PACIFIC PLANNING PTY LTD

SUPPLEMENTARY
TRAFFIC IMPACT ASSESSMENT REPORT
FOR
RE-ZONING APPLICATION FOR
1-17 GREY STREET AND 32-48 SILVERWATER ROAD
SILVERWATER

REVISED VERSION 2c (22.8.18)

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Transport Report for Rezoning Prepared by Colston Budd Hunt and Kafes Pty Ltd May 2013

1.0 INTRODUCTION

1.1 Background

A previous planning proposal No P3/2015 for Grey Street, Silverwater Planning Proposal was lodged to Auburn Council (Now Cumberland Council) in July 2015. The matter was formally considered on 7 October 2015 and was referred to the Department of Planning and Environment NSW for consideration and determination. At this time Council went into Administration and planning proposals were put on hold pending the outcome of the Public Inquiry. The Public Inquiry was completed in February 2017 and the Planning proposal was cleared to continue. At this time the land to which the proposal applied had been transferred from the Auburn government area to the City of Parramatta area.

The proposal was finally considered by Council on 28 February 2018. At this meeting Council resolved to "endorse the former Auburn Council officer's recommendation (dated 7 October 2015) as the pathway to progress the Grey Street Silverwater Road Planning Proposal".

Item 1d) listed below forms the basis of this Supplementary report.

1. That Council amend the planning proposal application for the rezoning of land at 1-17 Grey Street and 32-48 Silverwater Road, Silverwater (PP-3/2015), as follows:

(a) amend the proposed rezoning to B1 Neighbourhood Centre;

(b) reduce the proposed FSR to a maximum of 2.7:1, as recommended by the feasibility analysis undertaken by the AEC Group on behalf of Council;

(c) reduce the maximum height of buildings to 20 metres, and require the applicant to undertake urban design analysis to test the impact in terms of building envelope and relationship with surrounding development;

(d) require the applicant to undertake additional traffic modelling and analysis to assess the potential cumulative impact of the proposal on traffic across the broader traffic network, including Silverwater Road, as recommended by the RMS;

(e) require the applicant to provide further justification for the reasons for refusal cited in the Department of Planning's Gateway Determination, and justify inconsistency with section 117 Direction 1.1 ï Business and Industrial zones (via a study in accordance with the regional, subregional or the Auburn Employment Lands Strategy 2015) for Director General of DPE's agreement prior to proceeding;

(f) require the applicant to undertake a Phase 1 contamination assessment of the site (subject land) in accordance with SEPP 55 ï Remediation of Land to investigate possible site contamination, and suitability of the site for residential uses.

(g) require the applicant to modify the Planning Proposal to ensure that the 4,000 sqm retail component comprises a 2,500 sqm supermarket and 1,500 sqm of local specialty retail/commercial floor space.

(h) The applicant provides a site-specific development control plan for the controls identified above.

2. Once all required amendments have been made, finalise the planning proposal and send to the Department of Planning for a Gateway determination.

(1.1 Continued)

An application is to be made by Pacific Planning Pty Ltd for a revised Rezoning Planning Proposal for a development site at **1-17 Grey Street and 32-48 Silverwater Road Silverwater.**
The planning proposal seeks to amalgamate lots into one development site and to ***change the zoning from B2 to B1 and a density of the site from 4:1 FSR to 2:7:1 FSR.*** *The planning proposal also seeks to change to include residential and retail uses within the site.*

The site is shown in **Figure 1 Locality Plan**. The lots to be amalgamated are listed in Table 1.1 below

Table 1.1 Amalgamated lots

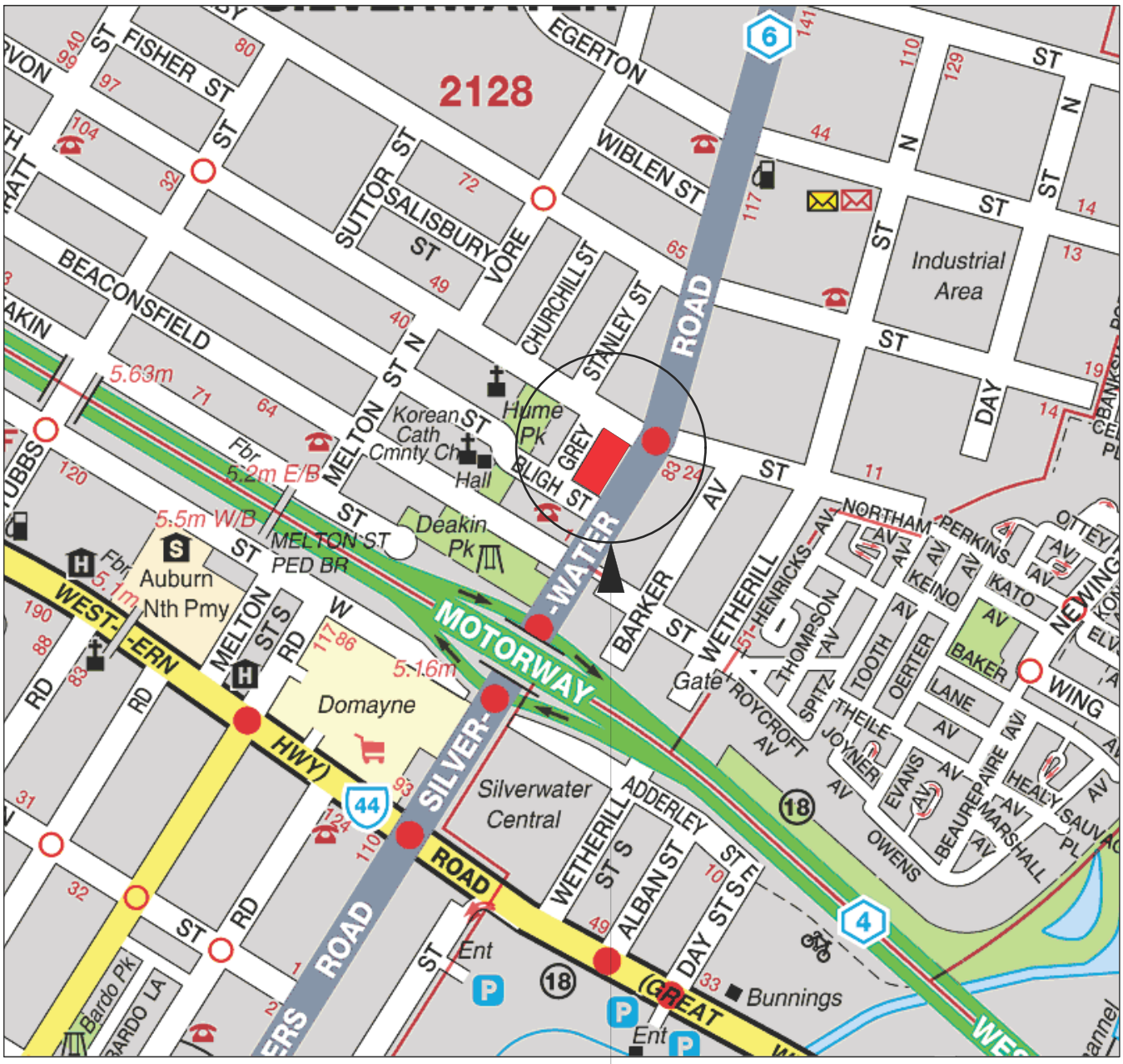
Street Number	Street Name	Lot Numbers	DP	Notes
32-34	Silverwater Road	1,2	DP1110059	
36-38	Silverwater Road	1	DP90071	
40	Silverwater Road	5	DP89550	
42	Silverwater Road	6	DP89550	
44	Silverwater Road	7	DP89550	
46	Silverwater Road	8	DP89550	
48	Silverwater Road	9	DP979428	
1	Grey Street	18	DP77341	
3	Grey Street	17	DP77341	
5	Grey Street	16	DP77341	
7	Grey Street	15	DP979426	
9	Grey Street	14	DP979426	
11	Grey Street	13	DP75209	
13	Grey Street	12	DP76894	
15	Grey Street	11	DP76894	
17	Grey Street	10	DP76894	

The site area is **7595.98** square metres which includes all of the amalgamated lots. The site is bounded to the north by Carnarvon Street, to the east by Silverwater Road, Bligh Street to the south and Grey Street to the west. The Street inventory plan is shown in **Figure 2**.

1.2 Scope of Report

This report addresses the *changes to the traffic generation as a result of changes to the number of apartments and commercial and retail component of the development with a reduction from 4:1 FSR to 2.7:1 FSR.*

The report seeks to update the SIDRA modelling for the intersection of Silverwater Road and Carnarvon Street based upon the requirements of the RMS. A copy of this letter dated 9 September 2015 is included in **Appendix A** of this report.



Proposed Site: 1-17 Grey Street
and 32-48 Silverwater Road Silverwater

FIGURE 1: LOCALITY MAP

(1.2 Continued)

The comments from the RMS are as follows: -

As a result of the above, to ensure that the modelling is fit for purpose in identifying the traffic impact of the planning proposal on the existing signalized intersection of Silverwater Road and Carnarvon Street, it is recommended that the SIDRA modelling be updated and include the following inputs:

- *Cycle length is fixed at 130 seconds*
- *Signal Phasing sequence should be set at A, D, E, F*
- *Phase A has a 5 second late start and minimum green time for any phase is 8 seconds*
- *Check priorities*
- *Approaches on the South and East approaches should be revised. Approaches should not extend beyond the next signalized intersection.*

It is also recommended that site observations be undertaken to determine blockages (particularly the departures) in the peak periods and whether this needs to be accounted for in the revised modelling.

It would be appreciated if the revised SIDRA modelling can be submitted in Version 6 to ensure consistency in the output data results when reviewed by RMS.

Since 2015, software updates have occurred, and we have used SIDRA version 8 and in the modelling of the intersections. Scates diagrams and phasing information was obtained from the RMS and is included in **Appendix C** of this report.

In preparation of this traffic report, we also refer to the following information and reports.

- Transport report For Proposed Rezoning 32-48 Silverwater Road & 1-17 Grey Street Silverwater Prepared by Colston Budd Hunt and Kafes Pty Ltd May 2014
- Transport report For Proposed Rezoning 32-48 Silverwater Road & 1-13 Grey Street Silverwater Prepared by Colston Budd Hunt and Kafes Pty Ltd May 2013
- Roads and Maritime Services Letter -Public Exhibition Grey Street Silverwater Planning Proposal (PP 3/2015) Dated 9 September 2015.
- Technical Paper 1 West Connex M4 East 2015
- Roads and Maritime Services ï West Connex M4 Widening Road Network Performance Migration Plan (RNPMP) March 2016

Acronymns used in this report are: -

Colston Budd Hunt and Kafes Pty Ltd	CBH&K
Roads and Maritime Services	RMS

1.3 Executive Summary

RMS Comment	Response
It is noted that the intersection of Silverwater Road and Carnarvon Street was modelled as an isolated intersection with optimum cycle time and signal phase input settings. Roads and Maritime advises that this intersection forms part of a coordinated and linked signal corridor along Silverwater Road with the cycle time and phasing fixed.	The intersection of Carnarvon Road has been modelled in isolation as well as in a network model configuration with the adjoining intersections of Bligh Street-Silverwater Road, Bligh Street- Grey Street and Grey Street and Carnarvon Road.
To ensure that the modelling is fit for purpose in identifying the traffic impact of the planning proposal on the existing signalized intersection of Silverwater Road and Carnarvon Street, it is recommended that the SIDRA modelling be updated and include the following inputs:	The SIDRA modelling has been undertaken using the latest version of Network SIDRA Version 8 released in 2018.
It is also recommended that site observations be undertaken to determine blockages (particularly the departures) in the peak periods and whether this needs to be accounted for in the revised modelling.	Using the history SCATES files for the exact days that the counts were undertaken we are able to check the site observations against the modelled existing SIDRA analysis.
It would be appreciated if the revised SIDRA modelling can be submitted in Version 6 to ensure consistency in the output data results when reviewed by RMS.	Attached in Appendix D are all of the existing SIDRA modelling and also in Appendix E is the Future Development SIDRA modelling and Mitigation investigations.

We understand that we have addressed the additional traffic modelling requested in Item 1(d) of the letter dated 9 September 2015 from the Transport and Maritime Services response to Planning Proposal PP 3/2015.

The development traffic for a Floor Space Ratio of 2.7:1 Floor Space Ratio including a Retail component of 4000 square metres has been calculated and additional traffic has been assigned to the road network and modelled.

There is no change to the existing Level of Service at the intersection of Carnarvon Road and Silverwater Road as a result of the development proposal.

2.0 EXISTING TRAFFIC CONDITIONS

2.1 Existing Road Network

The site has a frontage of approximately **105.9** metres to Silverwater Road and **66.3 metres to Carnarvon Road and 108.6 metres to Grey Street** and a frontage to Bligh Street of **70.6** metres. The site is located within the Rosehill Ward and is identified as currently zoned B6 Enterprise Corridor in the Auburn LEP 2010.

Since the Traffic report prepared by CBH& K in 2014, Silverwater Road has extended clearways implemented in September 2016 from Silverwater Road Between Parramatta Road, Auburn and Marsden Road, Ermington. The extended clearways operate in both directions from:

- 6am to 7pm on weekdays
- 9am to 6pm on weekends and public holidays.

The existing No Stopping and No Parking restrictions continue to operate outside these clearway times.

Detailed street inventory is provided in the CBH & K report 2014 attached in **Appendix F** of this report.

The road inventory and number of traffic lanes are illustrated in **Figure 2**.

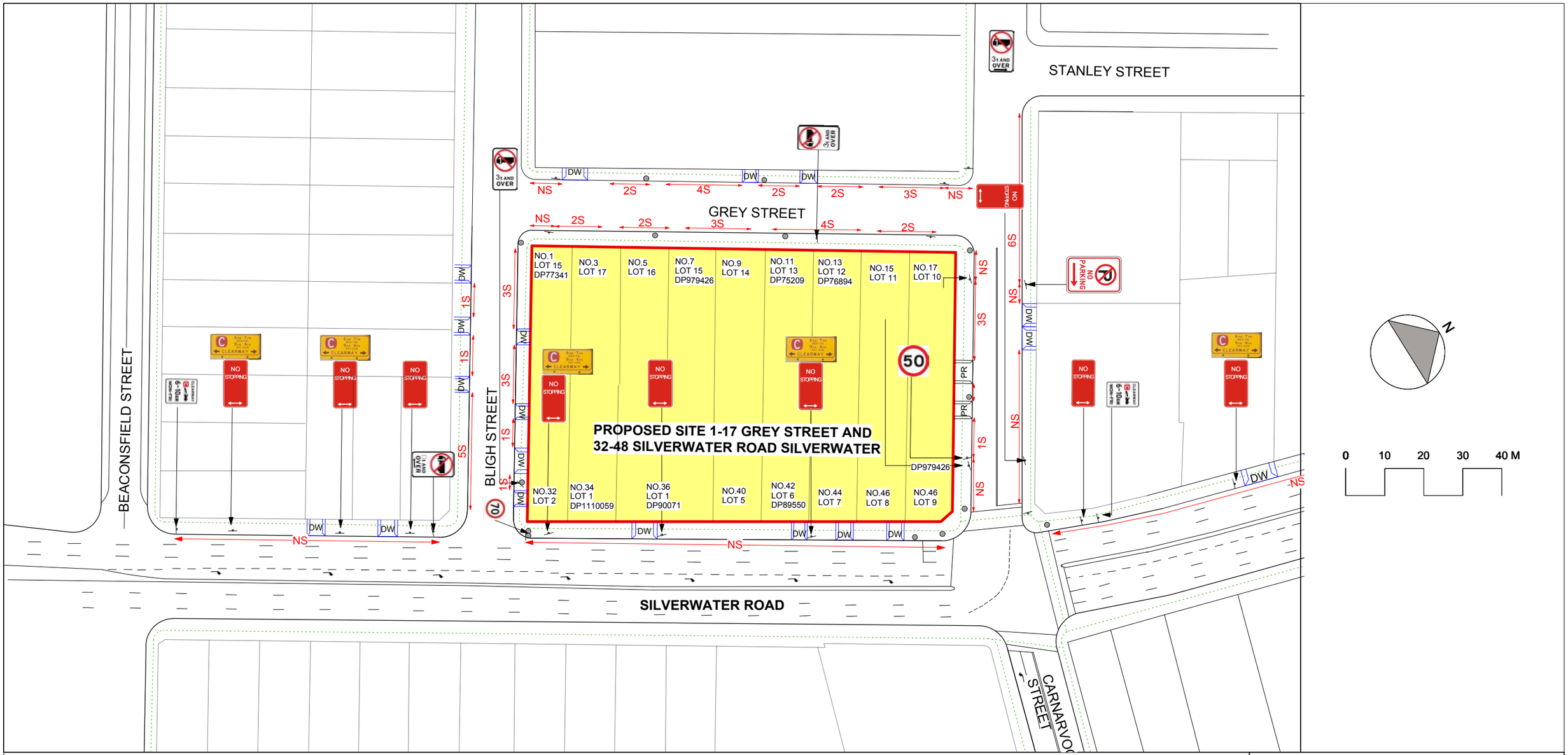
2.2 Road Inventory and Parking

There is parking permitted on both sides of Bligh Street with no parking restrictions and a 3T load limit is signposted on the southern approach to Bligh Street from Silverwater Road and within Bligh Street.

Unrestricted Parking is permitted on both sides of Grey Street which runs east west between Carnarvon Street and Bligh Street west of the subject site.

There is unrestricted parking on the southern side of Carnarvon Street west of Silverwater Road and a No Stopping Zone on the northern side for approximately 55 metres west of Silverwater Road.

The existing street inventory is shown in **Figure 2.**



LEGEND

NS	= NO STOPPING
S	= PARKING SPACES AVAILABLE
	= DRIVEWAY
	= PRAM RAMP
	= PEDESTRAIN WALKWAY

FIGURE 2 STREET INVENTORY PLAN - SCALE 1:1000@A3

ISSUE	DATE	APPD	COMMENTS

plot date : 4/7/18
file name : 1976-18 - Figures 2, 3A, 3B, 4, 5A, 5B_27.6.18_WL.vwx

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CLIENT:
PACIFIC PLANNING
PROPOSED MIXED USE DEVELOPMENT FOR REZONING

32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVEWATER

STREET INVENTORY-SITE PLAN

SCALE	PASSED	DATE
1:1000	EMMC	4.6.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
DRAWN	EMMC	1176-18	02	A
CHECKED	EMMC	DATE FIRST ISSUED. 31.5.18	OF	

2.3 Existing Peak Hour Traffic Volumes

A Traffic and vehicle classification count was carried out at the intersection of Silverwater Road and Carnarvon Street on Wednesday 23/5/2018 from 7-9am and 4pm to 6pm. The growth percentages were then assigned to the existing intersections of

- **Bligh Street/ Silverwater Road**
- **Grey Street/Bligh Street**
- **Grey Street/Carnarvon Road**

The **am** peak hour was **7:30-8:30am** at all intersections. The **PM** peak hour was **4:45-5:45pm.** The results of the surveys are located in **Appendix B**.

Table 2.3a Changes in Peak Hour Traffic Volumes between 2013 and 2018

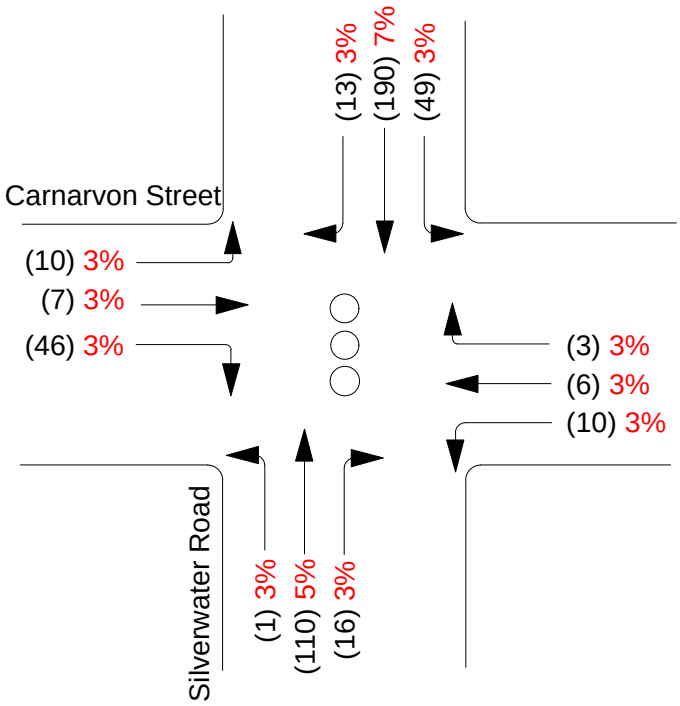
	AM Peak Hour Changes 7:30-8:30AM							
	Silverwater Road		**Silverwater Road**		**Carnarvon Street**		**Carnarvon Street**	
	Northbound (South Approach)		**Southbound (North Approach)**		**Eastbound (West Approach)**		**Westbound (East Approach)**	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	2370	2125	1850	3058	220	240	205	195
Change		-10%		+65%		+9%		-5%
	PM Peak Hour Changes-4:45-5:45PM							
	Silverwater Road		**Silverwater Road**		**Carnarvon Street**		**Carnarvon Street**	
	Northbound (South Approach)		**Southbound (North Approach)**		**Eastbound (West Approach)**		**Westbound (East Approach)**	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	1680	3021	1715	2734	375	426	345	308
Change		+80%		+59%		+14%		-11%

Table 2.3 b Heavy Vehicles Volumes By Percentage

	Northbound	**Southbound**
AM Peak Hour 7:30 – 8:30AM	7%	5%
PM Peak Hour 4:45 – 5:45PM	3%	3%

The percentage volumes in Carnarvon Street were provided in the CBH&K 2014 report and are 3% for all approaches AM and PM peak hour.

For heavy vehicles by direction, please refer to **Figures 3A and 3B.**



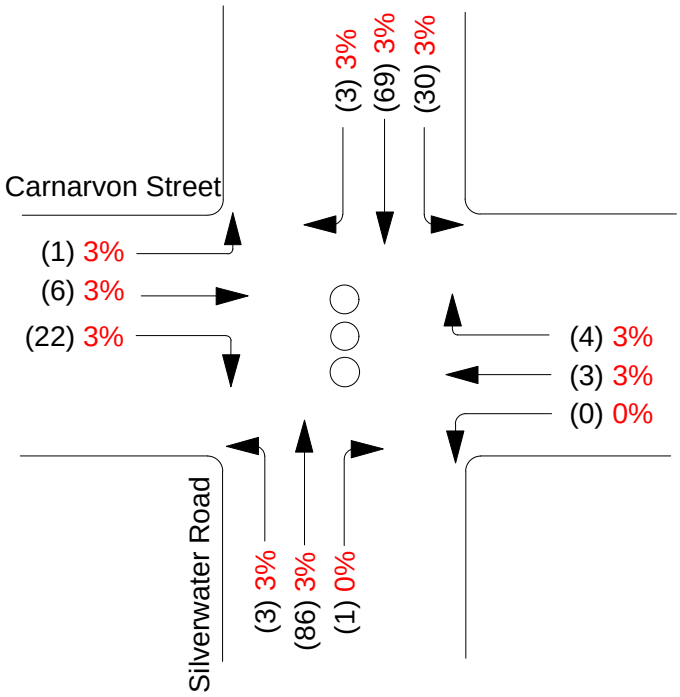
LEGEND:

(3) Heavy Vehicles Only

3% Heavy Vehicle Percentage

FIGURE 3A:

EXISTING AM PEAK HOUR TRAFFIC VOLUMES - HEAVY VEHICLES BY DIRECTION



LEGEND:

(3) Heavy Vehicles Only

3% Heavy Vehicle Percentage

FIGURE 3B:

EXISTING PM PEAK HOUR TRAFFIC VOLUMES - HEAVY VEHICLES BY DIRECTION

2.4 Intersection Performance

The intersections have been analyzed using **SIDRA** Version 8, 2018. The summary reports are located in **Appendix C** of this report.

The performance is determined by the Level of Service (**LoS**) Average Vehicle Delay (**AVD**), Degree of Saturation (**DoS**) and maximum delay on the critical movement at the intersection during peak hours. The Level of Service criteria for intersections are explained in **Table 4.2** taken from the *RTA Guide to Traffic Engineering Developments*.

