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Cockburn Central West

Traffic Impact Analysis

FINAL REPORT

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Rev	Nature of Change
A	First draft
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Change log

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EXECUTIVE SUMMARY

The Cockburn Central West development will be constructed on a greenfields site located between North Lake Road, Midgegooroo Avenue, Beeliar Drive and Poletti Road in the City of Cockburn. At build-out it will be home to nearly 1,000 dwellings, over 6,500 m^2 of office space, 1,000 m^2 of retail and a 23,500 m^2 Regional Recreation Centre.

Urbsol have been engaged by LandCorp to prepare an update and addendum to the original Transport Assessment prepared previously by GHD for this site.

The methodology adopted for this work uses the VISSIM model prepared by Urbsol for Main Roads Western Australia known as the North Lake Road Access Strategy (NLRAS) model.

This report provides detail regarding:

- Site trip estimation
- Projected intersection volumes for both AM and PM peak hours
- Intersection levels of service for key intersections for AM and PM peak periods
- Contribution of development traffic to projected network volumes

In terms of the immediate intersections analysed as part of this project all access points from and to the development area are expected to operate well at LOS of A under normal priority control.

Intersections on the more regional road network considered here are expected to largely operate within acceptable limits (LOS D or less).

At a daily level the total development area in Cockburn Central West is expected to contribute 20% of the projected Poletti Road flows with the Regional Recreation Centre responsible for 12% and the remaining LandCorp Development at 8%.

In terms of the Midgegooroo Road / Signal Terrace intersection the development as a whole is expected to contribute 5% to the peak hour flows – the majority of which are related to the LandCorp development (4%) with the Regional Recreation Centre responsible for approximately 1% of the volumes.

It is recommended that cost sharing for any required upgrades to these network areas be divided according to these development ratios.

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1 INTRODUCTION

The Cockburn Central West development will be constructed on a greenfields site located between North Lake Road, Midgegooroo Avenue, Beeliar Drive and Poletti Road in the City of Cockburn (Figure 1). At build-out it will be home to nearly 1,000 dwellings, over 6,500 m^2 of office space, 1,000 m^2 of retail and a 23,500 m^2 Regional Recreation Centre.

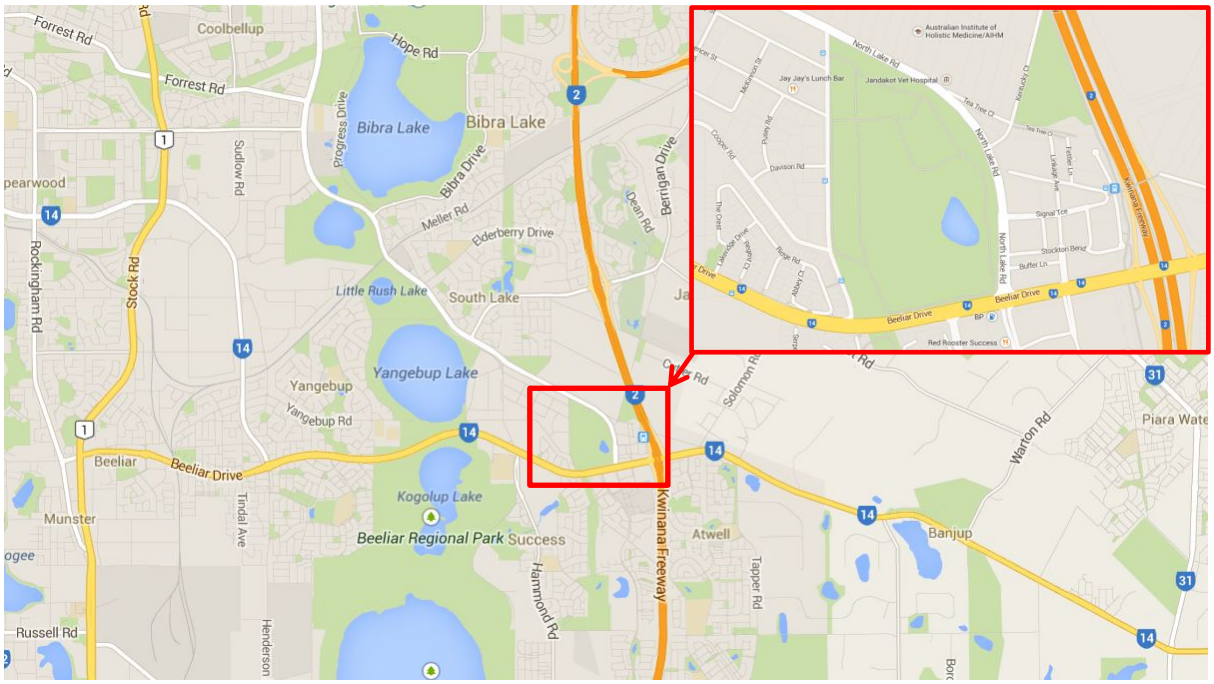

Figure 1 Site location

Urbsol have been engaged by LandCorp to prepare an update and addendum to the original Transport Assessment prepared previously by GHD for this site.

This report is not designed to replace the original assessment as the focus here is purely on the traffic impact analysis component of that piece of work and as such this should be read in conjunction with that report.

The purpose of this report is to:

- Update the traffic generation estimates for the site in light of latest landuse yields
- Model the development impact using more sophisticated techniques
- Assess the performance of impacted intersections
- Identify traffic contributions to flows on impacted roads from the site as a whole and specifically the Regional Recreation Centre

2 BACKGROUND

Urbsol were engaged by Main Roads Western Australia to prepare a large scale VISSIM dynamic assignment model for the North Lake Road Access Strategy.

This model encompassed a wide area of network (including this development site) as shown in Figure 2:

Figure 2 VISSIM model extent

VISSIM is a state of the art transportation simulator developed by PTV in Germany. Urbsol have successfully deployed VISSIM on a number of major traffic and transport projects for a variety of clients.

VISSIM was used for this project for a number of key reasons:

- Strengths in Traffic Engineering
- Dynamic Traffic Assignment based on user equilibrium concepts
- Detailed reporting capabilities
- SCATSIM interface

The 2031 modelled network in VISSIM was significantly upgraded to cater for the increase in through traffic and the traffic generated by added by new developments. The summary of major networks upgrades as modelled in VISSIM is shown in Figure 3.

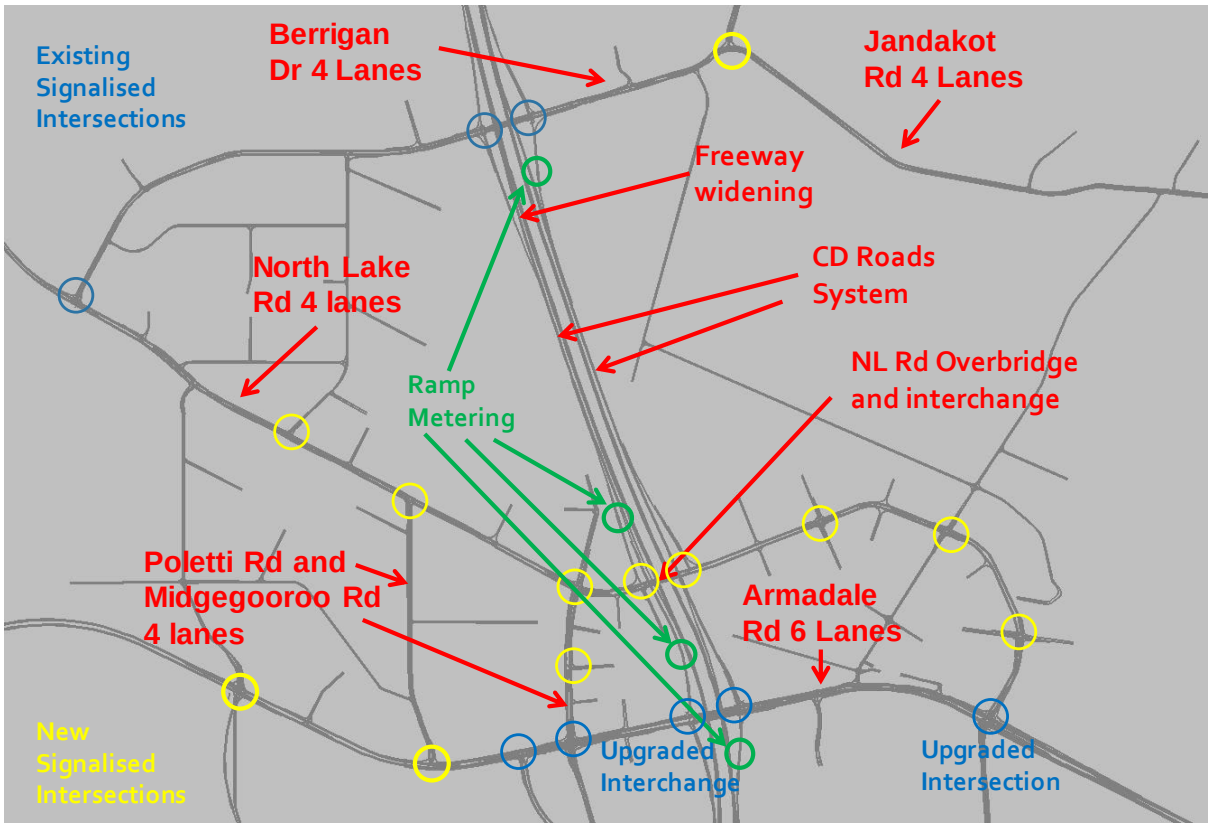

Figure 3 Included network upgrades

Full discussion surrounding the assumptions behind and development cycle of this model are beyond the scope of this document – interested readers are referred to the North Lake Road Access Strategy Report prepared for Main Roads for further details.

Figure 4 to Figure 15 show the key intersection layouts surrounding the development site.

For the site access points, the following general geometric attributes have been assumed:

- Deceleration lanes for left slips into the site ~ 20m including tapers
- Dedicated right turn lanes into the site ~ 50m including tapers
- Site exit point allowing right turn movements ~20m

