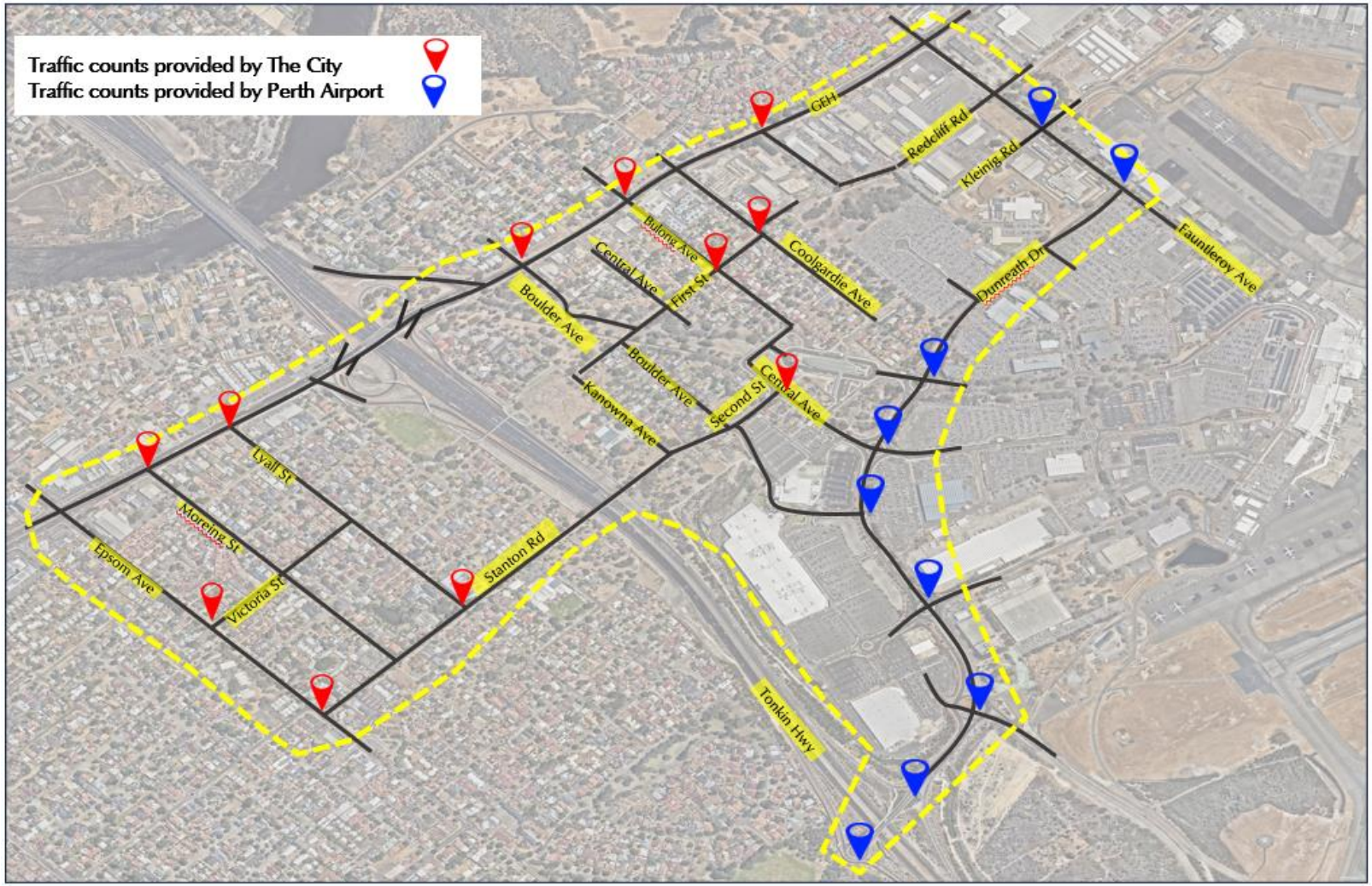


Figure 2: Traffic data collection points

2.1.1 *Road Network*

Figure 3 illustrates the existing posted speed limits within the modelling study area. Most roads have a speed limit of 50 km/h, while Great Eastern Highway (GEH) and Dunreath Drive have a higher speed limit of 60 km/h.

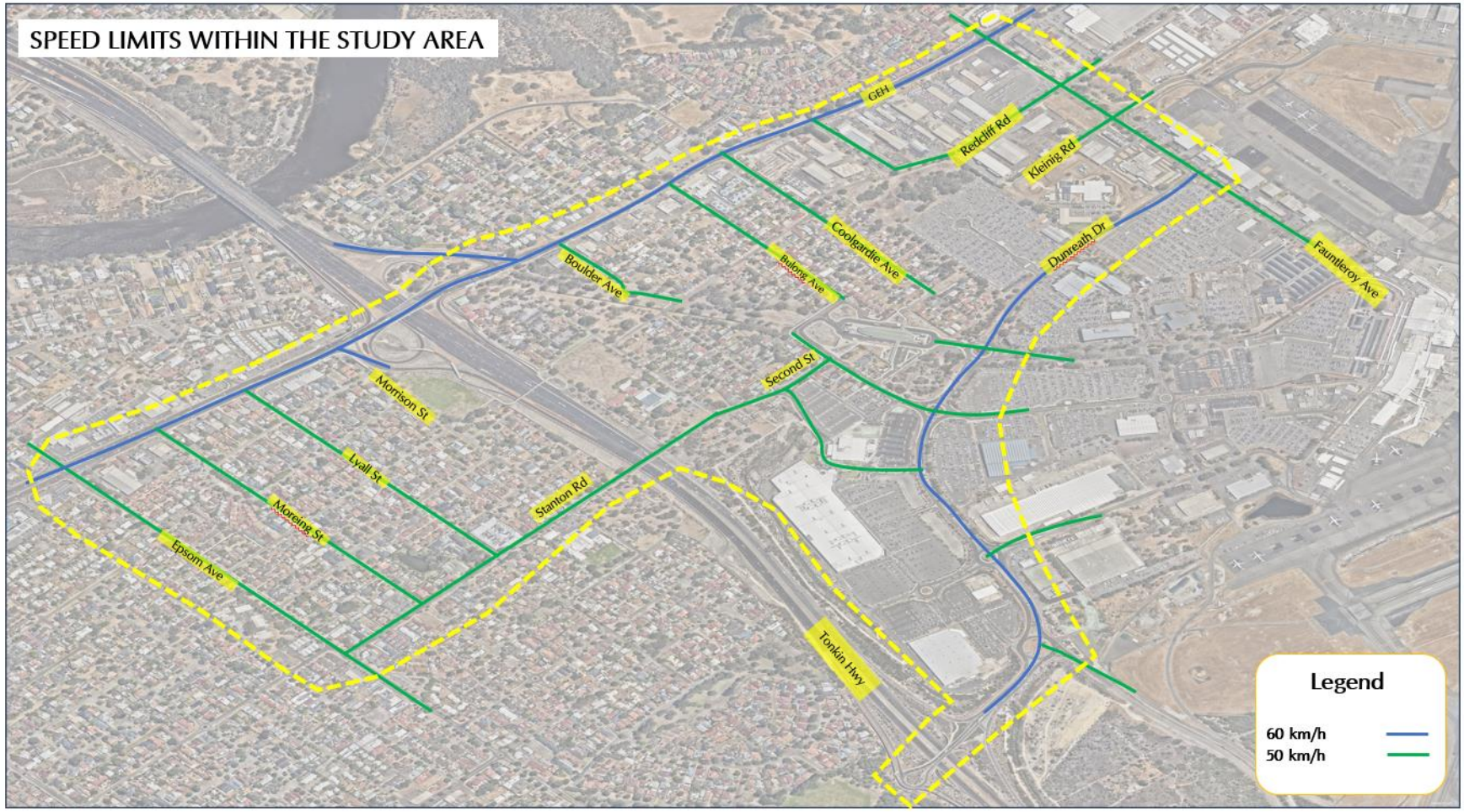


Figure 3: Speed limits for the roads within the study area

2.1.2 Signal Data (SCATS)

The SCATS history files for the nominated peak hours were sourced from Main Roads WA for signalised intersections for Thursday, 23 May 2024. This data is crucial for understanding the operational characteristics of traffic signals during the peak hours. Figure 4 shows the Signalised intersections within the study area

Figure 5 presents the phasing and timing information for the nominated peak hours, illustrating the operational patterns of traffic signals in the study area. This information was used for calibration of the base case model.

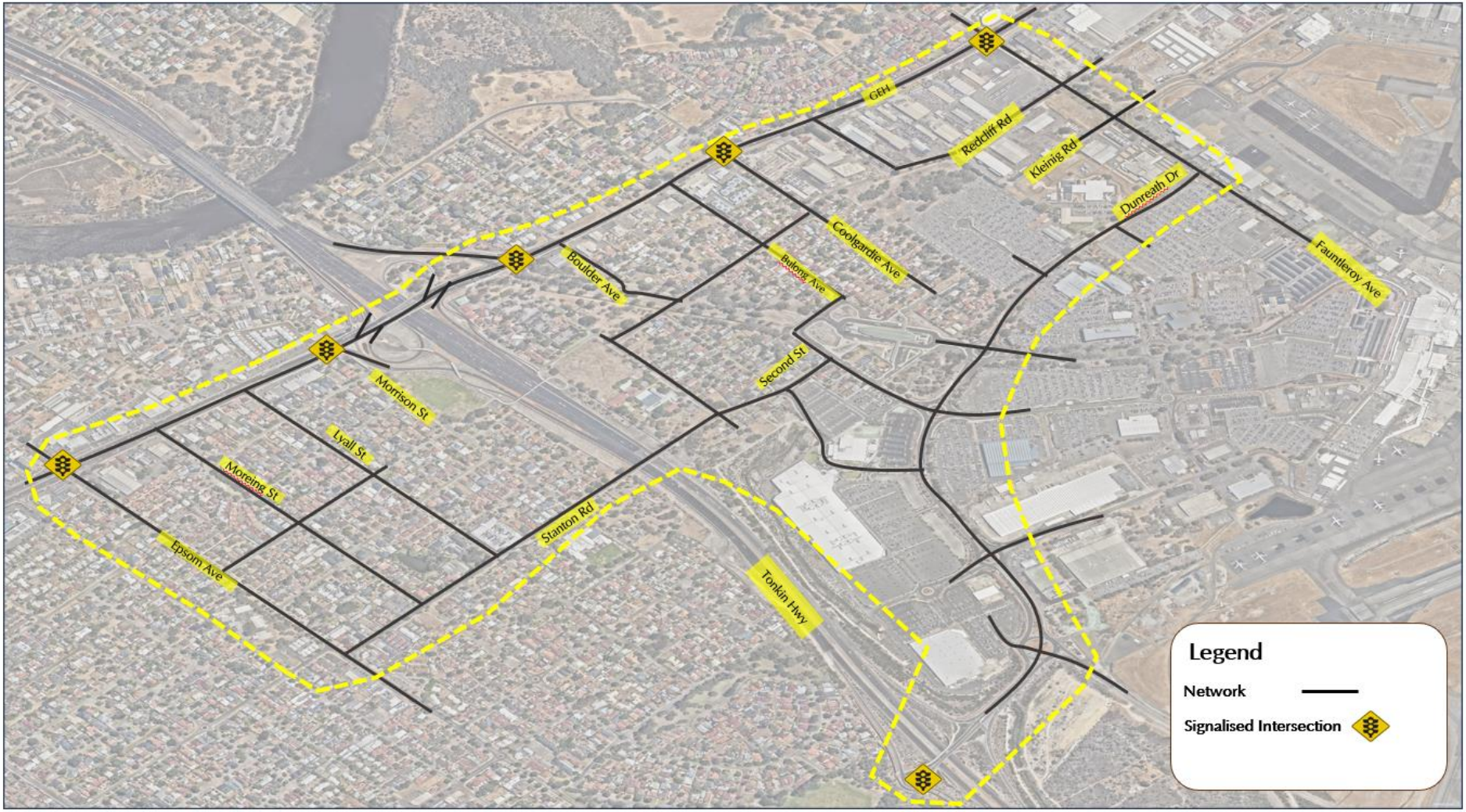
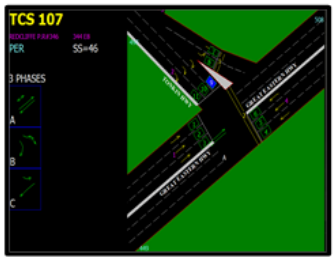