Table 4.2
***(RTA Guide to Traffic Generating Developments*)**
Level of Service criteria for intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	< 14	Good operation	Good operation
B	15 TO 28	Good with acceptable delays spare capacity	Acceptable delays & spare capacity
C	29 TO 42	Satisfactory	Satisfactory, but accident study required
D	43 TO 56	Operating near capacity	Near capacity & accident study required
E	57 TO 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode

The results of the analysis are set out in **Table 2.4a.**

Table 2.4a Sidra Analysis Existing AM and PM Peak Hour Volumes

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
1	Silverwater Road/ Carnarvon Street	S	AM	C	0.926	34.3	South Approach Silverwater Rd RHT 86.2 secs
1	Silverwater Road/ Carnarvon Street	S	PM	F	1.046	117.9	East Approach Carnarvon Street RHT 185.6 secs
2	Carnarvon Street/Grey Street	G	AM	A	0.157	0.4	South Approach Grey Street RHT 7.8 secs
2	Carnarvon Street/Grey Street	G	AM	A	0.223	0.2	South Approach Grey Street RHT 7.8 secs
3	Grey Street/Bligh Street	G	AM	A	0.051	3.7	North Approach Grey Street RHT 5.8 secs
3	Grey Street/Bligh Street	G	PM	A	0.045	3.5	North Approach Grey Street RHT 5.8 secs
4	Silverwater Road/Bligh Street	S	AM	A	0.526	0.1	South Approach Silverwater Rd LHT 7.2 secs
4	Silverwater Road/Bligh Street	S	PM	A	0.542	0.1	South Approach Silverwater Rd LHT 9.6 secs

Notes:
Degree of Saturation is the ratio of demand to capacity for the most disadvantaged movement.

(1) Average delay is the delay experienced on average by all vehicles. The value in brackets represents the delay to the most disadvantaged movement.

Level of Service is a qualitative measure of performance describing operational conditions. There are six levels of service, designated from A to F, with A representing the best operational condition and level of service F the worst. The LoS of the intersection is shown in bold, and the LoS of the most disadvantaged movement is shown in brackets

Note: **S Signals**

ST Stop

SI Sign

G Give Way

R Roundabout

Volumes have increased significantly in the southbound direction in Silverwater Road since the traffic counts were carried out in 2013 and in the northbound direction in the PM peak hour.

2.4.1 Network SIDRA analysis

We have analyzed the cumulative effects of existing development traffic by networking the intersections surrounding the development site. The results of the network model are shown in **Table 2.4b**.

Table 2.4b Sidra Analysis Existing AM and PM Peak Hour Volumes

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
5	Grey Street-Bligh St/ Bligh St – Silverwater Road		AM	C(D)	0.926	34.3	86.2s
5	Grey Street-Bligh St/ Bligh St – Silverwater Road		PM	F(E)	1.046	78.7	139.2s

Please note that the network model shows a slight change in LOS but DOS is the same as main signalized intersection. Network modelling is designed for linked signalized intersections in SIDRA. The network model software is limited as it can only model to the nearest intersection i.e. Bligh Street and Silverwater Road.

Figure 3c shows the AM and PM linked intersections which were modelled.

2.5 Current Uses of Existing Site

The current uses are as follows: -

No. 32-24 Silverwater Road	Building Supplies
36-38 Silverwater Road	Cleared site with vehicles
No 48 Silverwater Road	Vacant Yard Area
17 Grey Street	Residential Dwelling House
15 Grey Street	Take away Shop
11-13 Grey Street	Vacant

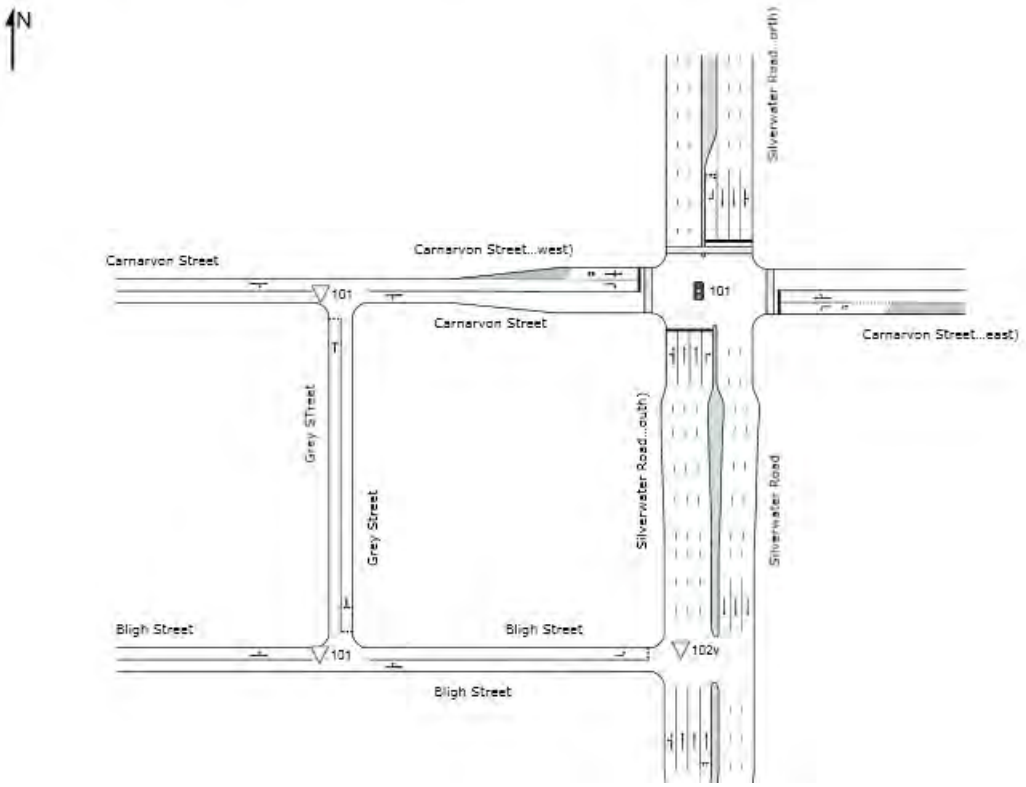
2.6 Existing Vehicular Access To the Site

There are currently vehicular driveways off Silverwater Road. There are two vehicle driveways off Carnarvon Road to No 17 Grey Street. No 32 Silverwater Road has one access driveway to Bligh Street and No 1 Grey Street has one access driveway to Bligh Street. There are several driveways off Grey Street.

NETWORK LAYOUT

Network: N101 [Network1 - AM Existing]

New Network
Network Category: (None)



NETWORK LAYOUT

Network: N101 [Network1 - PM Existing]

New Network
Network Category: (None)

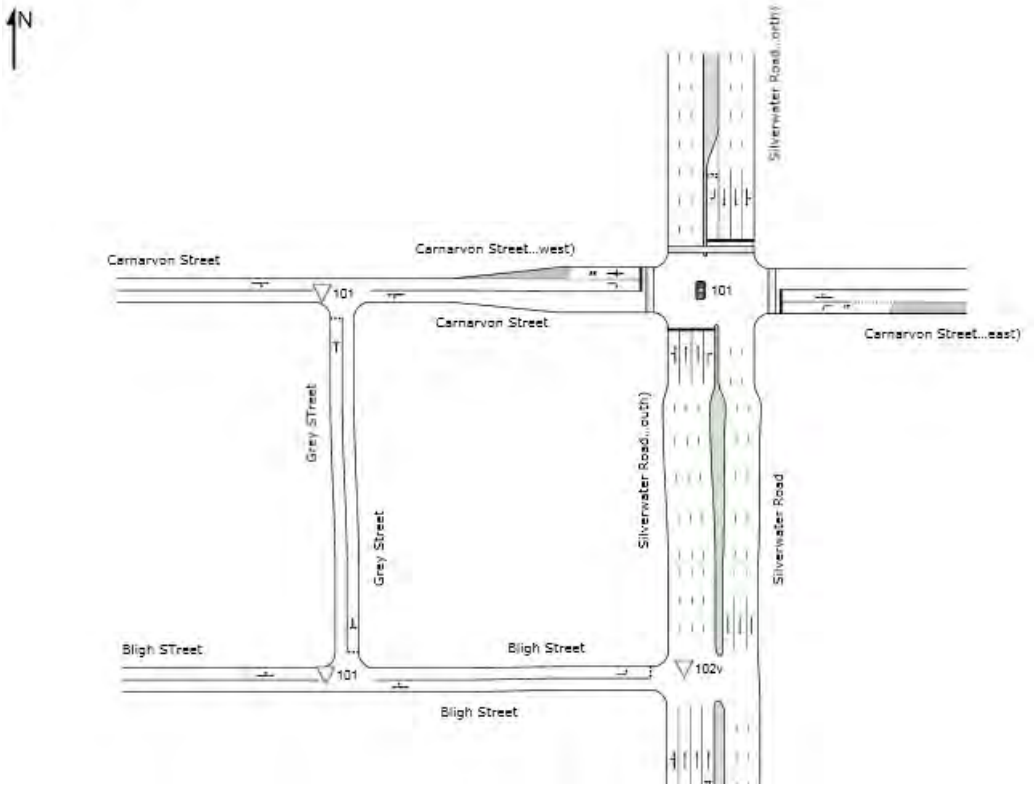


FIGURE 3C
NETWORK DIAGRAM

2.7 Existing Public Transport

Public transport access is covered in the CBH & K report in 2014.

A layout vehicle map has been prepared. Bus routes and proximity to transport services is shown in **Figure 4.**

2.8 Car Driver Mode – Residents

Silverwater is located in SA3 Auburn Statistical area. Car driver mode for residents is 53% as shown in **Figure 4A.** Car driver mode for retail use is 74.4%.

LEGEND

B BUS STOP

32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVERWATER
TO BUS STOP 212848(CARNARVON ST OPPOSITE HUME PARK) 3 MIN WALK
BUS STOP 212848 TO AUBURN STATION - 9 MIN TRIP

BUS ROUTE 544 MACQUARIE CENTRE TO AUBURN VIA EASTWOOD

32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVERWATER
TO BUS STOP 212851(CARNARVON ST AT VORE ST) 5 MIN WALK
BUS STOP 212851 TO AUBURN STATION - 9 MIN TRIP

BUS ROUTE 540 SILVERWATER REMAND CENTRE TO AUBURN

32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVERWATER
TO BUS STOP 2144178(AUBURN NORTH PUBLIC SCHOOL, PARRAMATTA ROAD) 12 MIN WALK
BUS STOP 2144178 TO AUBURN STATION - 9 MIN TRIP

BUS ROUTE 909 BANKSTOWN TO PARRAMATTA VIA BIRRONG & AUBURN

32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVERWATER
TO BUS STOP 2144179(PARRAMATTA ROAD AT STATION ROAD) 11 MIN WALK
BUS STOP 2144179 TO LIDCOMBE STATION - 9 MIN TRIP

BUS ROUTE M92 SUTHERLAND TO PARRAMATTA

AUBURN STATION

FIGURE 4:
TRANSPORT NETWORKS

32-38 SILVERWATER ROAD
AND 1-17 GREY STREET SILVERWATER

Auburn

Population*	89,897
Households	30,746
Vehicles	50,192
Land area (sq. km)	33

Travel by MODE, Auburn 2016/17

	Number of Trips	% of Total Trips	Trip Distance (km)	% of Total Distance	Avg. Distance (km)
Vehicle Driver	197,267	53	1,385,003	57	7
Vehicle Passenger	66,020	18	411,129	17	6
Train	35,606	10	467,019	19	13
Bus	16,006	4	94,662	4	6
Walk Only	55,095	15	35,558	1	1
Other	1,776	0	16,528	1	9
Grand Total	**371,770**		**2,409,899**		

FIGURE 4A

TRAVEL MODE OF RESIDENTS
AUBURN SA3

3.0 TRAFFIC EFFECTS FOR VARIOUS DEVELOPMENT SCENARIOS

3.1 Floor Areas and Traffic Generation

The traffic generation for the proposed development has been calculated in accordance with the **RMS** Technical note **TDT 2013/04a** which lists the rates for high density residential units and the RMS Guide to Traffic Generating Developments.

3.1.1 Base Case CDC Scenario No 1 under Part 5A.4 SEPP (Exempt and Complying Development Code) 2008

As the site is split into 2 sites, each less than 5000m^2 referral to the RMS is not required under EPA Regulation 2000.

A review of the Traffic generation for a site where FSR is 1:1

The highest Traffic generation for this base case is factory use which has a traffic generation of 1.0/100m^2 GFA. Other uses that were investigated were warehouse distribution 0.5 trips/100m^2 and ancillary retail up to 20% which uses the RMS formula for slow trade retail of 20A(S)/1000m^2 GFA. As requested, the site was split into 2 development sites Site 1 and Site 2. Each of these sites has a GFA of less than 5000m^2 or 3780m^2 each.

Table 3.1.1 shows the Traffic generation calculated for this Base Case No 1.

Table 3.1.1 Traffic Generation for Existing CDC Uses

	Use	**Area m^2**	**Generation Rate- Peak Hour Trips RMS**	**Traffic Generation**					
				AM Peak		PM Peak			
				8:00-9:00AM		5:00-6:00PM			
	Site 1			**IN**	**OUT**	**IN**	**OUT**		
1	Factory	3780	1.0/100m^2 GFA Distribution 50/50	18.9	18.9	18.9	18.9		
		3780	Total	18.9	18.9	18.9	18.9		
	Use	**Area m^2**	**Generation Rate- Peak Hour Trips RMS**	**Traffic Generation**					
				AM Peak		PM Peak			
				8:00-9:00AM		5:00-6:00PM			
	Site 2			**IN**	**OUT**	**IN**	**OUT**		
1	Factory	3780	1.0/100m^2 GFA Distribution 50/50	18.9	18.9	18.9	18.9		
		3780	Total	18.9	18.9	18.9	18.9	Total Peak	
								AM	PM
	TOTAL AM and PM Peak Hour 2 Sites			37.8	37.8	37.8	37.8	75.6	75.6

3.1.1 (continued)

The Peak AM and PM was **75.6** Vehicles. This is substantially less than the case No 2 for existing permissible uses on the site.

Proposed Traffic Volumes have been assigned to the road network as shown in **Figures 5A1** and **5B2** for AM and PM peak hours respectively.

3.1.2 Base Case Scenario No 2 - Existing Permissible Uses

We have prepared a scenario test based upon the development that would consist of the existing permissible uses on the development site. The areas and estimated traffic are shown in **Table 3.1.2**.

Table 3.1.2 Traffic Generation for Existing Permissible Uses

	Use	Area m^2	Generation Rate- Peak Hour Trips	Traffic Generation			
				AM Peak		PM Peak	
				8:00-9:00AM		5:00-6:00PM	
				IN	OUT	IN	OUT
1	Bulky Goods	2500	2 .7 Trip/ Hour/100m^2 GLA Distribution 50/50	33.75	33.75	33.8	33.75
2	Neighborhood Shops	200	12.3/100m2 Distribution 50/50	12.3	12.3	12.3	12.3
3	Food Takeaway	400	Car Driver BTS J to W 74.4% 50% Emp Patron Distribution 50/50 20.4 *0.744	7.58	7.58	7.58	7.58
4	Indoor Sports	1000	9/100 GFA IN and Out 50% Employees and Patrons	45	45	45	45
6	Landscape Supplies/Nurseries	1460	57 + 0.7/100m2 50/50 Distribution	29	29	29	29
7	Building Supplies	2000	4.2/100m2 GFA (RMS TDT 2013/04a) 50/50 distribution AM and 50/50 PM	42	42	42	42
		7560	Total	169.6	169.6	169.6	169.6
TOTAL AM and PM Peak Hour				339.3		339.3	

We calculated the existing traffic generation based upon a range of existing permissible uses upon the site. The AM and PM Peak Hour traffic generation was **339.3** vehicles trips per hour.

Assignment to the road network is shown in **Figures 5A2** and **5B2** for AM and PM peak hours respectively. Refer to Section 4.0 of the report.

3.1.3 Future Development Option 1 FSR 2.7:1

The gross floor areas for the retail premises and the gross leasable floor areas for the residential components have been calculated. The **FSR** for the site is calculated to be **2.7:1**

Table 3.1.3a Proposed Floor Areas and Uses for 2.7:1 FSR

Use	Area M^2
Medical Centre	1000
Supermarket	1000
Specialty Shops	
Ancillary Food	470
Pharmacy	80
Pharmacy Online Support	700
Office	750
Total	**4000**

HIGH DENSITY RESIDENTIAL UNITS

	Units
Residential	210

Table 3.1.3b Previous Report CBH & K 2014 FSR 4:1

Use	Area M^2
Retail	3500
Commercial	500

HIGH DENSITY RESIDENTIAL UNITS

	Units
Residential	250

3.1.3 (continued)

TABLE 3.1.3c PROPOSED TRAFFIC GENERATION FOR 32-48 SILVERWATER RD AND1-17 GREY ST, SILVERWATER 2.7:1 FSR

RETAIL USES

Use	Area M^2	Generation Rate	IN	OUT	TOTAL
Medical Centre	1000	RMS 3.5/100M^2; 74.4% Car Driver; 50% IN & OUT	13	13	26
Supermarket	1000	RMS 155A THURS; 155 x 0.8/1000=124			
		AM 0.1 IN & OUT	12.4	12.4	24.8
		PM 0.5 IN & OUT	62	62	124
Speciality Shops					
Ancillary Food	470	RMS 46A (SS) THURS			
Pharmacy	80	1250x0.8x46/1000=46			
Pharmacy Online Support	700	AM	4.6	4.6	9.2
		PM	23	23	46
Office	750	RMS 2/100M^2; 74.4% Car Driver; 30% IN, 20% OUT AM	12	3	15
		20% IN, 80% OUT PM	3	12	15

HIGH DENSITY RESIDENTIAL UNITS

	Assume similar to Rockdale				
	No. of Units/ Area	**Distribution**	**IN**	**OUT**	**TOTAL**
Residential	210	AM	25	75	
		PM	67	33	
		Rate			
		AM (0.32/ Unit)	16.8	50.4	67.2
		PM (0.23/ Unit)	32.4	15.9	48.3
Specialty Shops	1250m^2				
Employees	1/50m^2	Travel Mode 53% x 25	13.2	0	13.2
		PM (included in above)			
		TOTAL AM	72	83	155
		TOTAL PM	147	126	273

Notes:

(1) AM Peak Hour for Residential is based on 0.25 IN and 0.75 OUT and in the PM Peak Hour 0.66 IN and 0.33 OUT.

(2) AM PM Peak Hour rates for retail, the assumptions are listed in the traffic generation rate.

3.1.3 (continued)

The traffic generation for the development prepared in 2014 is shown in **Table 3.1.4** for comparative purposes

Scenario Testing of Future Traffic Generation should include reduction of volumes by 10%. For implementation of Green Travel Plan and the incidence of linked multi-model trips is likely and can result in a reduction of traffic generation.

Table 3.1.3d Reduced Traffic Generation

	IN	OUT	TOTAL
TOTAL AM PEAK HOUR	61.2	79.2	**139.5**
TOTAL PM PEAK HOUR	136	109	**245**

Reduction AM Volume is 15.5 and PM is 28 vehicles.

Traffic volumes have been assigned to the road network as shown in **Figure 5A3** and **5B3** for AM and PM peak hours respectively. Refer to Section 4.0 of the report.

It should be noted that the CBH & K Report 2014, the generation rate for residential assumed between 0.3 and 0.4 per hour per dwelling for peak hour traffic. The calculation of retail traffic generation also assumed a reduction for 25% of parking traffic as referred to in RMS – Guide to traffic generating developments Section 3. We do not believe that this has been substantiated.

3.1.3 (continued)

Table 3.1.4 Traffic Generation Silverwater Based upon the land use descriptions in CBH & K Report 2014

RETAIL USES

Use	Area M^2	Generation Rate	Calculation	IN	OUT	TOTAL
Retail AM	3500	RMS 12.3/100M^2; 20% IN AM	86.10	43	43	86
Retail PM	3500	RMS 12.3/100M^2, 50% IN and OUT	430.50	215	215	431
Commerical AM and PM	500	RMS 2/100M^2; 74.4% Car Driver; 50% IN & OUT	10	5	5	10

HIGH DENSITY RESIDENTIAL UNITS

Assume similar to Rockdale						TOTAL
	Units	Distribution		IN	OUT	
Residential	250	AM	87.5	25	75	
		PM	87.5	67	33	
		Rate				
		AM (0.35/ Unit)		21.875	65.625	87.5
		PM (0.35/ Unit)		58.625	28.875	87.5
		TOTAL AM		70	114	**184**
		TOTAL PM		279	249	**528**

As shown in **Table 3.1.4** the PM Peak Hour traffic generation is significantly higher.

3.2 Intersection Performance

The future volumes at the intersections surrounding the development site have been modelled using SIDRA 8 for the following scenarios: -

- Base scenario No 1 – CDC
- Base scenario No 2 – Permissible Uses
- Proposed Development Option 1 FSR 2.7:1

The critical intersection of Carnarvon Street and Silverwater Road has been modelled and the following assumptions have been made. A 135 second cycle time has been adopted.

Assumptions for all future modelling: -

Base Scenario 2018 A 10% reduction to traffic generation to and from the site is given to the incidence of linked multi-modal trips and green travel plan.

We refer to the Roads and Maritime Services RMS-West Connex M4 Widening Road Network Performance Mitigation Plan(RNPMP) MARCH 2016. Here it predicts a reduction and improvement to the Level of Service in Carnarvon Street and Silverwater Road after the M4 widening but predicts that this intersection will operate past capacity after full West Connex in 2031.

The high percentage of heavy vehicles in Carnarvon Street may result in a reduction of vehicle percentage as land use changes and driver behavior around the tolls installation to M4 changes.

Table 3.2a SIDRA ANALYSIS OF BASE DEVELOPMENT SCENARIO No 1 - CDC

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Base 1	Silverwater Road/ Carnarvon Street	S	AM	C	0.897	37.1	South Approach Silverwater Rd RHT 86.8 secs
Base 1	Silverwater Road/ Carnarvon Street	S	PM	F	1.046	117.9	East Approach Carnarvon Street RHT 180.6 secs

There is no change in Level of Service in the AM or PM Peak Hour periods. The PM is already at saturation.

3.2 (continued)

Table 3.2b SIDRA ANALYSIS OF BASE DEVELOPMENT SCENARIO No 2 – PERMISSIBLE USES

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Base 2	Silverwater Road/ Carnarvon Street	S	AM	D	0.93	48	East Approach Carnarvon Street RHT 95.1 secs
Base 2	Silverwater Road/ Carnarvon Street	S	PM	F	1.131	208.1	East Approach Carnarvon Street RHT 324.1 secs

Change in LoS in the AM from C to D and increase in Degree of Saturation by 0.084.

The critical intersection of Carnarvon Street and Silverwater Road has been modelled and the following assumptions have been made. A 135 second cycle time has been adopted.

Table 3.2c SIDRA ANALYSIS OF FUTURE DEVELOPMENT NO MITIGATION. DEVELOPMENT FSR 2.7:1

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Future Opt 1	Silverwater Road/ Carnarvon Street	S	AM	C	0.892	39.1	North Approach Silverwater Road RHT 164.8 secs
Future Opt 1	Silverwater Road/ Carnarvon Street	S	PM	F	1.016	162.2	South Approach Silverwater Road RHT 285.9 secs

There is No change in Level of Service for future development. Very minor change in Average Delay for the AM Peak Hour Period and in the PM Peak Hour Period.

Notes:
Degree of Saturation is the ratio of demand to capacity for the most disadvantaged movement.

(1) Average delay is the delay experienced on average by all vehicles. The value in brackets represents the delay to the most disadvantaged movement.

Level of Service is a qualitative measure of performance describing operational conditions. There are six levels of service, designated from A to F, with A representing the best operational condition and level of service F the worst. The LoS of the intersection is shown in bold, and the LoS of the most disadvantaged movement is shown in brackets

Note: **S** **Signals**
ST **Stop**
SI **Sign**
G **Give Way**
R **Roundabout**

3.3 Provision of Alternative Transport

It is recommended that a "Green Travel Plan" be adopted for this development to *reduce car-based travel* to encourage employees in the retail tenancies to make *greater use* of public transport, cycling, walking and car sharing for the journey to work.