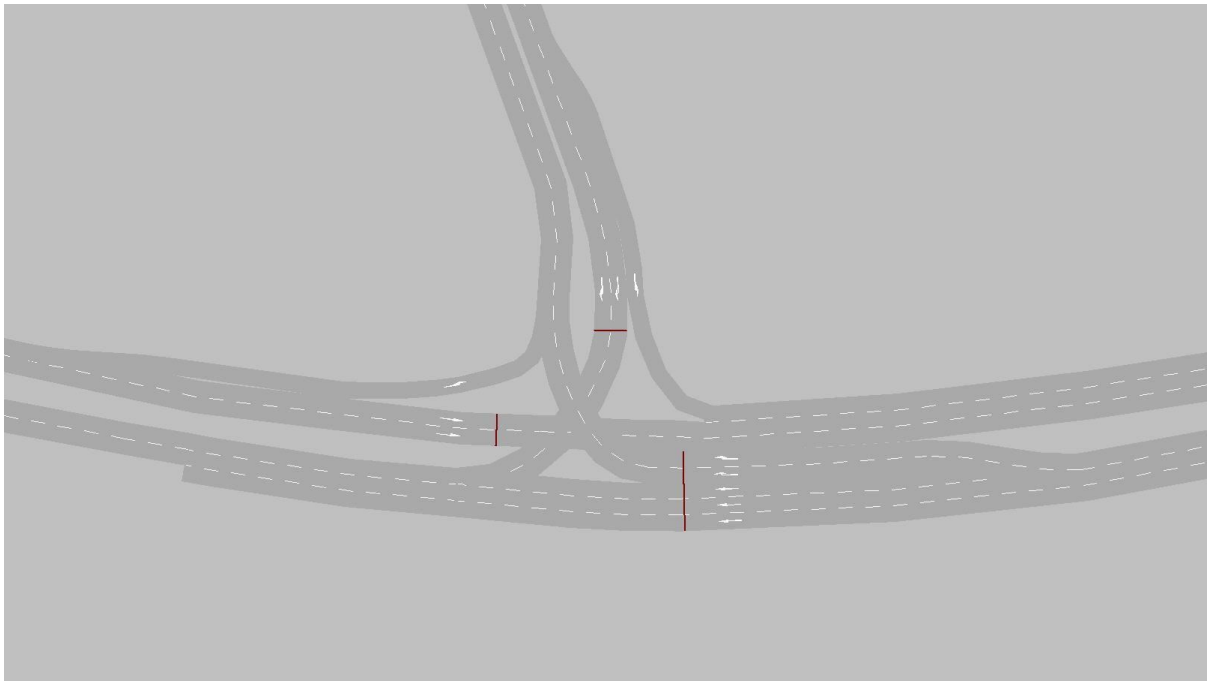

Figure 4 Beeliar Drv / Poletti Rd layout

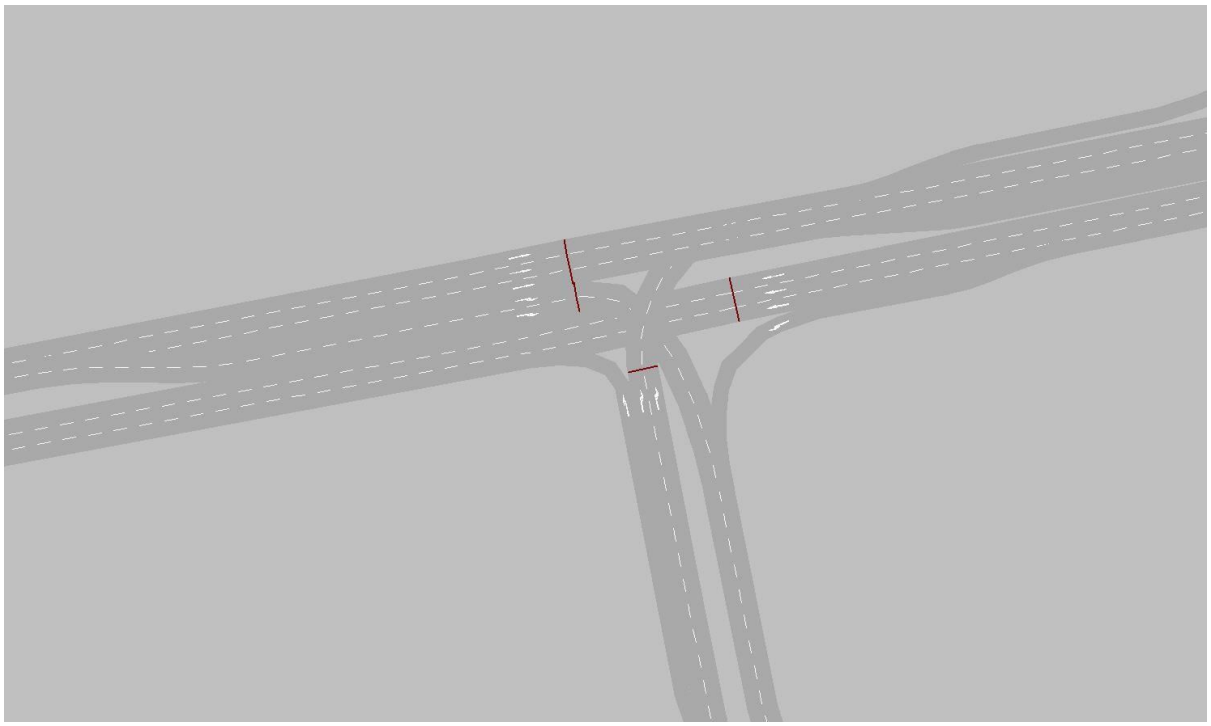

Figure 5 Beeliar Drv / Wentworth Pde layout

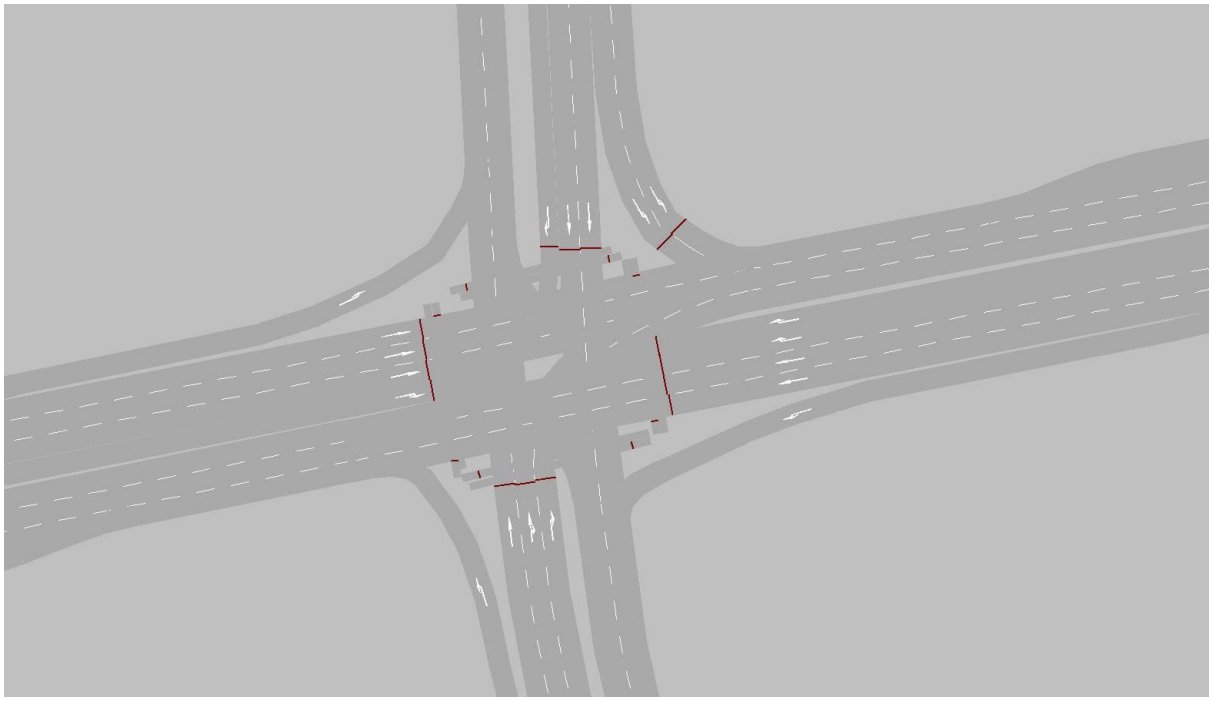

Figure 6 Beeliar Drv / Midgegooroo Rd layout

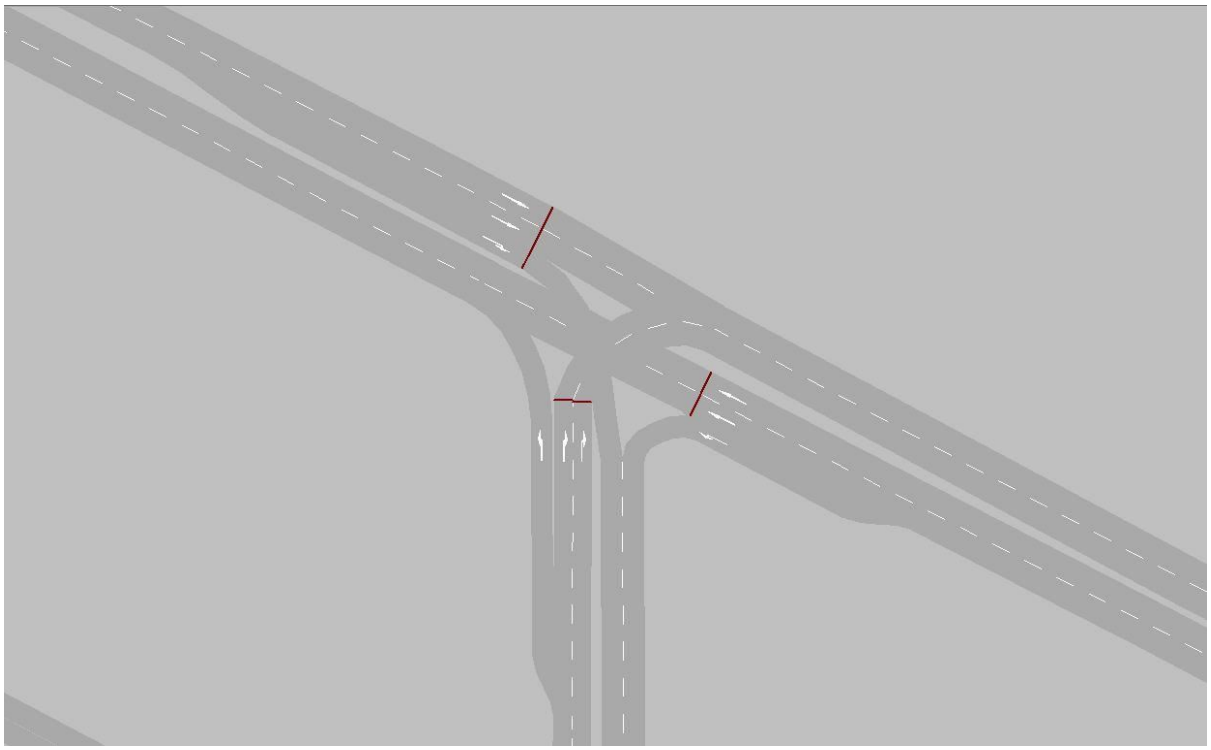

Figure 7 North Lake Rd / Poletti Rd layout

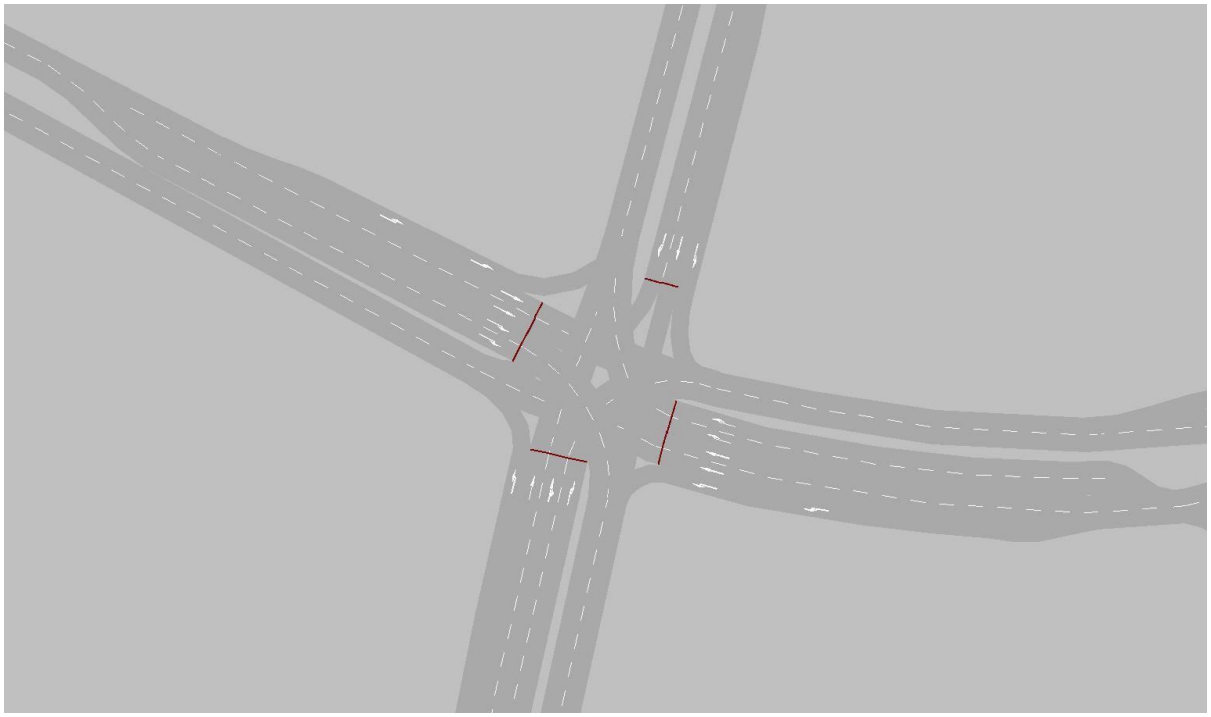

Figure 8 Midgegooroo Rd / Kentucky Crt layout

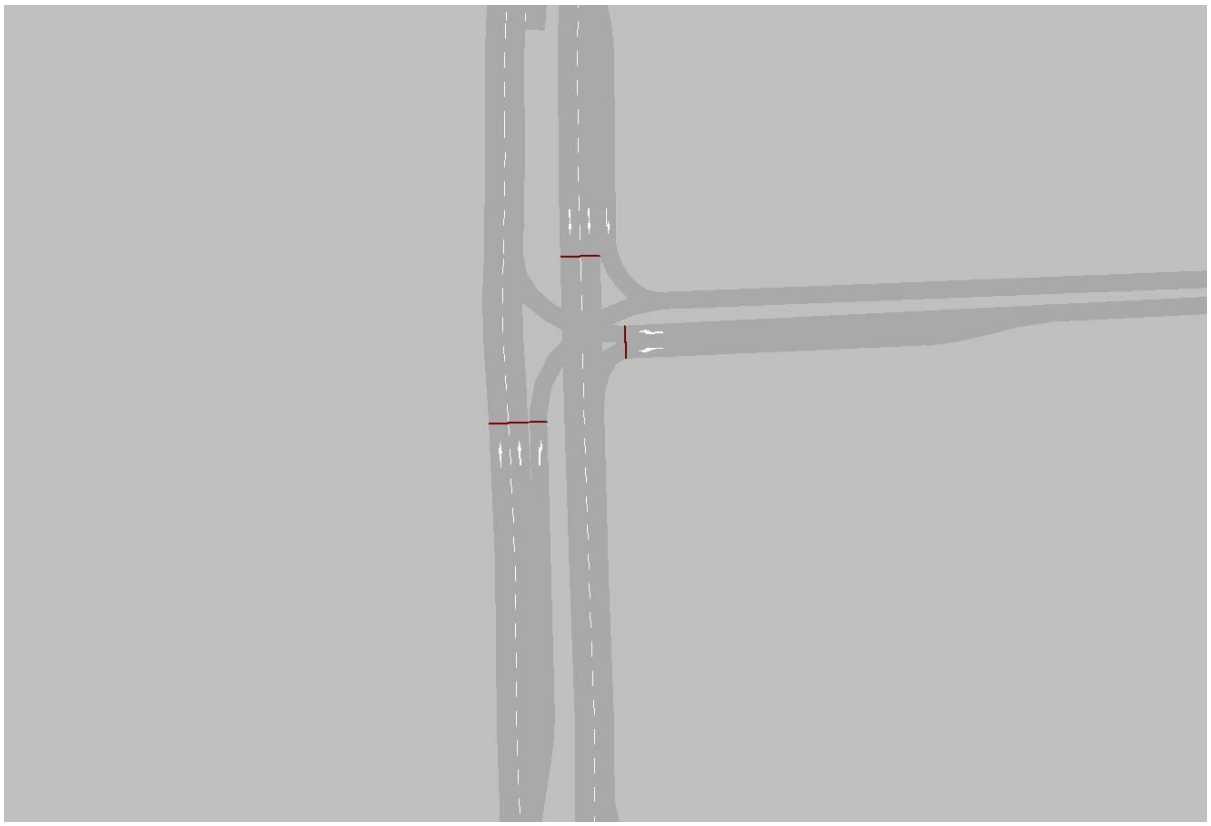

Figure 9 Midgegooroo Rd / Signal Tce layout

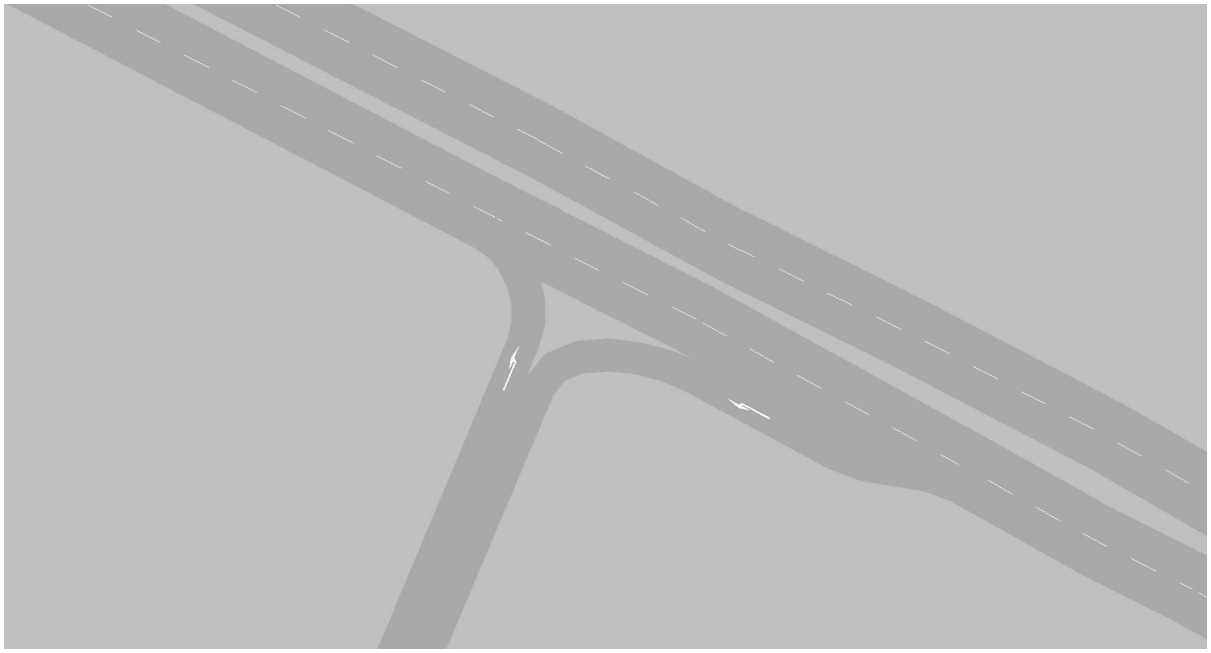

Figure 10 North Lake Rd / Site Access layout

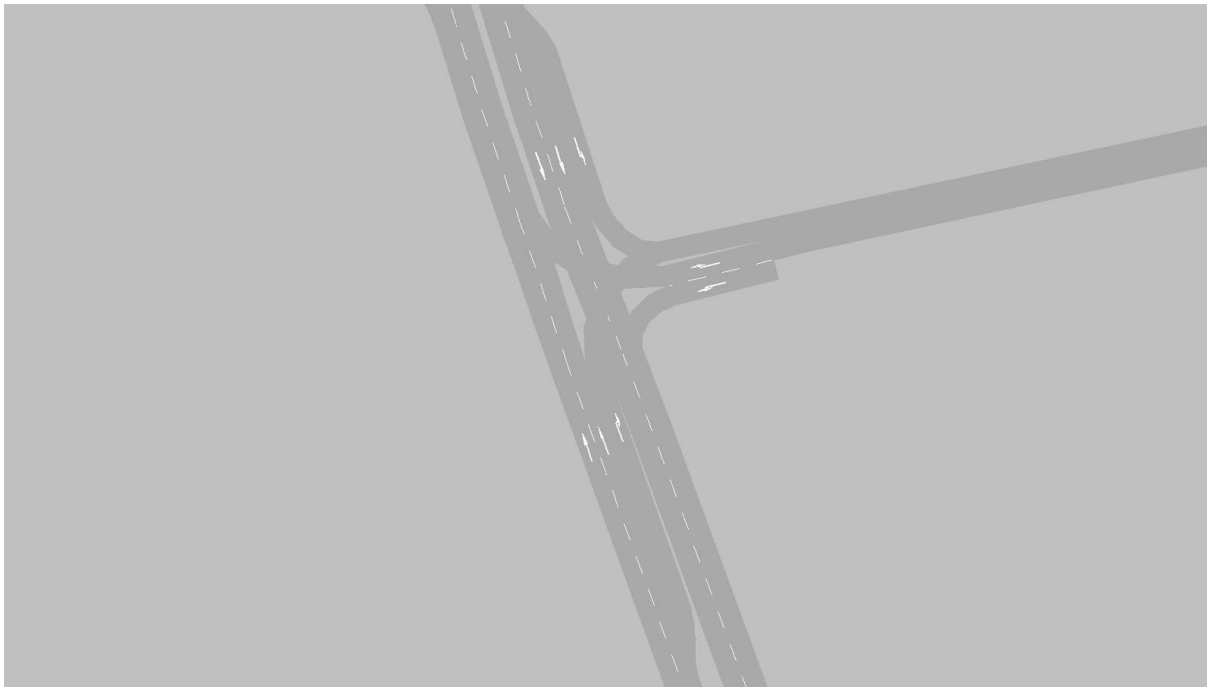

Figure 11 Poletti Rd / Northern Site Access layout

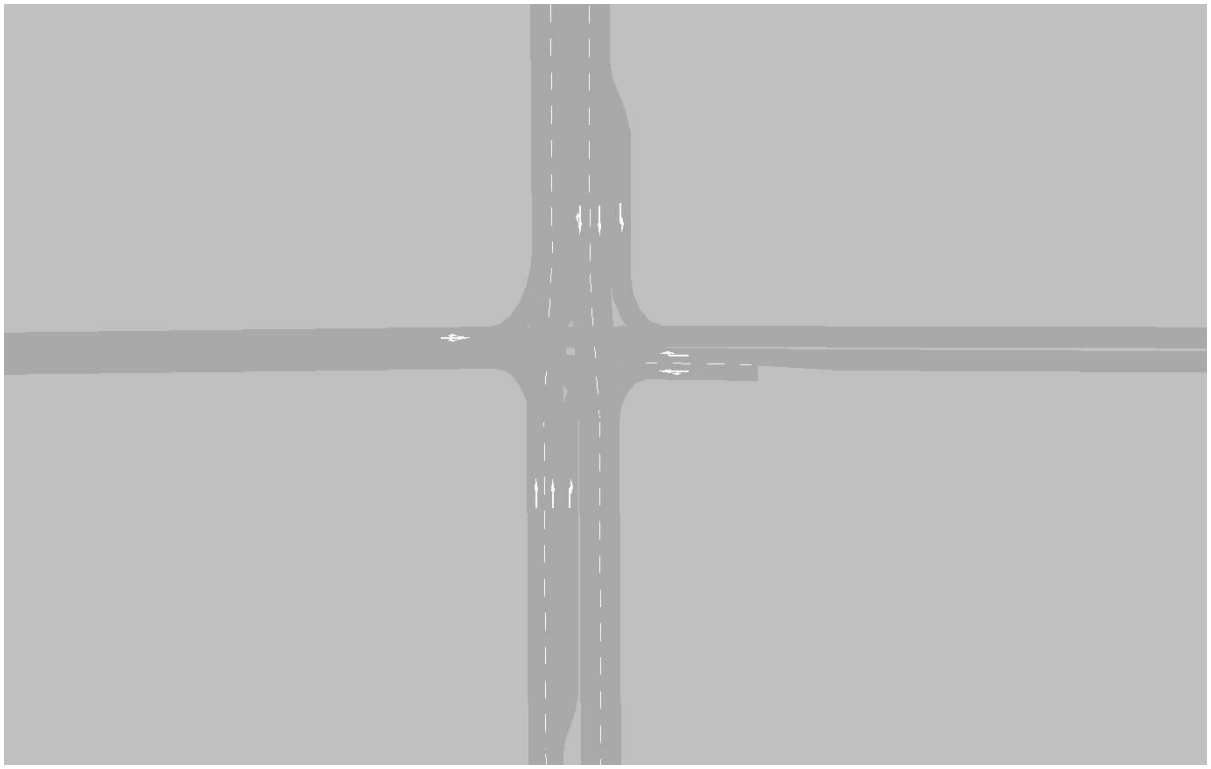

Figure 12 Poletti Rd / Central Site Access layout

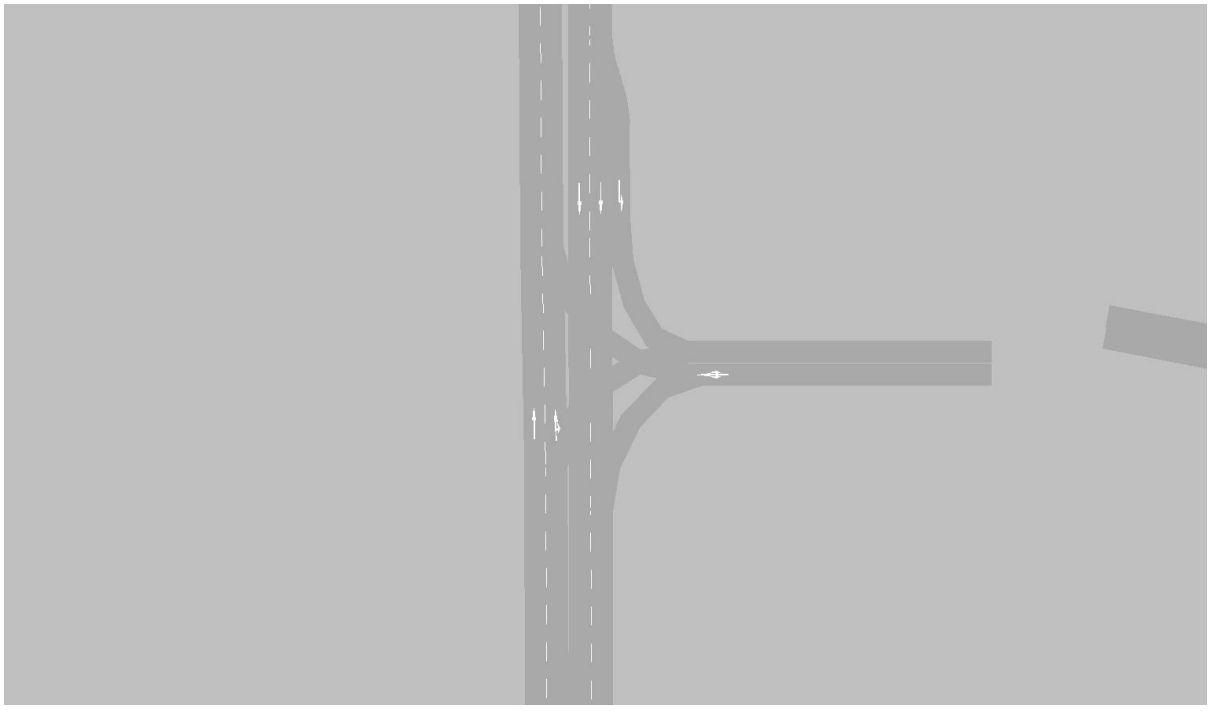

Figure 13 Poletti Rd / Southern Site Access layout

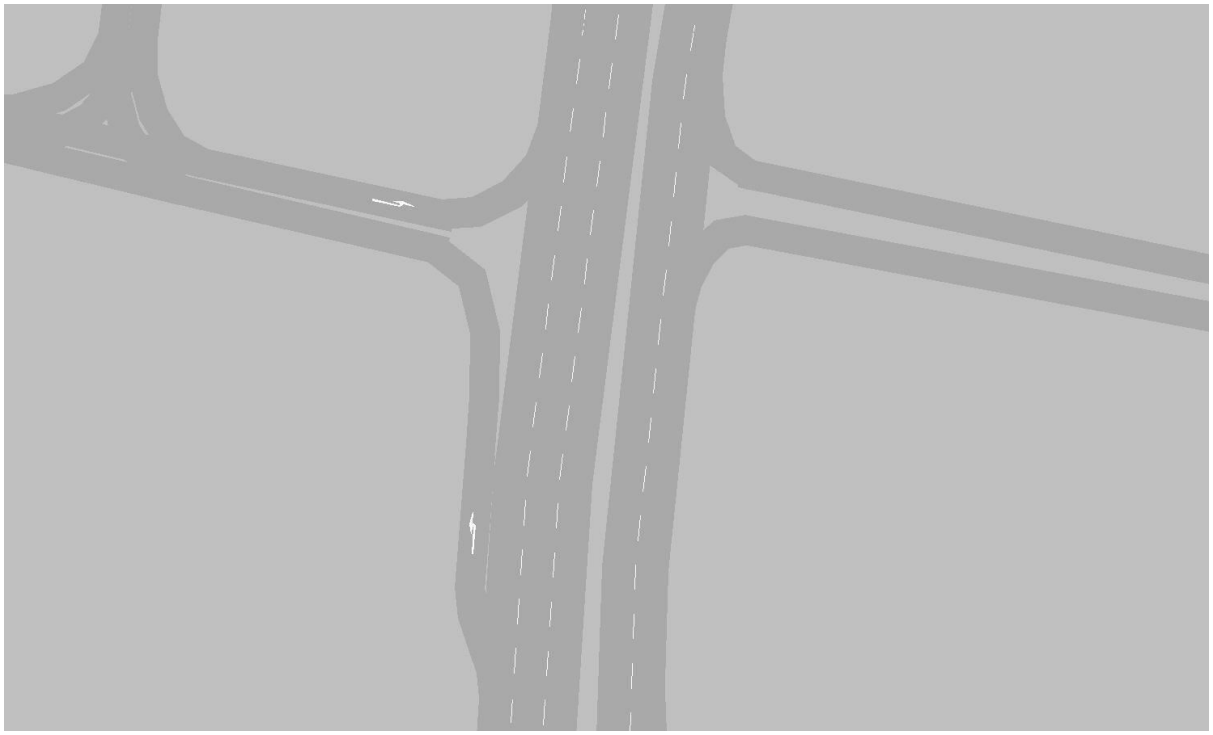

Figure 14 Midgegooroo Rd / Northern Site Access layout

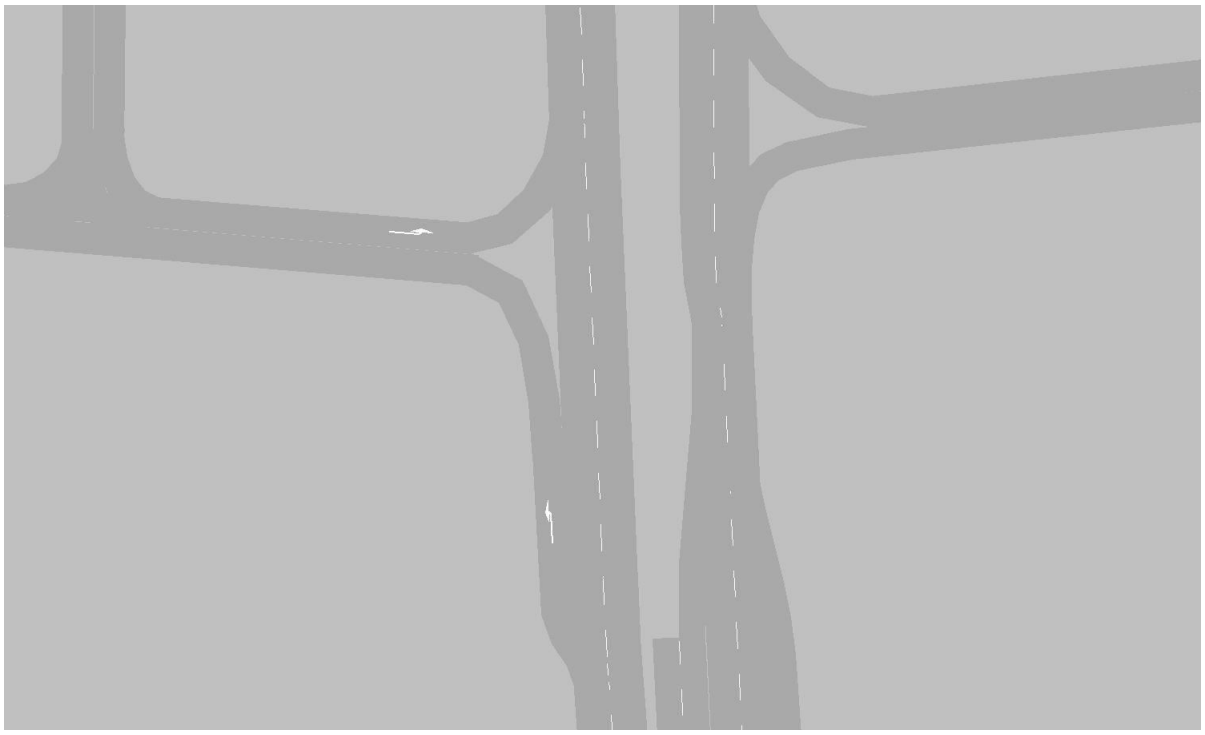

Figure 15 Midgegooroo Rd / Southern Site Access layout

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3 ANALYSIS METHODOLOGY

The original VISSIM model used a tiered approach to the demand estimation that involved macro, meso and micro modelling levels. Thus trip generation was largely based around the trip generation equations used in the Main Roads Regional Operations Model (ROM).

The development site in question in this process was modelled as a single traffic zone with one centroid (Figure 2 and Figure 3). The methodology adopted for this analysis thus involves the refinement of both the demand estimates for the development site and the internal road network and associated zone system.

The method broadly adopts the following process:

1. Identify internal network layout including zone locations
2. Identify access control points, type of control and mechanisms to external network
3. External (manual) trip generation by landuse based on trip generation rates for the development site for each zone
4. Replace ROM generated demand in the original VISSIM model with demand from 3 above assuming retention of distribution
5. Run model and extract outputs

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3.1 INTERNAL NETWORK LAYOUT

The following internal road layouts were provided and included in the model (Figure 16):

Figure 16 Internal network layout

The zone system used matches the Project Stage Locations:

- Stage 1A
- Stage 1B
- Stage 2
- Stage 3A and 3B
- Stage 3C

The only exception was for Stage 1A which segregated the Regional Recreation Centre into a standalone zone. The locations of these development Stages are shown in Figure 17.