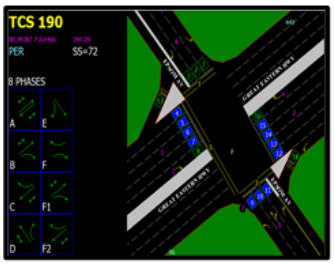
Figure 4: Signalised intersections within the study area

Phase duration during the peak hours – GEH / Fauntleroy Ave						
Phase	Min		Max		Average	
	AM	PM	AM	PM	AM	PM
A	47	57	93	89	68	69
D	20	38	40	66	30	49
E	22	13	36	35	27	21

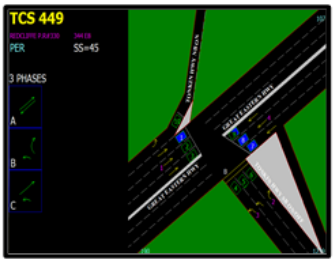


Phase duration during the peak hours – GEH / Tonkin Hwy						
Phase	Min		Max		Average	
	AM	PM	AM	PM	AM	PM
A	39	57	1308	84	128	72
B	28	18	50	37	36	30
C	13	–	37	–	20	–

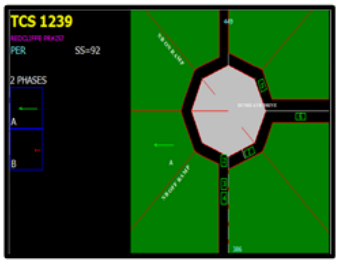
Phase duration during the peak hours – GEH / Coolgardie Ave						
Phase	Min		Max		Average	
	AM	PM	AM	PM	AM	PM
A	65	87	125	117	85	100
D	15	17	28	28	22	22
E	14	14	26	23	19	18



Phase duration during the peak hours – GEH / Epsom Ave						
Phase	Min		Max		Average	
	AM	PM	AM	PM	AM	PM
A	52	35	91	93	74	70
D	16	16	39	40	22	25
E	15	15	25	24	17	18
F	18	18	30	35	23	27



Phase duration during the peak hours – GEH / Tonkin Hwy SB on/off						
Phase	Min		Max		Average	
	AM	PM	AM	PM	AM	PM
A	72	48	104	92	92	75
B	22	21	40	39	33	28
C	29	19	29	33	29	27



Phase duration during the peak hours – Dunreath Dr / Tonkin Hwy NB off						
Phase	Min		Max		Average	
	AM	PM	AM	PM	AM	PM
A	15	14	819	294	171	45
B	14	23	36	61	31	40

Figure 5: SCATS history data for signalised intersections

2.1.3 Existing Queue Length

Queue lengths at the start of the green time for every movement/lane were observed and recorded for signalised intersections. Queue lengths also were collected for key unsignalised intersections. The collected queue data was used to calibrate and validate the base case models. Figure 6 shows the maximum queue lengths observed for key intersections during the AM and PM peak hours.

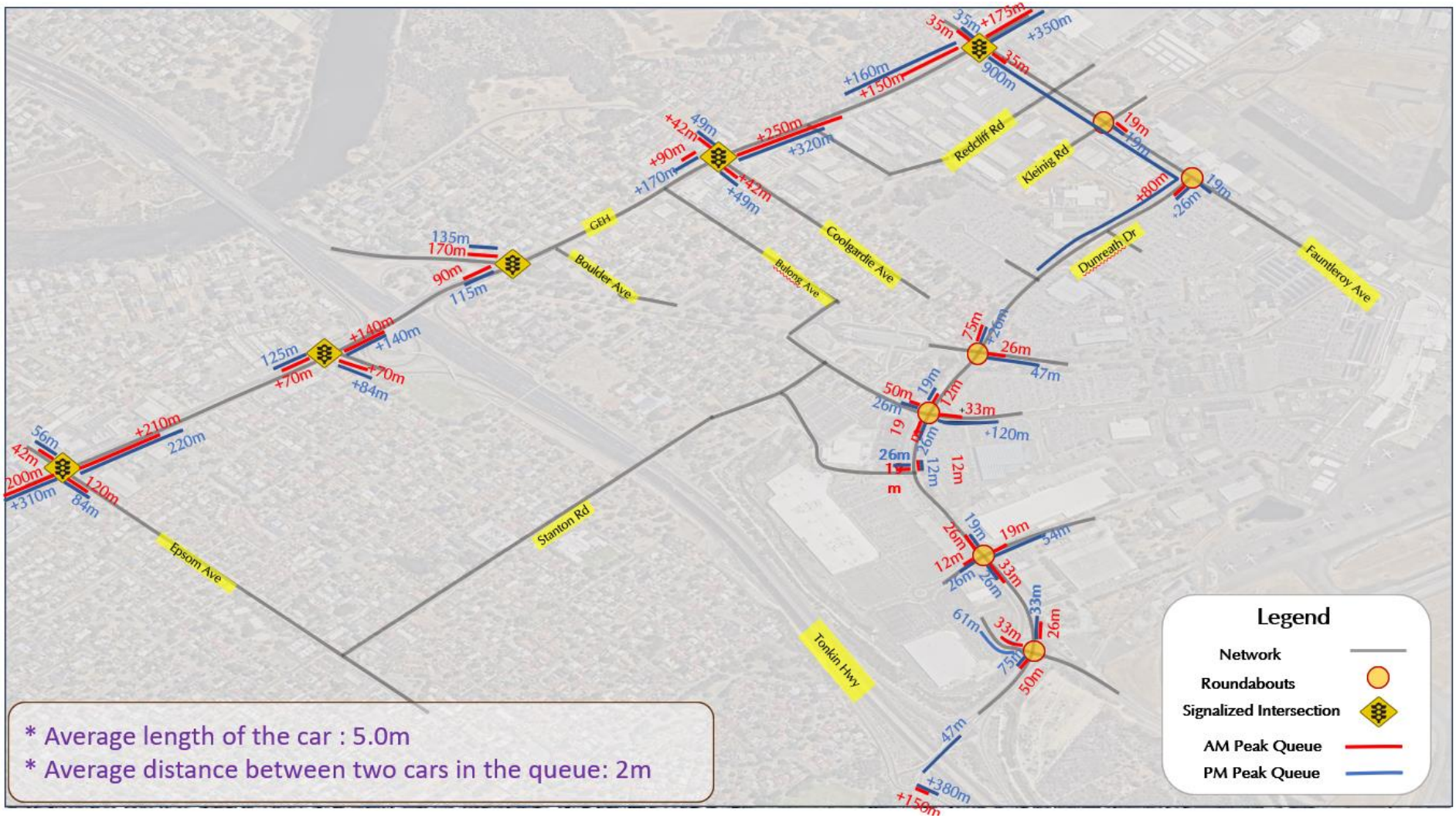


Figure 6: Maximum queue lengths observed at key intersections (Existing)

2.1.4 Public Transport

Figure 7 and Figure 8 show the existing public transport routes and bus stops within the modelling study area.

All public transit lines within the study area have been modelled according to the current schedule and headways reported by Transperth during the AM and PM peak hours. Details of the schedule and headways for each bus stop during the modelled peak hours are provided in the traffic report for Existing Situation.