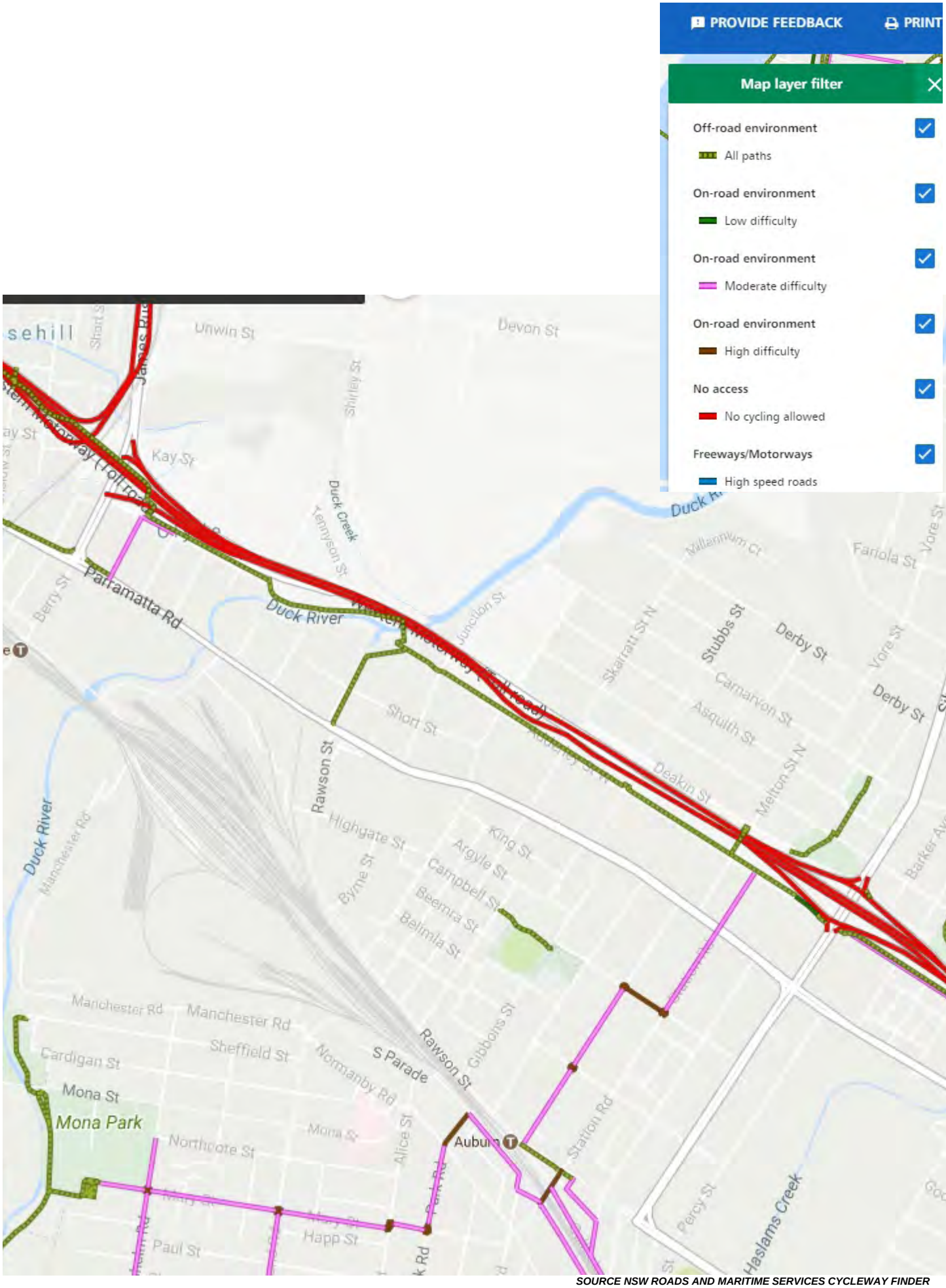
The following initiatives are recommended: -

1. Bicycle storage, showers and changing facilities can be provided to encourage cycling by employees and bicycle storage for residents.

2. Provide train and bus timetables to staff and residents.

3. Provide a walking map that shows walking distances to bus stops, schools, parks and local shops.

An existing cycleway network map is provided in this report as shown in **Figure 4B.**



SOURCE NSW ROADS AND MARITIME SERVICES CYCLEWAY FINDER

NORTH

FIGURE 4B
EXISTING CYCLEWAY NETWORK

4.0 TRAFFIC IMPACTS OF PROPOSED DEVELOPMENT

4.1 Impacts on Frontage Road Traffic

Future traffic volumes have been assigned to the road network as shown in **Figures 5A1** and **5B1** for the Scenario 1 Base Case, Scenario 2 for permissible uses. Refer to **Figures 5A2** and **5B2** and Development Option 1 for FSR of 2.7:1. Refer to **Figures 5A3** and **5B3**. The reduction of 10% traffic generation can be supported by the implementation of the Green travel Plan incentive.

There has been significant growth in Silverwater Road since the 2013 traffic counts were undertaken. The traffic volumes from this development are significantly less than what was modelled in 2014. The traffic volumes for the future whilst they have an impact on the operation of Carnarvon Street in the AM there is no change in the PM peak hour operation.

Mitigation measures will alleviate the existing capacity saturation in the PM peak Hour. The mitigation measures are explained in **Appendix E** of this report.

SIDRA analysis using a Network Model demonstrates the existing impacts of the 2.7:1 development upon the road network.

Future growth at the intersection of Silverwater Road and Carnarvon Street intersection is predicted to occur at the Sydney-wide growth at 1.6 per cent per annum compound growth between 2018 and 2021 and 1.2 per cent per annum compound growth between 2021 and 2028.

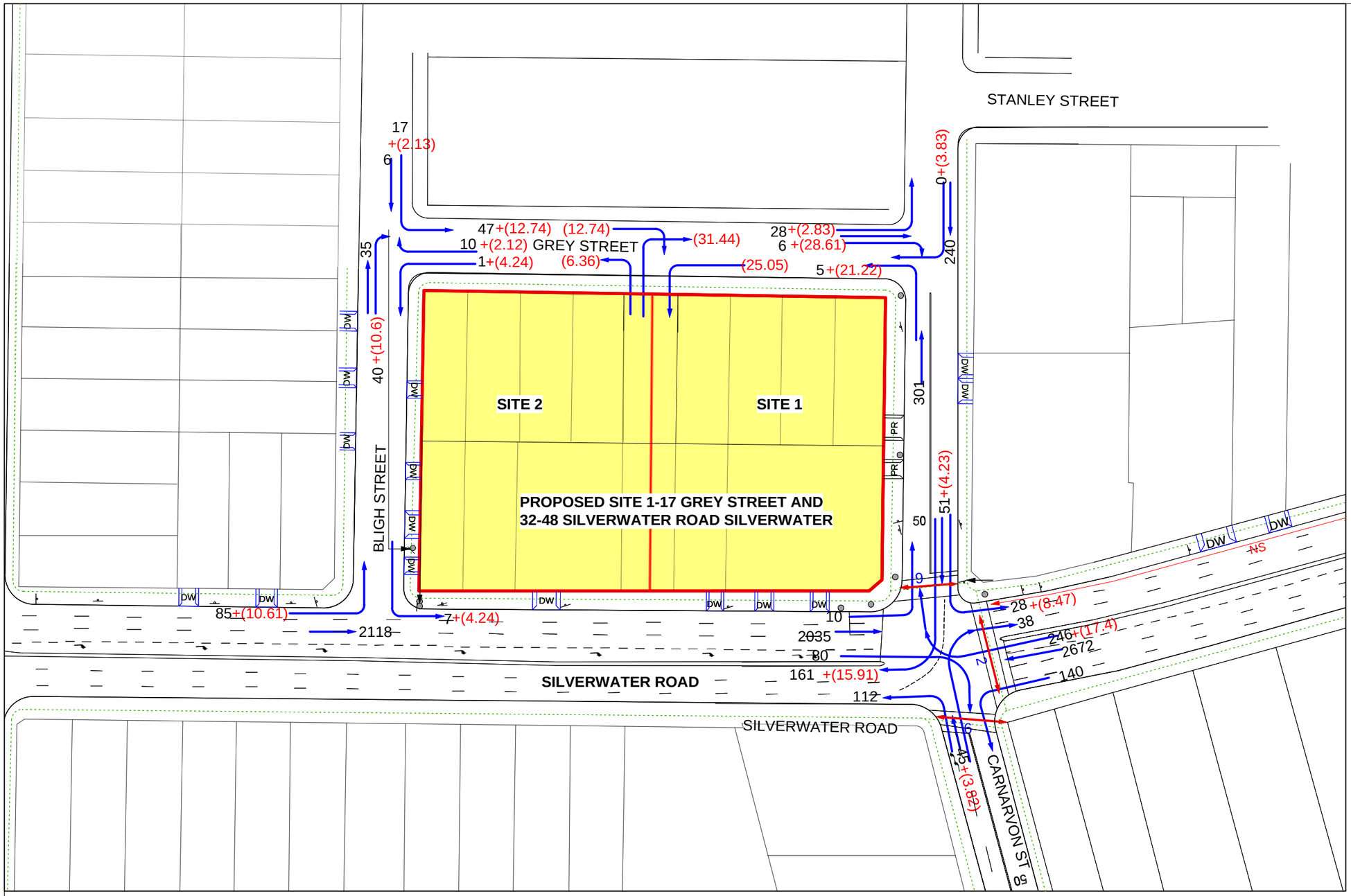
The volumes are calculated as follows using the formula
$FT= T(1+r)^n$

Where T = current 2018 Peak Hour volume
n = number of years
r =growth rate per annum

	Northbound			**Southbound**		
		3 years	**7 years**		**3 years**	**7 years**
	Base	**0.016**	**0.012**	**Base**	**0.016**	**0.012**
Year	2018	2021	2028	2018	2021	2028
Rate		1.049	1.087		1.049	1.087
AM Peak Hour	2035	2134	**2212**	2672	2802	**2905**
PM Peak Hour	2760	2895	**3000**	2597	2724	**2823**

The future traffic increase volumes were tested with scenario mitigation test DEV 2b. Refer to **Appendix E** of this report.

The results showed that for 2021 growth volumes there was no change in the Level of Service for the AM or PM peak hour periods with additional growth.



N

AM HOUR TRAFFIC

	IN	*OUT*	*TOTAL*
FUTURE LESS 10%	88.56	106.92	195.48
FUTURE	(37.8)	(37.8)	(75.6)

LEGEND

11	EXISTING AM PEAK TRAFFIC
+(19)	FUTURE DEVELOPMENT TRAFFIC
2	EXISTING PEDESTRIAN VOLUMES

0 10 20 30 40 M

AM Peak Hour Changes 7:30-8:30AM

	Silverwater Road Northbound (South Approach)		Silverwater Road Southbound (North Approach)		Carnarvon Street Eastbound (West Approach)		Carnarvon Street Westbound (East Approach)	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	2370	2125	1850	3058	220	240	205	195
Change		-10%		+65%		+9%		-5%

FIGURE 5A1 - BASE SCENARIO CDC FUTURE AM PEAK HOUR TRAFFIC 7:30-8:30AM EXISTING PLUS FUTURE DEVELOPMENT

SCALE 1:1000 (A3)

ISSUE	DATE	APPD	COMMENTS

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AM PEAK HOUR BASE SCENARIO CDC

SCALE	PASSED	DATE
1:1000	EMMC	27.7.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
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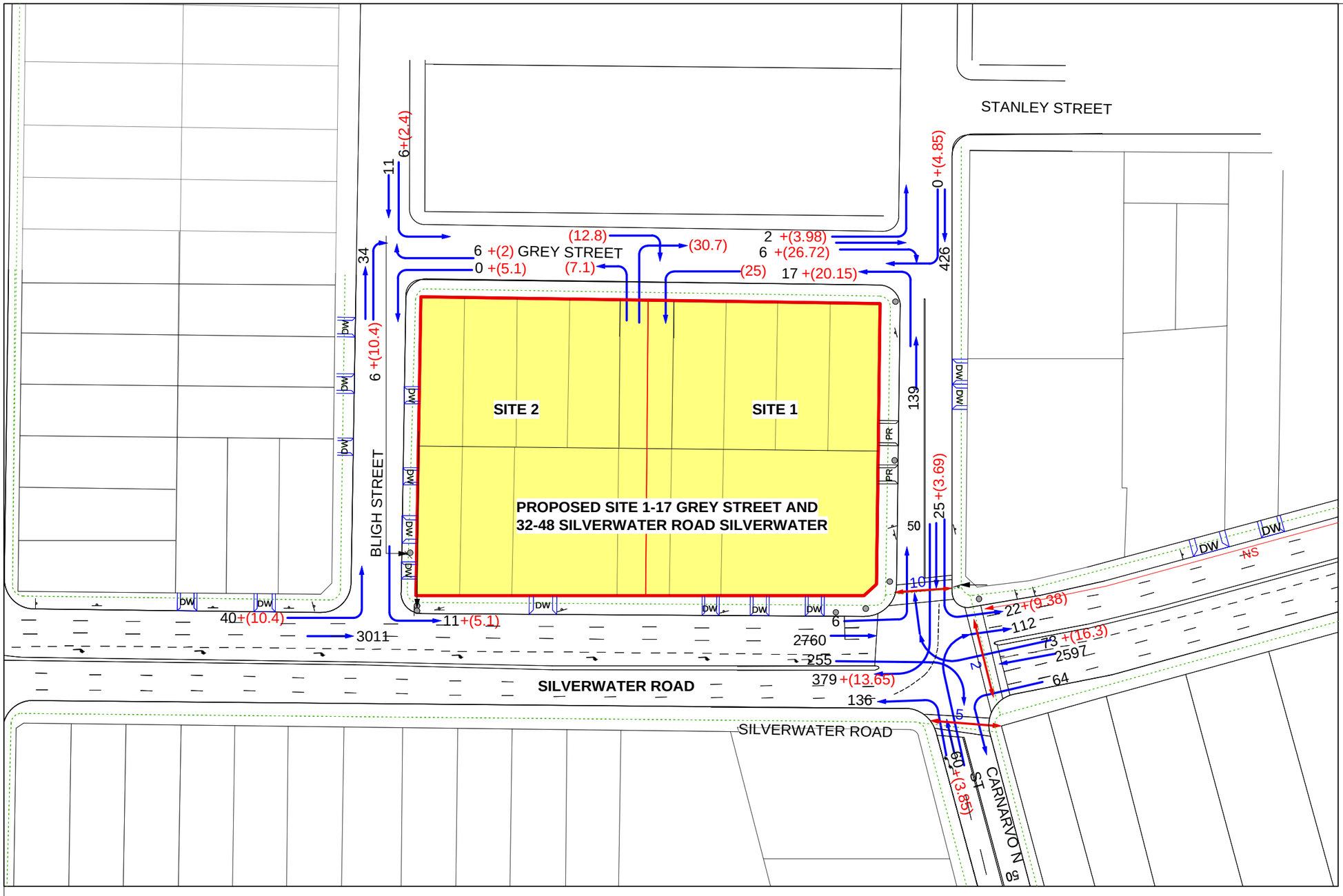
CHECKED	EMMC	DATE FIRST ISSUED. 31.5.18	OF	



PM HOUR TRAFFIC

	IN	*OUT*	*TOTAL*
FUTURE LESS 10%	147.6	132.75	280.35
FUTURE	(37.8)	(37.8)	(75.6)

LEGEND

11	EXISTING PM PEAK TRAFFIC
+(19)	FUTURE DEVELOPMENT TRAFFIC
2	EXISTING PEDESTRIAN VOLUMES

0 10 20 30 40 M

PM Peak Hour Changes-4:45-5:45PM

	Silverwater Road Northbound (South Approach)		Silverwater Road Southbound (North Approach)		Carnarvon Street Eastbound (West Approach)		Carnarvon Street Westbound (East Approach)	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	1680	3021	1715	2734	375	426	345	308
Change		+80%		+59%		+14%		-11%

FIGURE 5B1 - BASE SCENARIO CDC FUTURE PM PEAK HOUR TRAFFIC 4:45-5:45PM EXISTING PLUS FUTURE DEVELOPMENT

SCALE 1:1000 (A3)

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PM PEAK HOUR BASE SCENARIO CDC

SCALE	PASSED	DATE
1:1000	EMMC	27.7.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
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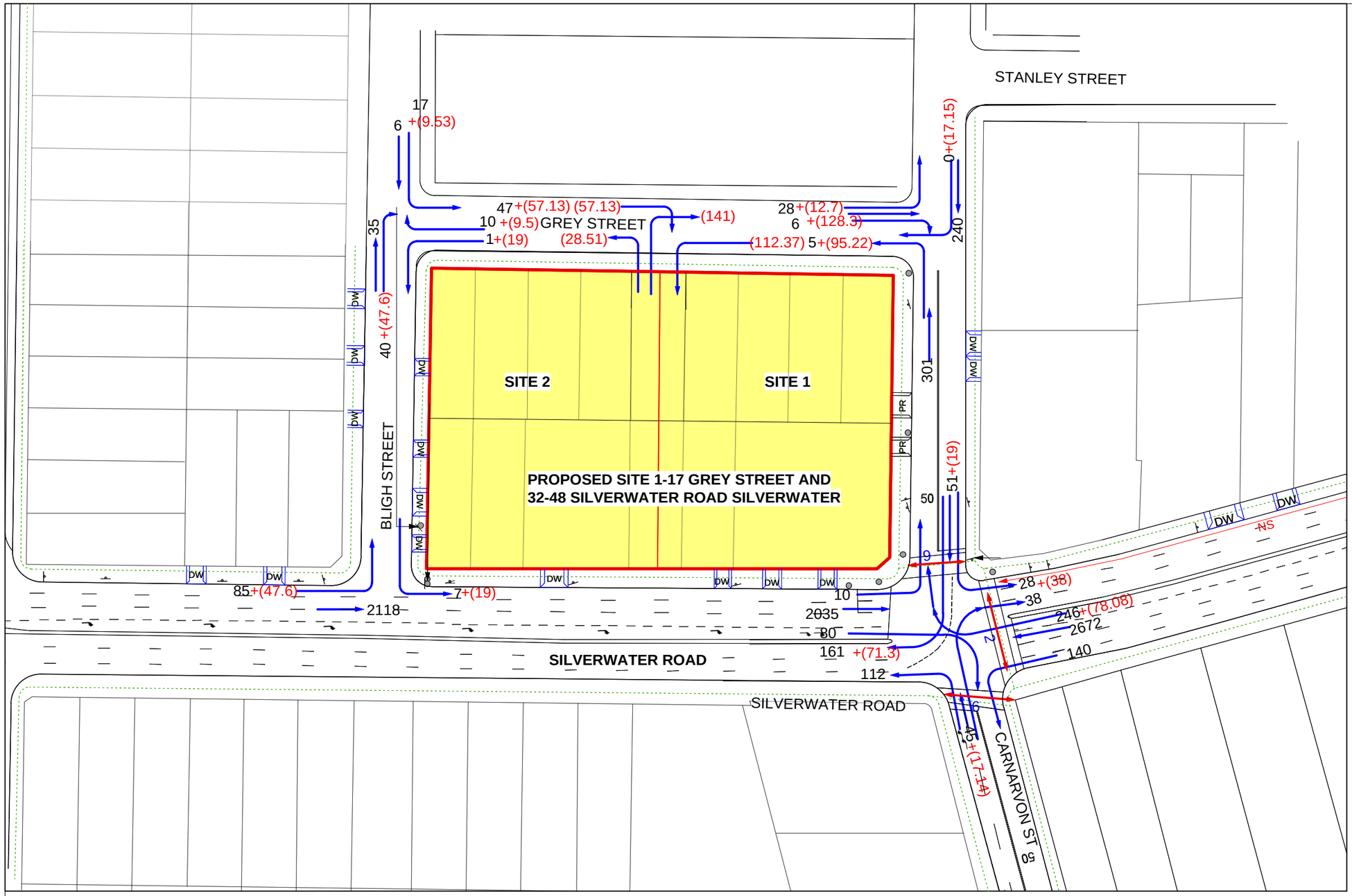

AM HOUR TRAFFIC

	IN	*OUT*	*TOTAL*
FUTURE LESS 10%	88.56	106.92	195.48
FUTURE	(169.5)	(169.5)	(339)

LEGEND

11	EXISTING AM PEAK TRAFFIC
+(19)	FUTURE DEVELOPMENT TRAFFIC
2	EXISTING PEDESTRIAN VOLUMES

0 10 20 30 40 M

AM Peak Hour Changes 7:30-8:30AM

	Silverwater Road Northbound (South Approach)		Silverwater Road Southbound (North Approach)		Carnarvon Street Eastbound (West Approach)		Carnarvon Street Westbound (East Approach)	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	2370	2125	1850	3058	220	240	205	195
Change		-10%		+65%		+9%		-5%

FIGURE 5A2 - AM PEAK HOUR PERMISSIBLE USES FUTURE
SCALE 1:1000 (A3)

ISSUE	DATE	APPD	COMMENTS

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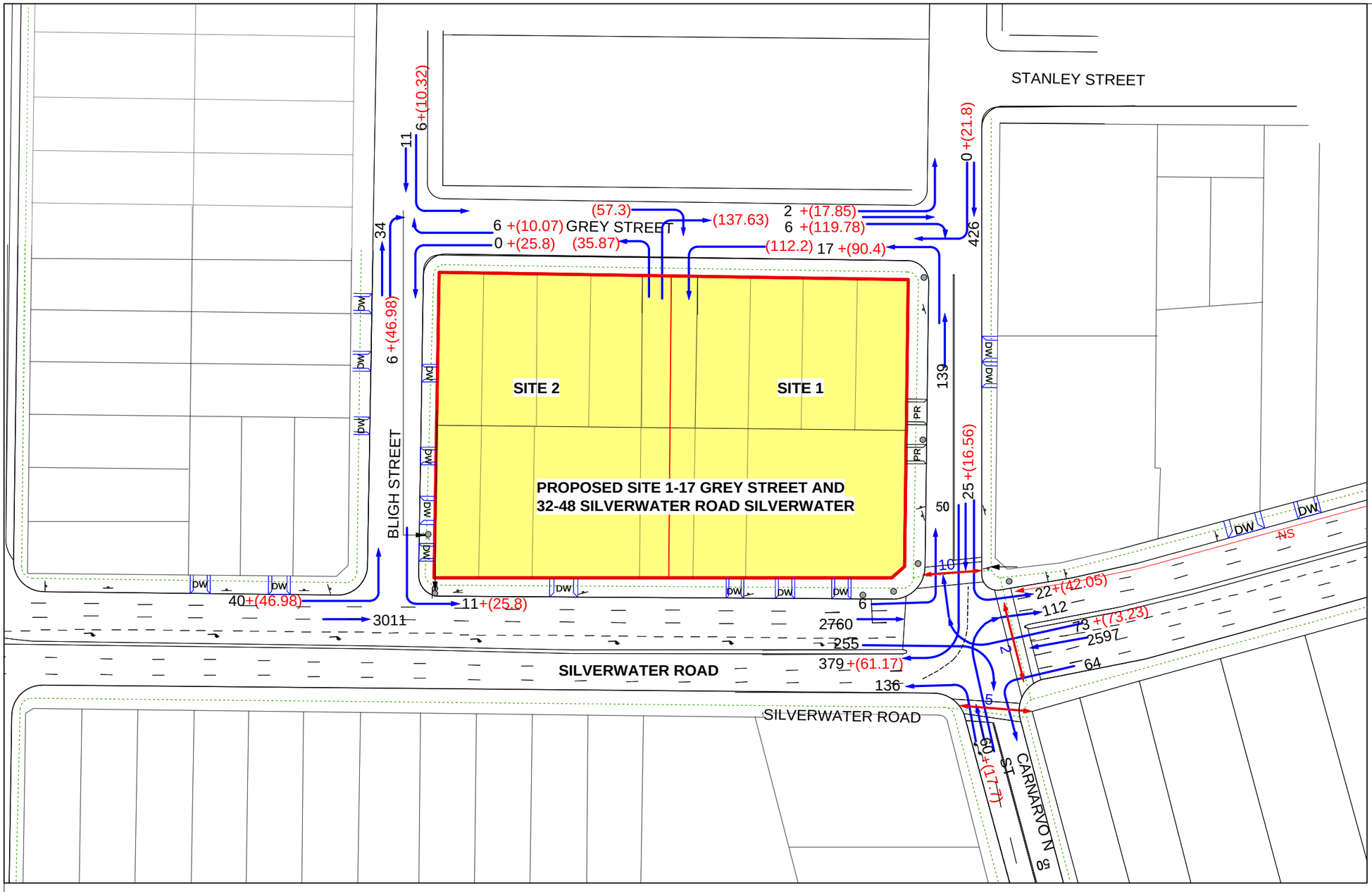
AM PEAK HOUR PERMISSIBLE USES FUTURE