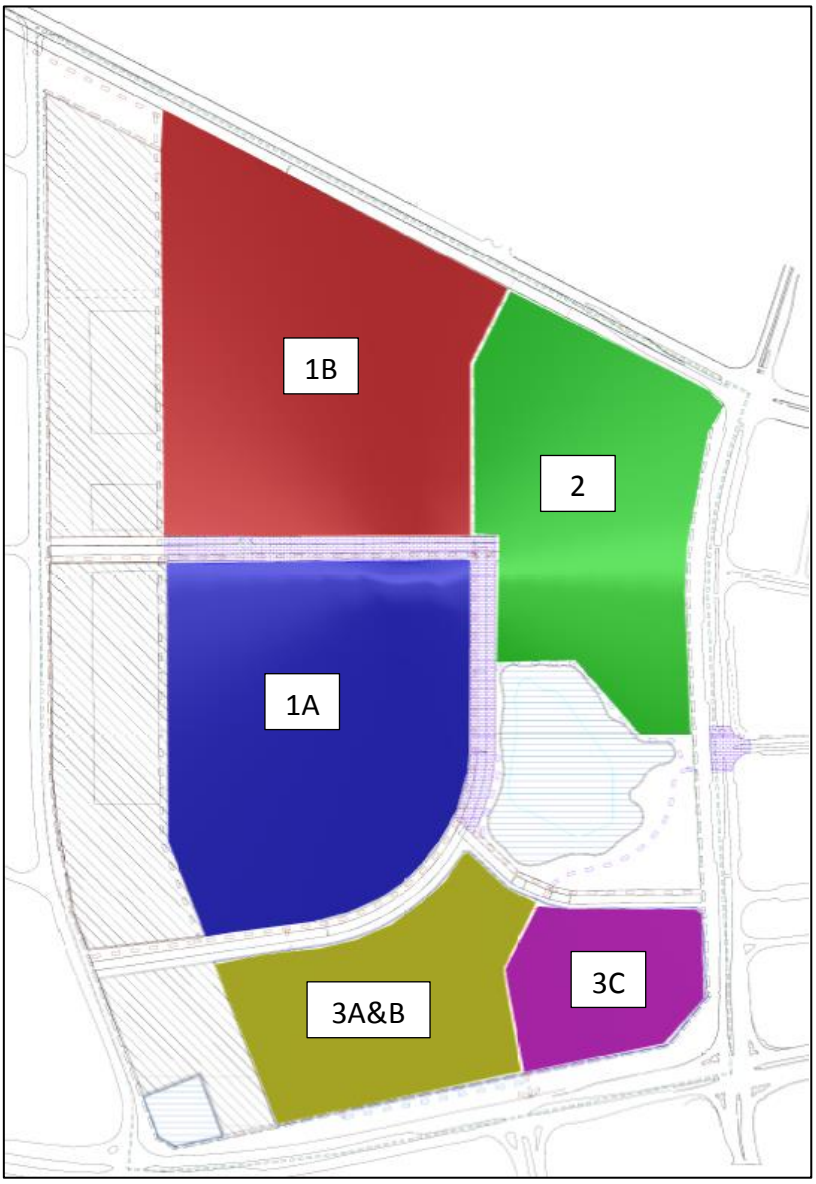

Figure 17 Development stage locations

3.2 SITE ACCESS POINTS AND CONTROL

Connectivity to the greater road network is shown below in Figure 18 (intersection details have been discussed earlier in this report)

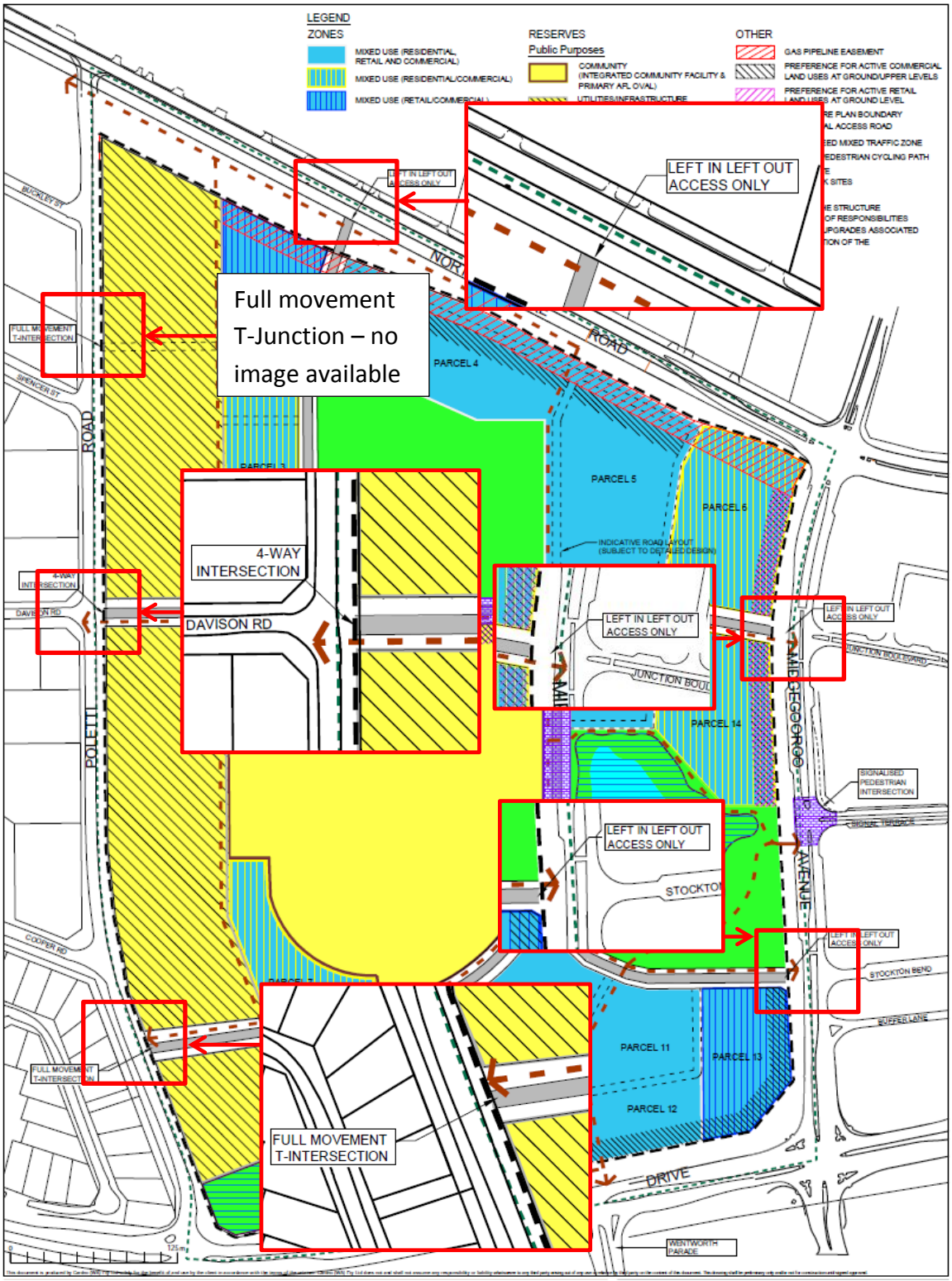

Figure 18 Site connectivity to wider road network

This essentially involves:

- A left-in / Left-out access from North Lake Road
- A 4-way priority controlled intersection on Poletti Road
- Two priority controlled full movement T-junctions on Poletti Road

All intersections for site access are planned to operate without signalisation under normal give-way rules.

Figure 19 shows the VISSIM modelled network for the development site superimposed on the current aerial image.

Figure 19 VISSIM modelled network

4 DEVELOPMENT TRIPS

Trip generation for the development site is undertaken using a first principles approach.

4.1 DEVELOPMENT LANDUSE

The supplied landuse yields are outlined in Table 1.

Stage	Landuse
Stage 1A	~34,000m² NDA - Regional Recreation Facility (GFA - 23,500m²) and One Development Site (64 dwellings)
Stage 1B	~26,000m² NDA - 145 Dwellings 2300m² of Office + 1000m² of Retail across 8 development sites
Stage 2	~34,000m² NDA - 423 Dwellings, across 4 development sites
Stage 3A & 3B	~24,000m² NDA - 216 dwellings, across 7 development sites
Stage 3C	~16,000m² NDA - 152 Dwellings, 4225m² of Office, across 5 development sites

Table 1 Development landuse yields

4.2 PEAK HOUR TRIPS

The conversion of landuse yields to peak hour trip volumes is based on the 8th edition of the ITE Trip Generation Handbook (Table 2).

Landuse	ITE Category Adopted	ITE Code
Regional Recreation Facility	Recreational Com. Centre	495
Dwellings	Mid-Rise Apartment	223
Office	Office Park	750
Retail	Specialty Retail Centre	814

Table 2 Trip generation categories

The ITE definition of each of the categories is provided below.

Recreational Com. Centre (495): *Recreational Community Centres are standalone public facilities similar to and including YMCAs. These facilities often include classes and clubs for adults and children; a day care centre or nursery school; swimming pools and whirlpools; saunas; courts for various sports; locker rooms and a restaurant or snack bar. Typically public access is allowed, but a fee may be charged.*

Mid-Rise Apartment (223): *Mid-rise apartments (rental dwelling units) in rental buildings that have between 3 and 10 levels (floors).*

Office Park (750): *These are generally subdivisions of planned unit developments containing office buildings and support services such as banks, restaurants, and service stations arranged in a park or campus-like setup.*

Specialty Retail Centre (814): *Specialty Retail Centres are generally small strip shopping centres containing a variety of retail shops, specialising in quality apparel, hard goods, services such as real estate office, dance studios, or florists and small restaurants.*

4.2.1 TRIP GENERATION AND DISTRIBUTION

The ITE handbook prescribes the following trip rates (Table 3):

Landuse	Units	AM Peak Generation	PM Peak Generation	Daily Generation
Recreational Com. Centre	KSF^2	1.62	1.45	22.88
Mid-Rise Apartment	Dwellings	0.30	0.39	3.754
Office Park	KSF^2	1.71	1.48	11.42
Specialty Retail Centre	KSF^2	6.84	5.02	44.32

Table 3 Trip generation rates

The above rates produce total trip generation for the sites in question (in and outbound trips) – the directionality specified for each landuse from the ITE is listed below in Table 4 – note for daily trips a 50%/50% split is assumed (i.e. what leaves returns and vice versa).

Landuse	AM Peak		PM Peak	
	In	Out	In	Out
Recreational Com. Centre	61%	39%	37%	63%
Mid-Rise Apartment	31%	69%	58%	42%
Office Park	89%	11%	14%	86%
Specialty Retail Centre	48%	52%	44%	56%

Table 4 Trip directionality

Considering these rates and directionality produces the demand estimates in Table 5.

			GENERATION			AM		PM		DAILY	
Development Site	LU	Units	AM	PM	Daily	IN	OUT	IN	OUT	IN	OUT
Stage 1A	Rec. Centre	23500	410	367	5788	250	160	136	231	2894	2894
	Dwellings	64	19	25	239	6	13	14	10	120	120
Stage 1B	Dwellings	145	43	56	543	13	30	33	24	271	271
	Office	2300	42	37	283	38	5	5	32	141	141
	Retail	1000	74	54	477	35	38	24	30	239	239
Stage 2	Dwellings	423	127	165	1588	39	88	96	69	794	794
Stage 3A & 3B	Dwellings	216	65	84	812	20	45	49	35	406	406
Stage 3C	Dwellings	152	46	59	572	14	32	34	25	286	286
	Office	4225	70	68	501	63	8	9	58	250	250
TOTALS			896	915	10802	479	418	400	515	5401	5401

Table 5 Site trips

The original VISSIM model trip rates for the overall site are shown in Table 6.

		AM Peak	PM Peak
ROM	IN	473	475
	OUT	360	534
	TOTAL	833	1009

Table 6 Original VISSIM model demands

As can be seen the demand estimates derived from ROM (Table 6) match reasonably closely the manual estimates in Table 5. In the AM peak the manual estimation method produces about 7% more trips and in the PM approximately 10% fewer trips as compared to the ROM estimates.

The trip distribution adopted in the model for the manually generated trips is then based on the distribution determined in the VISSIM model which in turn is based on ROM.

5 ANALYSIS RESULTS

This section outlines the results of the analysis in terms of:

- Intersection Traffic Volumes
- Intersection Levels of Service (based on the HCM method) for key impacted intersections
- Development site contribution to key intersection and link volumes

In the absence of internal road names, the following intersection naming convention is used (Figure 20).

Figure 20 Intersection labelling convention

5.1 INTERSECTION TRAFFIC VOLUMES

Figure 21 and Figure 22 show the modelled volumes for each peak period in the immediate vicinity of the development site.

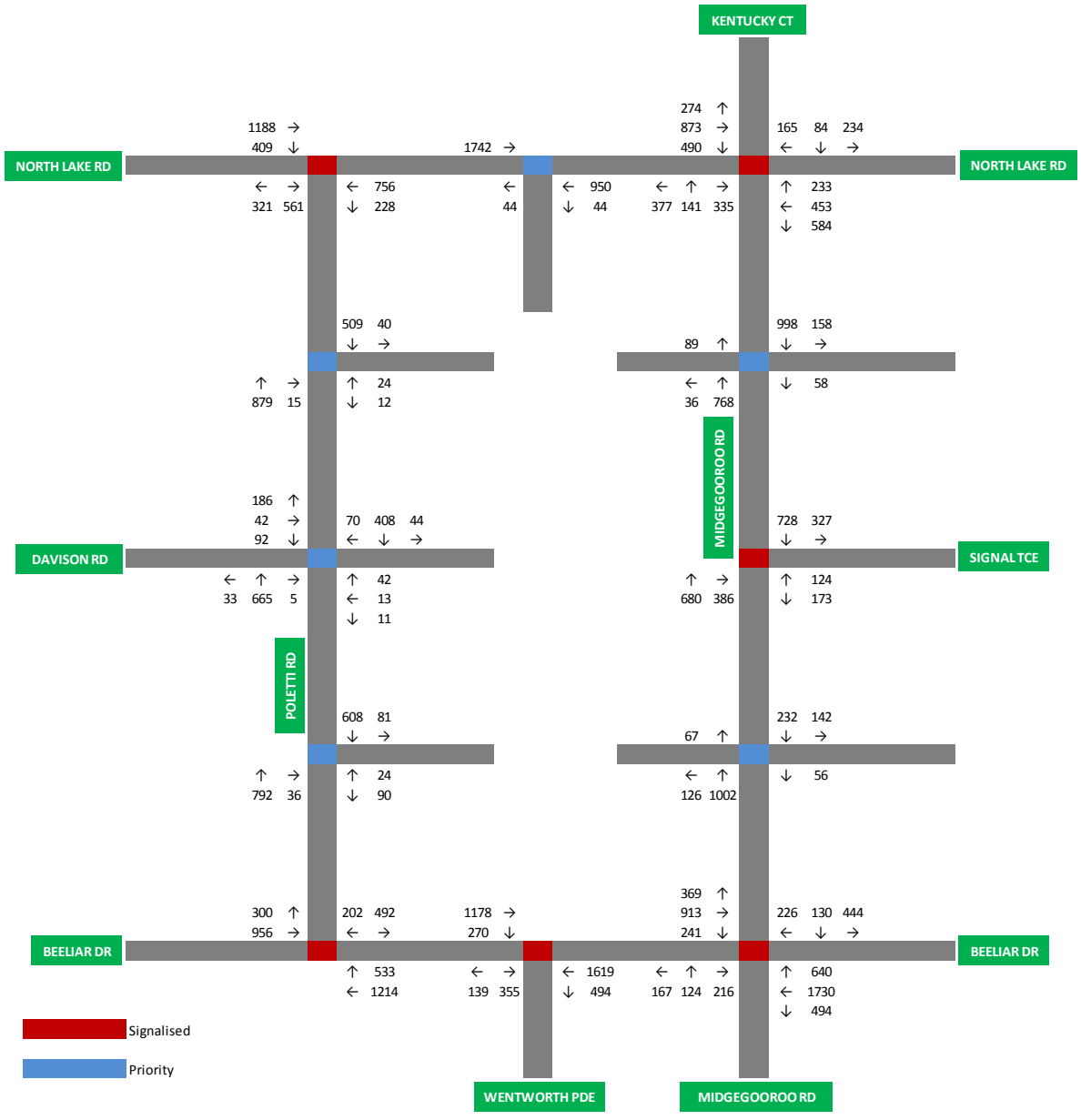

Figure 21 AM peak modelled demands

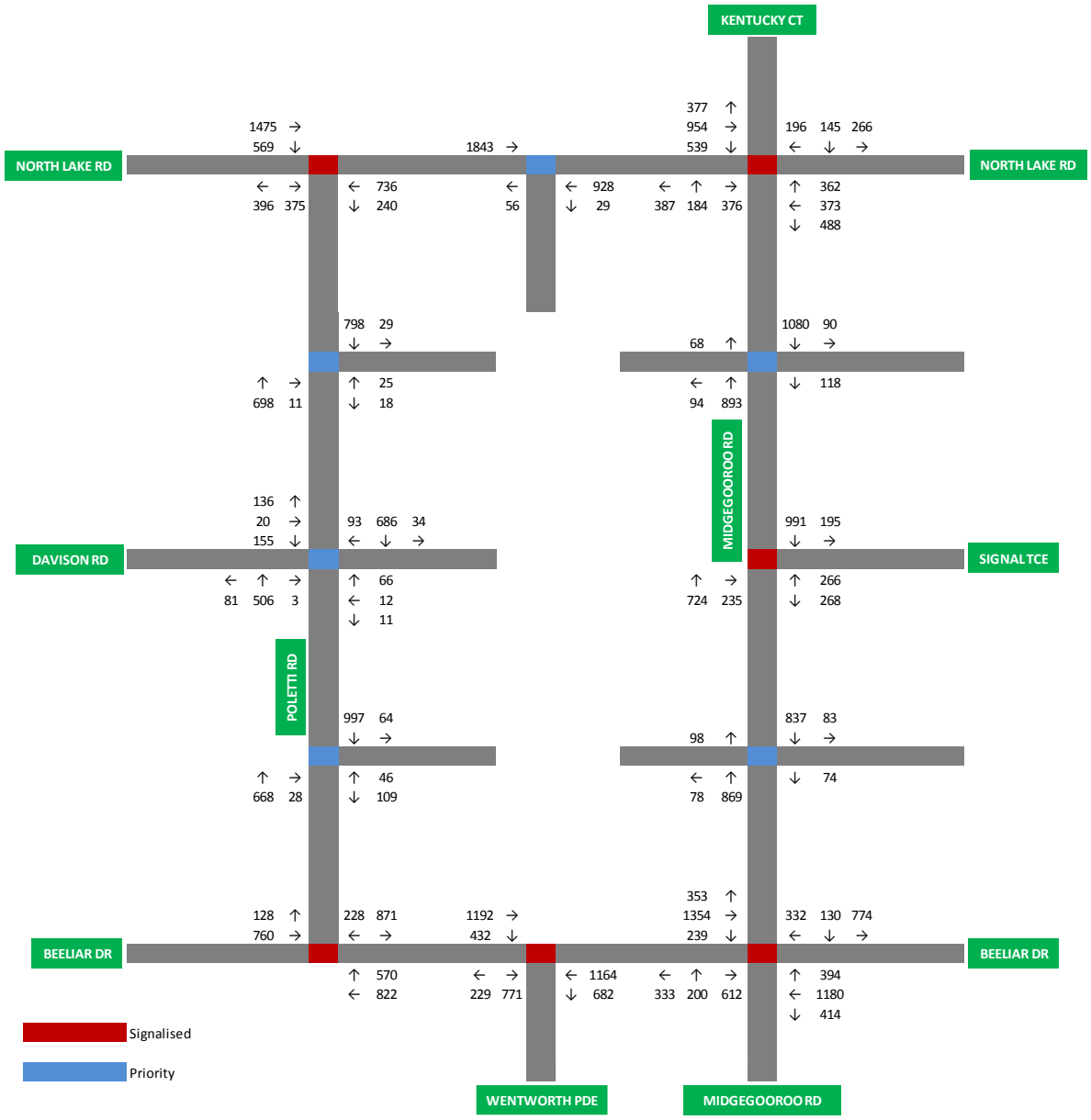

Figure 22 PM peak modelled demands

5.2 INTERSECTION LEVELS OF SERVICE

Detailed movement based Levels of Service are provided at Appendices 1 and 2 – Figure 23 and Figure 24 provide an intersection summary of the level of service for the AM and PM peak hours respectively for key intersections.

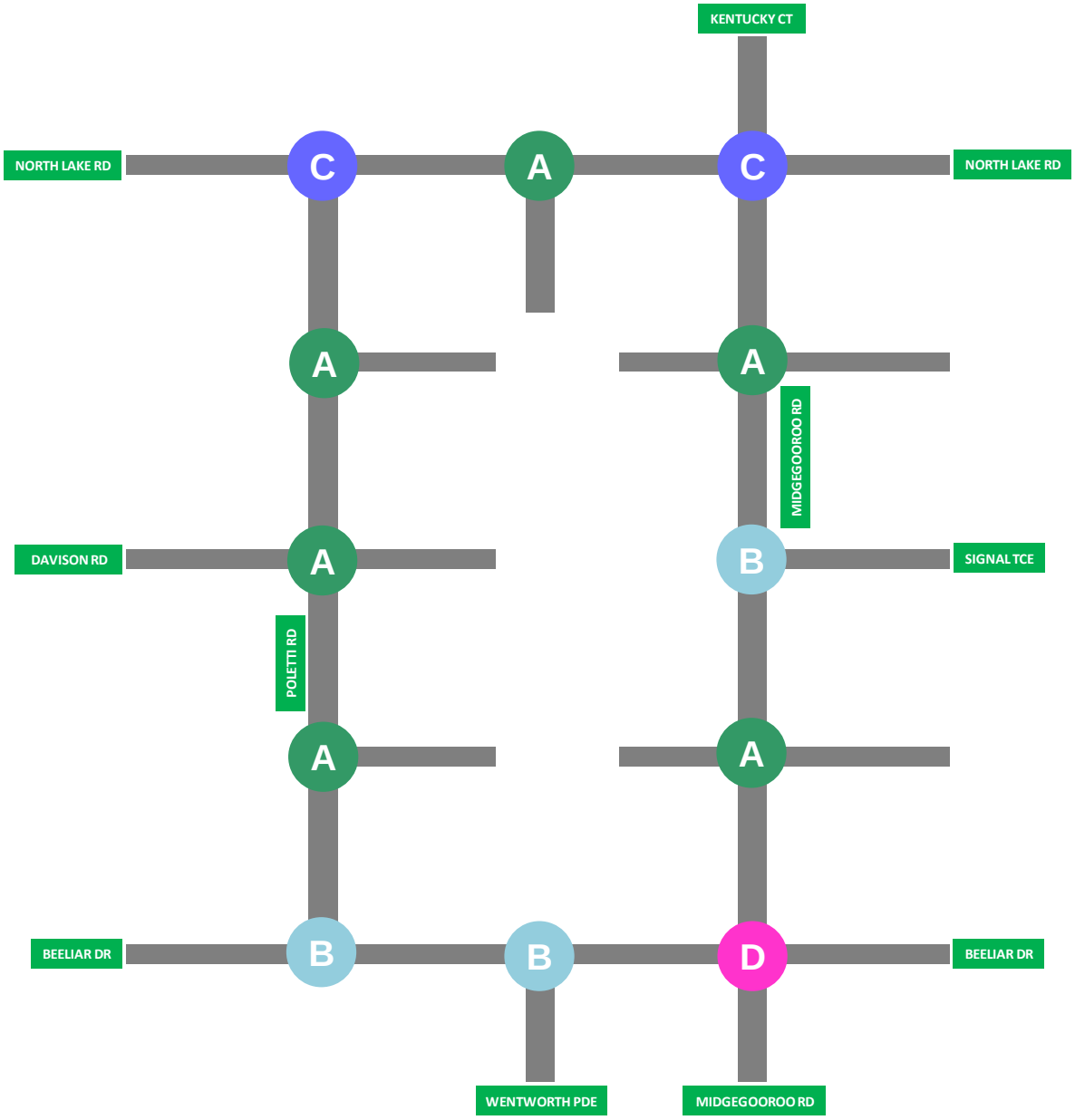

Figure 23 AM peak intersection LOS

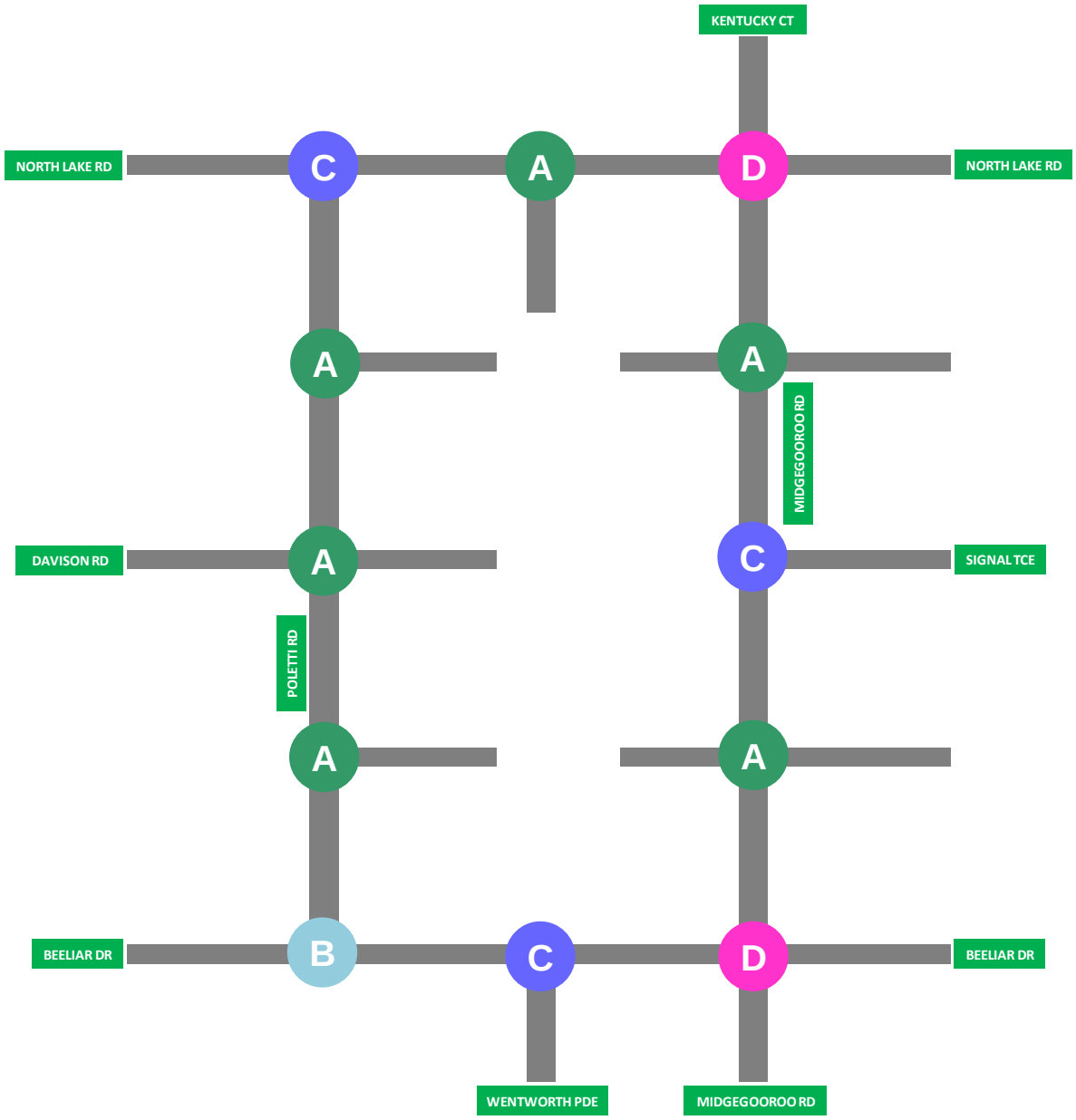

Figure 24 PM peak intersection LOS

It should be noted that since the development site volumes estimated for this work match closely the original demands estimated for the NLRAS VISSIM model the overall impact on other intersections within the model area will be very similar to those reported as part of the Main Roads NLRAS project and as such are not discussed in detail here.