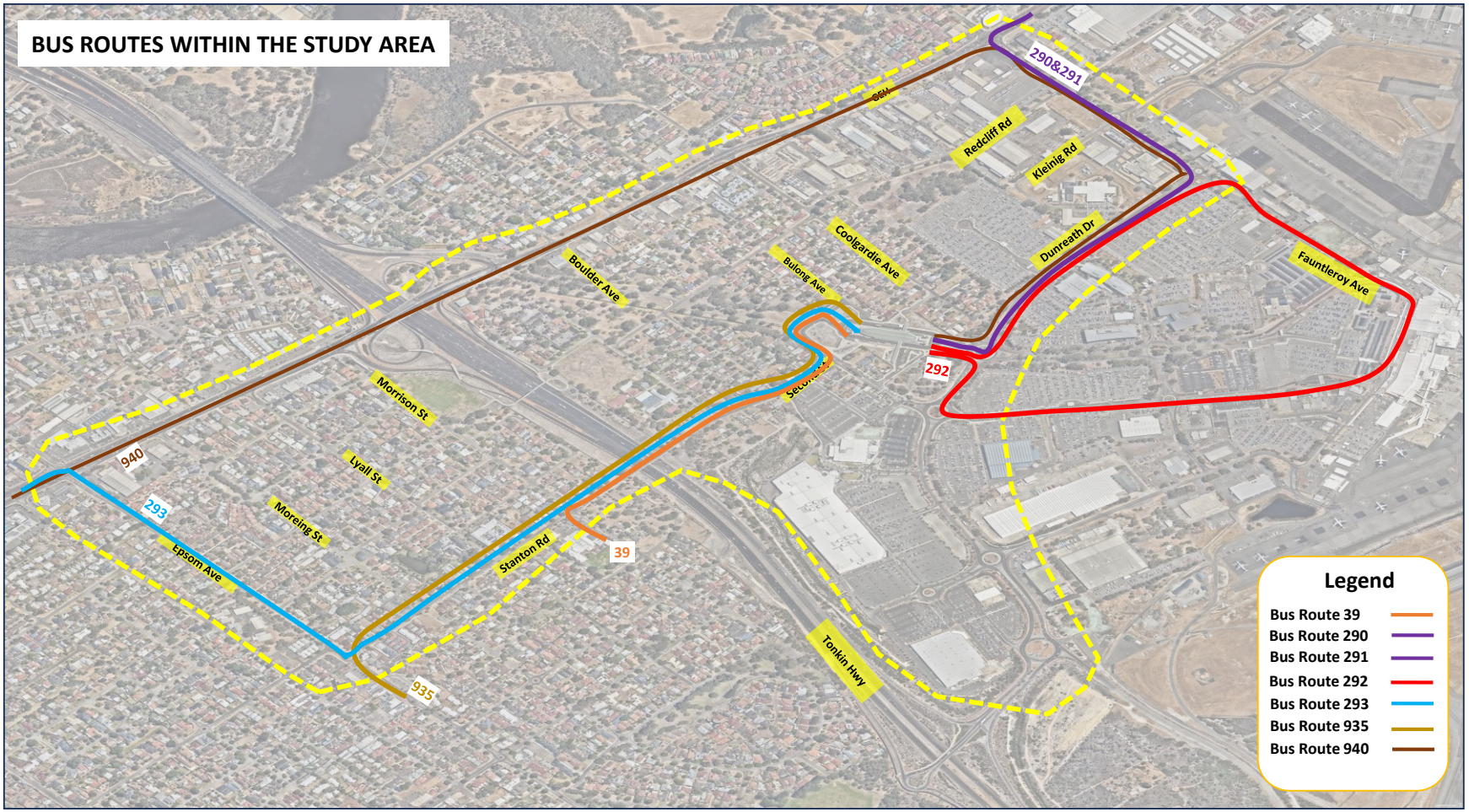


Figure 7: Existing public transport routes within the modelling study area

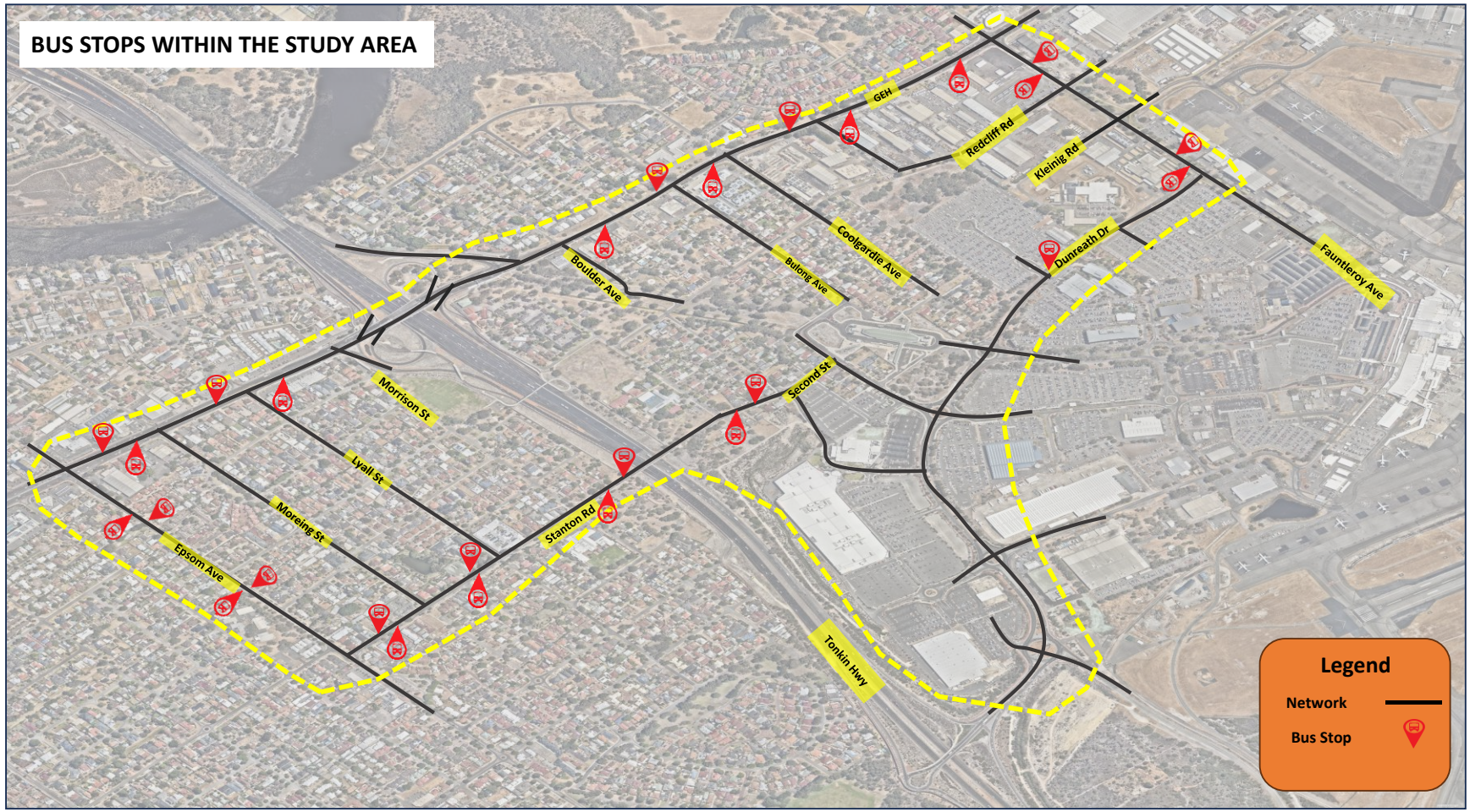


Figure 8: Existing bus stops within the modelling study area

2.1.5 Zone Structure

Two types of zones were used in the existing base case and proposed development models:

- **External zones**: these zones are defined as an area within which vehicles are released into or removed from the network. They generally represent the 'cuts' in the external road network, where vehicles enter or exit from the model.
- **Internal zones**: these zones represent an internal destination within the study area. Vehicles enter the study area from the external zones and drive to one of the internal zones.

Figure 9 presents the zoning map for the base models, delineating both internal and external zones. The base case models are structured with 18 internal zones, specifically numbered from 22 to 25, 29, 30,34 and 45.

In addition, there are 28 external zones, numbered from 1 to 21, 26 to 28, 31 to 33, and 46. These external zones encompass areas outside the modelling study area, providing a broader context for understanding how traffic interacts with the surrounding road network.

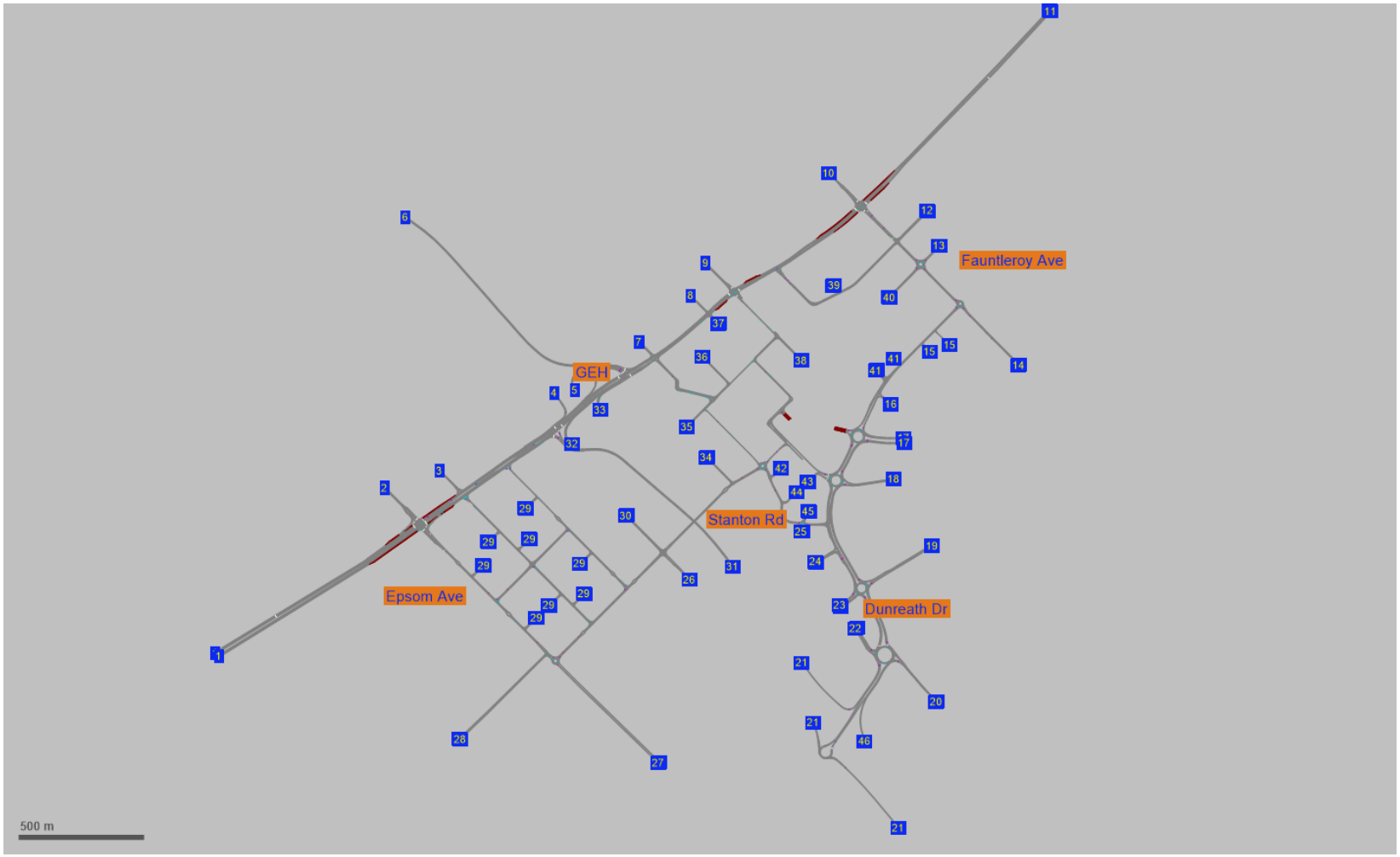


Figure 9: Zoning map for base models

3 Model Calibration and Validation

3.1.1 *Existing Base Case Models*

The existing AM and PM peak hour models were built for 8:00 – 9:00 and 16:00 – 17:00 periods respectively. For the base case a "warm up" and "cool down" periods of 15 minutes were introduced to populate all road links prior to and after the model period. The microsimulation model (for existing and future scenarios) was developed in accordance with Main Roads WA Operational Modelling Guidelines.

3.1.2 *Software Version*

The software version which is used for this study is VISSIM 11.00 – 14.