SCALE	PASSED	DATE
1:1000	EMMC	27.7.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
DRAWN	EMMC	1176-18	**05**	A
CHECKED	EMMC	DATE FIRST ISSUED. 31.5.18	OF	



PM HOUR TRAFFIC

	IN	*OUT*	*TOTAL*
FUTURE LESS 10%	147.6	132.75	280.35
FUTURE	(169.5)	(169.5)	(339)

LEGEND

11	EXISTING PM PEAK TRAFFIC
+(19)	FUTURE DEVELOPMENT TRAFFIC
2	EXISTING PEDESTRIAN VOLUMES

0 10 20 30 40 M

PM Peak Hour Changes-4:45-5:45PM

	Silverwater Road Northbound (South Approach)		Silverwater Road Southbound (North Approach)		Carnarvon Street Eastbound (West Approach)		Carnarvon Street Westbound (East Approach)	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	1680	3021	1715	2734	375	426	345	308
Change		+80%		+59%		+14%		-11%

FIGURE 5B2 - PM PEAK HOUR PERMISSIBLE USES FUTURE

SCALE 1:1000 (A3)

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PM PEAK HOUR PERMISSIBLE USES FUTURE

SCALE	PASSED	DATE
1:1000	EMMC	27.7.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
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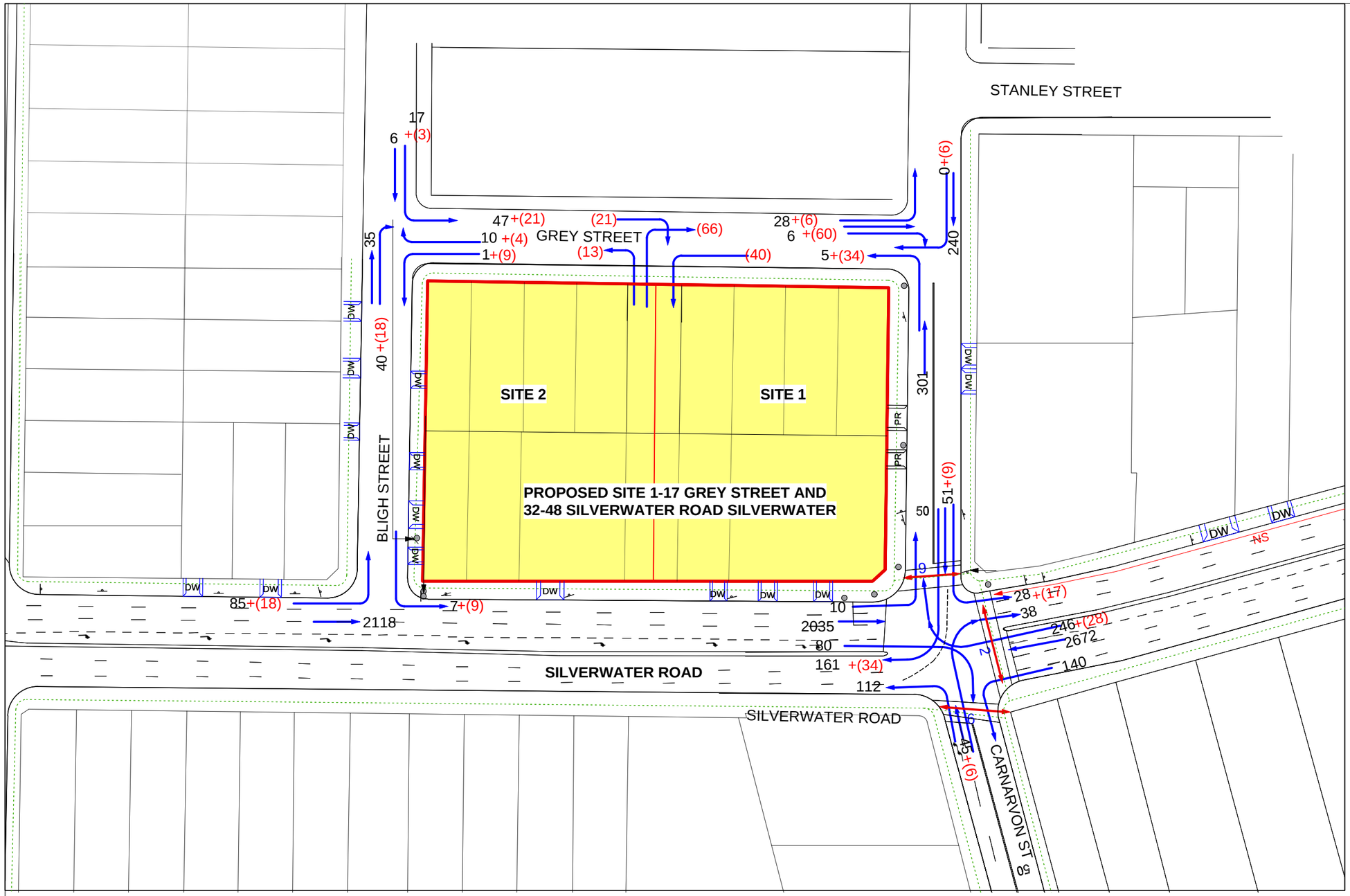

	AM Peak Hour Changes 7:30-8:30AM							
	Silverwater Road (South Approach)		Silverwater Road (North Approach)		Carnarvon Street (East Approach)		Carnarvon Street (West Approach)	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	2370	2125	1850	3058	220	240	205	195
Change		-10%		+65%		+9%		-5%

AM HOUR TRAFFIC

	IN	*OUT*	*TOTAL*
FUTURE LESS 10%	61.2	79.2	139.5
FUTURE	(68)	(88)	(155)

LEGEND

11	EXISTING AM PEAK TRAFFIC
+(19)	FUTURE DEVELOPMENT TRAFFIC
2	EXISTING PEDESTRIAN VOLUMES

RESULTS	**LOSE**
DOS	-1.085
AV DEL	60.2SECS

CRITICAL SILVERWATER ROAD
RHT 164.8SECS NORTH APPROACH

0 10 20 30 40 M

FIGURE 5A3 - EXISTING AM PEAK HOUR + FUTURE DEVELOPMENT TRAFFIC 7:30-8:30AM 2.7:1 FSR

SCALE 1:1000 (A3)

ISSUE	DATE	APPD	COMMENTS

plot date : 3/8/18
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32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVEWATER
AM PEAK HOUR FUTURE DEVELOPMENT
2.7:1 FSR

SCALE	PASSED	DATE
1:1000	EMMC	27.7.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
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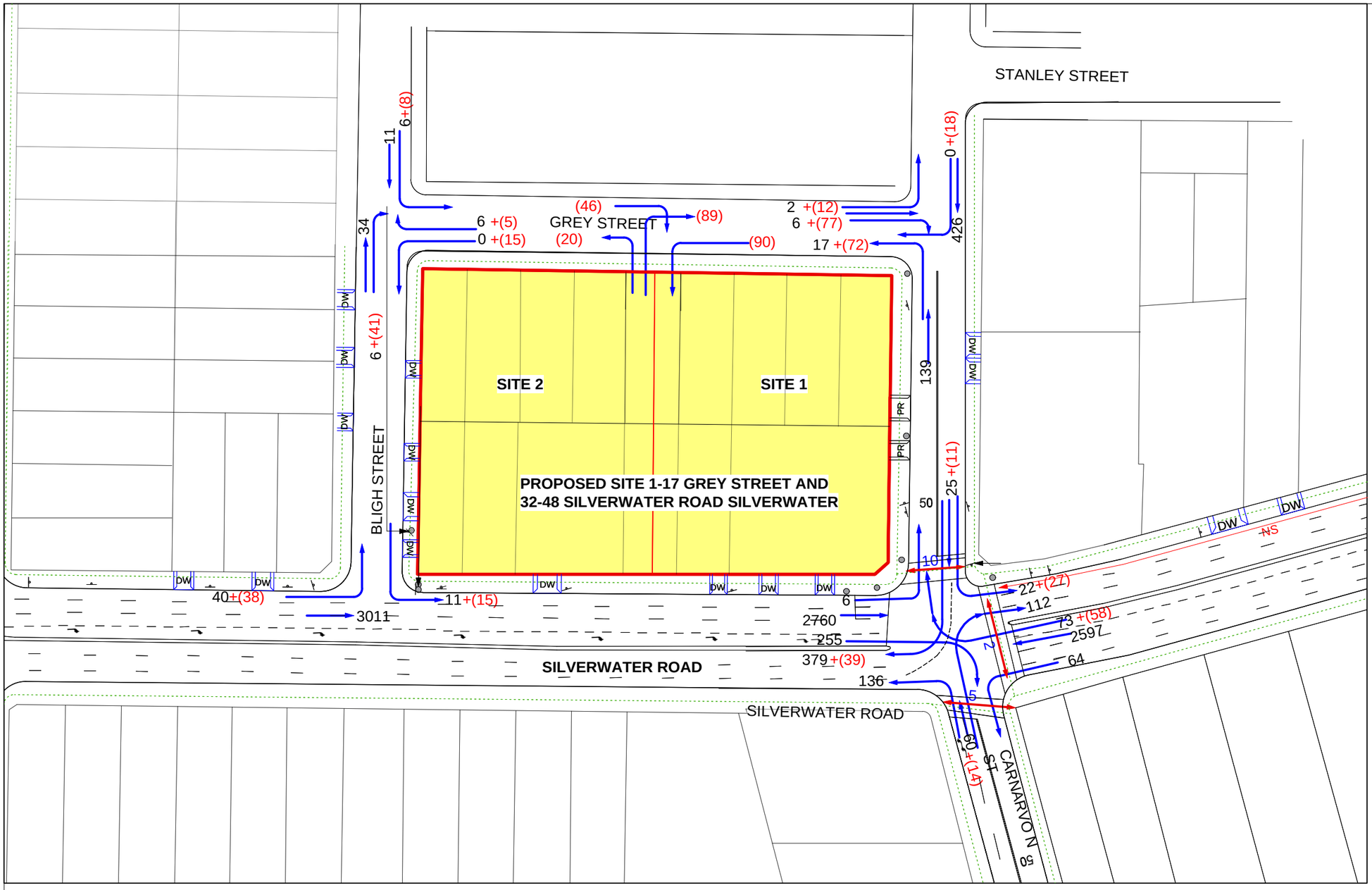

PM HOUR TRAFFIC

	IN	*OUT*	*TOTAL*
FUTURE LESS 10%	136	109	245
FUTURE	(151)	(121)	(273)

LEGEND

11	EXISTING PM PEAK TRAFFIC
+(19)	FUTURE DEVELOPMENT TRAFFIC
2	EXISTING PEDESTRIAN VOLUMES

RESULTS	**LOSE**
DOS	1.171
AV DEL	154.3SECS

0 10 20 30 40 M

PM Peak Hour Changes-4:45-5:45PM

	Silverwater Road Northbound (South Approach)		Silverwater Road Southbound (North Approach)		Carnarvon Street Eastbound (West Approach)		Carnarvon Street Westbound (East Approach)	
Year	2013	2018	2013	2018	2013	2018	2013	2018
Volume	1680	3021	1715	2734	375	426	345	308
Change		+80%		+59%		+14%		-11%

FIGURE 5B3 - EXISTING PM PEAK HOUR HOUR + FUTURE DEVELOPMENT TRAFFIC 4:45-5:45PM 2.7:1 FSR

SCALE 1:1000 (A3)

ISSUE	DATE	APPD	COMMENTS

plot date : 3/8/18
file name : 1176-18 - Figures 2, 3A, 3B, 4, 5A, 5B_27.7.18_ML.vwx

LYLE MARSHALL & PARTNERS PTY. LTD.
CONSULTING ENGINEERS, TRANSPORTATION, ENVIRONMENTAL PLANNERS & ARCHITECTS
NOMINATED ARCHITECT : ERICA MARSHALL-MCCLELLAND : NO. 6513
SUITE 31
401 PACIFIC HIGHWAY
ARTARMON N.S.W 2064
The Association of Consulting Engineers Australia
phone: (02) 9436 0086
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email:lyle@lylemarshall.com.au
web: www.lylemarshallandassociates.com.au

CLIENT: **PACIFIC PLANNING**
PROPOSED MIXED USE DEVELOPMENT FOR REZONING

32-38 SILVERWATER ROAD AND 1-17 GREY STREET SILVEWATER
PM PEAK HOUR FUTURE DEVELOPMENT
2.7:1 FSR

SCALE	PASSED	DATE
1:1000	EMMC	27.7.18

DESIGN	LMP	JOB No.	SHEET No.	ISSUE
DRAWN	EMMC	1176-18	**08**	A
CHECKED	EMMC	DATE FIRST ISSUED. 31.5.18	OF	

5.0 SUMMARY

- The site is located at 32-48 Silverwater Road. Silverwater and this supplementary report has been prepared to support an amended rezoning application. The application has been supported by the City of Parramatta Council for referral to the Department of Planning and Environment for Gateway Determination. The site proposes a 2.7:1 FSR with 210 residential units and 4000m^2 commercial/ retail use.

- The intersection of Carnarvon Street and Silverwater Road has been modelled using the Scates Periodic statistics from RMS.

- The existing intersection operates at Level of Service C in the AM and F in the PM.

- Existing Base development scenarios were tested to see what impact there will have at the critical intersection of Carnarvon Street and Silverwater Road. Base Scenario No 1- CDC and Base Scenario 2 – Existing Permissible Uses. The PM peak hour performance from both the developments was LoS F.

- The traffic generation from the Base Scenario 1-CDC (Exempt and complying development) is **75.6** vehicles in the AM and PM Peak Hour.

- The traffic generation from the Base Scenario 2 was substantially higher than the proposed development with an FSR 2.7:1.

- The traffic generation from the Base Scenario 2-Existing Permissible uses is **339.3** vehicles in the AM and PM Peak Hour.

- The proposed traffic generation for an FSR of 2.7:1will be **61.2** vehicles IN and **79.2** vehicles OUT in the AM peak hour and **136** vehicles IN and **109** vehicles OUT in the PM peak hour.

- Traffic generation volumes for the proposed 2.7:1 FSR are significantly lower in the AM and PM peak hours than the report prepared by CBH&K in 2014, by some **75** and **283** vehicles in the AM and PM Peak Hours respectively.

- Future Development Scenario testing DEV1 for FSR 2.7:1 shows that the intersection with future assigned volumes will continue to operate at LoS C in the AM and no change to Los in the PM peak hour periods.

- A reduction in Heavy vehicles volumes to Carnarvon Street may occur in the future by 1% due to changes in development and West Connex Construction tolls at M4. A mitigation showing this effect was included in Appendix E

- Mitigation option Dev 1a showing an additional left lane in Silverwater Road northbound were investigated and shows that the intersection performance does not change as state in Appendix E.

- Mitigation Option 3 showing a slip lane to the eastern approach to Carnarvon Street will not change Level of Service of the intersection but will improve Degree of Saturation and Average Delay which is an improvement to existing operation conditions.

- A combined mitigation method of DEV 1a and 3 provides additional capacity at the intersection allowing for future growth volumes along Silverwater Road. It is important to note that the development traffic has minimal effect on the intersection of Carnarvon Street and Silverwater Road and that mitigation should only be investigated as a future option to improve the overall network for the future growth along Silver water Road not as a result of this development.

- In summary, allowing additional uses within the zone can reduce the potential development traffic generation that could arise from permissible uses within the zone. It has been demonstrated in this report that the revised Floor Space and Uses, substantially reduce the proposed traffic generation from the previous scheme.

- We support this development on traffic grounds.

APPENDICES

APPENDIX A

Transport
Roads & Maritime
Services

9 September 2015

Roads and Maritime Reference: SYD13/00851/02
Council Reference: PP 3/2015

Manager Strategy
Auburn City Council
PO Box 118
Auburn NSW 1835

Attention: Jorge Alvarez

PUBLIC EXHIBITION: GREY STREET, SILVERWATER PLANNING PROPOSAL (PP 3/2015)

Dear Ms Cologna,

I refer to your letter received on 4 August 2015 inviting Roads and Maritime Services to comment on the abovementioned planning proposal. Roads and Maritime appreciates the opportunity to provide comment on the planning proposal.

Roads and Maritime has reviewed the documentation submitted with the planning proposal and advises that additional information is sought from the applicant to facilitate a comprehensive assessment of the traffic impact of the proposal on the regional road network.

In this regard, it is noted that the intersection of Silverwater Road and Carnarvon Street was modelled as an isolated intersection with optimum cycle time and signal phase input settings. Roads and Maritime advises that this intersection forms part of a co-ordinated and linked signal corridor along Silverwater Road with the cycle time and phasing fixed.

As a result of the above, to ensure that the modelling is fit for purpose in identifying the traffic impact of the planning proposal on the existing signalised intersection of Silverwater Road and Carnarvon Street, it is recommended that the SIDRA modelling be updated and include the following inputs:

- Cycle length is fixed at 130 seconds
- Signal Phasing sequence should be set at A, D, E, F
- Phase A has a 5 second late start and minimum green time for any phase is 8 Seconds
- Check priorities
- Approaches on the South and East approaches should be revised. Approaches should not extend beyond the next signalised intersection.

It is also recommended that site observations be undertaken to determine blockages (particularly the departures) in the peak periods and whether this needs to be accounted for in the revised modelling.

It would be appreciated if the revised SIDRA modelling can be submitted in Version 6 to ensure consistency in the output data results when reviewed by RMS.

Upon receipt of this additional information, Roads and Maritime will review the updated modelling and provide a submission to Auburn City Council outlining the impact (if any) of the planning proposal on the regional road network.

Roads and Maritime is willing to meet with Auburn City Council and the developer to clarify and outline the abovementioned issues in more detail.

Any inquiries in relation to this Application can be directed to James Hall – Senior Transport Planner, Strategic Land Use on 8849 – 2047 or james.hall@rms.nsw.gov.au

Yours sincerely

Greg Flynn
Manager, Strategic Land Use
Network and Safety

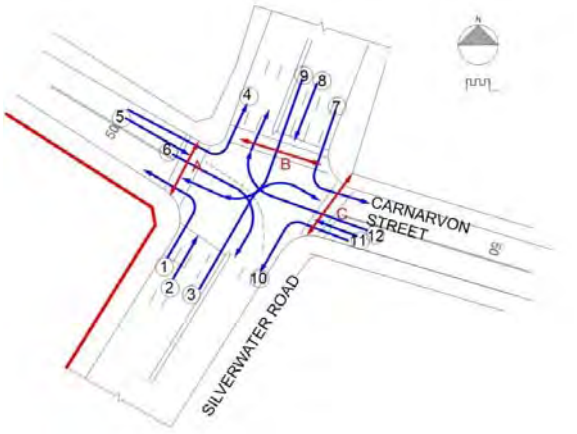
APPENDIX B

Lyle Marshall & Partners
PHONE (02) 9436 0086

INTERSECTION: SILVERWATER RD/ CARNARVON ST, SILVERWATER

TRAFFIC VOLUME COUNT

DAY: é Wednesday..... DATE: .....23/05/18.....é WEATHERé é Fineé ..OBSERVERé é HPé .é é é



TIME		SOUTH APPROACH SILVERWATER ROAD			WEST APPROACH CARNARVON STREET			NORTH APPROACH SILVERWATER ROAD			EAST APPROACH CARNARVON STREET			PEDESTRIANS		
	VEHICLE TYPE	1	2	3	4	5	6	7	8	9	10	11	12	A	B	C
		L	T	R	L	T	R	L	T	R	L	T	R	West	North	East
7.00AM TO 7:15AM	Cars - 1 & 2	0	451	4	**5**	6	25	19	523	49	**15**	5	9	2	1	2
	Heavy Vehicles		10						50							
7.15AM TO 7:30AM	Cars - 1 & 2	2	495	8	**4**	9	29	21	558	54	**17**	7	10	4	0	3
	Heavy Vehicles		12						62							
7.30AM TO 7:45AM	Cars - 1 & 2	3	511	17	**3**	11	30	17	624	47	**21**	6	9	2	0	1
	Heavy Vehicles		26						53							
7.45AM TO 8:00AM	Cars - 1 & 2	2	529	15	**4**	10	29	18	655	55	**22**	10	11	3	0	2
	Heavy Vehicles		25						45							
8.00AM TO 8:15AM	Cars - 1 & 2	1	432	19	**5**	12	30	25	594	61	**25**	11	8	3	2	0
	Heavy Vehicles		28						45							
8.15AM TO 8:30AM	Cars - 1 & 2	3	453	13	**6**	11	26	31	609	70	**34**	12	7	1	0	3
	Heavy Vehicles		31						47							
8.30AM TO 8:45AM	Cars - 1 & 2	2	506	5	**9**	9	19	22	552	62	**26**	9	6	3	0	0
	Heavy Vehicles		40						41							
8.45AM TO 9:00AM	Cars - 1 & 2	1	495	8	**5**	10	15	19	428	90	**23**	10	6	0	0	3
	Heavy Vehicles		29						39							

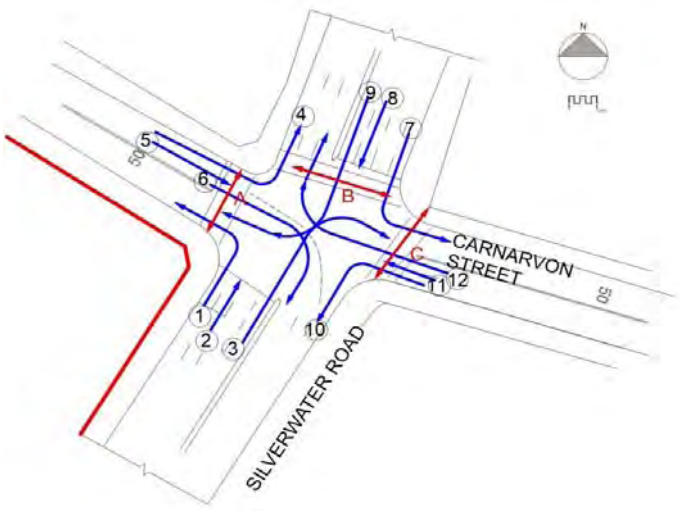
																		%
7:00-8:00	**5400**	7	2059	44	16	36	113	75	2570	205	75	28	39	11	1	8		
7:15-8:15	**5537**	8	2058	59	16	42	118	81	2636	217	85	34	38	12	2	6		
7:30-8:30	**5618**	9	2035	64	18	44	115	91	2672	233	102	39	35	9	2	6	**Peak**	5474
7:45-8:45	**5549**	8	2044	52	24	42	104	96	2588	248	107	42	32	10	2	5		
8:00-9:00	**5291**	7	2014	45	25	42	90	97	2355	283	108	42	27	7	2	6		
	Heavy Vehicle	0	110	0	0	0	0	0	190	0	0	0	0	0	0	0		300
	percentage	0%	5%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%		5.48%

Lyle Marshall & Partners
PHONE (02) 9436 0086

INTERSECTION: SILVERWATER RD/ CARNARVON ST, SILVERWATER

TRAFFIC VOLUME COUNT

DAY: é Wednesday..... DATE: .....23/05/18.....é WEATHERé é Fineé ..OBSERVERé é HPé .é é é