5.3 SITE CONTRIBUTION TO VOLUMES

5.3.1 INTERSECTION CONTRIBUTIONS

This section outlines at an intersection level how the development and more specifically the Regional Recreation Facility contribute to the intersection flows. These are detailed below for relevant intersections in Table 7 to Table 18*.

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	6%	4%	10%
PM	6%	3%	9%
Average	6%	3%	9%

Table 7 North Lake Rd/Poletti Rd

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	12%	7%	19%
PM	11%	6%	17%
Average	11%	6%	17%

Table 8 Poletti Rd/northern site access

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	8%	10%	18%
PM	9%	8%	17%
Average	8%	9%	17%

Table 9 Poletti Rd/central site access

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	11%	10%	21%
PM	11%	7%	18%
Average	11%	8%	19%

Table 10 Poletti Rd/southern site access

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	5%	2%	7%
PM	6%	2%	8%
Average	5%	2%	7%

Table 11 Beeliar Drv/Poletti Rd

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	3%	1%	4%
PM	3%	1%	4%
Average	3%	1%	4%

Table 12 Beeliar Drv/Wentworth Pde

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	5%	3%	8%
PM	6%	2%	8%
Average	5%	2%	7%

Table 13 North Lake Rd/site access

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	4%	1%	5%
PM	5%	2%	7%
Average	4%	1%	5%

Table 14 North Lake Rd/Midgegooroo Rd

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	7%	1%	8%
PM	10%	2%	12%
Average	9%	1%	10%

Table 15 Midgegooroo Rd/northern site access

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	3%	1%	4%
PM	6%	2%	8%
Average	5%	1%	6%

Table 16 Midgegooroo Rd/Signal Tce

Peak	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	9%	4%	13%
PM	9%	3%	12%
Average	9%	*3%*	12%

Table 17 Midgegooroo Rd/southern site access

Peak	LandCorp Development	Rec Centre Traffic	Total Development

	Traffic		Traffic
AM	3%	1%	4%
PM	3%	1%	4%
Average	3%	1%	4%

Table 18 Beeliar Drv/Midgegooroo Rd

** Note: rounding calculations in the above tables will affect additive results.*

These results are shown graphically in Figure 25 and Figure 26.

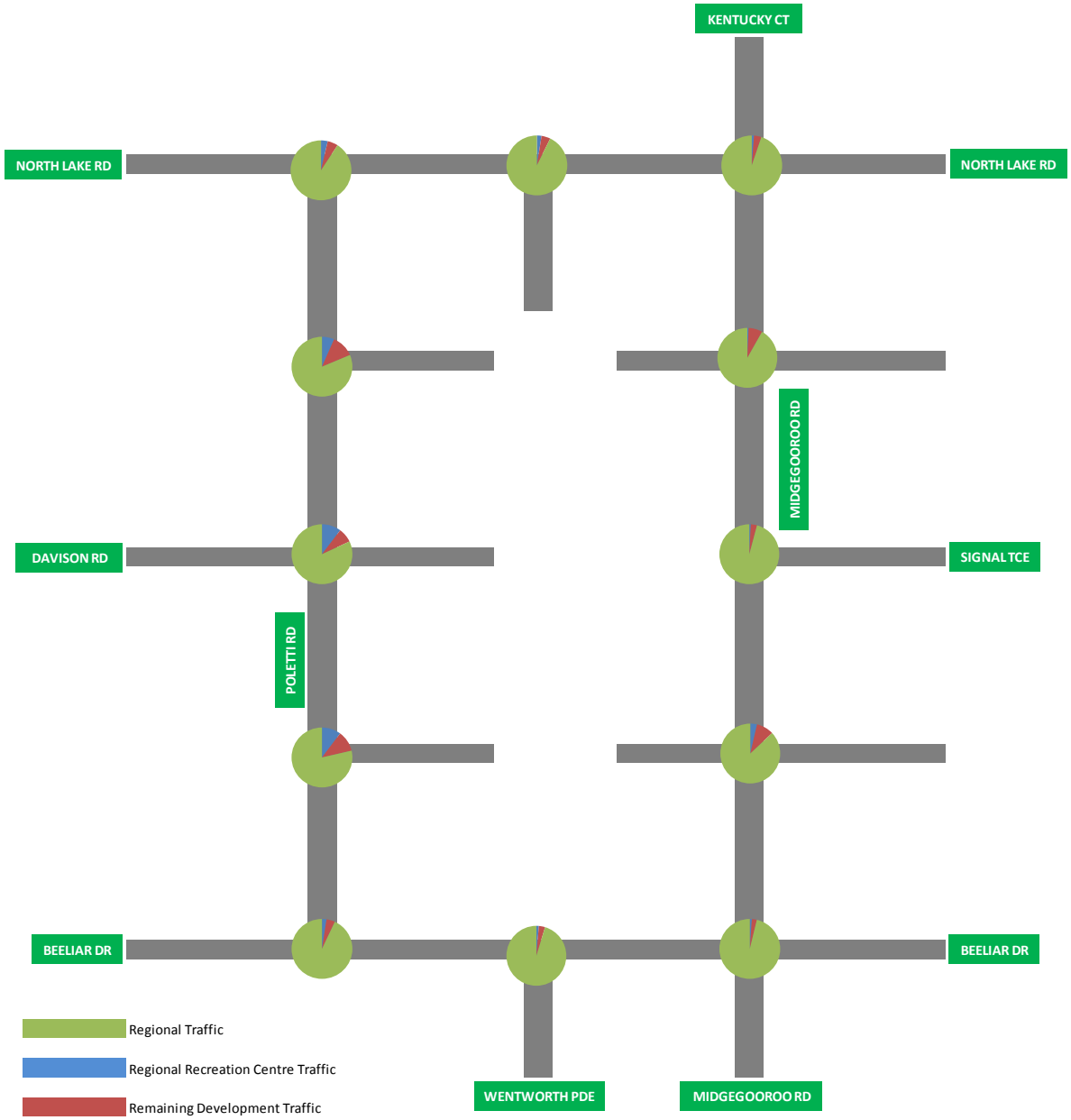

Figure 25 AM peak intersection volume contributions

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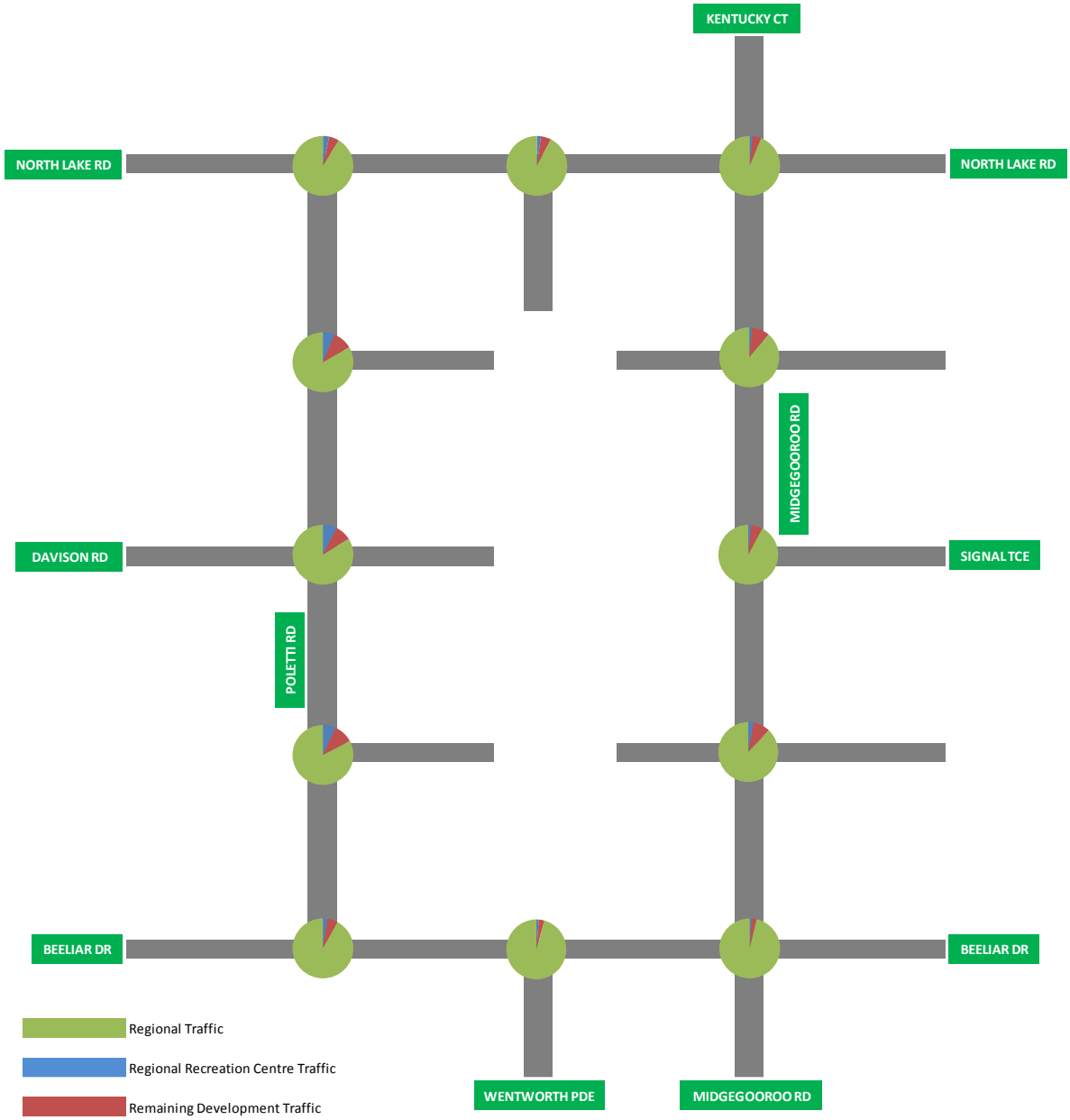


Figure 26 PM peak intersection volume contributions

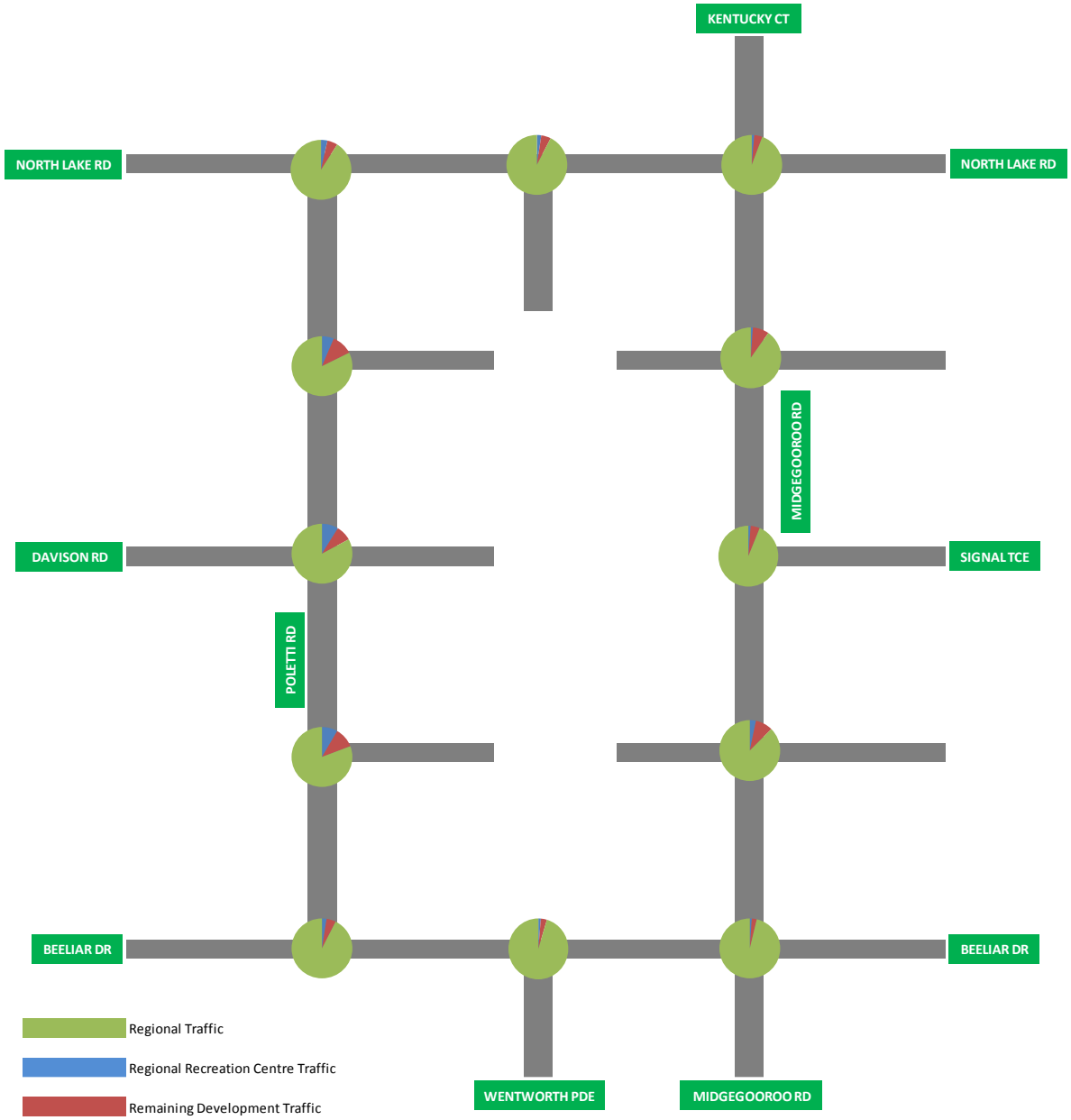


Figure 27 Average peak hour intersection volume contributions

5.3.2 POLETTI ROAD AND MIDGEGOOROO ROAD CONTRIBUTIONS

Looking more closely at the volumes on Poletti Road and Midgegooroo Road, Table 19 to Table 22 summarise the contribution of traffic on the links from the development site for each peak hour and at a daily level*.

Peak	Direction	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	NB	5%	4%	9%
	SB	17%	10%	27%
	Both	**10%**	**6%**	**16%**
PM	NB	6%	7%	13%
	SB	12%	5%	17%
	Both	**9%**	**6%**	**15%**
Average	Both	**9%**	**6%**	**15%**
Daily	NB	6%	13%	19%
	SB	12%	14%	25%
	Both	**11%**	**16%**	**27%**

Table 19 Poletti Rd S of North Lake Rd

Peak	Direction	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	NB	3%	4%	7%
	SB	18%	8%	26%
	Both	**10%**	**6%**	**16%**
PM	NB	3%	2%	5%
	SB	12%	6%	18%
	Both	**9%**	**5%**	**14%**
Average	Both	**9%**	**5%**	**14%**
Daily	NB	4%	7%	11%
	SB	12%	14%	26%
	Both	***8%***	***11%***	**20%**

Table 20 Poletti Rd N of Beeliar Drv

Peak	Direction	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	NB	14%	2%	16%
	SB	0%	0%	0%
	Both	**6%**	**1%**	**7%**
PM	NB	14%	4%	18%
	SB	0%	0%	0%
	Both	**6%**	**2%**	**8%**
Average	Both	**6%**	**1%**	**7%**
Daily	NB	10%	7%	17%
	SB	0%	0%	0%
	Both	**4%**	**3%**	**7%**

Table 21 Midgegooroo Rd S of North Lake Rd

Peak	Direction	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
AM	NB	10%	4%	14%
	SB	0%	0%	1%
	Both	**6%**	**2%**	**8%**
PM	NB	16%	3%	19%
	SB	0%	0%	0%
	Both	**7%**	**1%**	**8%**
Average	Both	**7%**	**2%**	**8%**
Daily	NB	9%	8%	18%
	SB	0%	0%	1%
	Both	**5%**	**4%**	**9%**

Table 22 Midgegooroo Rd N of Beeliar Drv

** Note: rounding calculations in the above tables will affect additive results.*

This can be seen in Figure 28.

Figure 28 Volume contributions on Poletti Rd and Midgegooroo Rd

Table 23 presents the average daily flow on Poletti Road and Midgegooroo Rd respectively.

Daily	Direction	LandCorp Development Traffic	Rec Centre Traffic	Total Development Traffic
Poletti Rd	NB	5%	9%	14%
	SB	12%	14%	25%
	Both	**8%**	**12%**	**20%**
Midgegooroo Rd	NB	10%	8%	18%
	SB	0%	0%	0%
	Both	**4%**	**3%**	**8%**

Table 23 Average daily contribution summary

5.4 24-HOUR VOLUME PROJECTIONS

Figure 29 below summarises the projected 24-hour modelled volumes on Poletti Road and Midgegooroo Road.

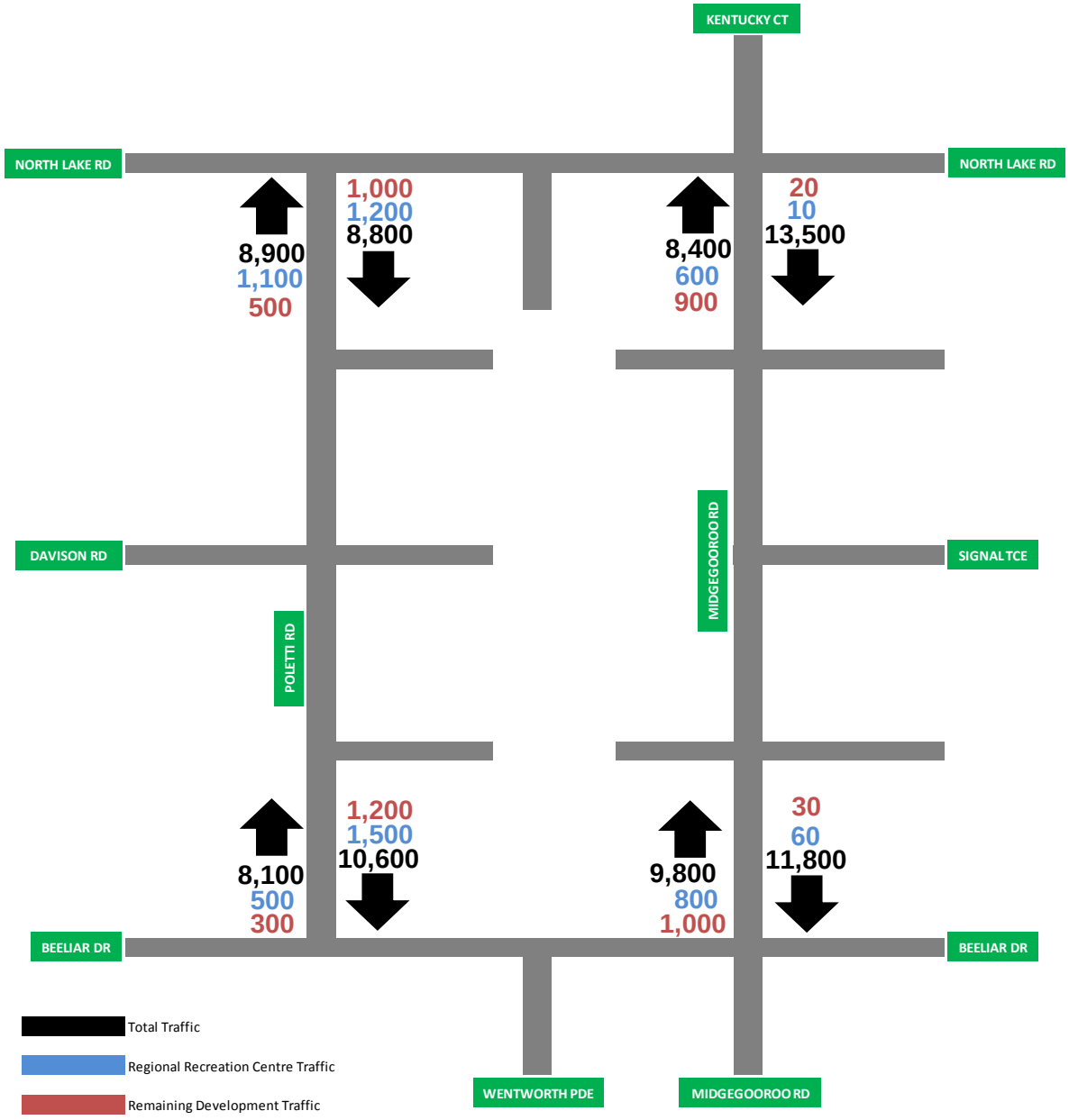


Figure 29 2031 24-hour volume projections

24 hour forecasts are established based on expanding the forecasted peak hour volumes based on current peaking characteristics at each observed site overlayed with daily site projected volumes.

5.5 UPGRADE CONTRIBUTION FOR POLETTI ROAD AND SIGNAL TERRACE

Poletti Road

In terms of Poletti Road it can be seen that in the future the overall development is likely to be responsible for about 20% of flows on the link.

Of these development flows the Regional Recreation Centre is predicted to contribute more than 50%.

It must however be recognised that the largest contribution of future traffic expected to use the link will be regional movements, accounting for the remaining 80% of traffic.

Given the nature of demand forecasting it is recommended to split 20% of the costs associated with the upgrading Poletti Road as follows: Regional Recreation Facility 12% and the remaining LandCorp Development at 8%.

Midgegooroo Road / Signal Terrace Intersection

Demand projections for the overall development sees approximately a 5% contribution to the Midgegooroo Road / Signal Terrace intersection. The vast majority of these flows (4%) can be attributable to the LandCorp component of the development with the Regional Recreation Centre at only 1%.

It must however be recognised that the largest contribution of future traffic expected to use the intersection will again be regional movements, accounting for the remaining 95% of traffic.

It is recommended to split 5% of the costs associated with the upgrading of the Midgegooroo Road / Signal Terrace intersection between the relative contributions from the Regional Recreation Centre (1%) and the LandCorp Development (4%).

6 SUMMARY

This analysis of the proposed Cockburn Central West development has used first principles demand estimation and imbedded these results into a wider area detailed VISSIM model prepared for Main Roads for the North Lake Road Access Strategy.

Review of the estimated demands has shown that the original estimates used in the wider VISSIM model are not dissimilar to those derived using first principles and as such the outcomes in terms of network performance are likely to be similar to those reported as part of the Main Roads work.

In terms of the immediate intersections analysed as part of this project all access points from and to the development area are expected to operate well at LOS of A under normal priority control.

Intersections on the more regional road network considered here are expected to largely operate within acceptable limits (LOS D or less).