3.1.3 *Vehicle Types*

The demand matrices were established using the Austroads Vehicle Classification System in accordance with Table 5.1 of Main Roads WA Operational Modelling Guidelines. The existing composition of heavy vehicle types on Stanton Road and GEH is noted in Table 1. The desired heavy vehicle acceleration values were adopted using the values provided in Table 5-2 of Main Roads WA Operational Modelling Guidelines. The recommended power and weight for different vehicle types were adjusted using the values in Table 5.3 of the Main Roads WA Operational Modelling Guidelines.

Table 1: Existing vehicle classification on Stanton Road and GEH

Austroads classification	Class 1	Class 2-5	Class 6-9	Class 10	Class 11
VISSIM classification	Car/Short	Medium	Long	Medium combination	
Stanton Road (%)	92.5%	7.1%	0.4%	0.0%	
GEH (West of Aurum St) (%)	90%	9.4%	0.6%	0.0%	

The network coding, priority rules, desired speed, reduced speed areas and conflict areas were coded in accordance with the recommendations of Main Roads WA Operational Modelling Guidelines.

3.1.4 *Link Counts*

The observed and modelled link volumes were compared for the key roads within the modelling study area and the results are shown in Table 2. This table also shows the calculated GEH[2] for each link. The locations of link volumes are shown in Figure 10. The following equation was used for the GEH calculation:

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where M is the hourly traffic volume from the traffic model and C is the real-world hourly traffic count.

80% of the volumes in the base case model should have a GEH less than 5.0 for a Category 3 modelling area. A GEH of less than 5.0 is considered a good match between the modelled and observed hourly volumes. GEHs in the range of 5.0 to 10.0 may warrant investigation. If the GEH is greater than 10.0, there is a high probability that there is a problem with either the travel demand model or the data.

As evident, the reported GEH is less than 5 for all links which confirms a good match between the modelled and observed hourly volumes.

Table 2: Comparison of observed and modelled traffic for key roads

Location		Traffic Volume - AM			Traffic Volume - PM		
		Observed	Modeled	GEH	Observed	Modeled	GEH
A	NB	1855	1696	3.77	2109	2010	2.18
	SB	1737	1572	4.06	1883	1741	3.34
B	EB	359	337	1.18	427	364	3.17
	WB	425	416	0.44	504	474	1.36
C	NB	453	460	0.33	516	504	0.53
	SB	402	355	2.42	582	557	1.05
D	NB	1148	1139	0.27	1123	1025	2.99
	SB	737	703	1.27	1399	1436	0.98
E	EB	593	559	1.42	626	576	2.04
	WB	304	291	0.75	561	485	3.32

[2] The GEH Statistic is a formula used in traffic engineering, and traffic modelling to compare two sets of traffic volumes. The GEH formula gets its name from Geoffrey E. Havers.

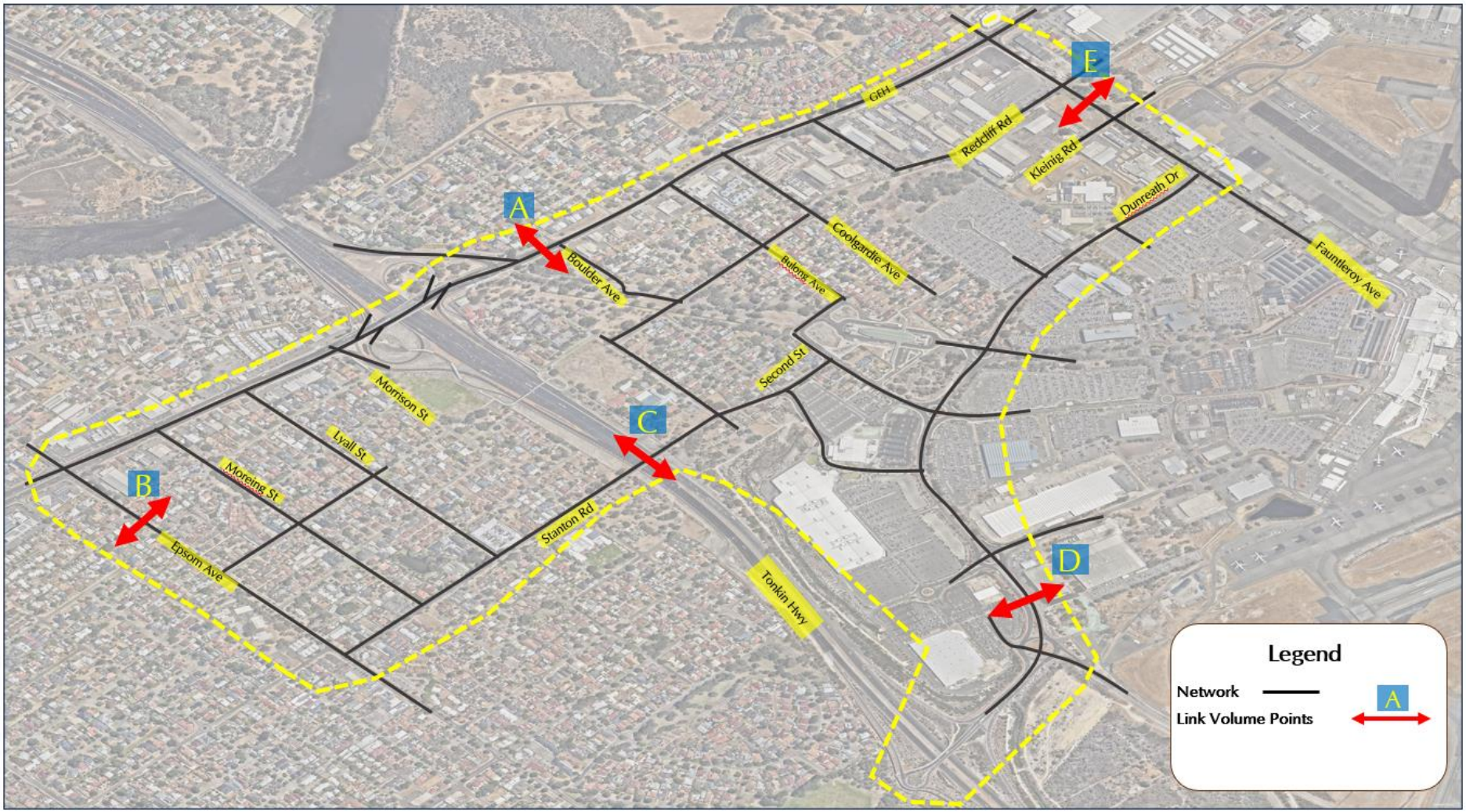


Figure 10: Link volume points for key roads within the study area

3.1.5 *Turn Counts*

The GEH value and R square [3] were utilised to assess the appropriateness of the base case models for the traffic study.

The GEH value is calculated for the turning movements at key existing intersections in the VISSIM model. As detailed in Appendix A, the estimated GEH values for all turning movements at critical intersections indicate that over 85% of movements were modelled with a GEH of less than 5. This performance meets and exceeds the requirements set forth in the Main Roads WA Operational Modelling Guidelines for Category 3 modelling areas.

Table 3 summarizes the desired GEH range compared to the modelled GEH for the turning movements at key intersections within the study area. Notably, 100% of the turning movements achieved a GEH of less than 10 during both the AM and PM peak hours, with more than 93% having a GEH of less than 5. These results indicate a strong correlation between the modelled and observed turning counts.

A modelled R square value greater than 0.90 is generally considered excellent, indicating that the model simulates the real-world traffic movements at the intersections reasonably well. In this case, the model achieved an R square value of 0.99, confirming a close alignment with the actual observed data (refer Figure 11).

Overall, the modelled results showcase a high level of accuracy and predictive performance, exceeding the desired targets across all criteria. The GEH results of less than 5 and less than 10 illustrate excellent prediction consistency, while the R squared value of 0.99 signifies a robust model with minimal unexplained variance. These outcomes suggest that the model is highly reliable and well-suited for making accurate predictions in this context.

Table 3: Traffic flow validation criteria

Criteria	AM		PM	
	Desired	Modelled	Desired	Modelled
GEH < 5	80%	98%	80%	93%
GEH < 10	90%	100%	90%	100%
R squared value	>0.90	0.99	>0.90	0.99

[3] The R square value serves as a statistical measure that reflects "goodness of fit" for observed and modelled data.

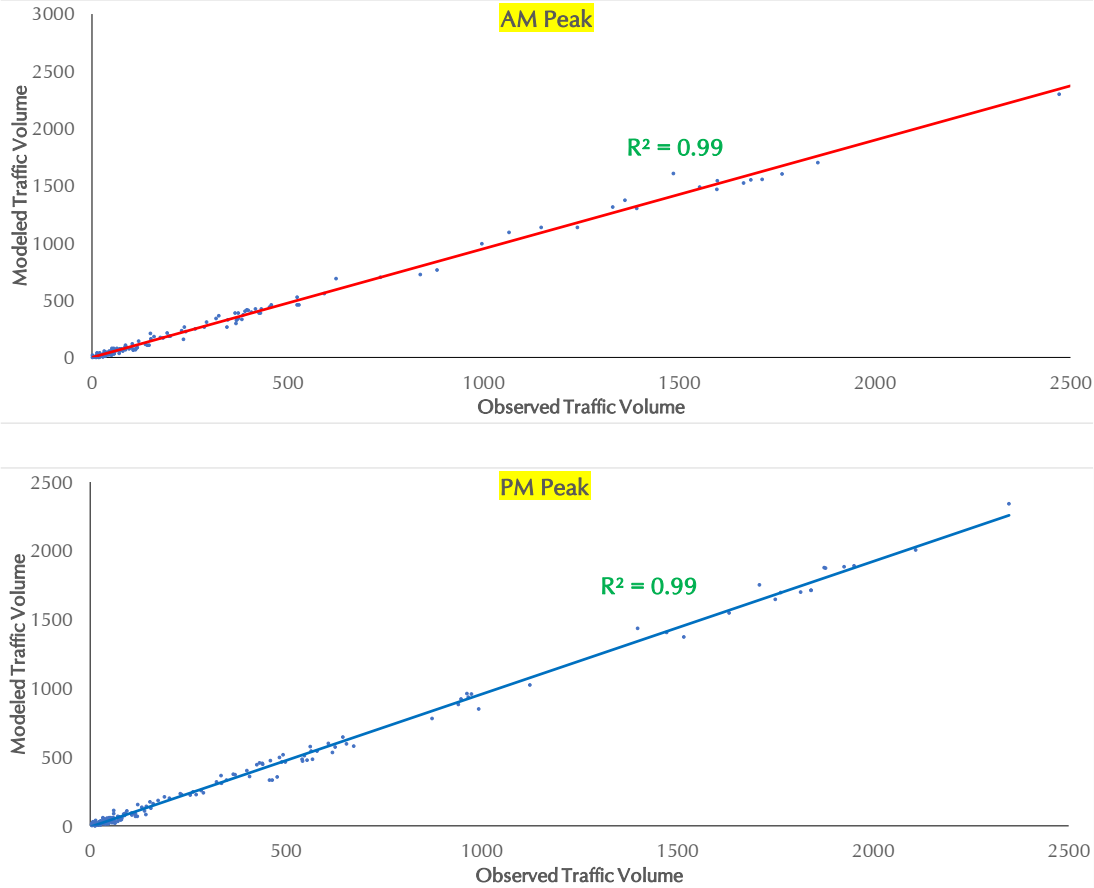


Figure 11: R-Square Value Comparison for Model Performance (AM & PM)

3.1.6 Model Stability

To evaluate the consistency and reliability of the network statistics generated by the model, the Coefficient of Variation[4] (COV) is employed. It is particularly useful in this context because it standardises the variability, allowing for comparison across different model runs.