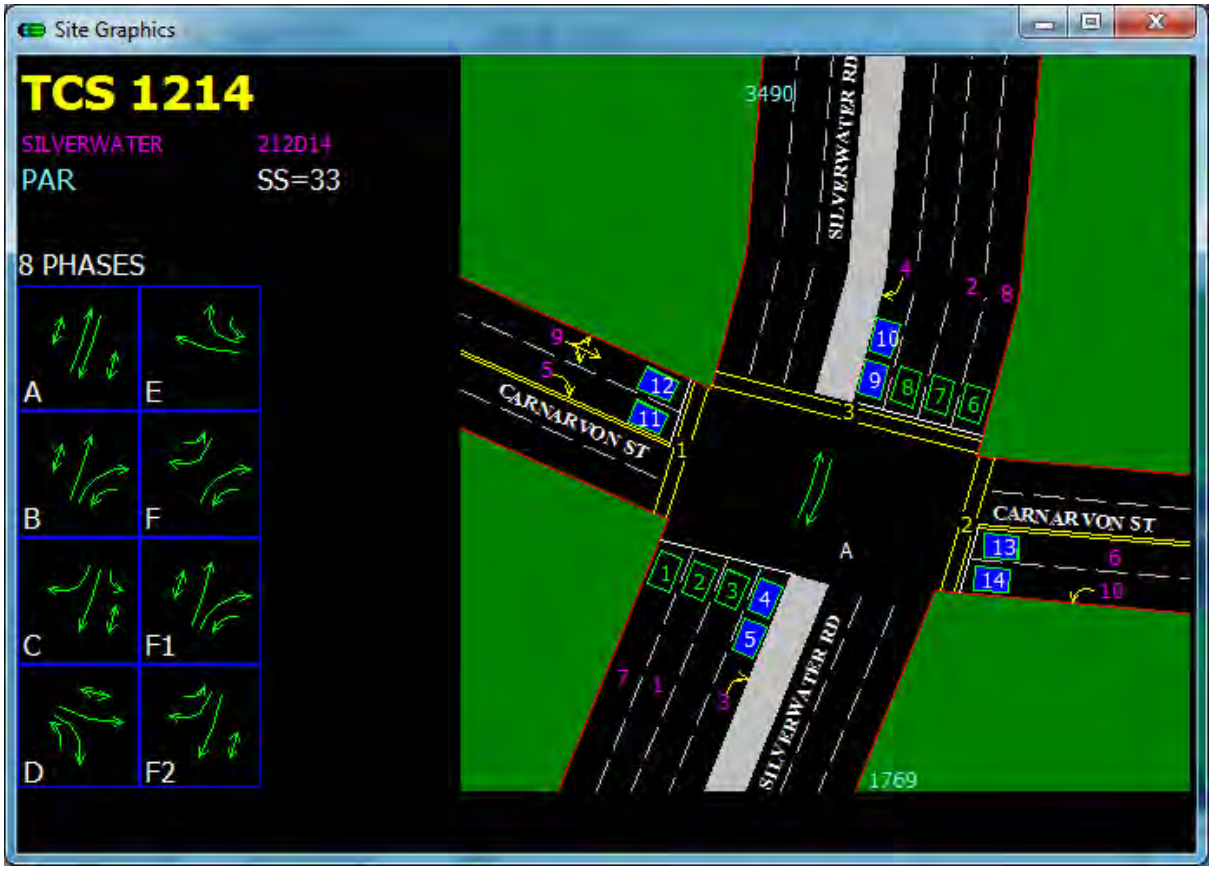


TIME		SOUTH APPROACH SILVERWATER ROAD			WEST APPROACH CARNARVON STREET			NORTH APPROACH SILVERWATER ROAD			EAST APPROACH CARNARVON STREET			PEDESTRIANS		
	VEHICLE TYPE	1	2	3	4	5	6	7	8	9	10	11	12	A	B	C
		L	T	R	L	T	R	L	T	R	L	T	R	West	North	East
4.00PM TO 4.15PM	class 1 and 2	1	652	35	**5**	2	102	10	524	18	**3**	18	15	2	1	2
	Heavy Vehicles		22						18							
4.15PM TO 4.30PM	class 1 and 2	0	598	39	**5**	3	85	8	562	20	**4**	19	14	4	0	3
	Heavy Vehicles		25						15							
4.30PM TO 4:45PM	class 1 and 2	0	664	49	**4**	5	74	7	514	21	**3**	22	13	2	0	1
	Heavy Vehicles		21						21							
4.45PM TO 5:00PM	class 1 and 2	1	634	51	**4**	4	85	9	582	26	**4**	21	17	3	0	2
	Heavy Vehicles		24						24							
5.00PM TO 5:15PM	class 1 and 2	0	542	60	**3**	3	135	11	715	19	**3**	14	26	3	2	0
	Heavy Vehicles		23						16							
5.15PM TO 5:30PM	class 1 and 2	2	702	62	**6**	5	71	10	655	13	**28**	6	39	1	0	3
	Heavy Vehicles		18						8							
5.30PM TO 5:45PM	class 1 and 2	2	804	81	**8**	8	67	5	585	12	**31**	16	27	3	0	0
	Heavy Vehicles		13						12							
5.45PM TO 6:00PM	class 1 and 2	1	615	57	**5**	3	52	2	574	9	**29**	20	24	0	0	3
	Heavy Vehicles		10						8							

4:00-5:00PM	**5943**	2	2640	174	18	14	346	34	2260	85	14	80	59	11	1	8	
4:15-5:15	**6086**	1	2531	199	16	15	379	35	2449	86	14	76	70	12	2	6	
4:30-5:30	**6278**	3	2628	222	17	17	365	37	2535	79	38	63	95	9	2	6	
4:45-5:45PM	**6489**	5	2760	254	21	20	358	35	2597	70	66	57	109	10	2	5	6369
5:00-6:00PM	**6368**	5	2727	260	22	19	325	28	2573	53	91	56	116	7	2	6	
	Heavy Vehicles	0	86	0	0	0	0	0	69	0	0	0	0	0	0	0	155
		0%	3%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	2.43%

APPENDIX C

TCS 1214: - Silverwater Road and Carnarvon Street, Silverwater



Ped 1	1				

Period: 6:15:00 AM to 6:30:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	19	83	59	475
B phase	6	19	20	19	117
D phase	7	15	24	18	131
E phase	4	15	16	15	61
F phase	7	14	23	16	116
Active CL	7	125	135	129	
IP3	1				
IP4	1				

Period: 6:30:00 AM to 6:45:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	7	66	53	428
B phase	7	14	20	18	132
D phase	7	16	23	18	131
E phase	7	14	15	14	104
F phase	7	14	16	15	105
Active CL	7	125	133	129	
IP4	1				

Period: 6:45:00 AM to 7:00:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	3	86	57	459
B phase	7	19	20	19	136
D phase	7	16	27	18	132
E phase	5	15	15	15	75
F phase	6	14	23	16	98
Active CL	6	127	134	129	
IP4	1				

Period: 7:00:00 AM to 7:15:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	61	69	64	453
B phase	7	19	20	19	138
D phase	7	15	27	17	121
E phase	6	15	15	15	90
F phase	7	4	17	14	98
Active CL	6	126	133	129	
IP4	1				
Ped 2	1				

Period: 7:15:00 AM to 7:30:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	54	71	63	444
B phase	7	19	20	19	139
D phase	7	15	28	21	149
E phase	5	15	17	15	78
F phase	6	11	19	15	90
Active CL	5	124	136	129	
IP4	1				
Ped 2	1				
Ped 3	3				

Period: 7:30:00 AM to 7:45:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	50	66	58	407
B phase	7	19	20	19	137
D phase	8	15	29	21	173
E phase	5	15	15	15	75
F phase	7	15	18	15	108
Active CL	6	128	133	130	
IP4	1				
Ped 3	1				

Period: 7:45:00 AM to 8:00:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	47	67	59	417
B phase	7	19	21	20	140
D phase	8	2	29	17	137
E phase	6	15	16	15	91
F phase	7	15	25	16	115
Active CL	5	126	140	131	
IP4	1				
Ped 2	1				
Ped 3	2				

Period: 8:00:00 AM to 8:15:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	52	77	61	428
B phase	6	19	20	19	117
D phase	8	9	29	19	159
E phase	6	15	16	15	91
F phase	7	15	15	15	105
Active CL	7	118	134	128	
IP2	1				
IP4	2				
Ped 1	1				
Ped 2	1				
Ped 3	3				

Period: 8:15:00 AM to 8:30:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	50	73	59	419
B phase	4	20	20	20	80
D phase	8	5	29	20	166
E phase	7	15	20	16	113
F phase	7	15	22	17	122
Active CL	6	126	134	130	
IP2	3				
IP4	4				
Ped 2	4				
Ped 3	2				

Period: 8:30:00 AM to 8:45:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	7	54	82	66	467
B phase	2	15	19	17	34

D phase	7	16	24	20	145
E phase	7	15	16	15	110
F phase	7	15	28	20	144
Active CL	7	128	136	131	
IP2	3				
IP3	1				
IP4	3				

Period: 8:45:00 AM to 9:00:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	19	81	52	421
B phase	4	19	20	19	79
D phase	7	21	29	24	172
E phase	7	15	18	15	111
F phase	7	15	19	16	117
Active CL	6	125	136	130	
IP1	2				
IP2	1				
IP4	3				
Ped 1	1				
Ped 2	1				
Ped 3	1				

Period: 9:00:00 AM to 9:15:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	17	70	53	426
B phase	6	19	20	19	119
D phase	7	15	37	23	161
E phase	5	15	16	15	77
F phase	7	15	26	16	117
Active CL	5	127	134	130	
IP2	1				
IP4	2				
Ped 1	1				
Ped 2	1				
Ped 3	1				

Period: 9:15:00 AM to 9:30:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	28	64	52	420
B phase	7	18	20	19	135
D phase	7	17	29	19	139
E phase	6	15	16	15	91
F phase	7	15	25	16	115
Active CL	5	122	134	127	
IP4	1				
Ped 2	2				

Period: 9:30:00 AM to 9:45:00 AM

Data	Freq.	Min	Max	Avg	Total
A phase	8	12	79	52	417
B phase	5	20	20	20	100
D phase	7	16	29	23	167
E phase	7	15	15	15	105
F phase	7	15	19	15	111
Active CL	5	130	136	132	

Data	Freq.	Min	Max	Avg	Total
A phase	7	55	69	60	425
B phase	6	15	20	18	108
D phase	7	19	29	22	160
E phase	7	15	26	16	117
F phase	6	15	15	15	90
Active CL	7	123	134	130	
IP2	1				
IP4	2				
Ped 2	2				
Ped 3	1				

Period: 4:15:00 PM to 4:30:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	7	54	85	64	451
B phase	4	1	20	15	60
D phase	7	21	29	24	168
E phase	7	15	19	16	114
F phase	7	15	17	15	107
Active CL	6	127	137	132	
IP2	2				
IP4	3				
Ped 2	1				
Ped 3	2				

Period: 4:30:00 PM to 4:45:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	5	78	50	405
B phase	6	16	20	18	112
D phase	7	21	29	23	166
E phase	7	15	16	15	110
F phase	7	15	17	15	107
Active CL	6	127	133	130	
IP2	2				
IP4	3				
Ped 3	1				

Period: 4:45:00 PM to 5:00:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	20	75	54	432
B phase	4	16	20	18	75
D phase	7	23	29	25	180
E phase	7	15	16	15	108
F phase	7	15	15	15	105
Active CL	6	125	132	127	
IP2	3				
IP4	3				
Ped 2	2				
Ped 3	3				

Period: 5:00:00 PM to 5:15:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	28	84	57	456
B phase	3	19	20	19	59
D phase	7	21	29	23	165
E phase	7	15	18	15	111

F phase	7	15	17	15	109
Active CL	7	127	137	130	
IP2	3				
IP4	3				
Ped 1	1				
Ped 2	1				
Ped 3	1				

Period: 5:15:00 PM to 5:30:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	25	73	52	422
B phase	6	14	20	18	110
D phase	7	20	27	21	152
E phase	7	15	18	15	110
F phase	7	15	16	15	106
Active CL	4	126	130	127	
IP2	1				
IP4	2				
Ped 2	1				

Period: 5:30:00 PM to 5:45:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	23	80	53	430
B phase	5	19	20	19	98
D phase	7	18	29	22	159
E phase	7	15	16	15	108
F phase	7	15	15	15	105
Active CL	5	127	137	132	
IP4	1				
Ped 1	1				
Ped 2	1				
Ped 3	3				

Period: 5:45:00 PM to 6:00:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	7	75	51	410
B phase	6	19	21	19	118
D phase	7	19	22	20	145
E phase	7	15	20	16	118
F phase	7	15	17	15	109
Active CL	7	126	137	130	
IP2	1				
IP4	2				
Ped 2	1				

Period: 6:00:00 PM to 6:15:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	15	78	59	472
B phase	5	15	20	17	87
D phase	7	16	25	20	143
E phase	6	15	19	16	97
F phase	6	15	26	16	101
Active CL	6	126	133	129	
IP1	1				
IP2	1				
IP4	2				

Period: 6:15:00 PM to 6:30:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	7	55	95	71	498
B phase	4	14	20	16	67
D phase	7	15	29	21	152
E phase	5	15	20	16	84
F phase	7	9	17	14	99
Active CL	6	127	137	131	
IP1	1				
IP4	1				
Ped 3	1				

Period: 6:30:00 PM to 6:45:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	7	54	102	77	541
B phase	4	15	20	17	69
D phase	7	17	22	19	139
E phase	5	15	20	16	83
F phase	6	2	15	11	68
Active CL	6	124	136	130	
IP4	1				
Ped 1	1				
Ped 2	1				

Period: 6:45:00 PM to 7:00:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	7	60	83	72	505
B phase	7	14	19	17	122
D phase	7	14	21	16	115
E phase	5	14	15	14	74
F phase	6	12	15	14	84
Active CL	6	113	132	122	
IP4	1				
Ped 2	1				

Period: 7:00:00 PM to 7:15:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	14	84	62	498
B phase	6	14	19	15	92
D phase	7	15	22	17	122
E phase	6	15	22	16	97
F phase	6	14	17	15	91
Active CL	6	116	133	126	
IP4	1				

Period: 7:15:00 PM to 7:30:00 PM

Data	Freq.	Min	Max	Avg	Total
A phase	8	45	92	63	506
B phase	7	14	19	16	112
D phase	6	14	17	15	91
E phase	5	15	17	15	78
F phase	7	14	18	16	113
Active CL	7	120	132	125	
IP2	1				

APPENDIX D

INTERSECTION SUMMARY

Site: 101 [2018 EX-AM Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 125 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	32.7	km/h	1.5	km/h	32.6	km/h
Travel Distance (Total)	3366.6	veh-km/h	0.6	ped-km/h	4040.6	pers-km/h
Travel Time (Total)	102.9	veh-h/h	0.4	ped-h/h	123.9	pers-h/h
Demand Flows (Total)	5618	veh/h	17	ped/h	6759	pers/h
Percent Heavy Vehicles (Demand)	5.6	%				
Degree of Saturation	0.926		0.016			
Practical Spare Capacity	-2.8	%				
Effective Intersection Capacity	6070	veh/h				
Control Delay (Total)	53.49	veh-h/h	0.27	ped-h/h	64.45	pers-h/h
Control Delay (Average)	34.3	sec	56.7	sec	34.3	sec
Control Delay (Worst Lane)	86.2	sec				
Control Delay (Worst Movement)	86.2	sec	56.7	sec	86.2	sec
Geometric Delay (Average)	0.8	sec				
Stop-Line Delay (Average)	33.5	sec				
Idling Time (Average)	28.7	sec				
Intersection Level of Service (LOS)	LOS C		LOS E			
95% Back of Queue - Vehicles (Worst Lane)	49.4	veh				
95% Back of Queue - Distance (Worst Lane)	366.4	m				
Queue Storage Ratio (Worst Lane)	1.56					
Total Effective Stops	4897	veh/h	16	ped/h	5892	pers/h
Effective Stop Rate	0.87		0.95		0.87	
Proportion Queued	0.92		0.95		0.92	
Performance Index	416.7		0.5		417.1	
Cost (Total)	4089.95	$/h	10.51	$/h	4100.46	$/h
Fuel Consumption (Total)	527.0	L/h				
Carbon Dioxide (Total)	1251.4	kg/h				
Hydrocarbons (Total)	0.123	kg/h				
Carbon Monoxide (Total)	1.487	kg/h				
NOx (Total)	2.880	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 2.0 %
Number of Iterations: 6 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 2.6% 2.4% 0.0%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,696,640	veh/y	8,160	ped/y	3,244,128	pers/y
Delay	25,674	veh-h/y	128	ped-h/y	30,937	pers-h/y
Effective Stops	2,350,367	veh/y	7,771	ped/y	2,828,211	pers/y
Travel Distance	1,615,982	veh-km/y	293	ped-km/y	1,939,471	pers-km/y
Travel Time	49,384	veh-h/y	191	ped-h/y	59,452	pers-h/y
Cost	1,963,174	$/y	5,046	$/y	1,968,220	$/y
Fuel Consumption	252,937	L/y				
Carbon Dioxide	600,679	kg/y				
Hydrocarbons	59	kg/y				
Carbon Monoxide	714	kg/y				
NOx	1,383	kg/y				

MOVEMENT SUMMARY

Site: 101 [2018 EX-AM Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 125 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	10	3.0	0.836	42.9	LOS D	38.7	282.6	0.96	0.91	1.01	9.2
11	T1	2035	5.0	0.836	37.1	LOS C	38.8	283.3	0.96	0.91	1.01	32.5
12	R2	80	3.0	0.917	86.2	LOS F	5.8	41.4	1.00	1.00	1.72	11.4
Approach		2125	4.9	0.917	38.9	LOS C	38.8	283.3	0.96	0.91	1.04	31.2
East: Carnarvon Street (east)												
1	L2	112	3.0	0.550	45.9	LOS D	5.5	39.8	0.99	0.78	0.99	16.9
2	T1	45	3.0	0.926	81.1	LOS F	6.0	43.3	1.00	1.09	1.76	10.2
3	R2	38	3.0	0.926	85.7	LOS F	6.0	43.3	1.00	1.09	1.76	19.3
Approach		195	3.0	0.926	61.8	LOS E	6.0	43.3	0.99	0.91	1.32	15.8
North: Silverwater Road (north)												
4	L2	140	3.0	0.856	30.0	LOS C	49.2	363.0	0.89	0.86	0.91	40.1
5	T1	2672	7.0	0.856	23.9	LOS B	49.4	366.4	0.87	0.84	0.90	40.0
6	R2	246	3.0	0.626	54.9	LOS D	13.8	98.8	0.96	0.83	0.96	24.0
Approach		3058	6.5	0.856	26.7	LOS B	49.4	366.4	0.88	0.84	0.91	38.1
West: Carnarvon Street (west)												
7	L2	28	3.0	0.794	65.1	LOS E	7.6	54.8	1.00	0.93	1.32	19.9
8	T1	51	3.0	0.794	60.5	LOS E	7.6	54.8	1.00	0.93	1.32	12.5
9	R2	161	3.0	0.794	70.0	LOS E	7.6	54.8	1.00	0.92	1.27	8.6
Approach		240	3.0	0.794	67.4	LOS E	7.6	54.8	1.00	0.92	1.29	11.0
All Vehicles		5618	5.6	0.926	34.3	LOS C	49.4	366.4	0.92	0.87	0.99	32.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	56.7	LOS E	0.0	0.0	0.95	0.95
P2	North Full Crossing	2	56.6	LOS E	0.0	0.0	0.95	0.95
P3	West Full Crossing	9	56.7	LOS E	0.0	0.0	0.95	0.95
All Pedestrians		17	56.7	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [2018 EX-PM Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values								
Performance Measure	**Vehicles**			**Pedestrians**			**Persons**	
Travel Speed (Average)	16.2	km/h		1.4	km/h		16.1	km/h
Travel Distance (Total)	3774.4	veh-km/h		0.6	ped-km/h		4529.9	pers-km/h
Travel Time (Total)	233.5	veh-h/h		0.4	ped-h/h		280.6	pers-h/h
Demand Flows (Total)	6489	veh/h		17	ped/h		7804	pers/h
Percent Heavy Vehicles (Demand)	2.8	%						
Degree of Saturation	1.046			0.019				
Practical Spare Capacity	-13.9	%						
Effective Intersection Capacity	6204	veh/h						
Control Delay (Total)	175.67	veh-h/h		0.29	ped-h/h		211.09	pers-h/h
Control Delay (Average)	97.5	sec		61.7	sec		97.4	sec
Control Delay (Worst Lane)	184.0	sec						
Control Delay (Worst Movement)	185.6	sec		61.7	sec		185.6	sec
Geometric Delay (Average)	0.8	sec						
Stop-Line Delay (Average)	96.6	sec						
Idling Time (Average)	90.2	sec						
Intersection Level of Service (LOS)	LOS F			LOS F				
95% Back of Queue - Vehicles (Worst Lane)	103.9	veh						
95% Back of Queue - Distance (Worst Lane)	745.7	m						
Queue Storage Ratio (Worst Lane)	2.59							
Total Effective Stops	8182	veh/h		16	ped/h		9835	pers/h
Effective Stop Rate	1.26			0.96			1.26	
Proportion Queued	0.99			0.96			0.99	
Performance Index	857.8			0.5			858.3	
Cost (Total)	8724.76	$/h		11.13	$/h		8735.89	$/h
Fuel Consumption (Total)	746.5	L/h						
Carbon Dioxide (Total)	1763.8	kg/h						
Hydrocarbons (Total)	0.192	kg/h						
Carbon Monoxide (Total)	1.909	kg/h						
NOx (Total)	2.456	kg/h						

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 7.5 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 12.9% 9.7% 7.5%

Intersection Performance - Annual Values								
Performance Measure	**Vehicles**			**Pedestrians**			**Persons**	
Demand Flows (Total)	3,114,720	veh/y		8,160	ped/y		3,745,825	pers/y
Delay	84,321	veh-h/y		140	ped-h/y		101,325	pers-h/y
Effective Stops	3,927,535	veh/y		7,800	ped/y		4,720,842	pers/y
Travel Distance	1,811,713	veh-km/y		293	ped-km/y		2,174,350	pers-km/y
Travel Time	112,090	veh-h/y		202	ped-h/y		134,711	pers-h/y
Cost	4,187,883	$/y		5,344	$/y		4,193,228	$/y
Fuel Consumption	358,335	L/y						
Carbon Dioxide	846,605	kg/y						
Hydrocarbons	92	kg/y						
Carbon Monoxide	916	kg/y						
NOx	1,179	kg/y						

MOVEMENT SUMMARY

Site: 101 [2018 EX-PM Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	0.917	51.1	LOS D	65.4	469.3	0.99	1.02	1.12	8.3
11	T1	2760	3.0	0.917	45.2	LOS D	65.4	469.4	0.99	1.02	1.12	29.2
12	R2	255	0.0	1.030	166.6	LOS F	29.5	206.2	1.00	1.28	2.13	6.4
Approach		3021	2.7	1.030	55.4	LOS D	65.4	469.4	0.99	1.05	1.21	25.0
East: Carnarvon Street (east)												
1	L2	136	0.0	0.309	33.1	LOS C	5.5	38.8	0.87	0.77	0.87	20.6
2	T1	60	3.0	1.046	181.1	LOS F	21.0	150.6	1.00	1.59	2.35	5.1
3	R2	112	3.0	1.046	185.6	LOS F	21.0	150.6	1.00	1.59	2.35	10.9
Approach		308	1.7	1.046	117.4	LOS F	21.0	150.6	0.94	1.23	1.69	11.0
North: Silverwater Road (north)												
4	L2	64	3.0	1.018	136.8	LOS F	103.9	745.7	1.00	1.48	1.72	15.1
5	T1	2597	3.0	1.018	130.6	LOS F	103.9	745.7	1.00	1.49	1.72	13.8
6	R2	73	3.0	0.602	76.5	LOS F	5.0	35.6	1.00	0.78	1.04	19.3
Approach		2734	3.0	1.018	129.3	LOS F	103.9	745.7	1.00	1.47	1.70	13.9
West: Carnarvon Street (west)												
7	L2	22	3.0	1.043	170.8	LOS F	23.7	170.3	1.00	1.44	2.29	9.0
8	T1	25	3.0	1.043	166.3	LOS F	23.7	170.3	1.00	1.44	2.29	5.0
9	R2	379	3.0	1.043	177.6	LOS F	25.7	184.7	1.00	1.48	2.29	3.6
Approach		426	3.0	1.043	176.6	LOS F	25.7	184.7	1.00	1.47	2.29	4.0
All Vehicles		6489	2.8	1.046	97.5	LOS F	103.9	745.7	0.99	1.26	1.51	16.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	61.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	61.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	61.7	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	61.7	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

NETWORK SUMMARY

Network: N101 [Network1 - AM Existing]

New Network
Network Category: (None)
Network Cycle Time = 125 seconds (Network Optimum Cycle Time - Minimum Delay)

Network Performance - Hourly Values								
Performance Measure	**Vehicles**		**Per Unit Distance**		**Pedestrians**		**Persons**	
Network Level of Service (LOS)	LOS D							
Travel Time Index	5.63							
Speed Efficiency	0.61							
Congestion Coefficient	1.65							
Travel Speed (Average)	36.4	km/h			1.5	km/h	36.3	km/h
Travel Distance (Total)	4404.0	veh-km/h			0.6	ped-km/h	5285.4	pers-km
Travel Time (Total)	120.9	veh-h/h			0.4	ped-h/h	145.5	pers-h/h
Desired Speed	60.0	km/h						
Demand Flows (Total for all Sites)	11463	veh/h			17	ped/h	13773	pers/h
Arrival Flows (Total for all Sites)	11463	veh/h			17	ped/h	13773	pers/h
Demand Flows (Entry Total)	5720	veh/h						
Midblock Inflows (Total)	32	veh/h						
Midblock Outflows (Total)	-61	veh/h						
Percent Heavy Vehicles (Demand)	5.6	%						
Percent Heavy Vehicles (Arrival)	5.6	%						
Degree of Saturation	0.926							
Control Delay (Total)	53.83	veh-h/h			0.27	ped-h/h	64.86	pers-h/h
Control Delay (Average)	16.9	sec			56.7	sec	17.0	sec
Control Delay (Worst Lane)	86.2	sec						
Control Delay (Worst Movement)	86.2	sec			56.7	sec	86.2	sec
Geometric Delay (Average)	0.5	sec						
Stop-Line Delay (Average)	16.4	sec						
Queue Storage Ratio (Worst Lane)	1.00							
Total Effective Stops	5014	veh/h			16	ped/h	6033	pers/h
Effective Stop Rate	0.44		1.14	per km	0.95		0.44	
Proportion Queued	0.45				0.95		0.45	
Performance Index	431.1				0.5		431.6	
Cost (Total)	4697.07	$/h	1.07	$/km	10.51	$/h	4707.58	$/h
Fuel Consumption (Total)	604.5	L/h	137.3	mL/km				
Fuel Economy	13.7	L/100km						
Carbon Dioxide (Total)	1435.6	kg/h	326.0	g/km				
Hydrocarbons (Total)	0.136	kg/h	0.031	g/km				
Carbon Monoxide (Total)	1.679	kg/h	0.381	g/km				
NOx (Total)	3.204	kg/h	0.728	g/km				

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: Standard Left.