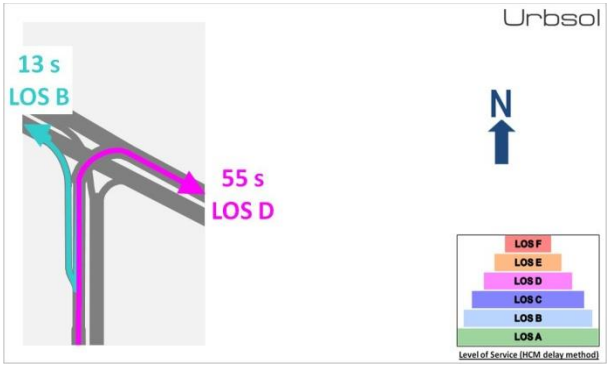
The highest concentration of development related traffic is expected to occur on Poletti Road which is not unsurprising given the majority of site access is focussed on this link. Volumes south of North Lake Road are likely to contain approximately 23% development related traffic at a daily level while north of Beeliar Drive this mix will be closer to 17%.

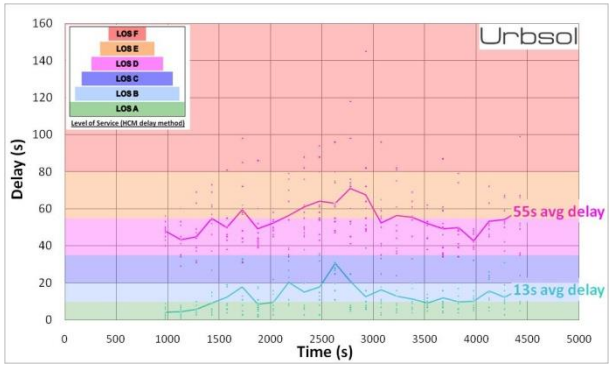
At a daily level the Regional Recreation Centre is expected to contribute 12% at the northern end of Poletti Road which represents about 52% of the total development volume at this point as compared to 9% at the southern end which represents about 53%.

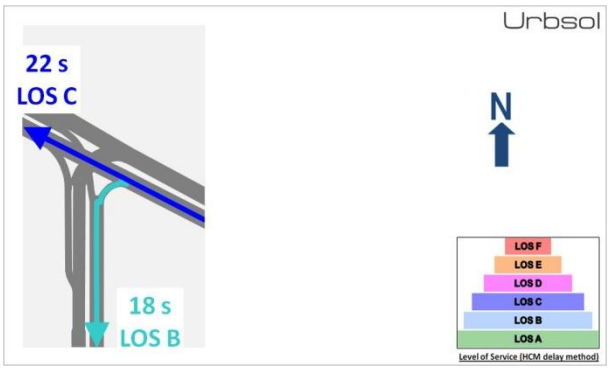
In terms of the Midgegooroo Road / Signal Terrace intersection the development as a whole is expected to contribute 5% to the peak hour flows – the majority of which are related to the LandCorp development with the Regional Recreation Centre responsible for approximately 1% of the total traffic volumes.

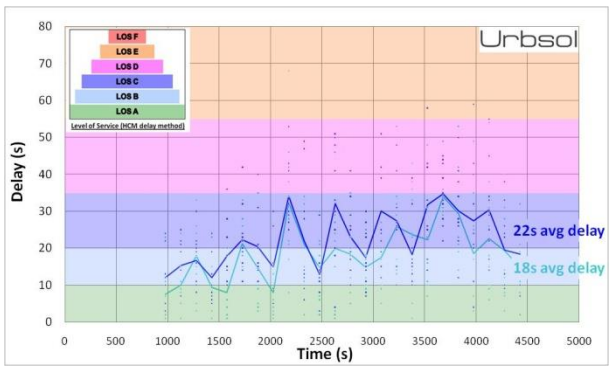
7 APPENDIX 1: MOVEMENT BASED LOS RESULTS - AM PEAK