In this analysis, five separate runs of the model were conducted, providing a comprehensive dataset for assessment. The results of these runs are presented in Table 4 and Table 5.

By calculating the COV for each run, it can be quantified how much the model outputs vary from one run to another. A COV value of 5% or less is generally accepted as a benchmark for demonstrating a strong correlation among the model runs. This threshold suggests that the model outputs are consistent and that the variation is minimal, which is essential for ensuring the model is reliable for making predictions or decisions. The results show that the COV values fall within this acceptable range, indicating that the model performs consistently across multiple runs. This consistency confirms the credibility of the model.

Table 4: Coefficient of variation (COV) results for calibrated existing-AM model

Model Run - AM	Delay (Average)	Total Travel Time(h)	Vehicle Arrived
1	78.50	676	9520
2	84.27	695	9560
3	81.12	684	9561
4	79.86	681	9562
5	83.00	691	9518
COV (%)	2.56%	1.00%	0.22%

Table 5: Coefficient of variation (COV) results for calibrated existing-PM model

Model Run - PM	Delay (Average)	Total Travel Time(h)	Vehicle Arrived
1	95.24	854	11645
2	102.70	876	11575
3	94.85	853	11665
4	96.63	856	11613
5	101.02	874	11636
COV (%)	3.24%	1.20%	0.27%

[4] The Coefficient of Variation COV is a statistical measure that indicates the extent of variability in relation to the mean of the data set.

3.1.7 Traffic Management

Figure 12 provides a visual representation of the school zones and reduced-speed areas within the study area. The school zones and reduced-speed areas have been coded into the base case models.

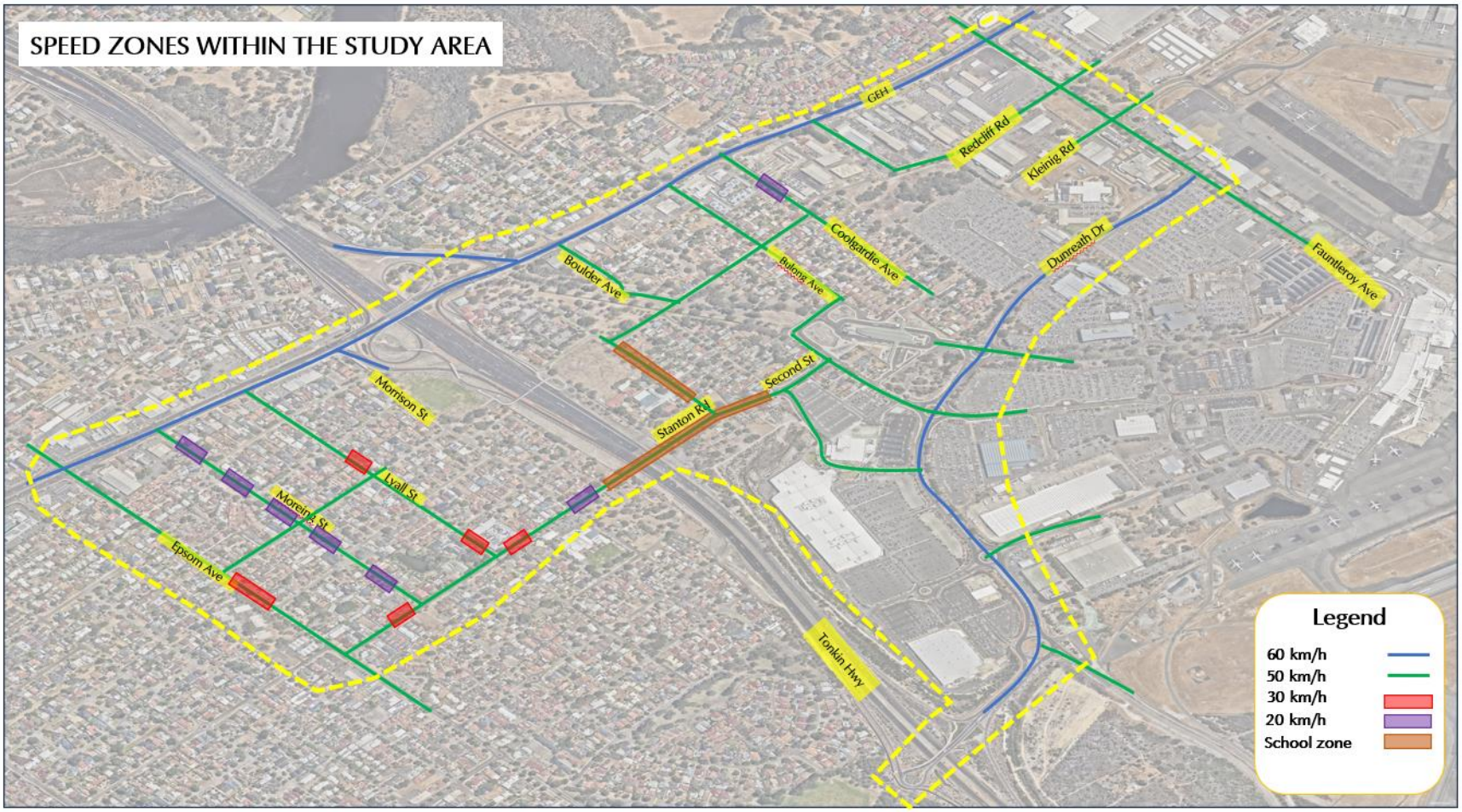


Figure 12: Reduced speed areas within the study area

3.2 Model Validation

3.2.1 *Queue Lengths*

The existing AM and PM models were visually checked a number of times to confirm the modelled queue operation is consistent with those observed on site for critical intersections and the feedback received from the community.

Figure 13 presents the modelled maximum queue lengths for both the AM and PM against the modelled queue during the peak hours. As evident the modelled maximum queue lengths are in the same range as the existing observed maximum queue length (refer Figure 6).

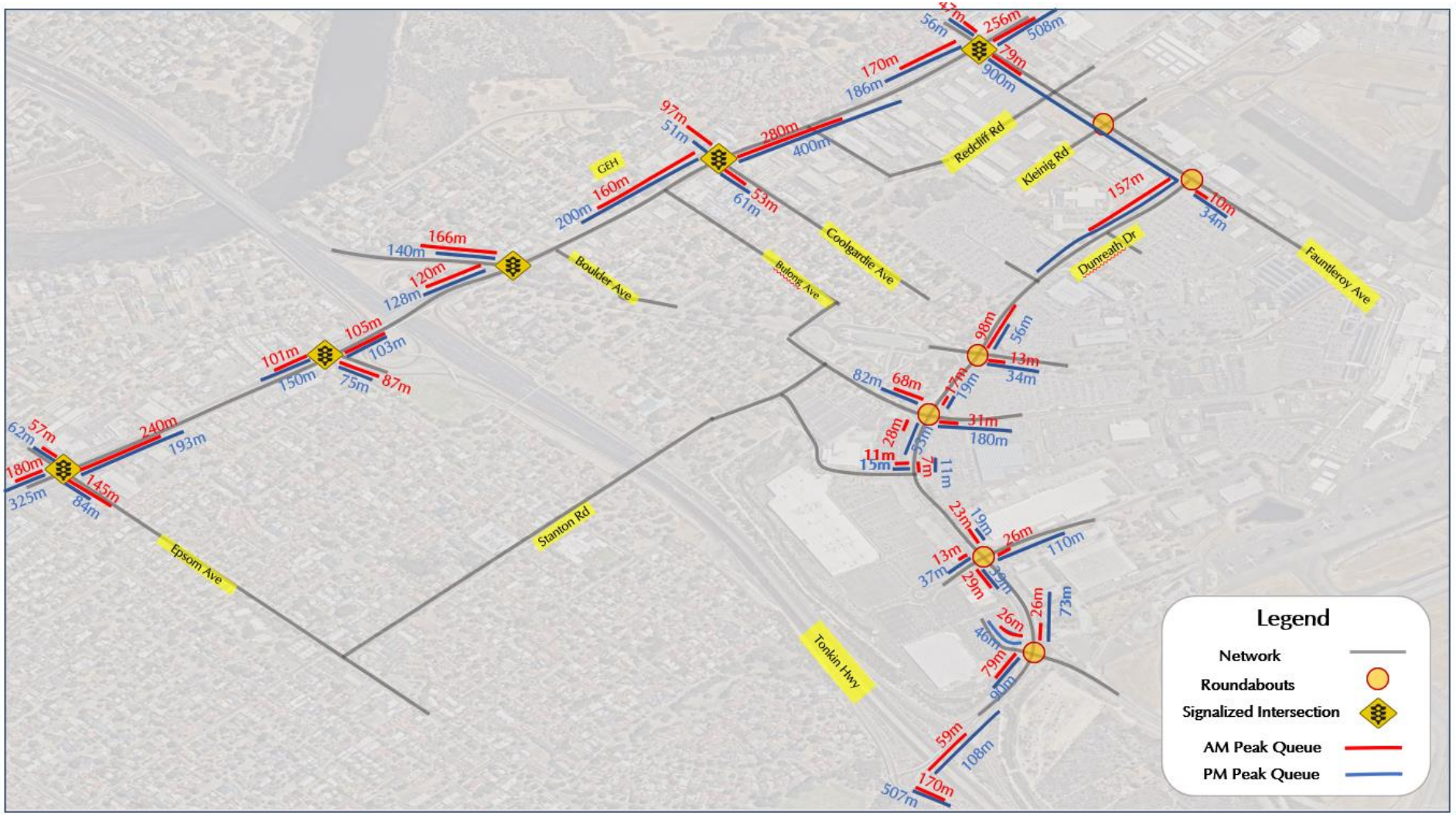


Figure 13: Modelled maximum queue lengths (AM and PM Peak)

3.2.2 *Travel Times*

In VISSIM, travel time is integral to the traffic assignment process, which distributes and assigns traffic across the network based on various dynamic factors. The software calculates the travel time for each road segment, or link, by considering several elements, such as the actual speed of vehicles, traffic flow, road capacity, and delays caused by queueing. This calculation reflects the real-time conditions on the road, taking into account how congestion and signal timing can affect travel times. For instance, if a road segment experiences heavy traffic, the speed will decrease, leading to longer travel times, which in turn influences how vehicles are assigned to different routes.