Network Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total for all Sites)	5,502,241	veh/y	8,160	ped/y	6,610,848	pers/y
Delay	25,838	veh-h/y	128	ped-h/y	31,134	pers-h/y
Effective Stops	2,406,675	veh/y	7,771	ped/y	2,895,781	pers/y
Travel Distance	2,113,929	veh-km/y	293	ped-km/y	2,537,008	pers-km/y
Travel Time	58,031	veh-h/y	191	ped-h/y	69,828	pers-h/y
Cost	2,254,594	$/y	5,046	$/y	2,259,640	$/y
Fuel Consumption	290,139	L/y				
Carbon Dioxide	689,086	kg/y				
Hydrocarbons	65	kg/y				
Carbon Monoxide	806	kg/y				
NOx	1,538	kg/y				

NETWORK SUMMARY

Network: N101 [Network1 - PM Existing]

New Network
Network Category: (None)
Network Cycle Time = 135 seconds (Network Optimum Cycle Time - Minimum Delay)

Network Performance - Hourly Values								
Performance Measure	**Vehicles**		**Per Unit Distance**		**Pedestrians**		**Persons**	
Network Level of Service (LOS)	LOS E							
Travel Time Index	3.07							
Speed Efficiency	0.38							
Congestion Coefficient	2.66							
Travel Speed (Average)	22.6	km/h			1.4	km/h	22.5	km/h
Travel Distance (Total)	4969.4	veh-km/h			0.6	ped-km/h	5963.8	pers-km
Travel Time (Total)	220.2	veh-h/h			0.4	ped-h/h	264.7	pers-h/h
Desired Speed	60.0	km/h						
Demand Flows (Total for all Sites)	13318	veh/h			17	ped/h	15999	pers/h
Arrival Flows (Total for all Sites)	13254	veh/h			17	ped/h	15922	pers/h
Demand Flows (Entry Total)	6537	veh/h						
Midblock Inflows (Total)	33	veh/h						
Midblock Outflows (Total)	-39	veh/h						
Percent Heavy Vehicles (Demand)	2.9	%						
Percent Heavy Vehicles (Arrival)	2.9	%						
Degree of Saturation	1.046							
Control Delay (Total)	142.04	veh-h/h			0.29	ped-h/h	170.73	pers-h/h
Control Delay (Average)	38.6	sec			61.7	sec	38.6	sec
Control Delay (Worst Lane)	137.8	sec						
Control Delay (Worst Movement)	139.2	sec			61.7	sec	139.2	sec
Geometric Delay (Average)	0.4	sec						
Stop-Line Delay (Average)	38.1	sec						
Queue Storage Ratio (Worst Lane)	1.00							
Total Effective Stops	7539	veh/h			16	ped/h	9063	pers/h
Effective Stop Rate	0.57		1.52	per km	0.96		0.57	
Proportion Queued	0.49				0.96		0.49	
Performance Index	761.2				0.5		761.7	
Cost (Total)	8181.67	$/h	1.65	$/km	11.13	$/h	8192.80	$/h
Fuel Consumption (Total)	769.7	L/h	154.9	mL/km				
Fuel Economy	15.5	L/100km						
Carbon Dioxide (Total)	1818.9	kg/h	366.0	g/km				
Hydrocarbons (Total)	0.187	kg/h	0.038	g/km				
Carbon Monoxide (Total)	2.030	kg/h	0.408	g/km				
NOx (Total)	2.525	kg/h	0.508	g/km				

Network Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation or Queue Storage Ratios for the last three Network Iterations: 0.0% 0.0% 0.0%
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Software Setup used: Standard Left.

Network Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total for all Sites)	6,392,640	veh/y	8,160	ped/y	7,679,329	pers/y
Delay	68,177	veh-h/y	140	ped-h/y	81,953	pers-h/y
Effective Stops	3,618,869	veh/y	7,800	ped/y	4,350,443	pers/y
Travel Distance	2,385,291	veh-km/y	293	ped-km/y	2,862,643	pers-km/y
Travel Time	105,691	veh-h/y	202	ped-h/y	127,032	pers-h/y
Cost	3,927,199	$/y	5,344	$/y	3,932,544	$/y
Fuel Consumption	369,476	L/y				
Carbon Dioxide	873,058	kg/y				
Hydrocarbons	90	kg/y				
Carbon Monoxide	974	kg/y				
NOx	1,212	kg/y				

INTERSECTION SUMMARY

Site: 101 [2018 Base 1 CDC-AM Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	31.3	km/h	1.4	km/h	31.2	km/h
Travel Distance (Total)	3386.9	veh-km/h	0.6	ped-km/h	4064.8	pers-km/h
Travel Time (Total)	108.2	veh-h/h	0.4	ped-h/h	130.2	pers-h/h
Demand Flows (Total)	5667	veh/h	17	ped/h	6817	pers/h
Percent Heavy Vehicles (Demand)	5.6	%				
Degree of Saturation	0.897		0.017			
Practical Spare Capacity	0.3	%				
Effective Intersection Capacity	6317	veh/h				
Control Delay (Total)	58.39	veh-h/h	0.29	ped-h/h	70.36	pers-h/h
Control Delay (Average)	37.1	sec	61.7	sec	37.2	sec
Control Delay (Worst Lane)	84.8	sec				
Control Delay (Worst Movement)	86.8	sec	61.7	sec	86.8	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	36.2	sec				
Idling Time (Average)	31.6	sec				
Intersection Level of Service (LOS)	LOS C		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	54.9	veh				
95% Back of Queue - Distance (Worst Lane)	407.3	m				
Queue Storage Ratio (Worst Lane)	1.68					
Total Effective Stops	4950	veh/h	16	ped/h	5956	pers/h
Effective Stop Rate	0.87		0.96		0.87	
Proportion Queued	0.92		0.96		0.92	
Performance Index	451.3		0.5		451.8	
Cost (Total)	4276.83	$/h	11.13	$/h	4287.96	$/h
Fuel Consumption (Total)	536.2	L/h				
Carbon Dioxide (Total)	1273.3	kg/h				
Hydrocarbons (Total)	0.126	kg/h				
Carbon Monoxide (Total)	1.508	kg/h				
NOx (Total)	2.907	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.5 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 2.4% 2.2% 0.0%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,720,160	veh/y	8,160	ped/y	3,272,352	pers/y
Delay	28,029	veh-h/y	140	ped-h/y	33,775	pers-h/y
Effective Stops	2,376,035	veh/y	7,800	ped/y	2,859,042	pers/y
Travel Distance	1,625,694	veh-km/y	293	ped-km/y	1,951,127	pers-km/y
Travel Time	51,914	veh-h/y	202	ped-h/y	62,499	pers-h/y
Cost	2,052,879	$/y	5,344	$/y	2,058,223	$/y
Fuel Consumption	257,384	L/y				
Carbon Dioxide	611,196	kg/y				
Hydrocarbons	60	kg/y				
Carbon Monoxide	724	kg/y				
NOx	1,395	kg/y				

MOVEMENT SUMMARY

Site: 101 [2018 Base 1 CDC-AM Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	10	3.0	0.840	45.6	LOS D	41.6	304.0	0.96	0.91	1.01	8.9
11	T1	2035	5.0	0.840	39.8	LOS C	41.7	304.8	0.96	0.91	1.01	31.3
12	R2	80	3.0	0.849	84.8	LOS F	5.9	42.2	1.00	0.92	1.43	11.5
Approach		2125	4.9	0.849	41.6	LOS C	41.7	304.8	0.96	0.91	1.02	30.1
East: Carnarvon Street (east)												
1	L2	112	3.0	0.520	47.9	LOS D	5.9	42.1	0.98	0.78	0.98	16.4
2	T1	49	3.0	0.897	82.3	LOS F	6.6	47.2	1.00	1.04	1.58	10.1
3	R2	38	3.0	0.897	86.8	LOS F	6.6	47.2	1.00	1.04	1.58	19.2
Approach		199	3.0	0.897	63.8	LOS E	6.6	47.2	0.99	0.89	1.24	15.4
North: Silverwater Road (north)												
4	L2	140	3.0	0.868	32.4	LOS C	54.7	403.7	0.90	0.87	0.93	38.7
5	T1	2672	7.0	0.868	26.3	LOS B	54.9	407.3	0.88	0.84	0.91	38.4
6	R2	263	3.0	0.651	58.3	LOS E	15.9	114.0	0.97	0.84	0.97	23.1
Approach		3075	6.5	0.868	29.3	LOS C	54.9	407.3	0.89	0.84	0.91	36.5
West: Carnarvon Street (west)												
7	L2	36	3.0	0.798	68.5	LOS E	9.1	65.5	1.00	0.93	1.29	19.3
8	T1	55	3.0	0.798	64.0	LOS E	9.1	65.5	1.00	0.93	1.29	12.0
9	R2	177	3.0	0.798	74.0	LOS F	9.1	65.5	1.00	0.92	1.24	8.2
Approach		268	3.0	0.798	71.2	LOS F	9.1	65.5	1.00	0.92	1.26	10.8
All Vehicles		5667	5.6	0.897	37.1	LOS C	54.9	407.3	0.92	0.87	0.98	31.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	61.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	61.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	9	61.7	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	61.7	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [2018 Base 1 CDC-PM Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	13.9	km/h	1.4	km/h	13.9	km/h
Travel Distance (Total)	3794.6	veh-km/h	0.6	ped-km/h	4554.2	pers-km/h
Travel Time (Total)	273.1	veh-h/h	0.4	ped-h/h	328.2	pers-h/h
Demand Flows (Total)	6537	veh/h	17	ped/h	7861	pers/h
Percent Heavy Vehicles (Demand)	2.8	%				
Degree of Saturation	1.043		0.019			
Practical Spare Capacity	-13.7	%				
Effective Intersection Capacity	6265	veh/h				
Control Delay (Total)	214.13	veh-h/h	0.30	ped-h/h	257.26	pers-h/h
Control Delay (Average)	117.9	sec	64.1	sec	117.8	sec
Control Delay (Worst Lane)	186.8	sec				
Control Delay (Worst Movement)	180.6	sec	64.2	sec	180.6	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	117.1	sec				
Idling Time (Average)	110.6	sec				
Intersection Level of Service (LOS)	LOS F		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	117.6	veh				
95% Back of Queue - Distance (Worst Lane)	844.7	m				
Queue Storage Ratio (Worst Lane)	3.10					
Total Effective Stops	8826	veh/h	16	ped/h	10607	pers/h
Effective Stop Rate	1.35		0.96		1.35	
Proportion Queued	1.00		0.96		1.00	
Performance Index	975.0		0.5		975.5	
Cost (Total)	10162.95	$/h	11.45	$/h	10174.40	$/h
Fuel Consumption (Total)	811.6	L/h				
Carbon Dioxide (Total)	1917.3	kg/h				
Hydrocarbons (Total)	0.212	kg/h				
Carbon Monoxide (Total)	2.014	kg/h				
NOx (Total)	2.624	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 6.3 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 21.8% 7.6% 6.3%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	3,137,611	veh/y	8,160	ped/y	3,773,294	pers/y
Delay	102,783	veh-h/y	145	ped-h/y	123,485	pers-h/y
Effective Stops	4,236,313	veh/y	7,813	ped/y	5,091,388	pers/y
Travel Distance	1,821,425	veh-km/y	293	ped-km/y	2,186,004	pers-km/y
Travel Time	131,090	veh-h/y	208	ped-h/y	157,516	pers-h/y
Cost	4,878,216	$/y	5,494	$/y	4,883,710	$/y
Fuel Consumption	389,580	L/y				
Carbon Dioxide	920,312	kg/y				
Hydrocarbons	102	kg/y				
Carbon Monoxide	967	kg/y				
NOx	1,260	kg/y				

MOVEMENT SUMMARY

Site: 101 [2018 Base 1 CDC-PM Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	0.951	69.2	LOS E	78.3	562.0	1.00	1.12	1.24	6.8
11	T1	2760	3.0	0.951	63.2	LOS E	78.3	562.0	1.00	1.11	1.24	23.6
12	R2	255	0.0	1.012	147.7	LOS F	27.8	194.9	1.00	1.21	1.96	7.2
Approach		3021	2.7	1.012	70.3	LOS E	78.3	562.0	1.00	1.12	1.30	21.3
East: Carnarvon Street (east)												
1	L2	136	0.0	0.302	33.2	LOS C	5.6	39.2	0.86	0.77	0.86	20.6
2	T1	64	3.0	1.033	166.7	LOS F	20.7	148.8	1.00	1.53	2.20	5.5
3	R2	112	3.0	1.033	171.2	LOS F	20.7	148.8	1.00	1.53	2.20	11.7
Approach		312	1.7	1.033	110.1	LOS F	20.7	148.8	0.94	1.20	1.62	11.6
North: Silverwater Road (north)												
4	L2	64	3.0	1.041	169.8	LOS F	117.6	844.7	1.00	1.61	1.90	12.6
5	T1	2597	3.0	1.041	163.7	LOS F	117.6	844.7	1.00	1.63	1.90	11.4
6	R2	89	3.0	0.625	77.3	LOS F	6.2	44.6	1.00	0.79	1.04	19.2
Approach		2750	3.0	1.041	161.0	LOS F	117.6	844.7	1.00	1.60	1.87	11.6
West: Carnarvon Street (west)												
7	L2	31	3.0	1.043	172.9	LOS F	26.6	191.3	1.00	1.41	2.23	8.9
8	T1	29	3.0	1.043	168.4	LOS F	26.6	191.3	1.00	1.41	2.23	4.9
9	R2	393	3.0	1.043	180.6	LOS F	27.3	196.2	1.00	1.45	2.24	3.5
Approach		453	3.0	1.043	179.3	LOS F	27.3	196.2	1.00	1.45	2.23	4.0
All Vehicles		6537	2.8	1.043	117.9	LOS F	117.6	844.7	1.00	1.35	1.62	13.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	64.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	64.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	64.2	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	64.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [2018 Base 2 Permissible Uses-AM Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	26.8	km/h	1.4	km/h	26.7	km/h
Travel Distance (Total)	3459.6	veh-km/h	0.6	ped-km/h	4152.1	pers-km/h
Travel Time (Total)	129.0	veh-h/h	0.4	ped-h/h	155.2	pers-h/h
Demand Flows (Total)	5841	veh/h	17	ped/h	7027	pers/h
Percent Heavy Vehicles (Demand)	5.5	%				
Degree of Saturation	0.933		0.018			
Practical Spare Capacity	-3.5	%				
Effective Intersection Capacity	6261	veh/h				
Control Delay (Total)	77.94	veh-h/h	0.30	ped-h/h	93.83	pers-h/h
Control Delay (Average)	48.0	sec	64.1	sec	48.1	sec
Control Delay (Worst Lane)	92.3	sec				
Control Delay (Worst Movement)	95.1	sec	64.2	sec	95.1	sec
Geometric Delay (Average)	1.0	sec				
Stop-Line Delay (Average)	47.1	sec				
Idling Time (Average)	41.9	sec				
Intersection Level of Service (LOS)	LOS D		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	66.3	veh				
95% Back of Queue - Distance (Worst Lane)	492.3	m				
Queue Storage Ratio (Worst Lane)	1.95					
Total Effective Stops	5595	veh/h	16	ped/h	6730	pers/h
Effective Stop Rate	0.96		0.96		0.96	
Proportion Queued	0.96		0.96		0.96	
Performance Index	546.3		0.5		546.9	
Cost (Total)	5080.56	$/h	11.44	$/h	5092.00	$/h
Fuel Consumption (Total)	585.6	L/h				
Carbon Dioxide (Total)	1390.2	kg/h				
Hydrocarbons (Total)	0.141	kg/h				
Carbon Monoxide (Total)	1.609	kg/h				
NOx (Total)	3.132	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 31.1% 2.7% 0.0%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,803,824	veh/y	8,160	ped/y	3,372,749	pers/y
Delay	37,410	veh-h/y	145	ped-h/y	45,037	pers-h/y
Effective Stops	2,685,475	veh/y	7,813	ped/y	3,230,384	pers/y
Travel Distance	1,660,604	veh-km/y	293	ped-km/y	1,993,018	pers-km/y
Travel Time	61,922	veh-h/y	208	ped-h/y	74,515	pers-h/y
Cost	2,438,669	$/y	5,494	$/y	2,444,162	$/y
Fuel Consumption	281,092	L/y				
Carbon Dioxide	667,285	kg/y				
Hydrocarbons	68	kg/y				
Carbon Monoxide	772	kg/y				
NOx	1,503	kg/y				

MOVEMENT SUMMARY

Site: 101 [2018 Base 2 Permissible Uses-AM Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	10	3.0	0.887	56.5	LOS E	48.3	352.4	1.00	1.00	1.11	7.8
11	T1	2035	5.0	0.887	50.6	LOS D	48.3	352.5	1.00	1.00	1.11	27.2
12	R2	80	3.0	0.880	89.9	LOS F	6.2	44.4	1.00	0.95	1.52	11.0
Approach		2125	4.9	0.887	52.2	LOS D	48.3	352.5	1.00	1.00	1.13	26.3
East: Carnarvon Street (east)												
1	L2	112	3.0	0.507	47.2	LOS D	5.9	42.1	0.98	0.78	0.98	16.6
2	T1	62	3.0	0.933	90.6	LOS F	8.1	58.5	1.00	1.12	1.69	9.4
3	R2	38	3.0	0.933	95.1	LOS F	8.1	58.5	1.00	1.12	1.69	18.1
Approach		212	3.0	0.933	68.5	LOS E	8.1	58.5	0.99	0.94	1.32	14.5
North: Silverwater Road (north)												
4	L2	140	3.0	0.906	43.5	LOS D	66.3	489.4	0.96	0.96	1.04	33.2
5	T1	2672	7.0	0.906	37.5	LOS C	66.3	492.3	0.93	0.93	1.02	32.2
6	R2	324	3.0	0.805	66.5	LOS E	22.2	159.4	1.00	0.90	1.10	21.2
Approach		3136	6.4	0.906	40.8	LOS C	66.3	492.3	0.94	0.93	1.03	30.7
West: Carnarvon Street (west)												
7	L2	66	3.0	0.851	71.5	LOS F	13.3	95.6	1.00	0.99	1.35	18.8
8	T1	70	3.0	0.851	66.9	LOS E	13.3	95.6	1.00	0.99	1.35	11.6
9	R2	232	3.0	0.851	77.3	LOS F	13.3	95.6	1.00	0.97	1.30	7.9
Approach		368	3.0	0.851	74.3	LOS F	13.3	95.6	1.00	0.98	1.32	10.9
All Vehicles		5841	5.5	0.933	48.0	LOS D	66.3	492.3	0.96	0.96	1.09	26.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	64.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	64.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	9	64.2	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	64.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [2018 Base 2 Permissible Uses-PM Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	8.6	km/h	1.4	km/h	8.6	km/h
Travel Distance (Total)	3863.8	veh-km/h	0.6	ped-km/h	4637.2	pers-km/h
Travel Time (Total)	451.4	veh-h/h	0.4	ped-h/h	542.1	pers-h/h
Demand Flows (Total)	6698	veh/h	17	ped/h	8055	pers/h
Percent Heavy Vehicles (Demand)	2.8	%				
Degree of Saturation	1.131		0.019			
Practical Spare Capacity	-20.4	%				
Effective Intersection Capacity	5923	veh/h				
Control Delay (Total)	387.14	veh-h/h	0.30	ped-h/h	464.88	pers-h/h
Control Delay (Average)	208.1	sec	64.1	sec	207.8	sec
Control Delay (Worst Lane)	324.1	sec				
Control Delay (Worst Movement)	324.1	sec	64.2	sec	324.1	sec
Geometric Delay (Average)	1.0	sec				
Stop-Line Delay (Average)	207.1	sec				
Idling Time (Average)	199.2	sec				
Intersection Level of Service (LOS)	LOS F		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	147.1	veh				
95% Back of Queue - Distance (Worst Lane)	1056.3	m				
Queue Storage Ratio (Worst Lane)	4.76					
Total Effective Stops	11791	veh/h	16	ped/h	14166	pers/h
Effective Stop Rate	1.76		0.96		1.76	
Proportion Queued	1.00		0.96		1.00	
Performance Index	1427.9		0.5		1428.4	
Cost (Total)	16543.66	$/h	11.45	$/h	16555.10	$/h
Fuel Consumption (Total)	1095.1	L/h				
Carbon Dioxide (Total)	2585.7	kg/h				
Hydrocarbons (Total)	0.300	kg/h				
Carbon Monoxide (Total)	2.473	kg/h				
NOx (Total)	3.304	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 38.3% 8.5% 0.0%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	3,215,040	veh/y	8,160	ped/y	3,866,209	pers/y
Delay	185,829	veh-h/y	145	ped-h/y	223,140	pers-h/y
Effective Stops	5,659,849	veh/y	7,813	ped/y	6,799,632	pers/y
Travel Distance	1,854,625	veh-km/y	293	ped-km/y	2,225,844	pers-km/y
Travel Time	216,657	veh-h/y	208	ped-h/y	260,197	pers-h/y
Cost	7,940,956	$/y	5,494	$/y	7,946,450	$/y
Fuel Consumption	525,625	L/y				
Carbon Dioxide	1,241,133	kg/y				
Hydrocarbons	144	kg/y				
Carbon Monoxide	1,187	kg/y				
NOx	1,586	kg/y				