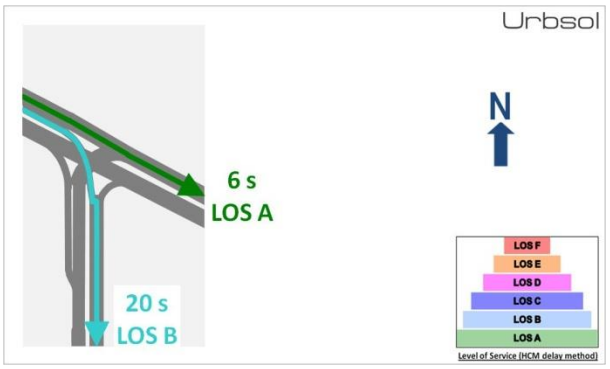
Poletti Road / North Lake Road

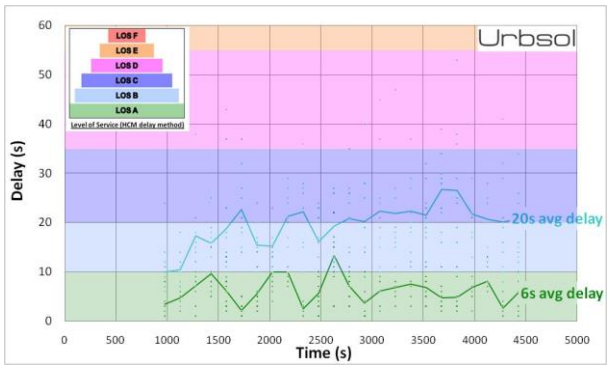




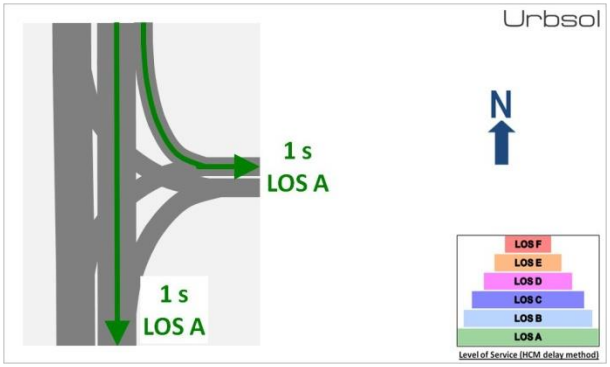


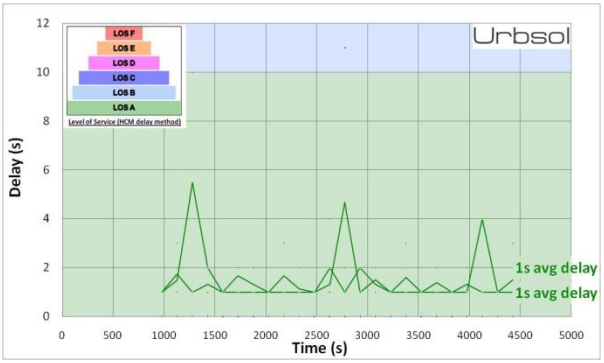


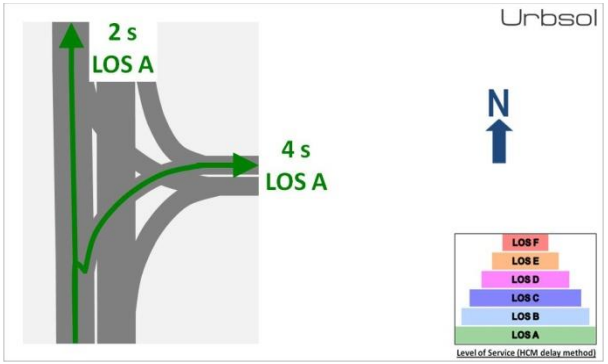


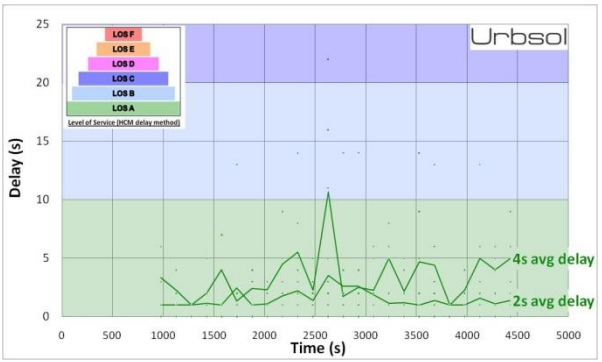


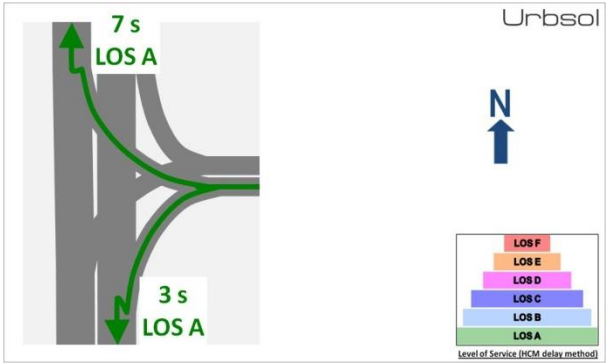
Poletti Road / Northern Site Access

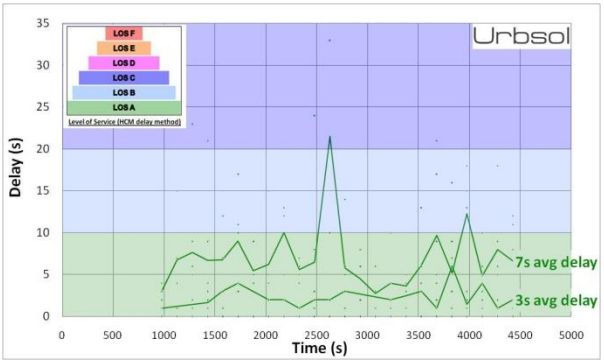




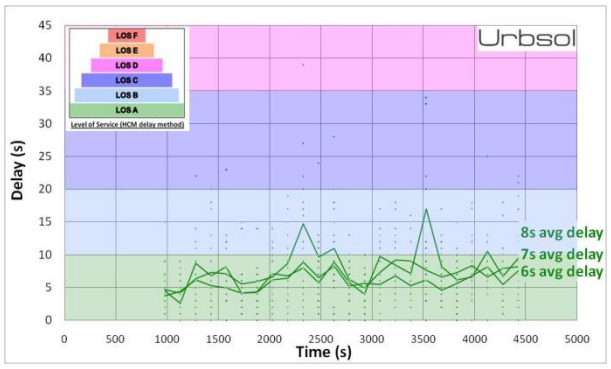


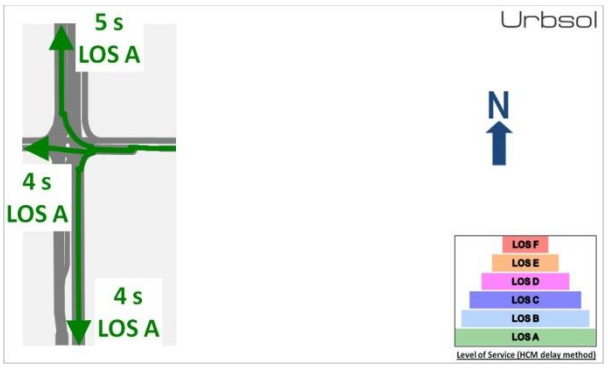


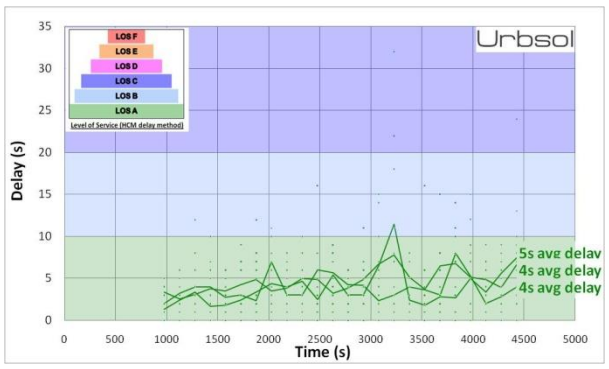


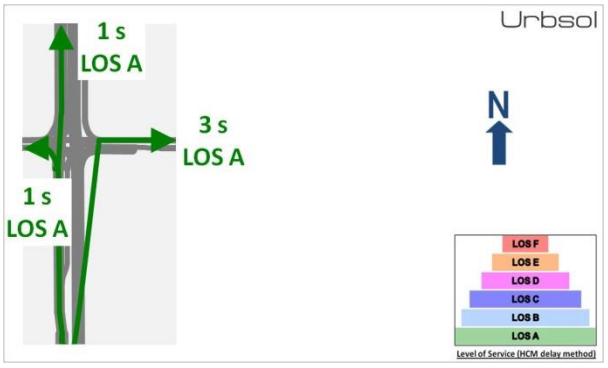


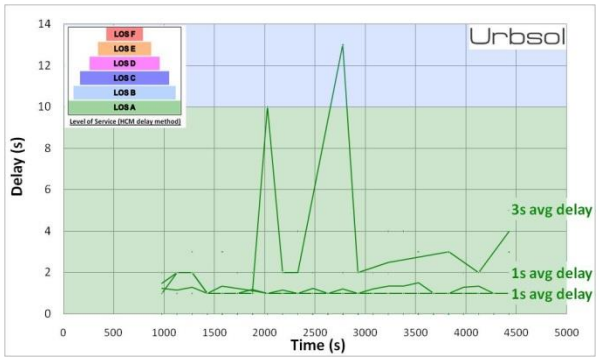
Poletti Road / Central Site Access

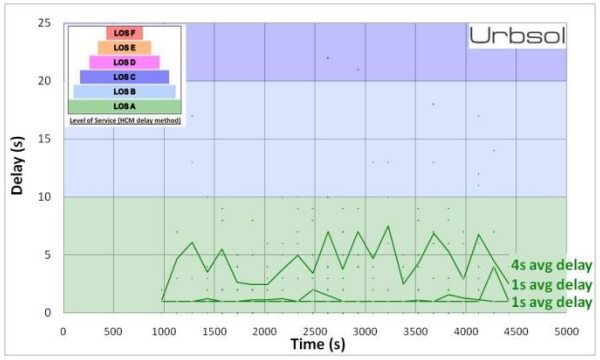




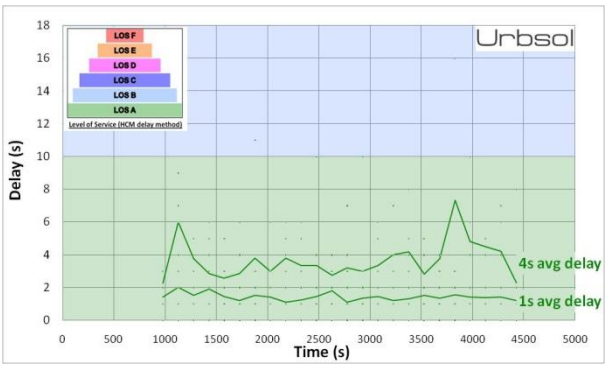


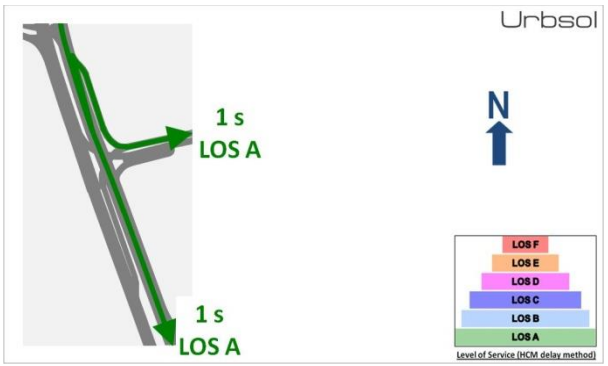


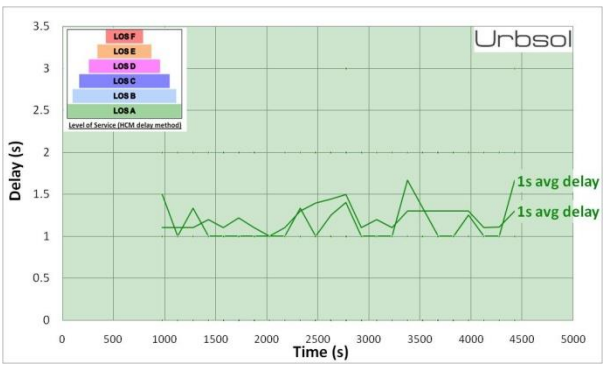


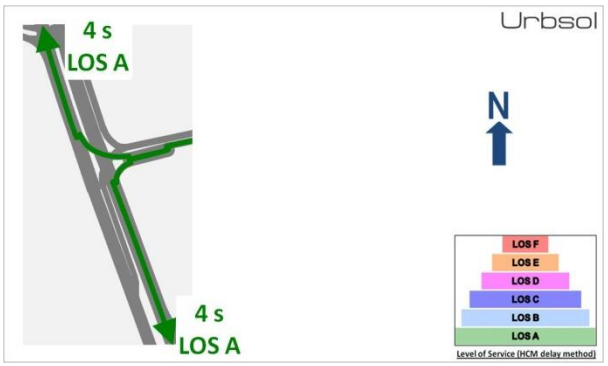


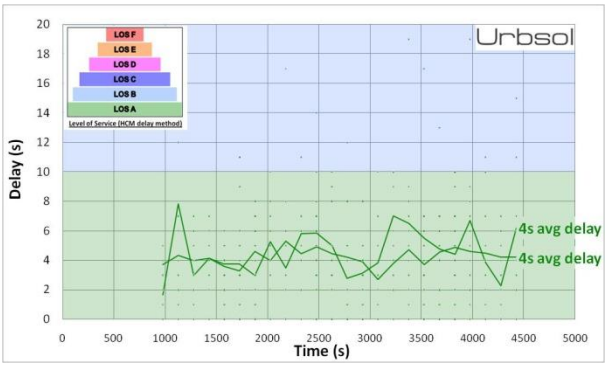
Poletti Road / Southern Site Access



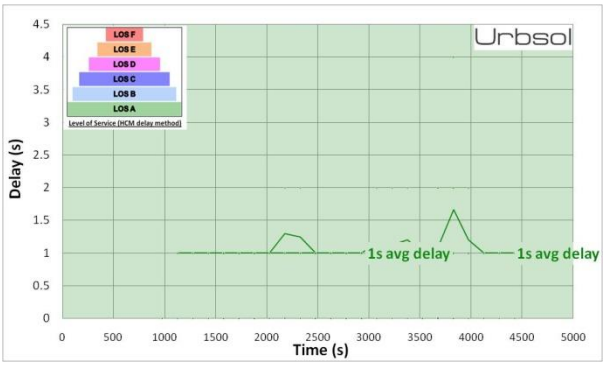


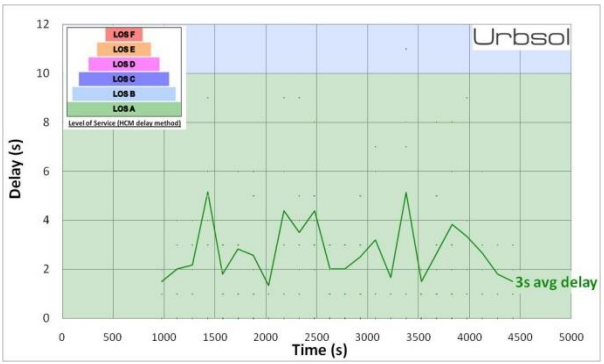




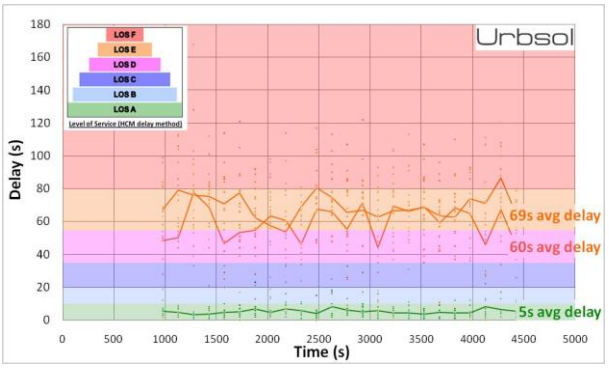


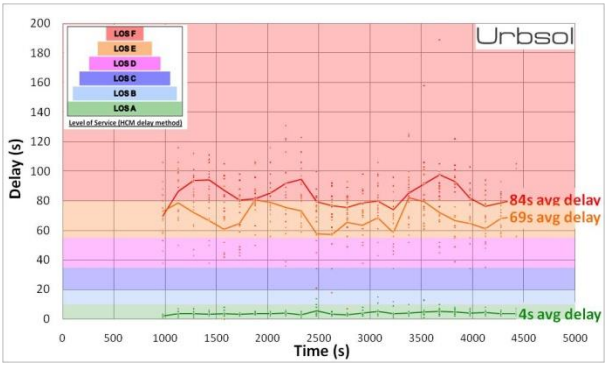
North Lake Road / Site Access

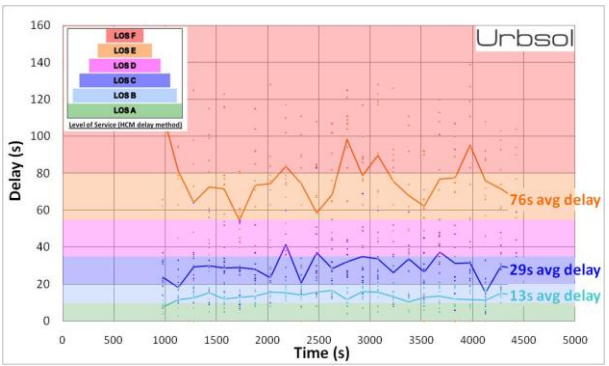


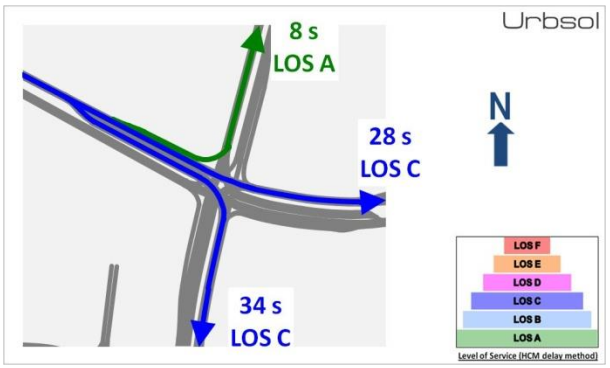


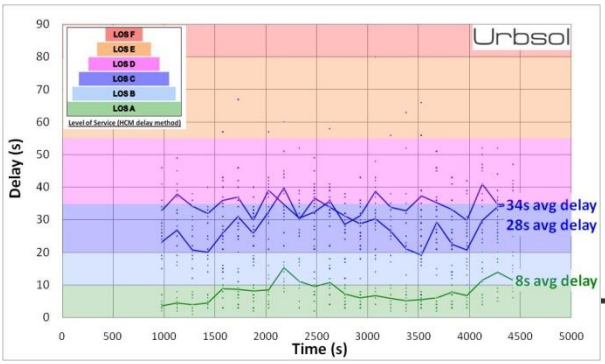
North Lake Road / Midgegooroo Road



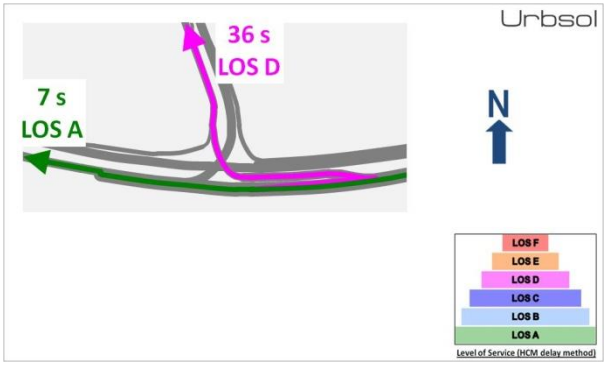


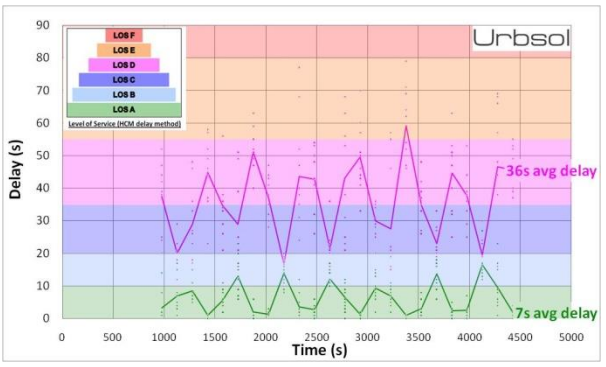


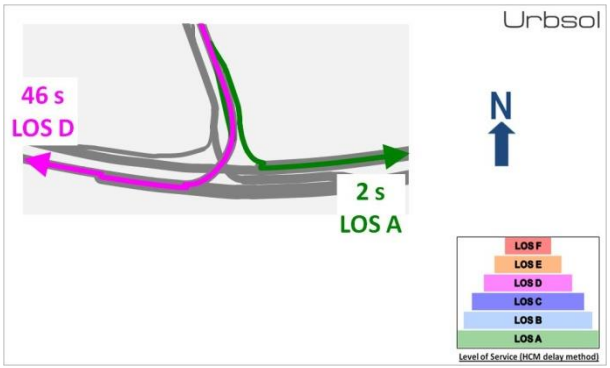


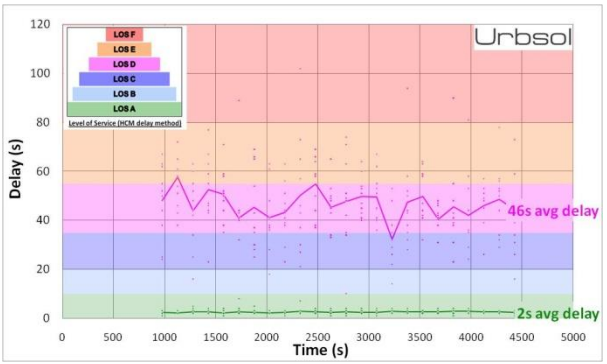


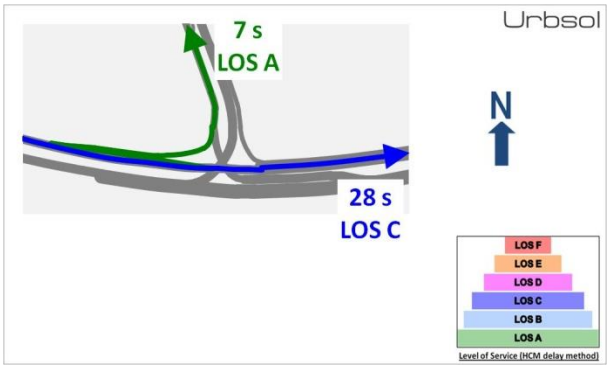
Beeliar Drive / Poletti Road

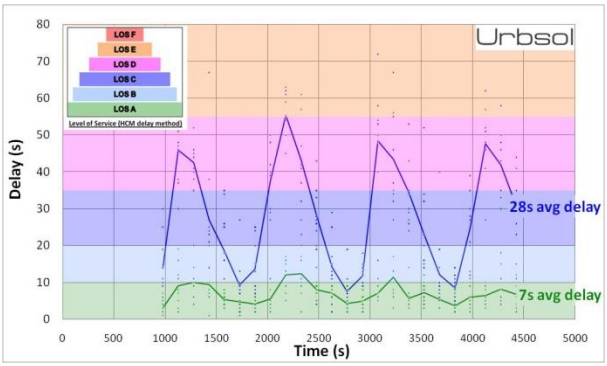




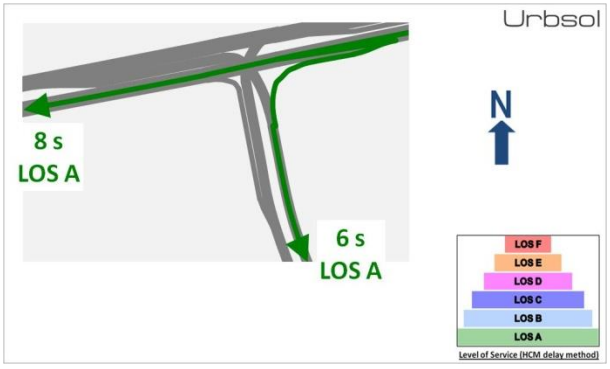


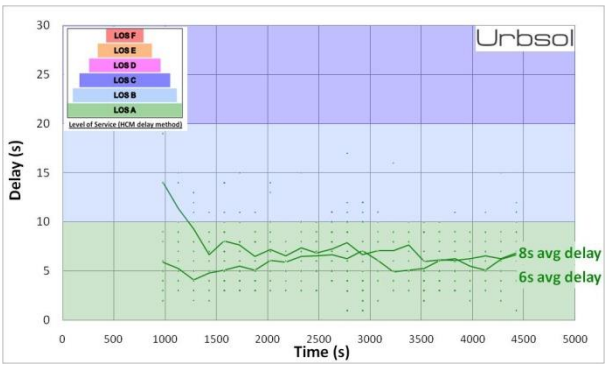


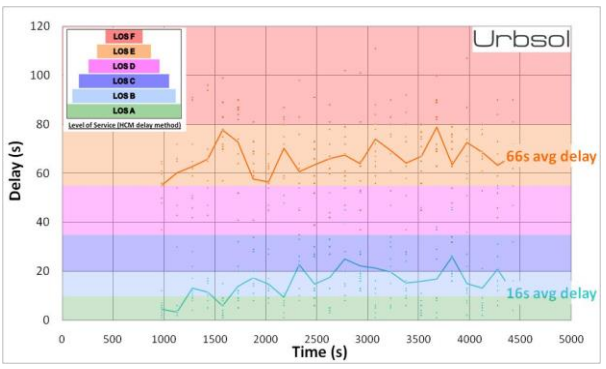


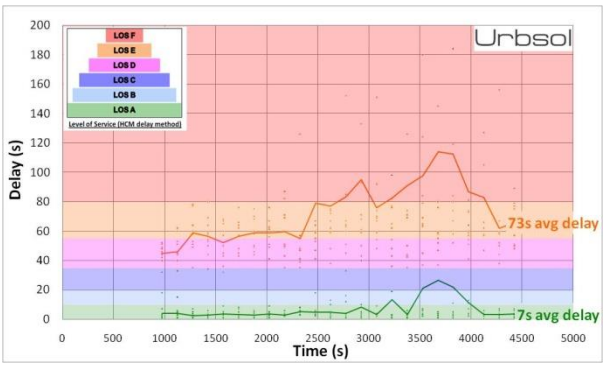


Beeliar Drive / Wentworth Parade

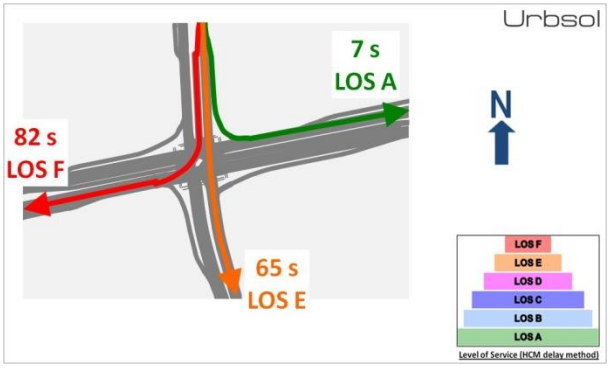


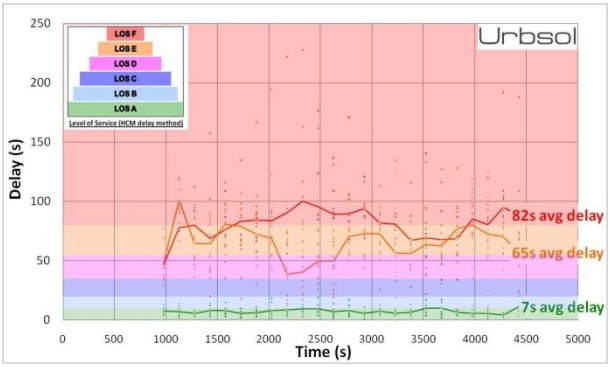


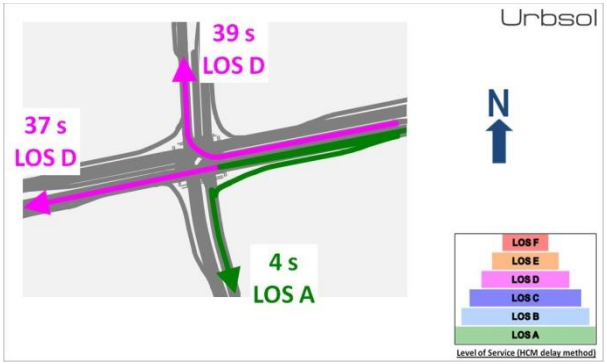


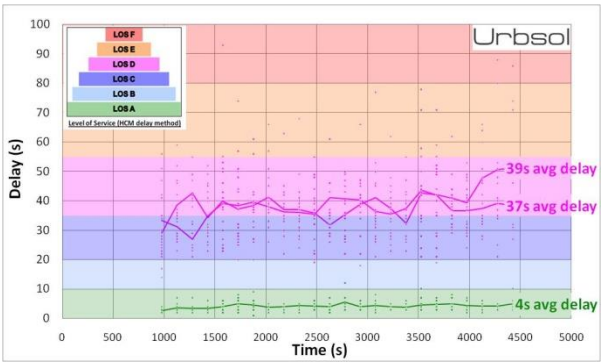


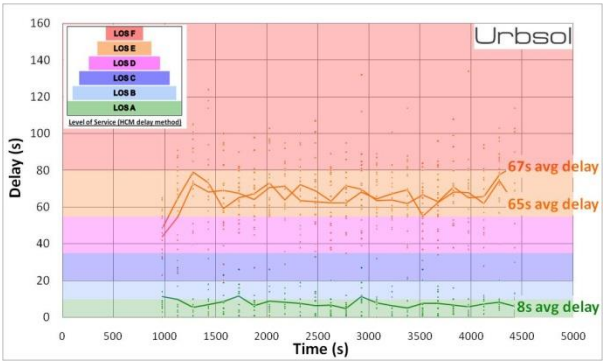
Beeliar Drive / Midgegooroo Road

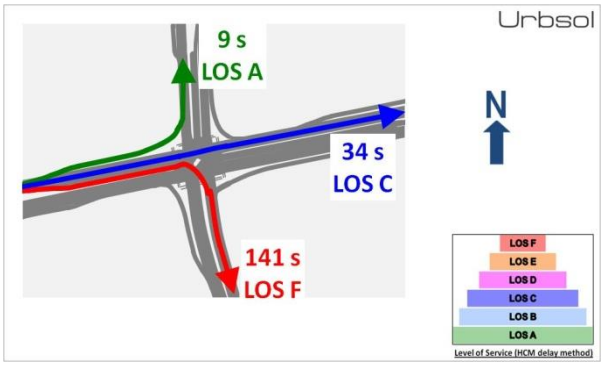


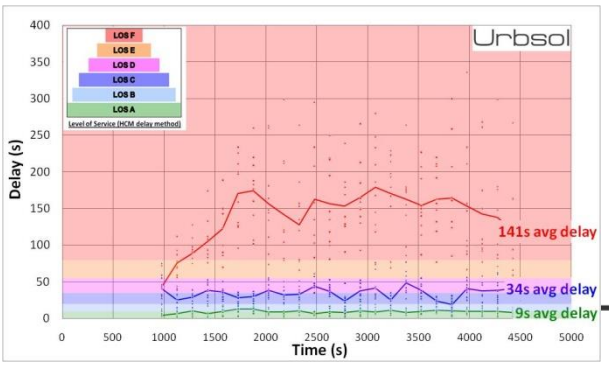




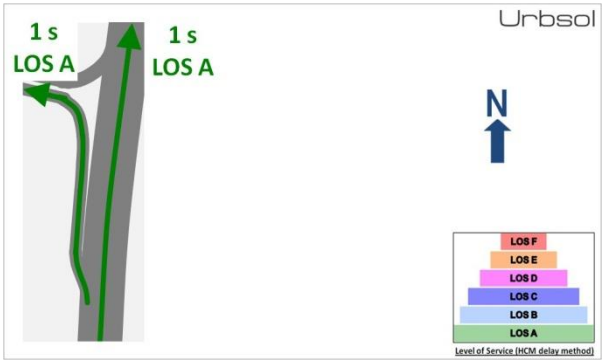


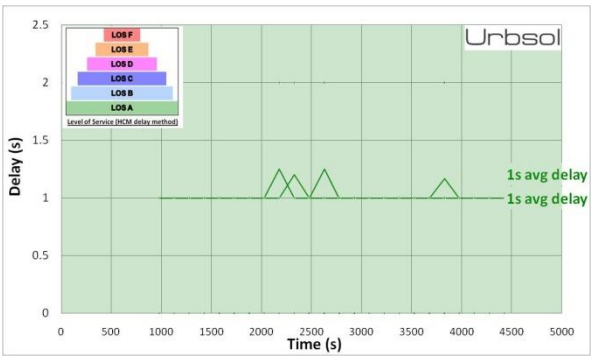


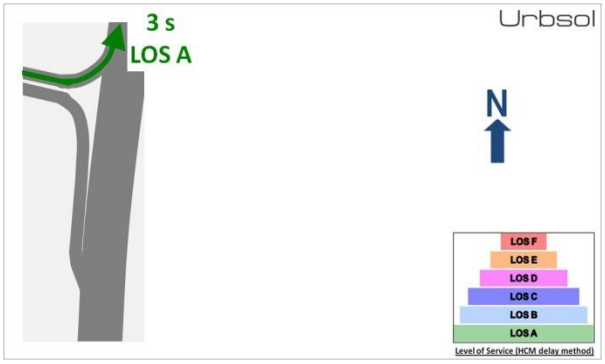


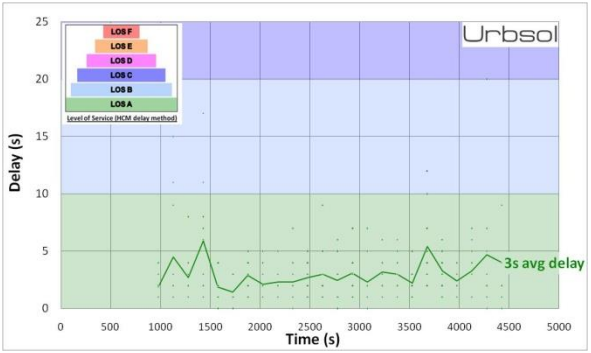


Midgegooroo Road / Northern Site Access

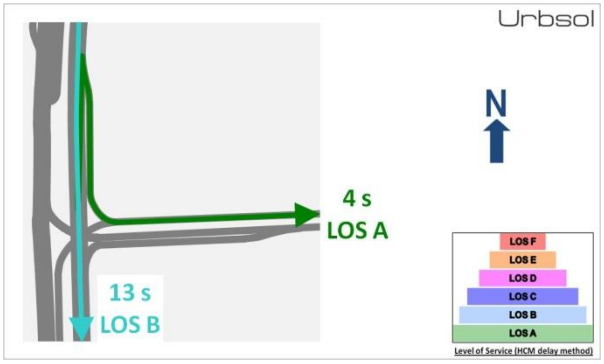


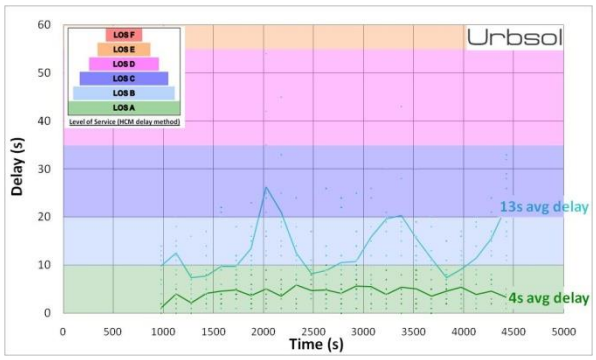


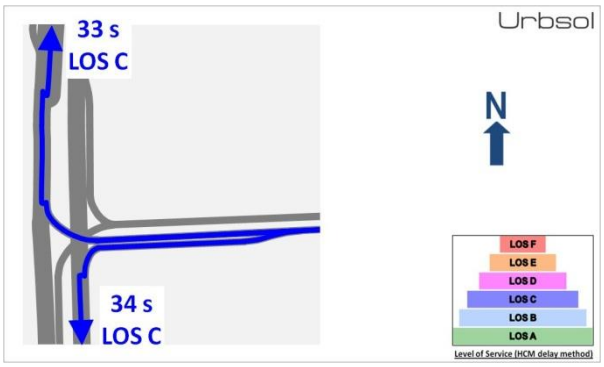


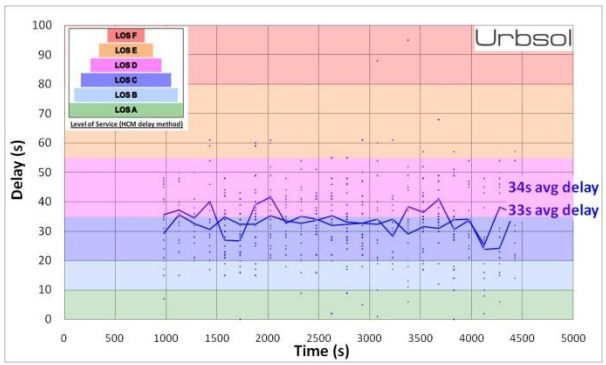


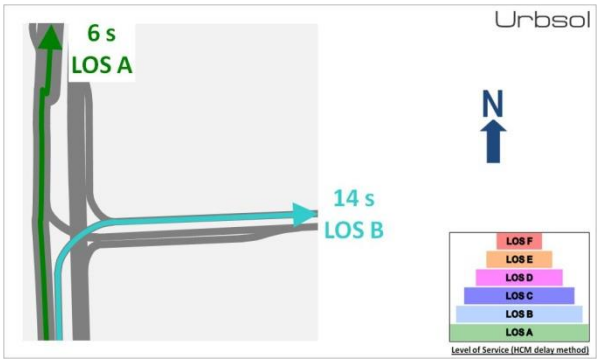
Midgegooroo Road / Signal Tce

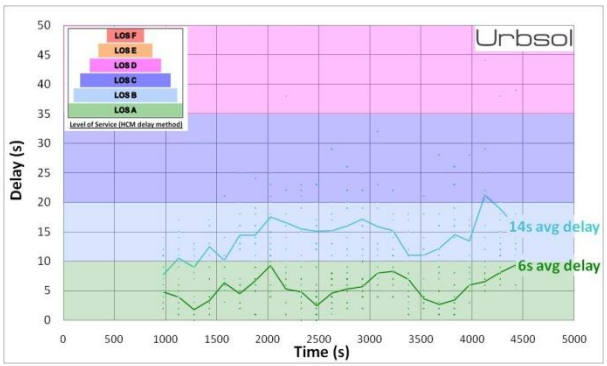




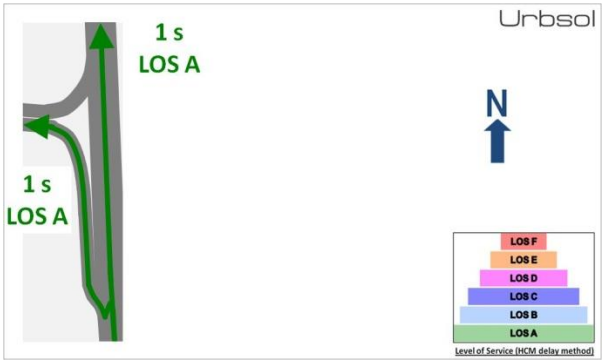


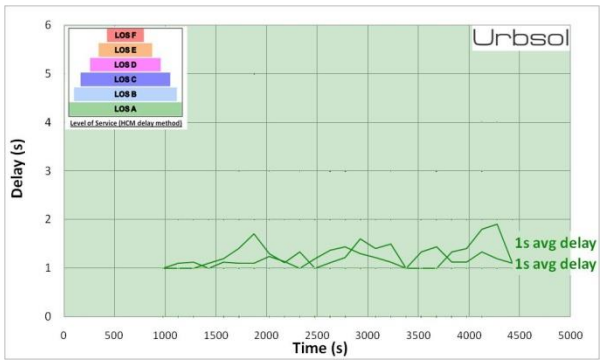


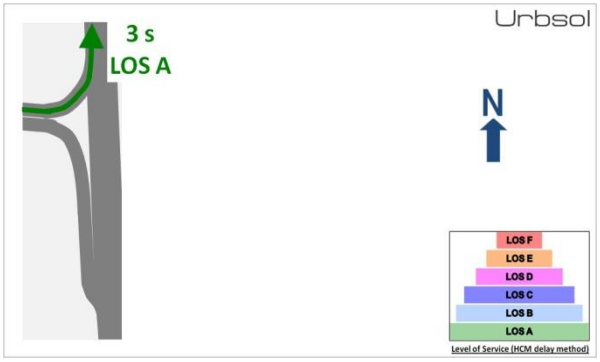


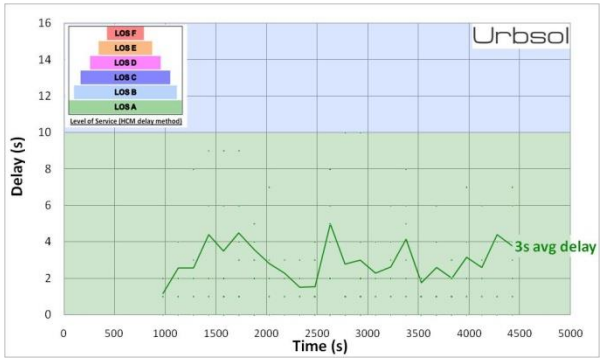


Midgegooroo Road / Southern Site Access



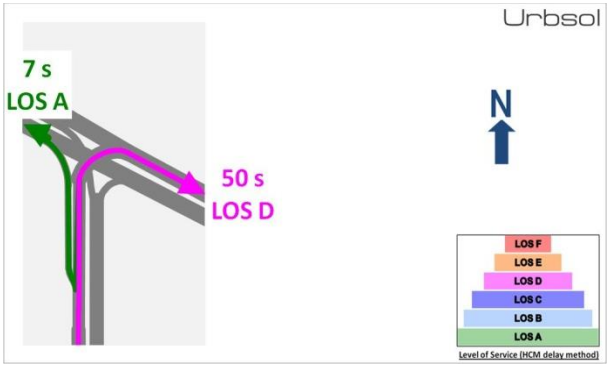


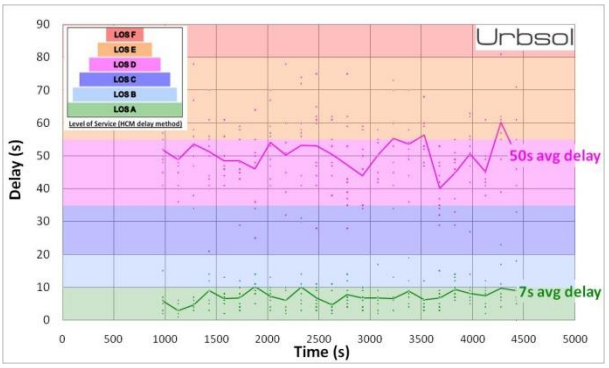


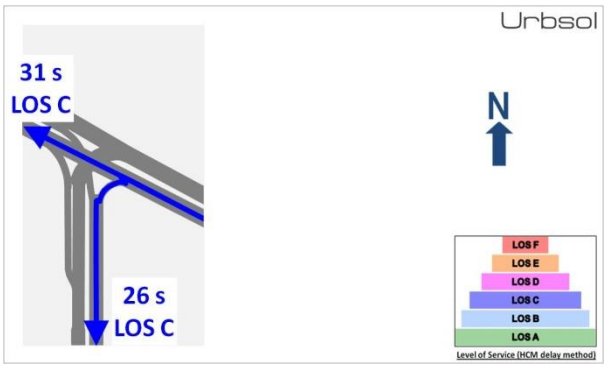


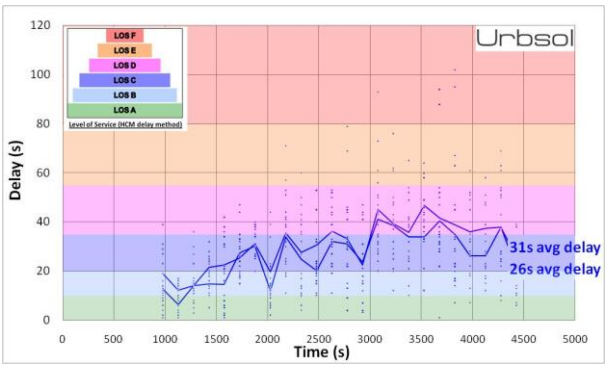
8 APPENDIX 2: MOVEMENT BASED LOS RESULTS - PM PEAK