Additionally, VISSIM employs a dynamic traffic assignment approach that continuously updates travel times as conditions change. As vehicles traverse the network, factors like vehicle density and the presence of bottlenecks can alter the travel times on various links. When a bottleneck or traffic incident occurs, travel times on affected routes increase, prompting vehicles to reroute to less congested alternatives. Moreover, the impact of traffic signal control plays a significant role, particularly in urban environments where coordinated signals can optimise flow but also affect the overall travel time experienced by vehicles. This real-time adaptability allows VISSIM to simulate traffic behaviour accurately, reflecting the complexities of urban traffic dynamics. In order to validate the base case model against travel time, the recorded vehicle travel times against the modelled travel times during the AM and PM peak hours were reviewed for main routes within the modelling study area to ensure the calibrated base case model reasonably predicts the observed travel times for the key roads within the modelling study area. Vehicle travel times on the following routes within the modelling study area were collected:

- GEH;
- Fauntleroy Avenue/ Dunreath Drive; and,
- Central Avenue/Second Street/ Stanton Road/ Epsom Avenue.

Figure 14 and Figure 15 present a comparative analysis of recorded versus modelled travel times for the AM and PM peak hours, respectively. These figures depict the alignment between actual travel times observed during field data collection and those predicted by the calibrated model.

Overall, the calibrated base case models produced results that closely aligned with the observed values for both AM and PM peak period conditions. The modelled travel times for all surveyed routes differed by less than 1 minute from the average observed travel times, thereby satisfying the travel time criteria set by Main Roads WA Guidelines.

Consequently, the base case models were deemed sufficiently accurate for the development of future models.

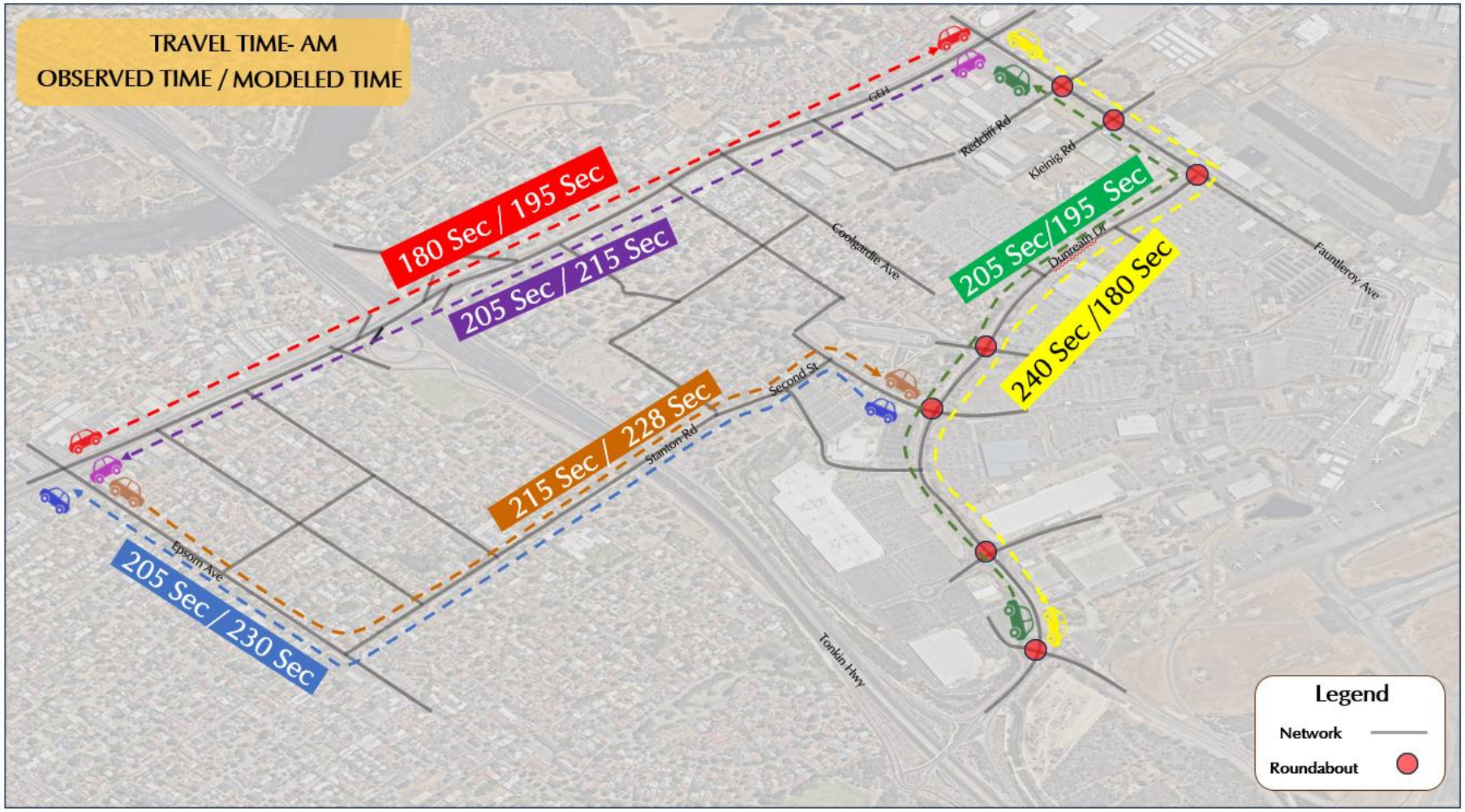


Figure 14: Comparison of observed and modelled vehicle travel times (AM Peak)

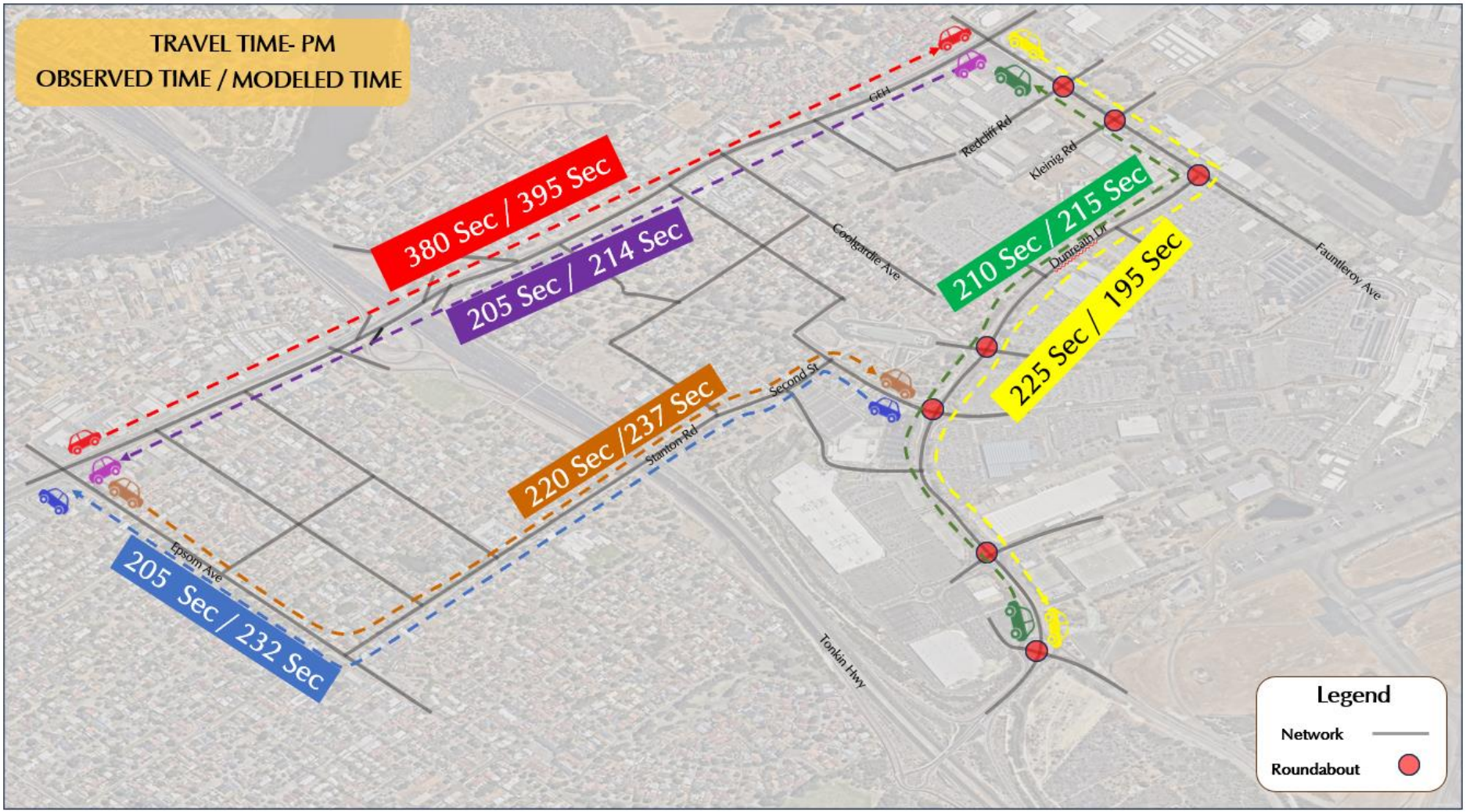


Figure 15: Comparison of observed and modelled vehicle travel times (PM Peak)