MOVEMENT SUMMARY

Site: 101 [2018 Base 2 Permissible Uses-PM Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 140 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	1.038	165.2	LOS F	120.1	862.2	1.00	1.61	1.87	3.5
11	T1	2760	3.0	1.038	159.0	LOS F	120.1	862.2	1.00	1.61	1.87	11.7
12	R2	255	0.0	1.131	324.1	LOS F	45.0	315.3	1.00	1.59	2.94	3.4
Approach		3021	2.7	1.131	173.0	LOS F	120.1	862.2	1.00	1.61	1.96	10.5
East: Carnarvon Street (east)												
1	L2	136	0.0	0.320	32.7	LOS C	5.4	37.8	0.88	0.77	0.88	20.8
2	T1	77	3.0	1.108	279.6	LOS F	30.6	219.7	1.00	1.89	2.79	3.4
3	R2	112	3.0	1.108	284.1	LOS F	30.6	219.7	1.00	1.89	2.79	7.7
Approach		325	1.7	1.108	177.8	LOS F	30.6	219.7	0.95	1.42	1.99	7.7
North: Silverwater Road (north)												
4	L2	64	3.0	1.096	257.0	LOS F	147.1	1056.3	1.00	2.01	2.42	8.8
5	T1	2597	3.0	1.096	250.9	LOS F	147.1	1056.3	1.00	2.04	2.42	7.9
6	R2	146	3.0	0.937	97.6	LOS F	12.1	86.9	1.00	1.05	1.63	16.2
Approach		2807	3.0	1.096	243.0	LOS F	147.1	1056.3	1.00	1.99	2.38	8.1
West: Carnarvon Street (west)												
7	L2	64	3.0	1.084	234.4	LOS F	39.5	283.9	1.00	1.58	2.53	7.1
8	T1	41	3.0	1.084	229.9	LOS F	39.5	283.9	1.00	1.58	2.53	3.8
9	R2	440	3.0	1.084	242.7	LOS F	39.5	283.9	1.00	1.63	2.54	2.7
Approach		545	3.0	1.084	240.7	LOS F	39.5	283.9	1.00	1.62	2.54	3.3
All Vehicles		6698	2.8	1.131	208.1	LOS F	147.1	1056.3	1.00	1.76	2.18	8.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	64.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	64.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	64.2	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	64.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Future DEV-AM Opt 1 2.7 FSR Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (South)												
10	L2	10	3.0	0.846	49.6	LOS D	46.0	335.4	0.97	0.91	1.00	8.5
11	T1	2035	5.0	0.846	43.9	LOS D	46.1	336.2	0.97	0.91	1.00	29.6
12	R2	80	3.0	0.825	91.1	LOS F	6.4	46.0	1.00	0.89	1.33	10.9
Approach		2125	4.9	0.846	45.7	LOS D	46.1	336.2	0.97	0.91	1.02	28.5
East: Carnarvon Street (east)												
1	L2	112	3.0	0.513	52.0	LOS D	6.4	46.3	0.98	0.78	0.98	15.5
2	T1	51	3.0	0.892	89.5	LOS F	7.4	52.9	1.00	1.02	1.51	9.4
3	R2	38	3.0	0.892	94.1	LOS F	7.4	52.9	1.00	1.02	1.51	18.2
Approach		201	3.0	0.892	69.5	LOS E	7.4	52.9	0.99	0.89	1.22	14.5
North: Silverwater Road (north)												
4	L2	140	3.0	0.865	30.8	LOS C	57.8	426.8	0.90	0.85	0.90	36.4
5	T1	2672	7.0	0.865	25.5	LOS B	58.1	430.9	0.87	0.82	0.87	35.6
6	R2	274	3.0	0.646	61.6	LOS E	18.1	130.3	0.96	0.84	0.96	21.3
Approach		3086	6.5	0.865	28.9	LOS C	58.1	430.9	0.88	0.82	0.88	33.8
West: Carnarvon Street (west)												
7	L2	45	3.0	0.796	73.8	LOS F	11.2	80.3	1.00	0.92	1.25	18.4
8	T1	60	3.0	0.796	69.2	LOS E	11.2	80.3	1.00	0.92	1.25	11.3
9	R2	195	3.0	0.796	79.6	LOS F	11.2	80.3	1.00	0.91	1.20	7.7
Approach		300	3.0	0.796	76.7	LOS F	11.2	80.3	1.00	0.91	1.22	10.3
All Vehicles		5712	5.6	0.892	39.1	LOS C	58.1	430.9	0.92	0.86	0.96	29.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	69.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	69.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	9	69.1	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	69.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future DEV-AM Opt 1 2.7 FSR Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values								
Performance Measure	**Vehicles**			**Pedestrians**			**Persons**	
Travel Speed (Average)	29.2	km/h		1.3	km/h		29.1	km/h
Travel Distance (Total)	3404.3	veh-km/h		0.6	ped-km/h		4085.7	pers-km/h
Travel Time (Total)	116.6	veh-h/h		0.5	ped-h/h		140.4	pers-h/h
Demand Flows (Total)	5712	veh/h		17	ped/h		6871	pers/h
Percent Heavy Vehicles (Demand)	5.6	%						
Degree of Saturation	0.892			0.019				
Practical Spare Capacity	0.9	%						
Effective Intersection Capacity	6405	veh/h						
Control Delay (Total)	62.03	veh-h/h		0.33	ped-h/h		74.76	pers-h/h
Control Delay (Average)	39.1	sec		69.1	sec		39.2	sec
Control Delay (Worst Lane)	91.5	sec						
Control Delay (Worst Movement)	94.1	sec		69.1	sec		94.1	sec
Geometric Delay (Average)	0.8	sec						
Stop-Line Delay (Average)	38.3	sec						
Idling Time (Average)	33.8	sec						
Intersection Level of Service (LOS)	LOS C			LOS F				
95% Back of Queue - Vehicles (Worst Lane)	58.1	veh						
95% Back of Queue - Distance (Worst Lane)	430.9	m						
Queue Storage Ratio (Worst Lane)	1.86							
Total Effective Stops	4908	veh/h		16	ped/h		5906	pers/h
Effective Stop Rate	0.86			0.96			0.86	
Proportion Queued	0.92			0.96			0.92	
Performance Index	490.7			0.5			491.3	
Cost (Total)	4422.59	$/h		12.07	$/h		4434.66	$/h
Fuel Consumption (Total)	515.0	L/h						
Carbon Dioxide (Total)	1223.1	kg/h						
Hydrocarbons (Total)	0.118	kg/h						
Carbon Monoxide (Total)	1.330	kg/h						
NOx (Total)	2.771	kg/h						

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.3 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 2.0% 1.9% 0.0%

Intersection Performance - Annual Values								
Performance Measure	**Vehicles**			**Pedestrians**			**Persons**	
Demand Flows (Total)	2,741,760	veh/y		8,160	ped/y		3,298,272	pers/y
Delay	29,773	veh-h/y		157	ped-h/y		35,885	pers-h/y
Effective Stops	2,355,996	veh/y		7,836	ped/y		2,835,031	pers/y
Travel Distance	1,634,045	veh-km/y		293	ped-km/y		1,961,148	pers-km/y
Travel Time	55,990	veh-h/y		219	ped-h/y		67,407	pers-h/y
Cost	2,122,842	$/y		5,792	$/y		2,128,635	$/y
Fuel Consumption	247,212	L/y						
Carbon Dioxide	587,089	kg/y						
Hydrocarbons	56	kg/y						
Carbon Monoxide	639	kg/y						
NOx	1,330	kg/y						

INTERSECTION SUMMARY

Site: 101 [Future DEV-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 145 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	10.6	km/h	1.4	km/h	10.6	km/h
Travel Distance (Total)	3839.5	veh-km/h	0.6	ped-km/h	4608.0	pers-km/h
Travel Time (Total)	361.0	veh-h/h	0.4	ped-h/h	433.6	pers-h/h
Demand Flows (Total)	6638	veh/h	17	ped/h	7983	pers/h
Percent Heavy Vehicles (Demand)	2.8	%				
Degree of Saturation	1.106		0.020			
Practical Spare Capacity	-18.6	%				
Effective Intersection Capacity	6001	veh/h				
Control Delay (Total)	299.52	veh-h/h	0.31	ped-h/h	359.74	pers-h/h
Control Delay (Average)	162.4	sec	66.6	sec	162.2	sec
Control Delay (Worst Lane)	285.9	sec				
Control Delay (Worst Movement)	285.9	sec	66.7	sec	285.9	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	161.5	sec				
Idling Time (Average)	154.8	sec				
Intersection Level of Service (LOS)	LOS F		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	133.4	veh				
95% Back of Queue - Distance (Worst Lane)	958.1	m				
Queue Storage Ratio (Worst Lane)	4.05					
Total Effective Stops	10100	veh/h	16	ped/h	12137	pers/h
Effective Stop Rate	1.52		0.96		1.52	
Proportion Queued	1.00		0.96		1.00	
Performance Index	1219.6		0.5		1220.2	
Cost (Total)	13319.67	$/h	11.76	$/h	13331.43	$/h
Fuel Consumption (Total)	948.3	L/h				
Carbon Dioxide (Total)	2239.6	kg/h				
Hydrocarbons (Total)	0.254	kg/h				
Carbon Monoxide (Total)	2.232	kg/h				
NOx (Total)	2.926	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 7.9 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 26.1% 9.5% 7.9%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	3,186,240	veh/y	8,160	ped/y	3,831,648	pers/y
Delay	143,771	veh-h/y	151	ped-h/y	172,676	pers-h/y
Effective Stops	4,848,092	veh/y	7,825	ped/y	5,825,534	pers/y
Travel Distance	1,842,940	veh-km/y	293	ped-km/y	2,211,822	pers-km/y
Travel Time	173,281	veh-h/y	214	ped-h/y	208,151	pers-h/y
Cost	6,393,442	$/y	5,643	$/y	6,399,085	$/y
Fuel Consumption	455,185	L/y				
Carbon Dioxide	1,075,004	kg/y				
Hydrocarbons	122	kg/y				
Carbon Monoxide	1,071	kg/y				
NOx	1,404	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future DEV-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 145 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	0.999	114.5	LOS F	102.3	734.5	1.00	1.33	1.51	4.7
11	T1	2760	3.0	0.999	108.3	LOS F	102.3	734.5	1.00	1.33	1.51	16.1
12	R2	255	0.0	1.106	285.9	LOS F	42.0	294.3	1.00	1.49	2.67	3.9
Approach		3021	2.7	1.106	123.3	LOS F	102.3	734.5	1.00	1.34	1.60	14.0
East: Carnarvon Street (east)												
1	L2	136	0.0	0.312	33.9	LOS C	5.7	39.8	0.87	0.77	0.87	20.4
2	T1	74	3.0	1.081	239.6	LOS F	27.7	198.6	1.00	1.75	2.53	3.9
3	R2	112	3.0	1.081	244.2	LOS F	27.7	198.6	1.00	1.75	2.53	8.7
Approach		322	1.7	1.081	154.3	LOS F	27.7	198.6	0.94	1.33	1.83	8.7
North: Silverwater Road (north)												
4	L2	64	3.0	1.066	209.1	LOS F	133.4	958.1	1.00	1.76	2.09	10.5
5	T1	2597	3.0	1.066	203.1	LOS F	133.4	958.1	1.00	1.78	2.09	9.5
6	R2	131	3.0	0.871	88.6	LOS F	10.3	73.9	1.00	0.94	1.38	17.4
Approach		2792	3.0	1.066	197.8	LOS F	133.4	958.1	1.00	1.74	2.06	9.7
West: Carnarvon Street (west)												
7	L2	49	3.0	1.060	199.4	LOS F	33.3	239.3	1.00	1.46	2.30	8.0
8	T1	36	3.0	1.060	194.8	LOS F	33.3	239.3	1.00	1.46	2.30	4.3
9	R2	418	3.0	1.060	207.9	LOS F	33.3	239.3	1.00	1.50	2.31	3.1
Approach		503	3.0	1.060	206.1	LOS F	33.3	239.3	1.00	1.49	2.31	3.7
All Vehicles		6638	2.8	1.106	162.4	LOS F	133.4	958.1	1.00	1.52	1.86	10.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	66.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	66.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	66.7	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	66.6	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

APPENDIX E

APPENDIX E

Proposed Mitigation for the Intersection of Carnarvon Street and Silverwater Road.

This analysis is provided to demonstrate if mitigation is possible or required at the intersection of Carnarvon Street and Silverwater Road in order to improve the PM peak hour performance.

1. *Development Scenario 1a 2018 DEV 1a: Inclusion of extra northbound lane kerbside along site frontage. This option shows that the provision of an additional lane does not change the Level of Service in the AM and PM peak periods. It does not provide any real benefits when used in isolation. Degree of Saturation change shows -0.05 which is minimal and small change in Average Delay of 52.6 seconds*

2. *Development Scenario 1b DEV 2a with reduction in Heavy Vehicle volumes to Carnarvon Street to 2% and DEV 2b modelled using the cumulative growth to the year 2021. This mitigation shows that there is no change to the Level of Service in the AM and PM Peak Periods.*

3. *Development Scenario 1c DEV 3. Additional Slip Lane to East Approach Carnarvon Street Left hand turn. Problems associated with Land Acquisition.*

4. *Development Scenario 1d DEV 1a+DEV 3 combined mitigation modelled for PM Peak Hour Period only. Additional Slip Lane to East Approach Carnarvon Street Left hand turn and additional left land northbound in Silverwater Road*

Table 3.4e SIDRA ANALYSIS OF FUTURE DEVELOPMENT DEV 1a MITIGATION. ADDITIONAL LEFT LANE

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Future DEV 1	Silverwater Road/ Carnarvon Street	S	AM	C	0.892	39	East Approach Carnarvon Street RHT 94.1 secs
Future DEV 1	Silverwater Road/ Carnarvon Street	S	PM	F	1.056	109.6	East Approach Carnarvon Street RHT 216.3 secs

Option DEV 1a has only a minimal effect by way of change in Degree of Saturation. The additional lane must be selected as left turn only in order to allow consistent through movement. **Figure 6A** shows the intersection diagram with the additional left lane across the site frontage which has been modelled. It provides little benefit to the network in isolation.

Table 3.4f SIDRA ANALYSIS OF FUTURE DEVELOPMENT DEV 2a MITIGATION. REDUCTION IN HEAVY VEHICLE VOLUMES BY 1% IN CARNARVON STREET.

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Future DEV 2a	Silverwater Road/ Carnarvon Street	S	AM	C	0.88	38.2	East Approach Carnarvon Street RHT 93.4s
Future DEV 2a	Silverwater Road/ Carnarvon Street	S	PM	F	1.082	165.1	East Approach Carnarvon Street RHT 257.2s

The change in heavy vehicle volumes only reduces the Degree of Saturation by a very minor amount 0.02.

Table 3.4g SIDRA ANALYSIS OF FUTURE DEVELOPMENT DEV 2b MITIGATION. REDUCTION IN HEAVY VEHICLE VOLUMES BY 1% IN CARNARVON STREET +FUTURE TRAFFIC VOLUME GROWTH TO 2021

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Future DEV 2b	Silverwater Road/ Carnarvon Street	S	AM	C	0.915	41.3	East Approach Carnarvon Street RHT 100.1s
Future DEV 2b	Silverwater Road/ Carnarvon Street	S	PM	F	1.121	190.8	East Approach Carnarvon Street RHT 302.8s

There is no change in LoS and a minor increase in Degree of Saturation and Average Delay in the AM and PM peak Hour.

Table 3.4h SIDRA ANALYSIS OF FUTURE DEVELOPMENT DEV 3 MITIGATION. EAST APPROACH CARNARVON STREET SLIP LANE

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Future DEV 3	Silverwater Road/ Carnarvon Street	S	AM	C	0.843	35.2	South Approach Silverwater Road RHT 86.4s
Future DEV 3	Silverwater Road/ Carnarvon Street	S	PM	F	1.086	103.3	East Approach Carnarvon Street RHT 302.8s

The mitigation for Option 3 does not change the Level of Service in the AM or PM peak hour periods. There is a small change in the Degree of Saturation for the AM of 0.049 and PM of 0.02. Refer to **Figure 6B.**

It is demonstration that the above mitigation methods do not alter the Level of Service at the intersection. This would be subject to further investigation by the RMS as it affects private property.

Table 3.4i SIDRA ANALYSIS OF FUTURE DEVELOPMENT DEV 1A + DEV 3 COMBINATION MITIGATION. LEFT LANE SILVERWATER ROAD PLUS SLIP LANE WEST APPROACH CARNARVON STREET

No	Location	Sign/ Control	Peak Hour	Level of Service LoS	Degree of Saturation DoS	Average Delay Av	Critical Movement
Future DEV 1a+3	Silverwater Road/ Carnarvon Street	S	PM	E	1.003	62.3	East Approach Carnarvon Street RHT 145.5s

A future combined mitigation option will allow for future development growth along Silverwater Road which is not the result of the proposed development traffic. Only the PM was modelled in the analysis. Refer to **Figure 6C.**

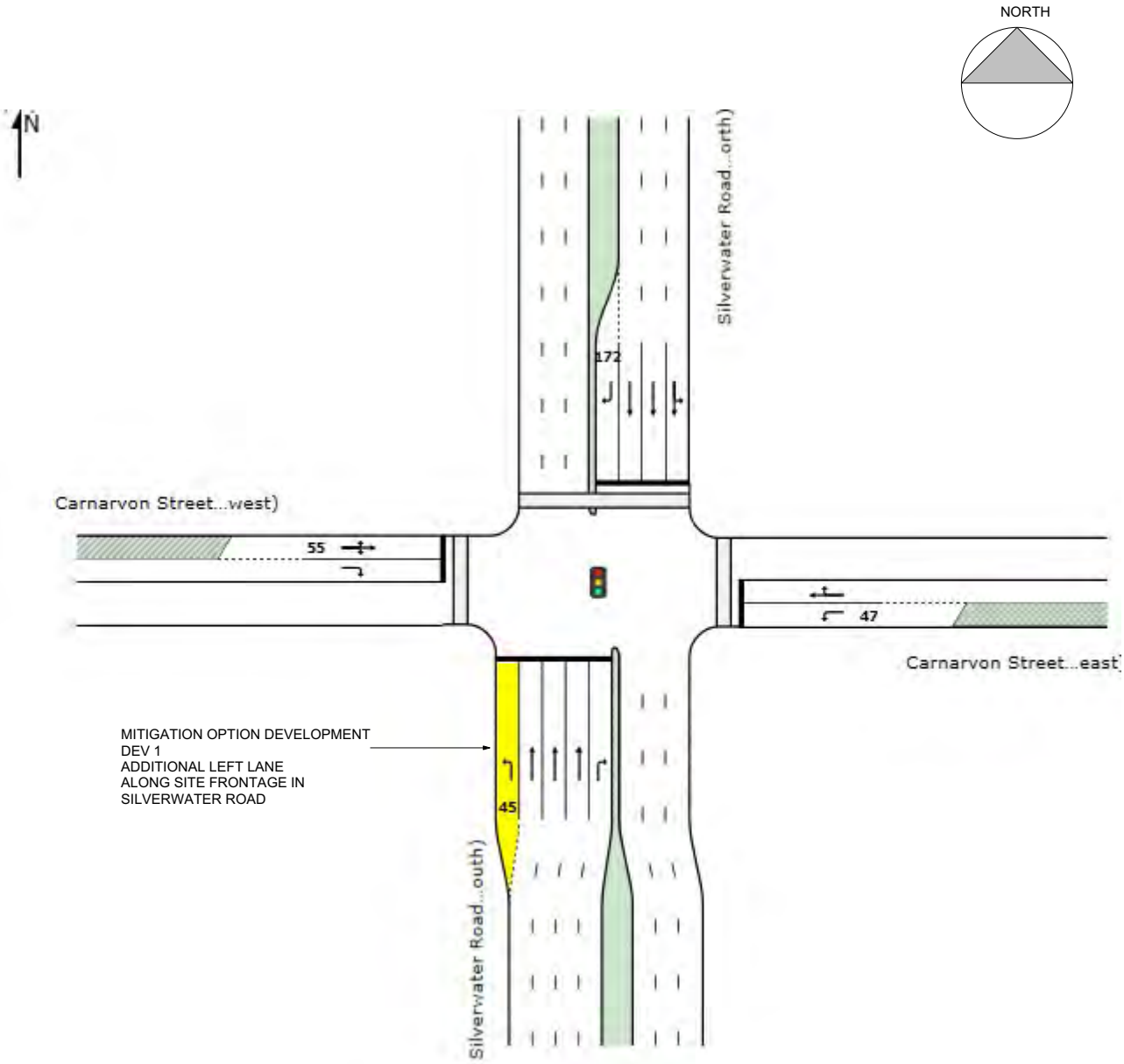


DIAGRAM TAKEN FORM SIDRA NETWORK MODEL WHICH IS ONLY INDICATIVE AND NOT TO TRUE GEOMETRIC LAYOUT OF THE INTERSECTION.

FIGURE 6A
MITIGATION DEVELOPMENT OPTION 1

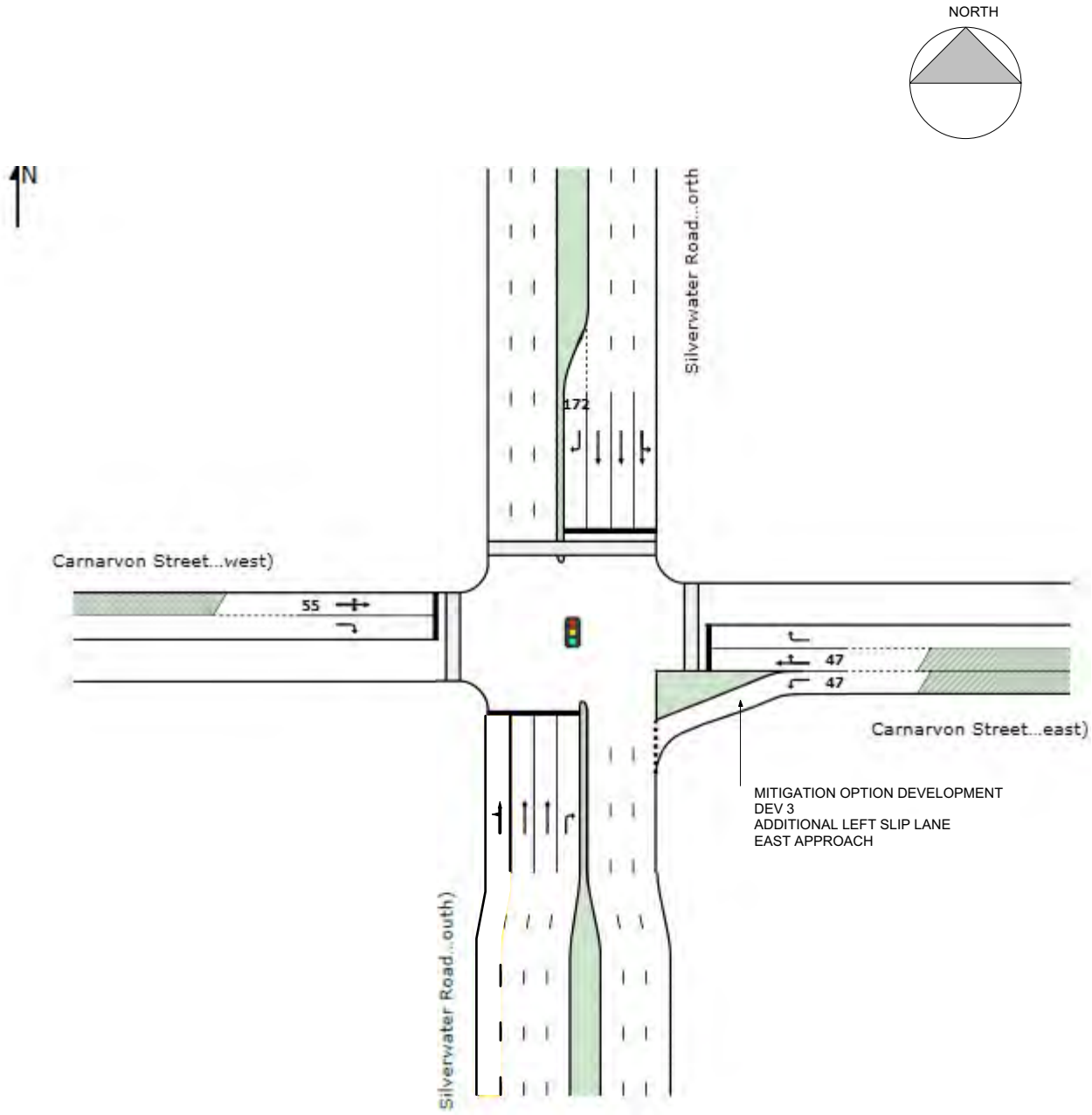


FIGURE 6B
MITIGATION DEVELOPMENT OPTION 3

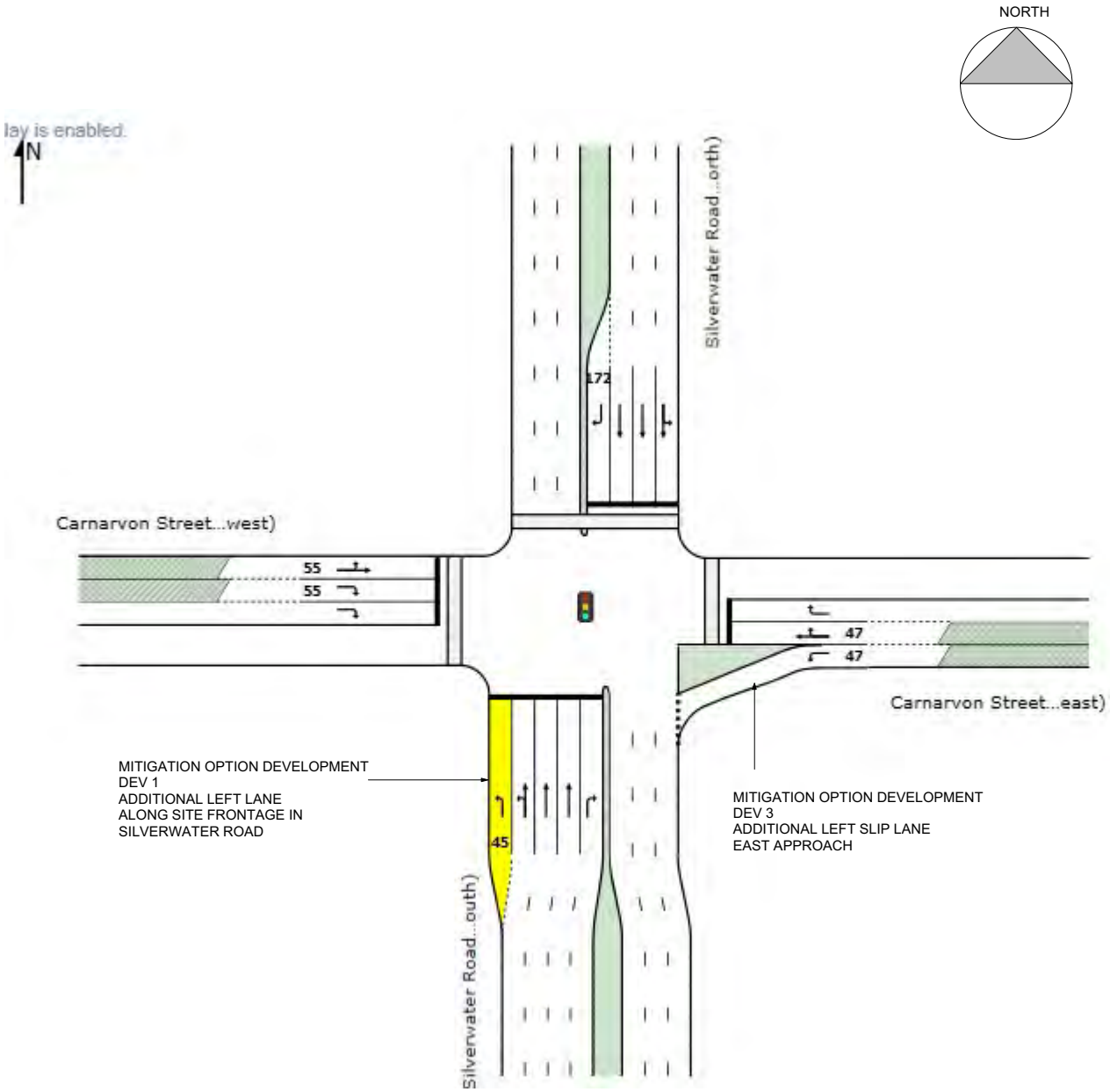


DIAGRAM TAKEN FORM SIDRA NETWORK MODEL WHICH IS ONLY INDICATIVE AND NOT TO TRUE GEOMETRIC LAYOUT OF THE INTERSECTION.