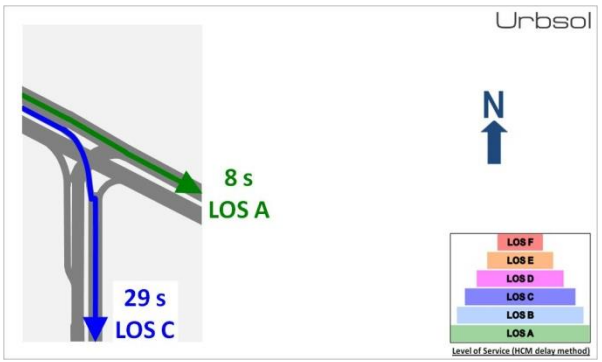
Poletti Road / North Lake Road

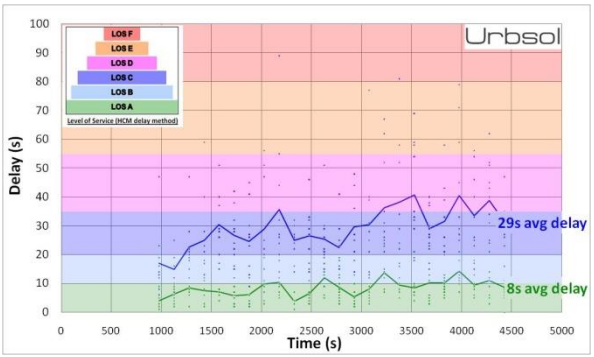




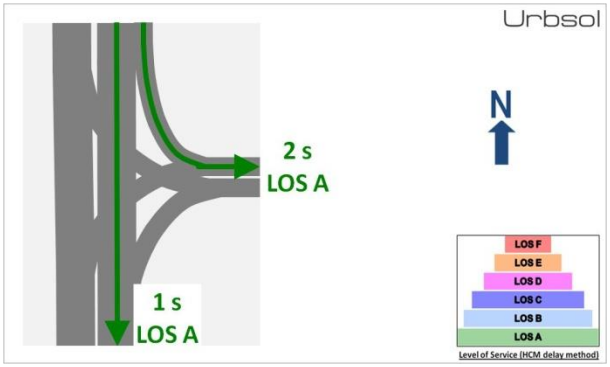


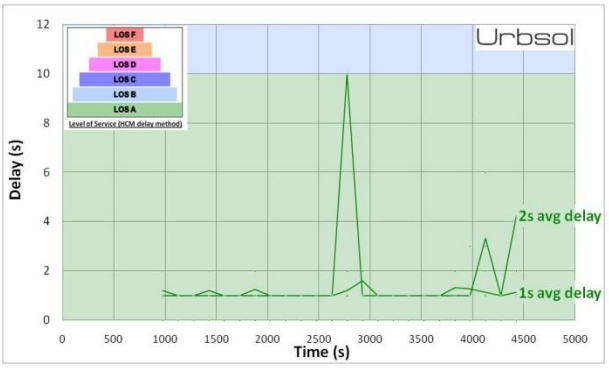


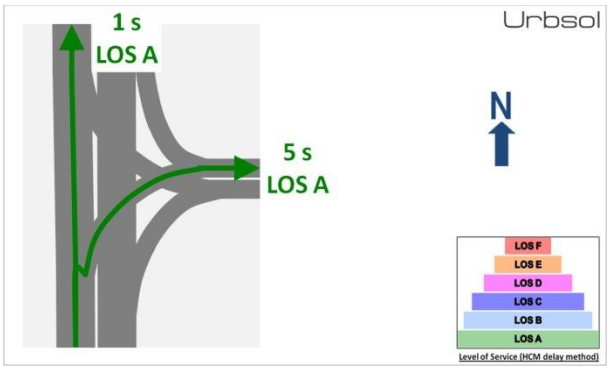


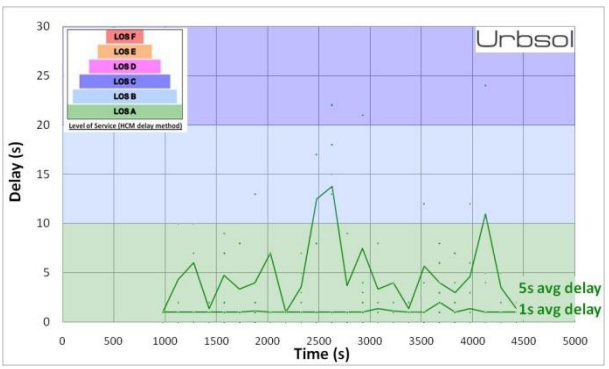


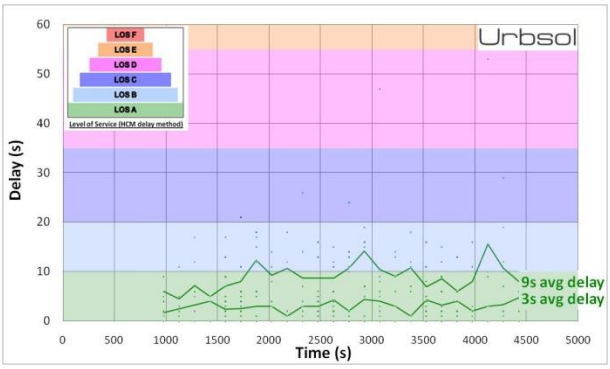
Poletti Road / Northern Site Access



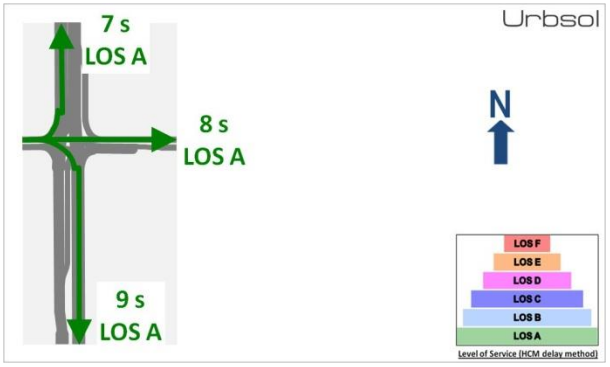


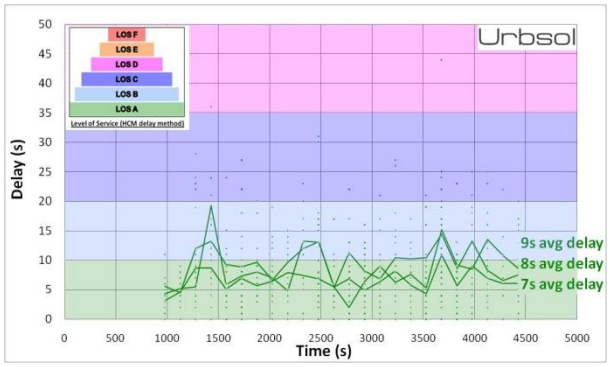


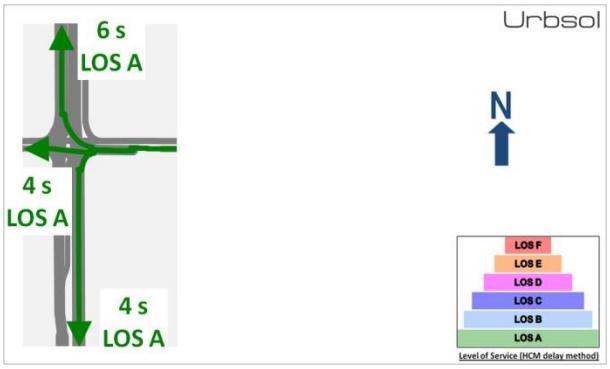


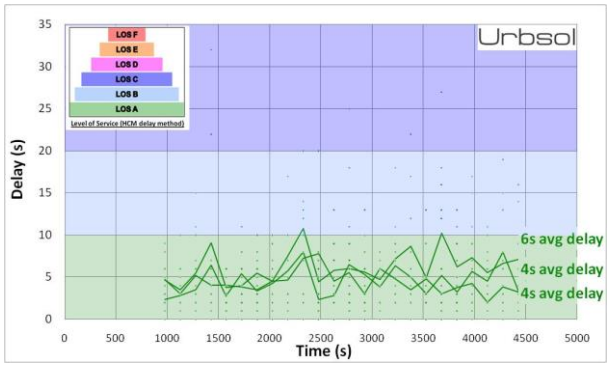


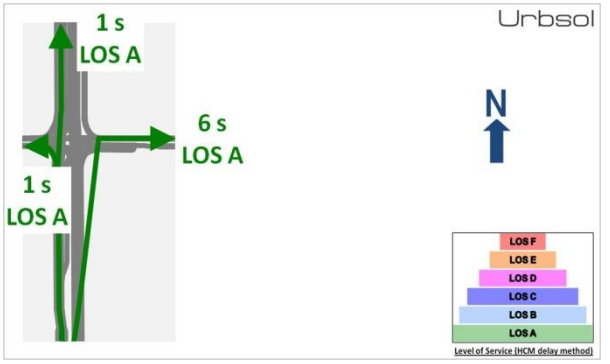
Poletti Road / Central Site Access

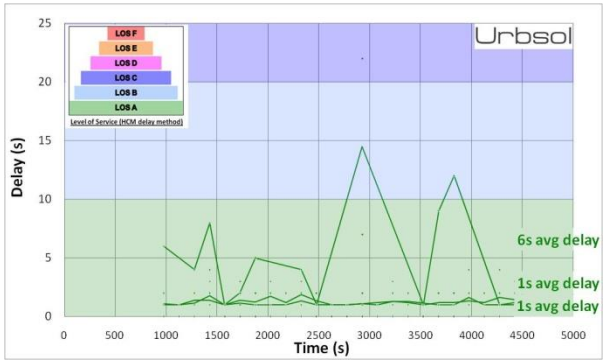


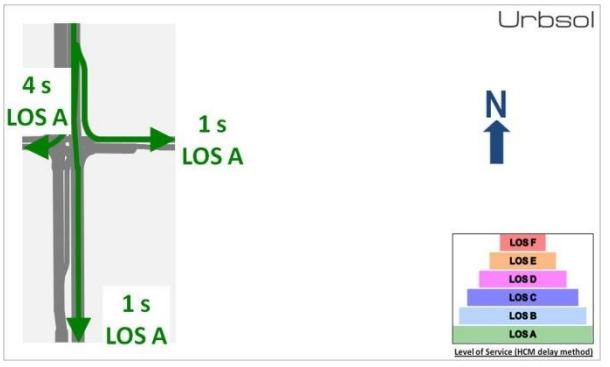


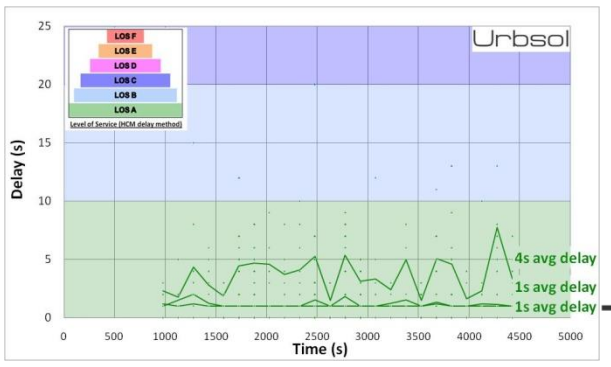




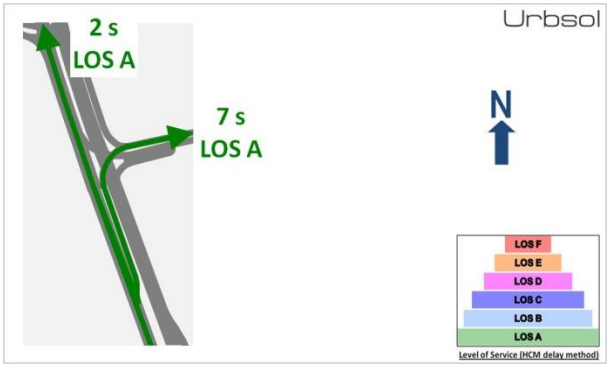


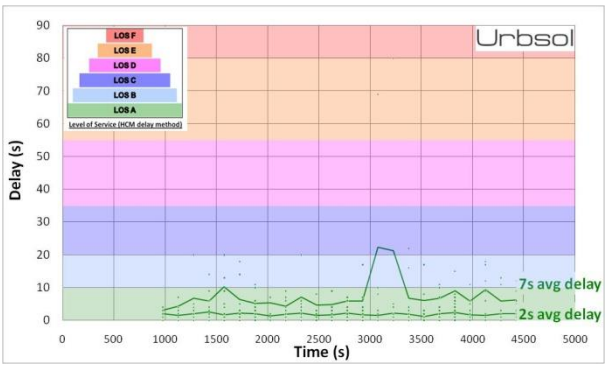


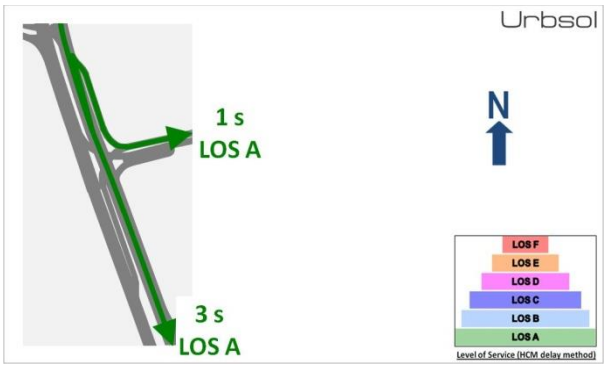


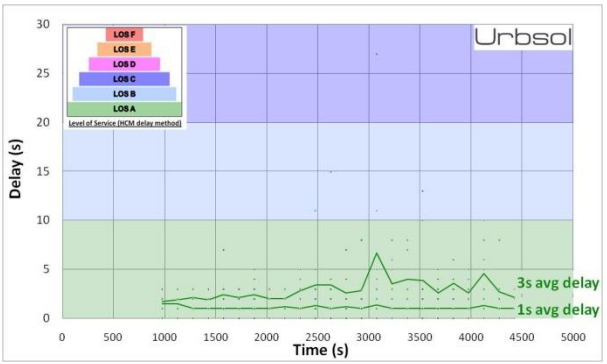


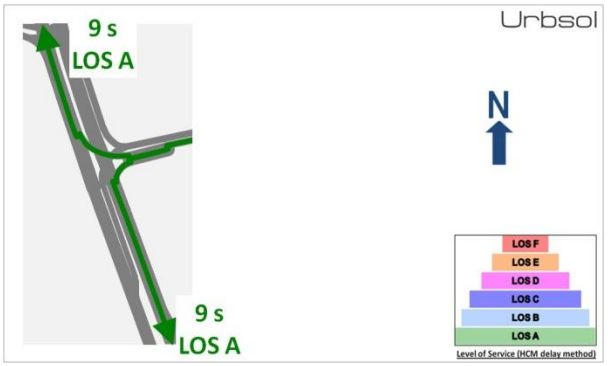
Poletti Road / Southern Site Access

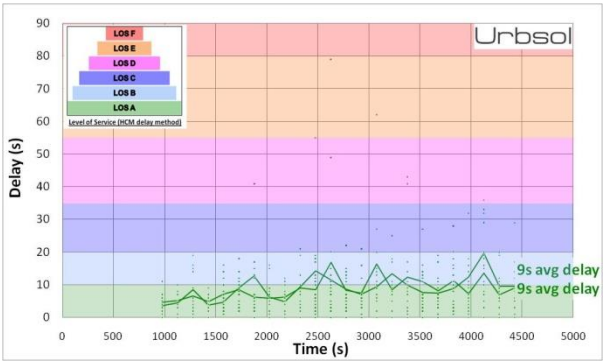




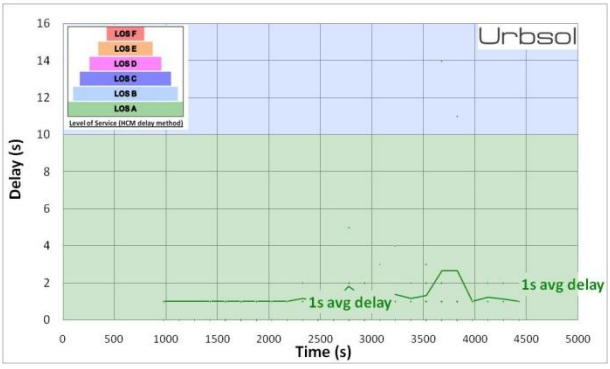


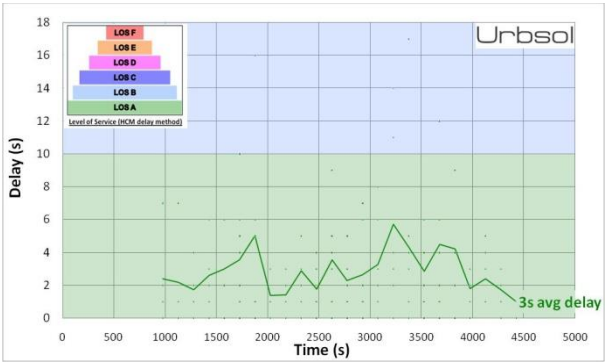




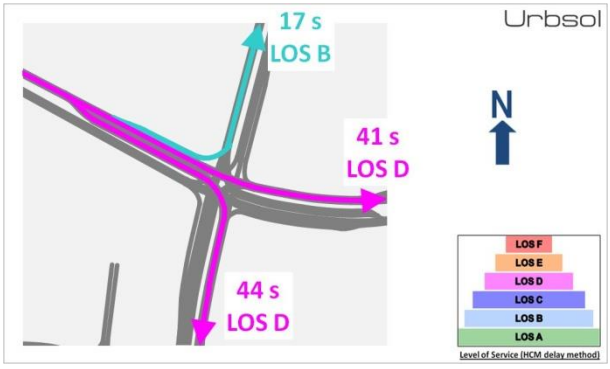


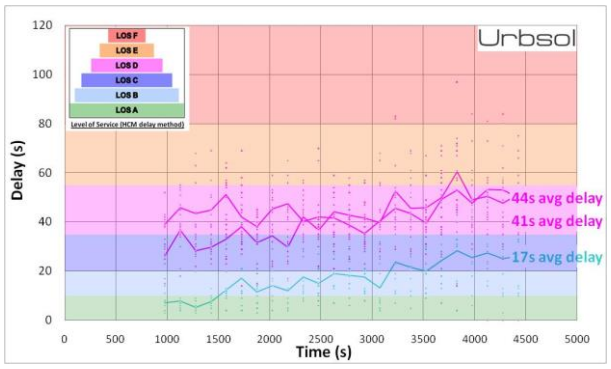
North Lake Road / Site Access

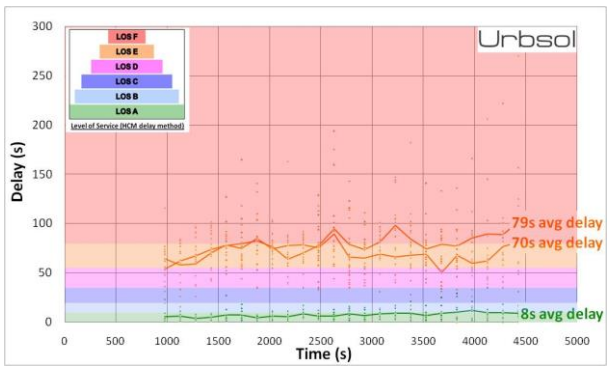


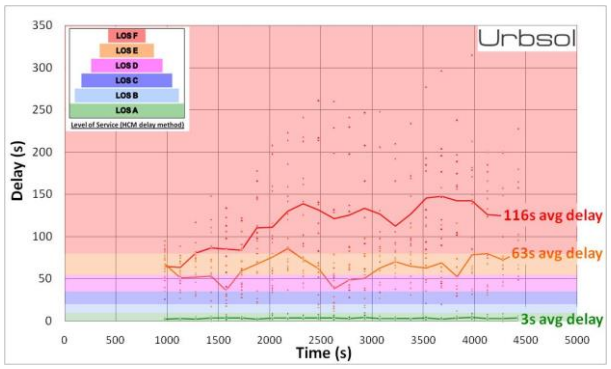


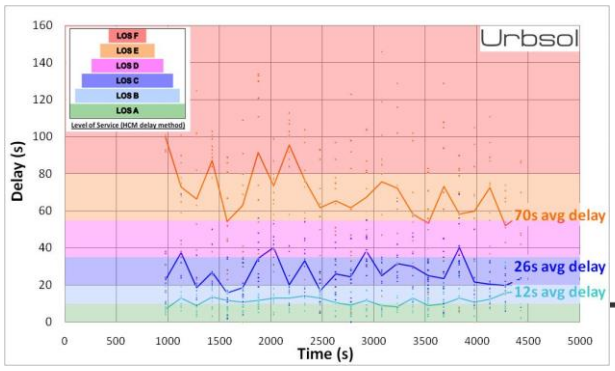
North Lake Road / Midgegooroo Road



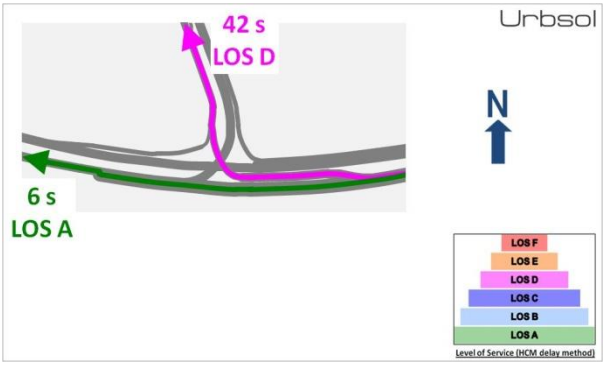


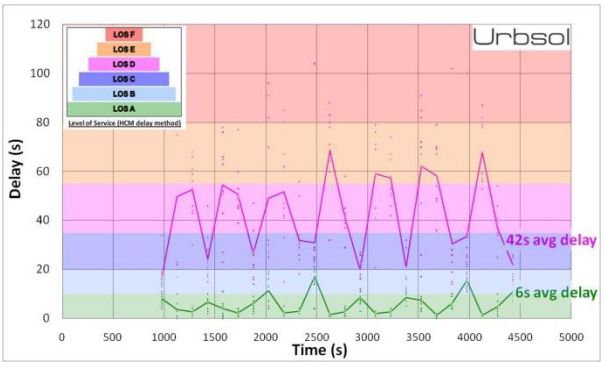


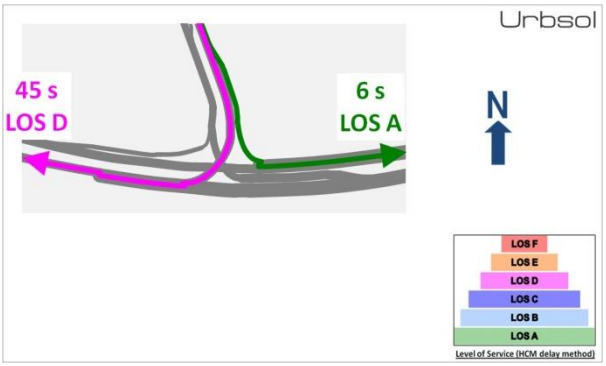


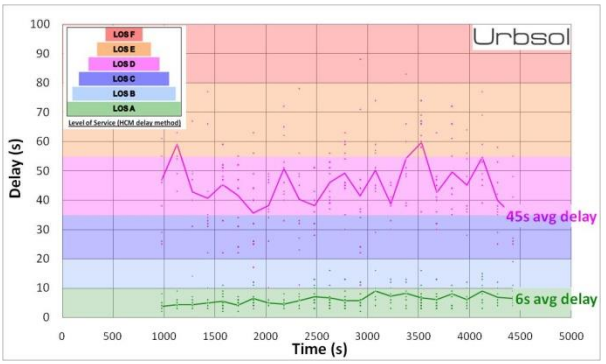


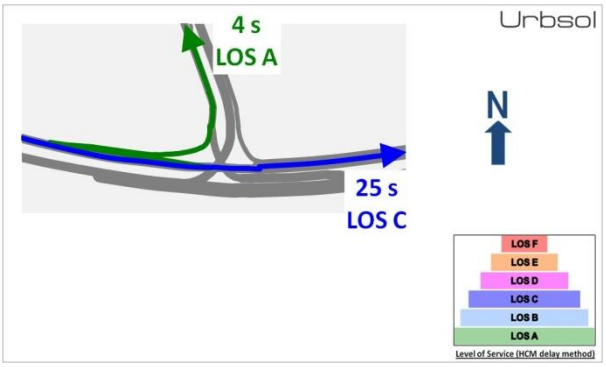
Beeliar Drive / Poletti Road

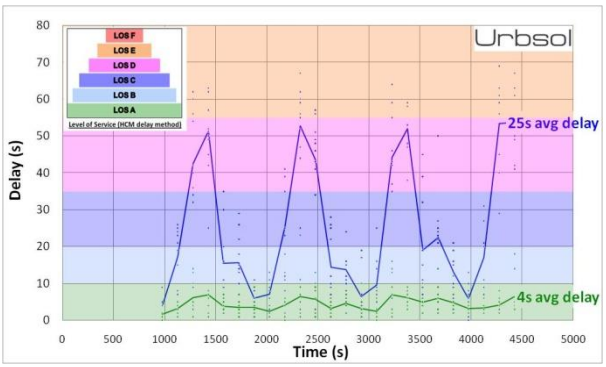




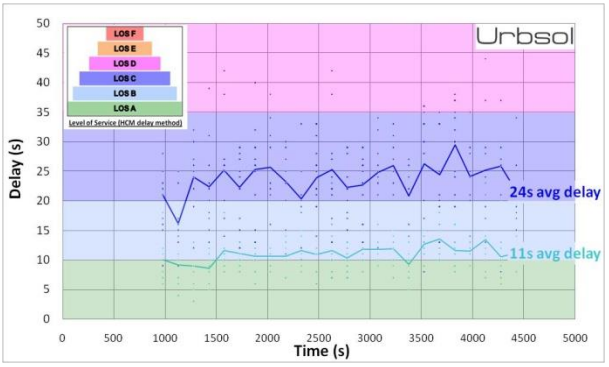


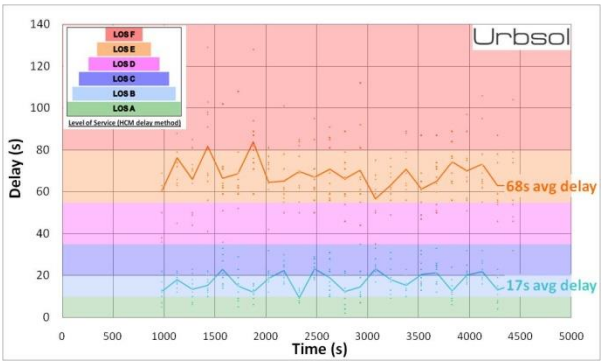