Appendix A

GEH VALUES

Intersection - AM Peak	From	To	Traffic Volume		GEH
			Observed	Modelled	
GEH / Epsom Ave	South	West	61	67	0.75
GEH / Epsom Ave	South	North	1485	1608	3.12
GEH / Epsom Ave	South	East	182	172	0.72
GEH / Epsom Ave	North	East	197	185	0.90
GEH / Epsom Ave	North	South	2559	2447	2.23
GEH / Epsom Ave	North	West	55	34	3.15
GEH / Epsom Ave	North	North	50	22	4.67
GEH / Epsom Ave	East	South	85	106	2.17
GEH / Epsom Ave	East	West	54	43	1.52
GEH / Epsom Ave	East	North	200	187	0.92
GEH / Epsom Ave	West	North	22	20	0.39
GEH / Epsom Ave	West	East	51	41	1.51
GEH / Epsom Ave	West	South	75	77	0.18
GEH / Moreing St	East	South	21	13	1.99
GEH / Moreing St	North	East	20	4	4.62
GEH / Moreing St	South	West	40	42	0.37
GEH / Moreing St	West	North	111	68	4.55
GEH / Lyall St	East	South	95	75	2.22
GEH / Lyall St	North	East	49	27	3.61
GEH / Tonkin Hwy	East	South	396	415	0.95
GEH / Tonkin Hwy	South	West	623	689	2.58
GEH / Tonkin Hwy	East	North	175	174	0.08
GEH / Tonkin Hwy	South	North	1240	1136	3.02
GEH / Tonkin Hwy	North	South	2471	2297	3.57
GEH / Tonkin Hwy	North	East	293	310	0.96
GEH / Tonkin Hwy	South	West	23	20	0.56
GEH / Tonkin Hwy	North	East	158	184	2.00
GEH / Tonkin Hwy	West	North	345	266	4.52
GEH / Tonkin Hwy	West	South	1066	1092	0.79
GEH / Tonkin Hwy	South	North	1392	1302	2.45
GEH / Tonkin Hwy	North	South	1855	1702	3.63
GEH / Boulder Ave	East	South	55	50	0.66
GEH / Boulder Ave	North	East	17	10	2.03
GEH / Boulder Ave	South	West	5	4	0.47
GEH / Boulder Ave	West	North	5	4	0.47
GEH / Bulong Ave	South	West	25	16	2.09
GEH / Bulong Ave	South	North	1712	1554	3.91
GEH / Bulong Ave	North	East	4	8	1.49
GEH / Bulong Ave	North	South	1763	1603	3.90
GEH / Bulong Ave	East	South	32	32	0.07
GEH / Bulong Ave	West	North	4	4	0.00
GEH / Coolgardie Ave	South	West	40	27	2.25
GEH / Coolgardie Ave	South	North	1597	1466	3.35
GEH / Coolgardie Ave	South	East	69	38	4.27
GEH / Coolgardie Ave	South	South	10	8	0.53
GEH / Coolgardie Ave	North	West	11	8	1.11
GEH / Coolgardie Ave	North	South	1665	1523	3.55
GEH / Coolgardie Ave	North	East	46	33	2.14
GEH / Coolgardie Ave	East	South	42	30	1.93
GEH / Coolgardie Ave	East	West	21	20	0.22
GEH / Coolgardie Ave	East	North	40	45	0.74
GEH / Coolgardie Ave	West	South	50	53	0.36
GEH / Coolgardie Ave	West	East	35	38	0.53
GEH / Coolgardie Ave	West	North	36	30	1.12
GEH / Redcliffe Rd	East	South	20	10	2.52
GEH / Redcliffe Rd	North	East	6	5	0.61
GEH / Redcliffe Rd	North	South	1683	1551	3.28
GEH / Redcliffe Rd	South	North	1598	1542	1.42
GEH / Fountleroy Ave	South	West	61	60	0.08
GEH / Fountleroy Ave	South	North	1331	1312	0.53
GEH / Fountleroy Ave	South	East	234	159	5.37
GEH / Fountleroy Ave	South	South	30	12	3.88

Intersection - PM Peak	From	To	Traffic Volume		GEH
			Observed	Modelled	
GEH / Epsom Ave	South	West	51	51	0.00
GEH / Epsom Ave	South	North	2348	2340	0.17
GEH / Epsom Ave	South	East	190	211	1.51
GEH / Epsom Ave	North	East	256	224	2.05
GEH / Epsom Ave	North	South	1875	1876	0.03
GEH / Epsom Ave	North	West	28	21	1.37
GEH / Epsom Ave	North	North	80	55	3.07
GEH / Epsom Ave	East	South	88	85	0.28
GEH / Epsom Ave	East	West	48	34	2.19
GEH / Epsom Ave	East	North	230	234	0.29
GEH / Epsom Ave	West	North	55	35	2.98
GEH / Epsom Ave	West	East	42	39	0.47
GEH / Epsom Ave	West	South	86	86	0.00
GEH / Moreing St	East	South	39	12	5.40
GEH / Moreing St	North	East	29	20	1.73
GEH / Moreing St	South	West	52	58	0.86
GEH / Moreing St	West	North	112	88	2.44
GEH / Lyall St	East	South	161	162	0.09
GEH / Lyall St	North	East	69	61	1.02
GEH / Tonkin Hwy	East	South	370	371	0.05
GEH / Tonkin Hwy	South	West	966	935	1.00
GEH / Tonkin Hwy	East	North	143	143	0.03
GEH / Tonkin Hwy	South	North	1815	1698	2.80
GEH / Tonkin Hwy	North	South	1764	1694	1.68
GEH / Tonkin Hwy	North	East	619	533	3.60
GEH / Tonkin Hwy	South	West	441	447	0.28
GEH / Tonkin Hwy	North	East	334	365	1.64
GEH / Tonkin Hwy	West	North	366	375	0.46
GEH / Tonkin Hwy	West	South	608	601	0.29
GEH / Tonkin Hwy	South	North	1517	1372	3.83
GEH / Tonkin Hwy	North	South	2109	2004	2.32
GEH / Boulder Ave	East	South	74	66	0.96
GEH / Boulder Ave	North	East	8	13	1.49
GEH / Boulder Ave	South	West	28	23	0.95
GEH / Boulder Ave	West	North	5	4	0.47
GEH / Bulong Ave	South	West	14	11	0.73
GEH / Bulong Ave	South	North	1842	1713	3.06
GEH / Bulong Ave	North	East	25	28	0.66
GEH / Bulong Ave	North	South	1952	1889	1.43
GEH / Bulong Ave	East	South	60	88	3.21
GEH / Bulong Ave	West	North	4	4	0.00
GEH / Coolgardie Ave	South	West	50	48	0.34
GEH / Coolgardie Ave	South	North	1750	1646	2.52
GEH / Coolgardie Ave	South	East	36	22	2.60
GEH / Coolgardie Ave	South	South	10	4	2.27
GEH / Coolgardie Ave	North	West	11	15	1.21
GEH / Coolgardie Ave	North	South	1879	1873	0.15
GEH / Coolgardie Ave	North	East	59	61	0.31
GEH / Coolgardie Ave	East	South	63	21	6.44
GEH / Coolgardie Ave	East	West	22	19	0.57
GEH / Coolgardie Ave	East	North	45	46	0.12
GEH / Coolgardie Ave	West	South	25	23	0.33
GEH / Coolgardie Ave	West	East	23	30	1.40
GEH / Coolgardie Ave	West	North	38	33	0.80
GEH / Redcliffe Rd	East	South	80	47	4.11
GEH / Redcliffe Rd	North	East	11	3	2.83
GEH / Redcliffe Rd	North	South	1926	1883	0.98
GEH / Redcliffe Rd	South	North	1842	1711	3.11
GEH / Fountleroy Ave	South	West	45	53	1.09
GEH / Fountleroy Ave	South	North	1633	1546	2.18
GEH / Fountleroy Ave	South	East	116	90	2.58
GEH / Fountleroy Ave	South	South	12	2	3.58

GEH / Fountleroy Ave	North	East	149	210	4.57
GEH / Fountleroy Ave	North	South	1553	1486	1.72
GEH / Fountleroy Ave	North	West	29	33	0.75
GEH / Fountleroy Ave	North	North	10	8	0.74
GEH / Fountleroy Ave	East	South	40	23	3.03
GEH / Fountleroy Ave	East	West	37	23	2.56
GEH / Fountleroy Ave	East	North	103	120	1.61
GEH / Fountleroy Ave	West	South	56	55	0.19
GEH / Fountleroy Ave	West	North	50	51	0.14
GEH / Fountleroy Ave	West	East	50	24	4.31
Fountleroy Ave / Redcliffe Rd	South	East	44	25	3.20
Fountleroy Ave / Redcliffe Rd	North	West	28	5	5.66
Fountleroy Ave / Redcliffe Rd	North	East	119	145	2.30
Fountleroy Ave / Redcliffe Rd	North	South	1	1	0.21
Fountleroy Ave / Redcliffe Rd	East	South	18	9	2.39
Fountleroy Ave / Redcliffe Rd	East	North	136	116	1.76
Fountleroy Ave / Redcliffe Rd	East	West	150	164	1.15
Fountleroy Ave / Redcliffe Rd	West	East	430	390	1.98
Fountleroy Ave / Kleinig road - S Approach			14	12	0.55
Fountleroy Ave / Kleinig road - W Approach			593	557	1.51
Fountleroy Ave / Kleinig road - N Approach			88	88	0.00
Fountleroy Ave / Kleinig road - E Approach			324	365	2.19
Fountleroy Ave / Dunreath Dr - S Approach			458	461	0.16
Fountleroy Ave / Dunreath Dr - W Approach			524	525	0.05
Fountleroy Ave / Dunreath Dr - E Approach			36	40	0.65
Dunreath Dr / Brearley ave - S Approach			996	995	0.03
Dunreath Dr / Brearley ave - W Approach			19	15	0.97
Dunreath Dr / Brearley ave - N Approach			433	424	0.43
Dunreath Dr / Brearley ave - E Approach			239	227	0.76
Dunreath Dr / Central Ave & Snook Rd - S Approach			882	766	4.03
Dunreath Dr / Central Ave & Snook Rd - W Approach			391	405	0.72
Dunreath Dr / Central Ave & Snook Rd - N Approach			366	387	1.07
Dunreath Dr / Central Ave & Snook Rd - E Approach			192	216	1.67
Central Ave / Second st	South	West	26	22	0.73
Central Ave / Second st	South	East	347	328	1.01
Central Ave / Second st	East	South	264	252	0.72
Central Ave / Second st	East	West	31	20	2.09
Central Ave / Second st	West	South	23	15	1.89
Central Ave / Second st	West	East	55	80	3.00
Bulong Ave / Central Ave	North	South	51	80	3.61
Coolgardie Ave / First St	South	West	109	73	3.77
Coolgardie Ave / First St	West	South	146	107	3.45
First St / Bulong Ave	South	North	84	72	1.38
First St / Bulong Ave	South	East	1	20	5.83
First St / Bulong Ave	North	South	105	66	4.17
First St / Bulong Ave	North	East	50	60	1.40
First St / Bulong Ave	East	South	11	20	2.24
First St / Bulong Ave	East	North	26	12	3.21
First St / Central Ave	South	North	84	91	0.79
First St / Central Ave	North	South	114	86	2.78
First St / Brearley Ave	South	West	20	23	0.56
First St / Brearley Ave	South	North	89	89	0.02
First St / Brearley Ave	North	West	35	28	1.32
First St / Brearley Ave	West	South	10	7	0.95
First St / Boulder Ave	South	North	78	56	2.74
First St / Boulder Ave	South	East	18	37	3.56
First St / Boulder Ave	North	South	50	38	1.84
First St / Boulder Ave	North	East	48	28	3.21
First St / Boulder Ave	East	South	12	7	1.62
First St / Boulder Ave	East	North	31	56	3.82
Second St / Boulder Ave - S Approach			407	398	0.43
Second St / Boulder Ave - W Approach			66	64	0.25
Second St / Boulder Ave - N Approach			287	266	1.26
Second St / Boulder Ave - E Approach			64	82	2.06
Dunreath Dr / High St	West	North	43	42	0.09

GEH / Fountleroy Ave	North	East	60	111	5.50
GEH / Fountleroy Ave	North	South	1710	1751	0.98
GEH / Fountleroy Ave	North	West	38	40	0.32
GEH / Fountleroy Ave	North	North	10	8	0.74
GEH / Fountleroy Ave	East	South	132	134	0.21
GEH / Fountleroy Ave	East	West	62	37	3.49
GEH / Fountleroy Ave	East	North	335	311	1.31
GEH / Fountleroy Ave	West	South	47	17	5.26
GEH / Fountleroy Ave	West	North	52	51	0.20
GEH / Fountleroy Ave	West	East	60	31	4.33
Fountleroy Ave / Redcliffe Rd	South	East	45	18	4.85
Fountleroy Ave / Redcliffe Rd	North	West	7	31	5.57
Fountleroy Ave / Redcliffe Rd	North	East	348	332	0.87
Fountleroy Ave / Redcliffe Rd	North	South	44	18	4.58
Fountleroy Ave / Redcliffe Rd	East	South	35	31	0.62
Fountleroy Ave / Redcliffe Rd	East	North	5	6	0.59
Fountleroy Ave / Redcliffe Rd	East	West	426	446	0.98
Fountleroy Ave / Redcliffe Rd	West	East	233	227	0.41
Fountleroy Ave / Kleinig road - S Approach			28	24	0.74
Fountleroy Ave / Kleinig road - W Approach			626	574	2.13
Fountleroy Ave / Kleinig road - N Approach			202	200	0.13
Fountleroy Ave / Kleinig road - E Approach			493	516	1.02
Fountleroy Ave / Dunreath Dr - S Approach			655	597	2.33
Fountleroy Ave / Dunreath Dr - W Approach			645	645	0.02
Fountleroy Ave / Dunreath Dr - E Approach			121	155	2.93
Dunreath Dr / Brearley ave - S Approach			940	883	1.89
Dunreath Dr / Brearley ave - W Approach			22	16	1.38
Dunreath Dr / Brearley ave - N Approach			673	581	3.69
Dunreath Dr / Brearley ave - E Approach			562	576	0.59
Dunreath Dr / Central Ave & Snook Rd - S Approach			993	848	4.78
Dunreath Dr / Central Ave & Snook Rd - W Approach			432	459	1.27
Dunreath Dr / Central Ave & Snook Rd - N Approach			947	923	0.80
Dunreath Dr / Central Ave & Snook Rd - E Approach			263	248	0.95
Central Ave / Second st	South	West	33	16	3.39
Central Ave / Second st	South	East	400	403	0.14
Central Ave / Second st	East	South	542	470	3.21
Central Ave / Second st	East	West	48	58	1.32
Central Ave / Second st	West	South	26	14	2.68
Central Ave / Second st	West	East	32	58	3.82
Bulong Ave / Central Ave	North	South	58	61	0.34
Coolgardie Ave / First St	South	West	142	82	5.71
Coolgardie Ave / First St	West	South	108	91	1.73
First St / Bulong Ave	South	North	115	70	4.68
First St / Bulong Ave	South	East	3	11	2.91
First St / Bulong Ave	North	South	77	54	2.79
First St / Bulong Ave	North	East	33	50	2.67
First St / Bulong Ave	East	South	13	24	2.48
First St / Bulong Ave	East	North	42	35	1.13
First St / Central Ave	South	North	106	81	2.56
First St / Central Ave	North	South	88	75	1.49
First St / Brearley Ave	South	West	36	18	3.37
First St / Brearley Ave	South	North	105	94	1.08
First St / Brearley Ave	North	West	38	48	1.55
First St / Brearley Ave	West	South	5	13	2.56
First St / Boulder Ave	South	North	70	68	0.29
First St / Boulder Ave	South	East	12	20	2.09
First St / Boulder Ave	North	South	21	16	1.06
First St / Boulder Ave	North	East	31	34	0.56
First St / Boulder Ave	East	South	18	16	0.39
First St / Boulder Ave	East	North	71	45	3.41
Second St / Boulder Ave - S Approach			460	473	0.59
Second St / Boulder Ave - W Approach			43	55	1.66
Second St / Boulder Ave - N Approach			568	483	3.71
Second St / Boulder Ave - E Approach			139	110	2.58
Dunreath Dr / High St	West	North	120	68	5.34

Dunreath Dr / High St	North	West	15	9	1.86
Dunreath Dr / High St	North	South	524	461	2.83
Dunreath Dr / High St	South	West	59	70	1.42
Dunreath Dr / High St	South	North	839	726	4.04
Dunreath Dr / Boud Ave - S Approach			1148	1137	0.34
Dunreath Dr / Boud Ave - W Approach			69	56	1.70
Dunreath Dr / Boud Ave - N Approach			529	460	3.09
Dunreath Dr / Boud Ave - E Approach			368	299	3.78
Dunreath Dr / Costco Entry - S Approach			1362	1372	0.28
Dunreath Dr / Costco Entry - W Approach			99	87	1.22
Dunreath Dr / Costco Entry - N Approach			737	702	1.30
Dunreath Dr / Costco Entry - E Approach			11	8	0.97
Stanton Rd / Kanowna Ave	South	West	86	68	2.05
Stanton Rd / Kanowna Ave	South	North	373	390	0.85
Stanton Rd / Kanowna Ave	North	West	10	5	2.00
Stanton Rd / Kanowna Ave	North	South	374	346	1.50
Stanton Rd / Kanowna Ave	West	North	34	12	4.69
Stanton Rd / Kanowna Ave	West	South	28	12	3.63
Stanton Rd / Morrison St	South	West	10	3	2.65
Stanton Rd / Morrison St	South	North	418	425	0.34
Stanton Rd / Morrison St	South	East	60	59	0.10
Stanton Rd / Morrison St	North	West	7	5	0.82
Stanton Rd / Morrison St	North	South	369	327	2.25
Stanton Rd / Morrison St	North	East	26	23	0.61
Stanton Rd / Morrison St	East	South	70	75	0.63
Stanton Rd / Morrison St	East	North	35	35	0.00
Stanton Rd / Lyall St	South	West	18	4	4.06
Stanton Rd / Lyall St	South	North	453	440	0.62
Stanton Rd / Lyall St	North	West	76	71	0.54
Stanton Rd / Lyall St	North	South	383	334	2.57
Stanton Rd / Lyall St	West	North	35	47	1.93
Stanton Rd / Lyall St	West	South	20	42	3.89
Stanton Rd / Moreing St	South	West	17	4	3.85
Stanton Rd / Moreing St	South	North	427	389	1.87
Stanton Rd / Moreing St	North	West	17	2	4.96
Stanton Rd / Moreing St	North	South	386	374	0.63
Stanton Rd / Moreing St	West	North	44	56	1.67
Stanton Rd / Moreing St	West	South	13	41	5.36
Stanton Rd / Epsom Ave - E Approach			372	337	1.87
Stanton Rd / Epsom Ave - W Approach			458	449	0.42
Stanton Rd / Epsom Ave - N Approach			399	413	0.70
Durban St / Epsom Ave	South	West	116	89	2.69
Durban St / Epsom Ave	South	East	141	109	2.82
Durban St / Epsom Ave	East	South	236	265	1.86
Durban St / Epsom Ave	East	West	229	235	0.37
Durban St / Epsom Ave	West	South	105	74	3.28
Durban St / Epsom Ave	West	East	317	340	1.27
Bulong Ave / Central Ave	South	North	57	32	3.75

Dunreath Dr / High St	North	West	55	22	5.32
Dunreath Dr / High St	North	South	963	962	0.03
Dunreath Dr / High St	South	West	94	110	1.62
Dunreath Dr / High St	South	North	873	782	3.16
Dunreath Dr / Boud Ave - S Approach			1123	1024	3.03
Dunreath Dr / Boud Ave - W Approach			323	320	0.19
Dunreath Dr / Boud Ave - N Approach			974	958	0.51
Dunreath Dr / Boud Ave - E Approach			498	463	1.60
Dunreath Dr / Costco Entry - S Approach			1473	1407	1.73
Dunreath Dr / Costco Entry - W Approach			283	256	1.67
Dunreath Dr / Costco Entry - N Approach			1399	1434	0.94
Dunreath Dr / Costco Entry - E Approach			37	32	0.85
Stanton Rd / Kanowna Ave	South	West	77	43	4.42
Stanton Rd / Kanowna Ave	South	North	439	456	0.82
Stanton Rd / Kanowna Ave	North	West	5	19	4.00
Stanton Rd / Kanowna Ave	North	South	564	545	0.82
Stanton Rd / Kanowna Ave	West	North	21	20	0.27
Stanton Rd / Kanowna Ave	West	South	18	16	0.54
Stanton Rd / Morrison St	South	West	21	15	1.41
Stanton Rd / Morrison St	South	North	483	497	0.62
Stanton Rd / Morrison St	South	East	70	34	4.93
Stanton Rd / Morrison St	North	West	6	19	3.59
Stanton Rd / Morrison St	North	South	541	484	2.50
Stanton Rd / Morrison St	North	East	35	53	2.77
Stanton Rd / Morrison St	East	South	60	24	5.55
Stanton Rd / Morrison St	East	North	26	8	4.37
Stanton Rd / Lyall St	South	West	21	6	3.94
Stanton Rd / Lyall St	South	North	547	512	1.52
Stanton Rd / Lyall St	North	West	152	174	1.69
Stanton Rd / Lyall St	North	South	465	334	6.54
Stanton Rd / Lyall St	West	North	26	37	1.96
Stanton Rd / Lyall St	West	South	23	24	0.21
Stanton Rd / Moreing St	South	West	21	7	3.88
Stanton Rd / Moreing St	South	North	554	478	3.34
Stanton Rd / Moreing St	North	West	30	24	1.15
Stanton Rd / Moreing St	North	South	458	333	6.30
Stanton Rd / Moreing St	West	North	14	39	4.89
Stanton Rd / Moreing St	West	South	14	23	2.09
Stanton Rd / Epsom Ave - E Approach			489	466	1.05
Stanton Rd / Epsom Ave - W Approach			580	542	1.59
Stanton Rd / Epsom Ave - N Approach			478	355	6.03
Durban St / Epsom Ave	South	West	155	130	2.09
Durban St / Epsom Ave	South	East	173	184	0.79
Durban St / Epsom Ave	East	South	270	227	2.70
Durban St / Epsom Ave	East	West	289	239	3.08
Durban St / Epsom Ave	West	South	90	91	0.11
Durban St / Epsom Ave	West	East	407	360	2.40
Bulong Ave / Central Ave	South	North	81	59	2.60