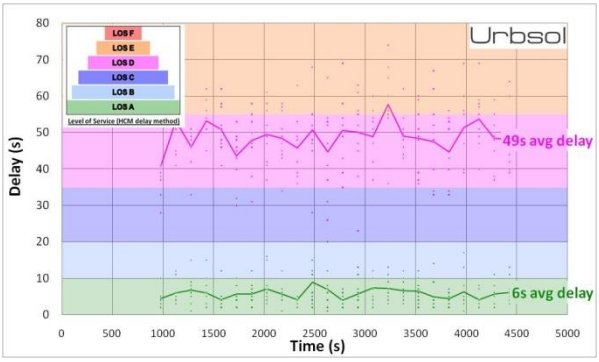




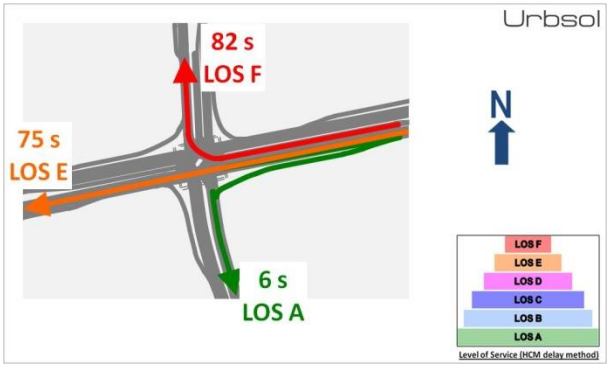
Beeliar Drive / Wentworth Parade

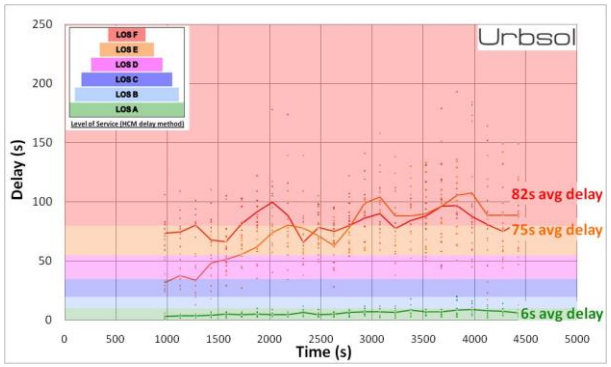


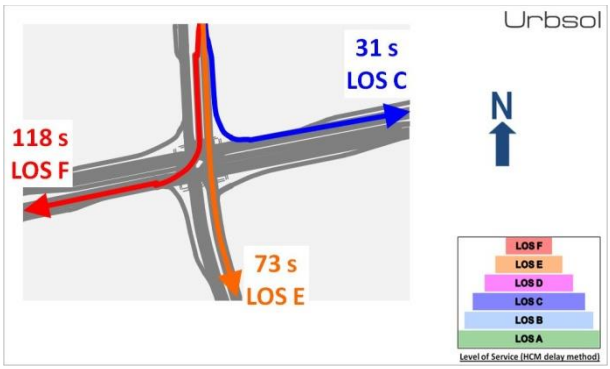


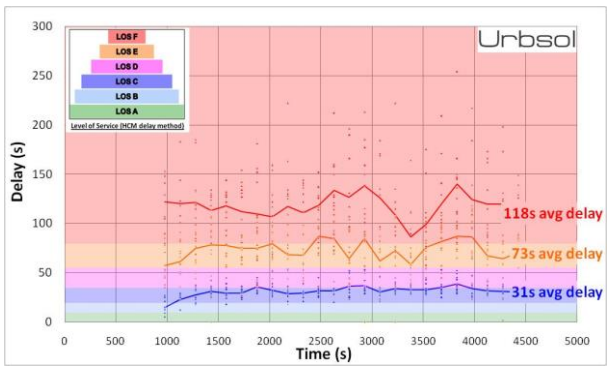


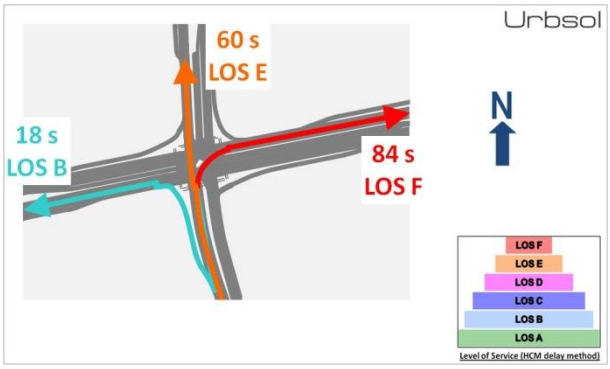
Beeliar Drive / Midgegooroo Road

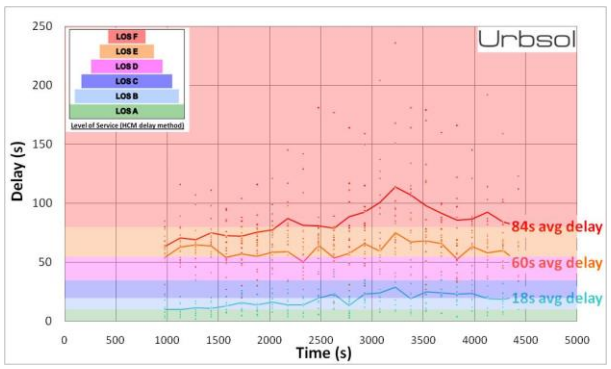


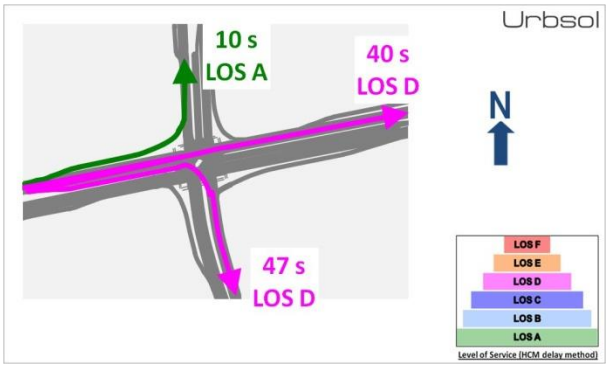


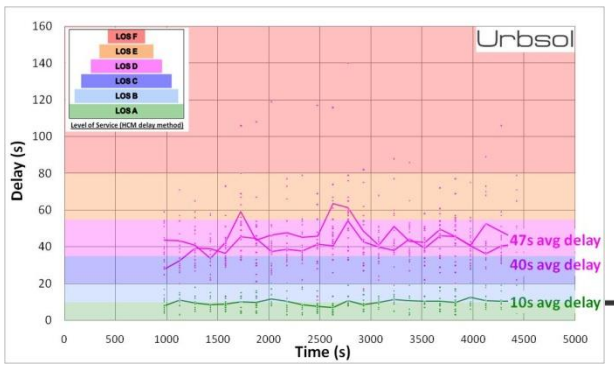




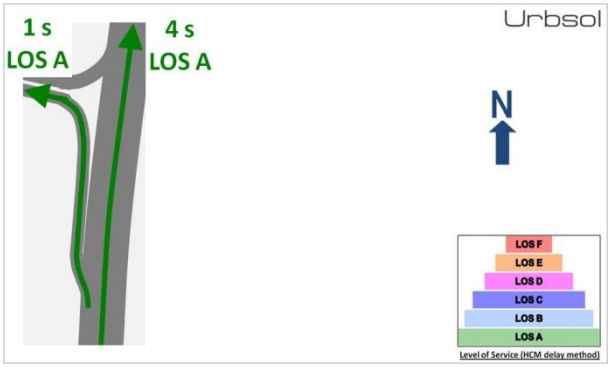


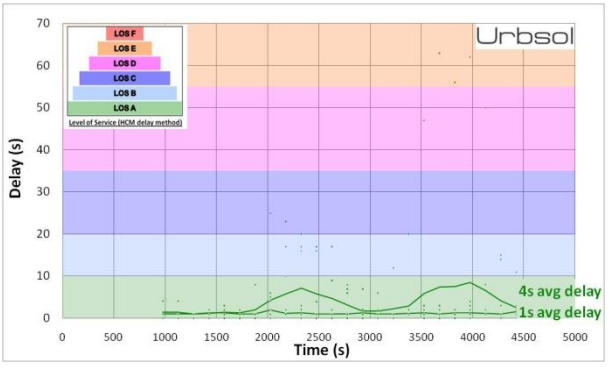


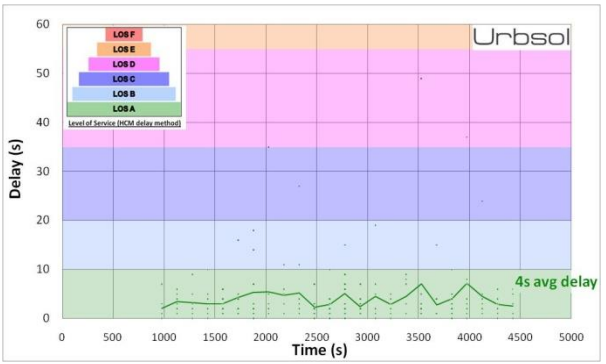




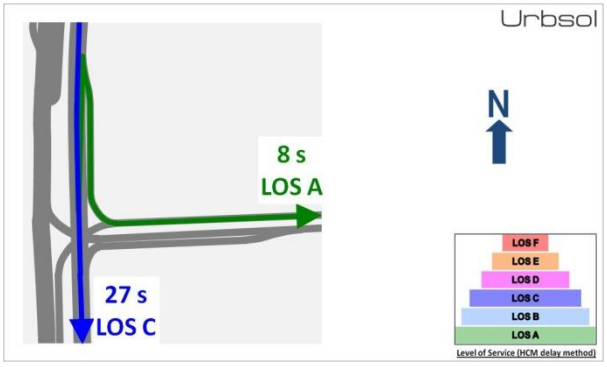
Midgegooroo Road / Northern Site Access

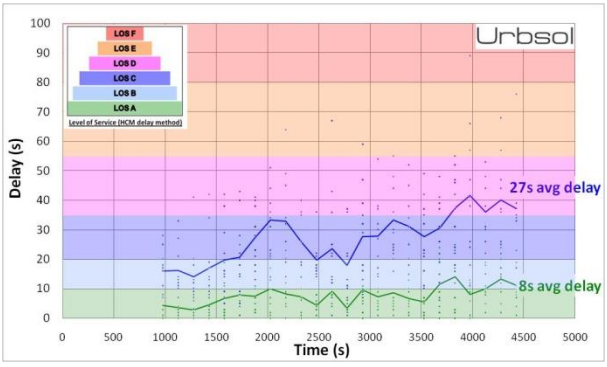


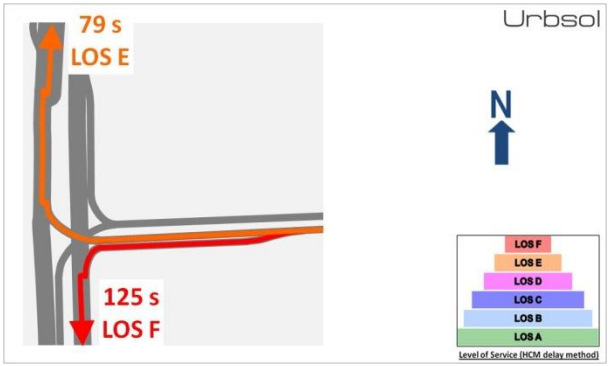


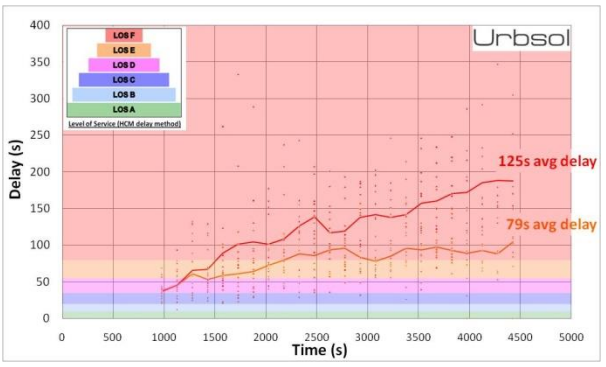


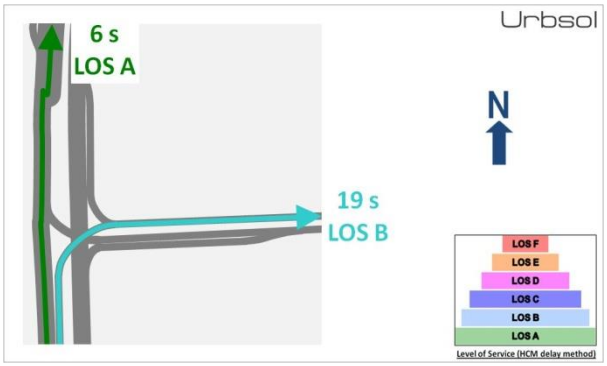
Midgegooroo Road / Signal Tce

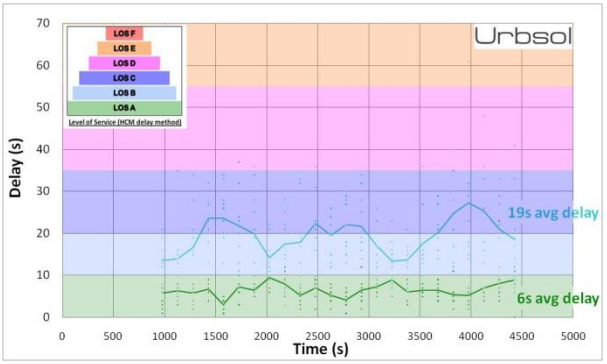




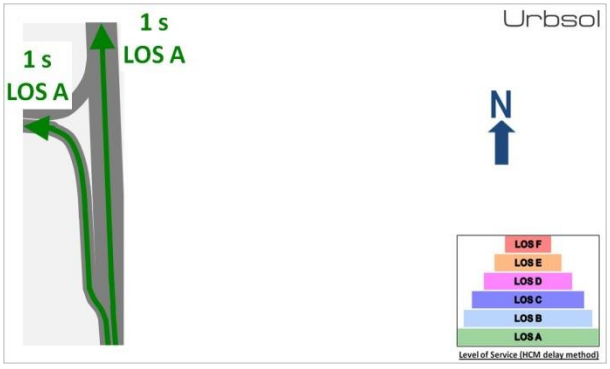


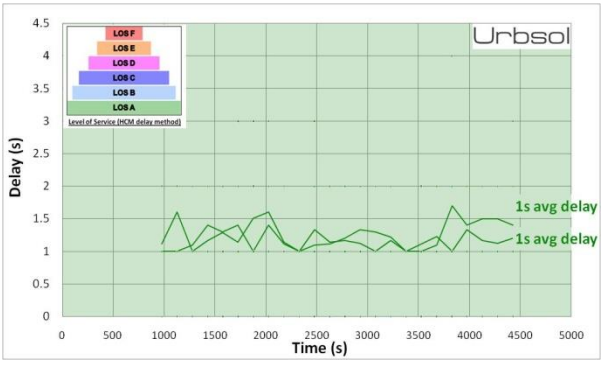


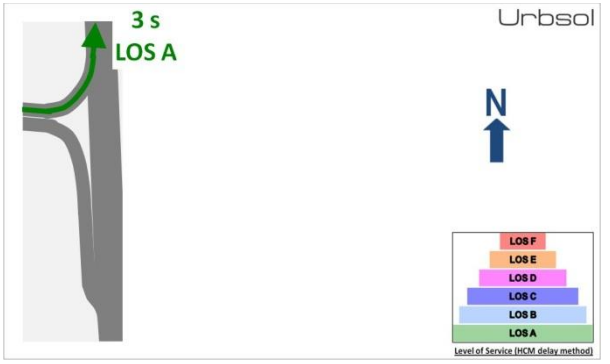


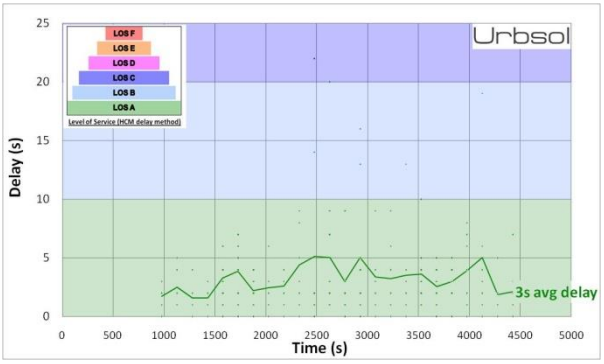


Midgegooroo Road / Southern Site Access









9 APPENDIX 3: AUSTROADS VEHICLE CLASSIFICATION SYSTEM

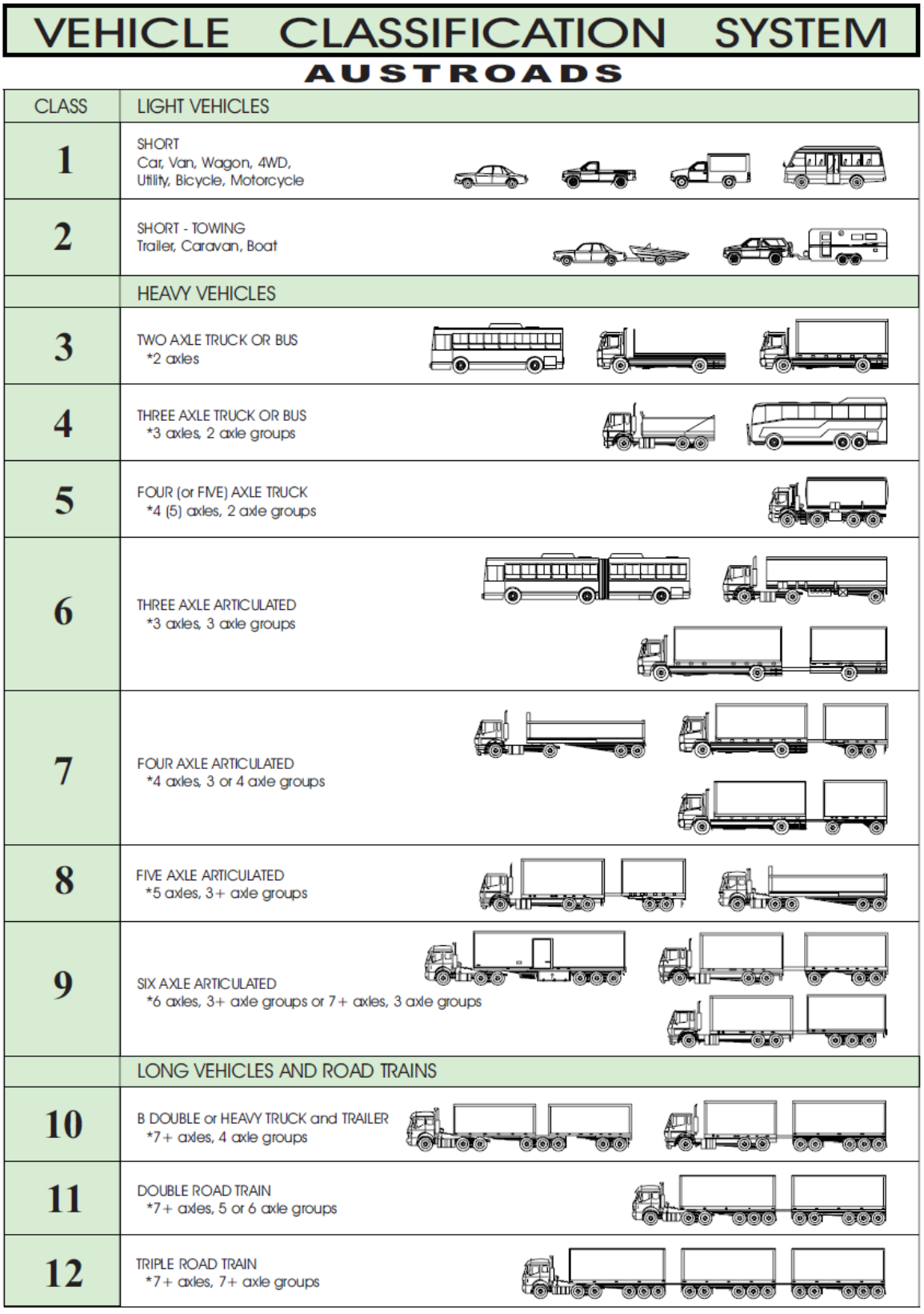


Figure 30 AUSTROADS vehicle classification system

10 APPENDIX 4: INTERSECTION LOS MEASURES

The table below outlines LoS measures with respect to intersection delay using the HCM method.

Level of Service (LOS)	Control Delay per vehicle in seconds (d)		
	Signals	Roundabouts	Stop and Giveway / Yield Signs
A	d ≤ 10	d ≤ 10	d ≤ 10
B	10 < d ≤ 20	10 < d ≤ 20	10 < d ≤ 15
C	20 < d ≤ 35	20 < d ≤ 35	15 < d ≤ 25
D	35 < d ≤ 55	35 < d ≤ 50	25 < d ≤ 35
E	55 < d ≤ 80	50 < d ≤ 70	35 < d ≤ 50
F	80 < d	70 < d	50 < d

Table 24 LOS definitions (HCM method)

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