FIGURE 6C
MITIGATION DEVELOPMENT OPTION 1+3

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-AM DEV 1a-2.7 Opt 1 Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	10	3.0	0.010	21.3	LOS B	0.3	2.2	0.46	0.65	0.46	20.3
11	T1	2035	5.0	0.845	43.9	LOS D	45.9	335.2	0.97	0.91	1.00	29.7
12	R2	80	3.0	0.825	91.1	LOS F	6.4	46.0	1.00	0.89	1.33	10.9
Approach		2125	4.9	0.845	45.5	LOS D	45.9	335.2	0.97	0.90	1.01	28.6
East: Carnarvon Street (east)												
1	L2	112	3.0	0.513	52.0	LOS D	6.4	46.3	0.98	0.78	0.98	15.5
2	T1	51	3.0	0.892	89.5	LOS F	7.4	52.9	1.00	1.02	1.51	9.5
3	R2	38	3.0	0.892	94.1	LOS F	7.4	52.9	1.00	1.02	1.51	18.3
Approach		201	3.0	0.892	69.5	LOS E	7.4	52.9	0.99	0.89	1.22	14.5
North: Silverwater Road (north)												
4	L2	140	3.0	0.865	30.8	LOS C	57.8	426.8	0.90	0.85	0.90	36.4
5	T1	2672	7.0	0.865	25.5	LOS B	58.1	430.9	0.87	0.82	0.87	35.6
6	R2	274	3.0	0.646	61.6	LOS E	18.1	130.3	0.96	0.84	0.96	21.3
Approach		3086	6.5	0.865	28.9	LOS C	58.1	430.9	0.88	0.82	0.88	33.8
West: Carnarvon Street (west)												
7	L2	45	3.0	0.796	73.8	LOS F	11.2	80.3	1.00	0.92	1.25	18.5
8	T1	60	3.0	0.796	69.2	LOS E	11.2	80.3	1.00	0.92	1.25	11.4
9	R2	195	3.0	0.796	79.6	LOS F	11.2	80.3	1.00	0.91	1.20	7.8
Approach		300	3.0	0.796	76.6	LOS F	11.2	80.3	1.00	0.91	1.22	10.4
All Vehicles		5712	5.6	0.892	39.0	LOS C	58.1	430.9	0.92	0.86	0.96	29.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	69.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	69.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	9	69.1	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	69.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-AM DEV 1a-2.7 Opt 1 Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values								
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	29.2	km/h	1.3	km/h	29.1	km/h
Travel Distance (Total)	3405.2	veh-km/h	0.6	ped-km/h	4086.9	pers-km/h
Travel Time (Total)	116.5	veh-h/h	0.5	ped-h/h	140.3	pers-h/h
Demand Flows (Total)	5712	veh/h	17	ped/h	6871	pers/h
Percent Heavy Vehicles (Demand)	5.6	%				
Degree of Saturation	0.892		0.019			
Practical Spare Capacity	0.9	%				
Effective Intersection Capacity	6405	veh/h				
Control Delay (Total)	61.95	veh-h/h	0.33	ped-h/h	74.67	pers-h/h
Control Delay (Average)	39.0	sec	69.1	sec	39.1	sec
Control Delay (Worst Lane)	91.5	sec				
Control Delay (Worst Movement)	94.1	sec	69.1	sec	94.1	sec
Geometric Delay (Average)	0.8	sec				
Stop-Line Delay (Average)	38.2	sec				
Idling Time (Average)	33.7	sec				
Intersection Level of Service (LOS)	LOS C		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	58.1	veh				
95% Back of Queue - Distance (Worst Lane)	430.9	m				
Queue Storage Ratio (Worst Lane)	1.85					
Total Effective Stops	4901	veh/h	16	ped/h	5897	pers/h
Effective Stop Rate	0.86		0.96		0.86	
Proportion Queued	0.92		0.96		0.92	
Performance Index	434.3		0.5		434.8	
Cost (Total)	4419.47	$/h	12.07	$/h	4431.54	$/h
Fuel Consumption (Total)	514.7	L/h				
Carbon Dioxide (Total)	1222.4	kg/h				
Hydrocarbons (Total)	0.117	kg/h				
Carbon Monoxide (Total)	1.330	kg/h				
NOx (Total)	2.769	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.3 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 2.0% 1.9% 0.0%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	2,741,760	veh/y	8,160	ped/y	3,298,272	pers/y
Delay	29,738	veh-h/y	157	ped-h/y	35,842	pers-h/y
Effective Stops	2,352,420	veh/y	7,836	ped/y	2,830,739	pers/y
Travel Distance	1,634,507	veh-km/y	293	ped-km/y	1,961,702	pers-km/y
Travel Time	55,921	veh-h/y	219	ped-h/y	67,324	pers-h/y
Cost	2,121,346	$/y	5,792	$/y	2,127,138	$/y
Fuel Consumption	247,068	L/y				
Carbon Dioxide	586,747	kg/y				
Hydrocarbons	56	kg/y				
Carbon Monoxide	638	kg/y				
NOx	1,329	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-DEV1-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation Widening o]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	0.005	14.9	LOS B	0.1	1.1	0.34	0.63	0.34	24.9
11	T1	2760	3.0	0.929	53.5	LOS D	77.2	554.4	1.00	1.02	1.12	26.4
12	R2	255	0.0	1.046	201.7	LOS F	35.2	246.2	1.00	1.26	2.09	5.4
Approach		3021	2.7	1.046	65.9	LOS E	77.2	554.4	1.00	1.04	1.20	22.3
East: Carnarvon Street (east)												
1	L2	136	0.0	0.293	36.8	LOS C	6.4	44.6	0.85	0.77	0.85	19.4
2	T1	74	3.0	1.056	211.8	LOS F	26.6	191.1	1.00	1.60	2.23	4.4
3	R2	112	3.0	1.056	216.3	LOS F	26.6	191.1	1.00	1.60	2.23	9.7
Approach		322	1.7	1.056	139.5	LOS F	26.6	191.1	0.94	1.25	1.65	9.5
North: Silverwater Road (north)												
4	L2	64	3.0	1.022	148.1	LOS F	117.8	845.5	1.00	1.41	1.63	14.2
5	T1	2597	3.0	1.022	142.4	LOS F	117.8	845.5	1.00	1.42	1.63	12.9
6	R2	131	3.0	0.961	117.9	LOS F	12.8	92.0	1.00	1.08	1.70	14.1
Approach		2792	3.0	1.022	141.4	LOS F	117.8	845.5	1.00	1.41	1.63	13.0
West: Carnarvon Street (west)												
7	L2	49	3.0	0.324	49.7	LOS D	4.8	34.2	0.94	0.75	0.94	23.3
8	T1	36	3.0	0.324	45.2	LOS D	4.8	34.2	0.94	0.75	0.94	15.3
9	R2	418	3.0	1.046	202.1	LOS F	28.9	207.8	1.00	1.45	2.14	3.3
Approach		503	3.0	1.046	176.0	LOS F	28.9	207.8	0.99	1.34	1.94	4.5
All Vehicles		6638	2.8	1.056	109.6	LOS F	117.8	845.5	1.00	1.23	1.46	14.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	74.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	74.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	74.1	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	74.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-DEV1-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation Widening o]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values

Performance Measure	Vehicles		Pedestrians		Persons	
Travel Speed (Average)	14.8	km/h	1.3	km/h	14.8	km/h
Travel Distance (Total)	3859.1	veh-km/h	0.6	ped-km/h	4631.6	pers-km/h
Travel Time (Total)	260.6	veh-h/h	0.5	ped-h/h	313.2	pers-h/h
Demand Flows (Total)	6638	veh/h	17	ped/h	7983	pers/h
Percent Heavy Vehicles (Demand)	2.8	%				
Degree of Saturation	1.056		0.022			
Practical Spare Capacity	-14.8	%				
Effective Intersection Capacity	6283	veh/h				
Control Delay (Total)	202.02	veh-h/h	0.35	ped-h/h	242.77	pers-h/h
Control Delay (Average)	109.6	sec	74.1	sec	109.5	sec
Control Delay (Worst Lane)	214.5	sec				
Control Delay (Worst Movement)	216.3	sec	74.1	sec	216.3	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	108.6	sec				
Idling Time (Average)	102.7	sec				
Intersection Level of Service (LOS)	LOS F		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	117.8	veh				
95% Back of Queue - Distance (Worst Lane)	845.5	m				
Queue Storage Ratio (Worst Lane)	3.06					
Total Effective Stops	8143	veh/h	16	ped/h	9788	pers/h
Effective Stop Rate	1.23		0.96		1.23	
Proportion Queued	1.00		0.96		1.00	
Performance Index	838.4		0.6		839.0	
Cost (Total)	9684.50	$/h	12.88	$/h	9697.37	$/h
Fuel Consumption (Total)	783.6	L/h				
Carbon Dioxide (Total)	1851.3	kg/h				
Hydrocarbons (Total)	0.203	kg/h				
Carbon Monoxide (Total)	1.976	kg/h				
NOx (Total)	2.497	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 4.2% 3.1% 0.0%

Intersection Performance - Annual Values

Performance Measure	Vehicles		Pedestrians		Persons	
Demand Flows (Total)	3,186,240	veh/y	8,160	ped/y	3,831,648	pers/y
Delay	96,969	veh-h/y	168	ped-h/y	116,531	pers-h/y
Effective Stops	3,908,846	veh/y	7,856	ped/y	4,698,471	pers/y
Travel Distance	1,852,381	veh-km/y	309	ped-km/y	2,223,167	pers-km/y
Travel Time	125,083	veh-h/y	234	ped-h/y	150,333	pers-h/y
Cost	4,648,559	$/y	6,181	$/y	4,654,740	$/y
Fuel Consumption	376,150	L/y				
Carbon Dioxide	888,632	kg/y				
Hydrocarbons	98	kg/y				
Carbon Monoxide	949	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-HV DEV2b-AM Opt 1 2.7 FSR + Future Growth 2021 Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 155 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (South)												
10	L2	10	2.0	0.863	51.6	LOS D	50.7	370.1	0.98	0.93	1.02	8.3
11	T1	2134	5.0	0.863	45.8	LOS D	50.8	370.9	0.98	0.93	1.02	28.9
12	R2	80	2.0	0.847	95.1	LOS F	6.7	47.4	1.00	0.91	1.38	10.5
Approach		2224	4.9	0.863	47.5	LOS D	50.8	370.9	0.98	0.93	1.03	27.9
East: Carnarvon Street (east)												
1	L2	112	2.0	0.527	54.6	LOS D	6.7	48.0	0.99	0.78	0.99	15.0
2	T1	51	2.0	0.915	95.5	LOS F	7.8	55.2	1.00	1.06	1.59	9.0
3	R2	38	2.0	0.915	100.1	LOS F	7.8	55.2	1.00	1.06	1.59	17.5
Approach		201	2.0	0.915	73.6	LOS F	7.8	55.2	0.99	0.90	1.25	13.9
North: Silverwater Road (north)												
4	L2	140	2.0	0.886	33.2	LOS C	65.5	483.4	0.92	0.88	0.93	35.2
5	T1	2802	7.0	0.886	28.0	LOS B	65.7	487.8	0.88	0.84	0.90	34.3
6	R2	274	2.0	0.644	63.5	LOS E	18.7	133.3	0.96	0.84	0.96	20.9
Approach		3216	6.4	0.886	31.3	LOS C	65.7	487.8	0.89	0.84	0.91	32.6
West: Carnarvon Street (west)												
7	L2	45	2.0	0.817	77.6	LOS F	11.7	83.3	1.00	0.94	1.28	17.8
8	T1	60	2.0	0.817	73.0	LOS F	11.7	83.3	1.00	0.94	1.28	10.9
9	R2	195	2.0	0.817	83.5	LOS F	11.7	83.3	1.00	0.92	1.23	7.4
Approach		300	2.0	0.817	80.5	LOS F	11.7	83.3	1.00	0.93	1.25	9.9
All Vehicles		5941	5.4	0.915	41.3	LOS C	65.7	487.8	0.93	0.88	0.98	28.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	71.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	71.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	9	71.6	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	71.6	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-HV DEV2b-AM Opt 1 2.7 FSR + Future Growth 2021 Silverwater Rd and Carnarvon St]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 155 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values

Performance Measure	Vehicles		Pedestrians		Persons	
Travel Speed (Average)	28.4	km/h	1.3	km/h	28.3	km/h
Travel Distance (Total)	3547.8	veh-km/h	0.6	ped-km/h	4258.0	pers-km/h
Travel Time (Total)	125.0	veh-h/h	0.5	ped-h/h	150.4	pers-h/h
Demand Flows (Total)	5941	veh/h	17	ped/h	7146	pers/h
Percent Heavy Vehicles (Demand)	5.4	%				
Degree of Saturation	0.915		0.019			
Practical Spare Capacity	-1.7	%				
Effective Intersection Capacity	6490	veh/h				
Control Delay (Total)	68.12	veh-h/h	0.34	ped-h/h	82.09	pers-h/h
Control Delay (Average)	41.3	sec	71.6	sec	41.4	sec
Control Delay (Worst Lane)	97.5	sec				
Control Delay (Worst Movement)	100.1	sec	71.6	sec	100.1	sec
Geometric Delay (Average)	0.8	sec				
Stop-Line Delay (Average)	40.5	sec				
Idling Time (Average)	35.8	sec				
Intersection Level of Service (LOS)	LOS C		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	65.7	veh				
95% Back of Queue - Distance (Worst Lane)	487.8	m				
Queue Storage Ratio (Worst Lane)	2.05					
Total Effective Stops	5235	veh/h	16	ped/h	6298	pers/h
Effective Stop Rate	0.88		0.96		0.88	
Proportion Queued	0.93		0.96		0.93	
Performance Index	535.0		0.6		535.6	
Cost (Total)	4739.61	$/h	12.38	$/h	4751.98	$/h
Fuel Consumption (Total)	542.5	L/h				
Carbon Dioxide (Total)	1288.0	kg/h				
Hydrocarbons (Total)	0.124	kg/h				
Carbon Monoxide (Total)	1.395	kg/h				
NOx (Total)	2.877	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.3 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 1.9% 1.8% 0.0%

Intersection Performance - Annual Values

Performance Measure	Vehicles		Pedestrians		Persons	
Demand Flows (Total)	2,851,680	veh/y	8,160	ped/y	3,430,177	pers/y
Delay	32,699	veh-h/y	162	ped-h/y	39,401	pers-h/y
Effective Stops	2,512,746	veh/y	7,846	ped/y	3,023,141	pers/y
Travel Distance	1,702,954	veh-km/y	293	ped-km/y	2,043,838	pers-km/y
Travel Time	59,988	veh-h/y	225	ped-h/y	72,211	pers-h/y
Cost	2,275,011	$/y	5,942	$/y	2,280,953	$/y
Fuel Consumption	260,391	L/y				
Carbon Dioxide	618,240	kg/y				
Hydrocarbons	60	kg/y				
Carbon Monoxide	670	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-HV-DEV2a-AM Opt 1 2.7 FSR Silverwater Rd and Carnarvon St - Copy]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (South)												
10	L2	10	2.0	0.833	47.3	LOS D	44.6	325.3	0.96	0.89	0.98	8.7
11	T1	2035	5.0	0.833	41.5	LOS C	44.7	326.3	0.96	0.89	0.98	30.6
12	R2	80	2.0	0.819	90.8	LOS F	6.4	45.5	1.00	0.89	1.32	10.9
Approach		2125	4.9	0.833	43.4	LOS D	44.7	326.3	0.96	0.89	0.99	29.4
East: Carnarvon Street (east)												
1	L2	112	2.0	0.510	52.0	LOS D	6.4	45.9	0.98	0.78	0.98	15.5
2	T1	51	2.0	0.886	88.8	LOS F	7.3	52.2	1.00	1.01	1.49	9.5
3	R2	38	2.0	0.886	93.4	LOS F	7.3	52.2	1.00	1.01	1.49	18.3
Approach		201	2.0	0.886	69.1	LOS E	7.3	52.2	0.99	0.88	1.21	14.6
North: Silverwater Road (north)												
4	L2	140	2.0	0.864	30.7	LOS C	57.7	426.0	0.90	0.85	0.90	36.4
5	T1	2672	7.0	0.864	25.4	LOS B	58.0	430.2	0.86	0.81	0.87	35.6
6	R2	274	2.0	0.660	62.6	LOS E	18.3	130.2	0.97	0.84	0.97	21.1
Approach		3086	6.3	0.864	29.0	LOS C	58.0	430.2	0.88	0.82	0.88	33.8
West: Carnarvon Street (west)												
7	L2	45	2.0	0.790	73.5	LOS F	11.1	79.4	1.00	0.92	1.24	18.5
8	T1	60	2.0	0.790	68.9	LOS E	11.1	79.4	1.00	0.92	1.24	11.4
9	R2	195	2.0	0.790	79.3	LOS F	11.1	79.4	1.00	0.90	1.19	7.7
Approach		300	2.0	0.790	76.4	LOS F	11.1	79.4	1.00	0.91	1.21	10.4
All Vehicles		5712	5.4	0.886	38.2	LOS C	58.0	430.2	0.92	0.85	0.95	29.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	6	69.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	69.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	9	69.1	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	69.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-HV-DEV2a-AM Opt 1 2.7 FSR Silverwater Rd and Carnarvon St - Copy]

New Site
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values

Performance Measure	Vehicles		Pedestrians		Persons	
Travel Speed (Average)	29.5	km/h	1.3	km/h	29.4	km/h
Travel Distance (Total)	3404.3	veh-km/h	0.6	ped-km/h	4085.7	pers-km/h
Travel Time (Total)	115.3	veh-h/h	0.5	ped-h/h	138.8	pers-h/h
Demand Flows (Total)	5712	veh/h	17	ped/h	6871	pers/h
Percent Heavy Vehicles (Demand)	5.4	%				
Degree of Saturation	0.886		0.019			
Practical Spare Capacity	1.6	%				
Effective Intersection Capacity	6448	veh/h				
Control Delay (Total)	60.67	veh-h/h	0.33	ped-h/h	73.13	pers-h/h
Control Delay (Average)	38.2	sec	69.1	sec	38.3	sec
Control Delay (Worst Lane)	90.8	sec				
Control Delay (Worst Movement)	93.4	sec	69.1	sec	93.4	sec
Geometric Delay (Average)	0.8	sec				
Stop-Line Delay (Average)	37.4	sec				
Idling Time (Average)	33.0	sec				
Intersection Level of Service (LOS)	LOS C		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	58.0	veh				
95% Back of Queue - Distance (Worst Lane)	430.2	m				
Queue Storage Ratio (Worst Lane)	1.80					
Total Effective Stops	4859	veh/h	16	ped/h	5847	pers/h
Effective Stop Rate	0.85		0.96		0.85	
Proportion Queued	0.92		0.96		0.92	
Performance Index	485.5		0.5		486.1	
Cost (Total)	4363.30	$/h	12.07	$/h	4375.37	$/h
Fuel Consumption (Total)	509.3	L/h				
Carbon Dioxide (Total)	1209.2	kg/h				
Hydrocarbons (Total)	0.116	kg/h				
Carbon Monoxide (Total)	1.316	kg/h				
NOx (Total)	2.694	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 1.0 %
Number of Iterations: 4 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 4.4% 2.0% 0.0%

Intersection Performance - Annual Values

Performance Measure	Vehicles		Pedestrians		Persons	
Demand Flows (Total)	2,741,760	veh/y	8,160	ped/y	3,298,273	pers/y
Delay	29,121	veh-h/y	157	ped-h/y	35,101	pers-h/y
Effective Stops	2,332,112	veh/y	7,836	ped/y	2,806,370	pers/y
Travel Distance	1,634,045	veh-km/y	293	ped-km/y	1,961,148	pers-km/y
Travel Time	55,332	veh-h/y	219	ped-h/y	66,618	pers-h/y
Cost	2,094,386	$/y	5,792	$/y	2,100,178	$/y
Fuel Consumption	244,447	L/y				
Carbon Dioxide	580,407	kg/y				
Hydrocarbons	56	kg/y				
Carbon Monoxide	632	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-HV-DEV2a-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 165 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	2.0	0.994	113.2	LOS F	108.2	776.7	1.00	1.25	1.40	4.8
11	T1	2760	3.0	0.994	107.1	LOS F	108.2	776.7	1.00	1.25	1.40	16.2
12	R2	255	0.0	1.079	252.6	LOS F	40.6	284.5	1.00	1.34	2.29	4.3
Approach		3021	2.7	1.079	119.4	LOS F	108.2	776.7	1.00	1.26	1.48	14.3
East: Carnarvon Street (east)												
1	L2	136	0.0	0.302	36.7	LOS C	6.3	44.1	0.86	0.77	0.86	19.4
2	T1	74	2.0	1.082	252.7	LOS F	29.9	212.6	1.00	1.69	2.38	3.8
3	R2	112	2.0	1.082	257.2	LOS F	29.9	212.6	1.00	1.69	2.38	8.3
Approach		322	1.2	1.082	163.0	LOS F	29.9	212.6	0.94	1.30	1.74	8.3
North: Silverwater Road (north)												
4	L2	64	2.0	1.067	217.4	LOS F	143.9	1032.7	1.00	1.67	1.97	10.2
5	T1	2597	3.0	1.067	211.6	LOS F	143.9	1032.7	1.00	1.69	1.97	9.1
6	R2	131	2.0	0.843	95.7	LOS F	11.4	80.8	1.00	0.90	1.27	16.4
Approach		2792	2.9	1.067	206.3	LOS F	143.9	1032.7	1.00	1.65	1.94	9.3
West: Carnarvon Street (west)												
7	L2	49	2.0	1.056	203.7	LOS F	35.5	253.0	1.00	1.38	2.13	7.8
8	T1	36	2.0	1.056	199.2	LOS F	35.5	253.0	1.00	1.38	2.13	4.2
9	R2	418	2.0	1.056	213.2	LOS F	35.5	253.0	1.00	1.42	2.15	3.0
Approach		503	2.0	1.056	211.3	LOS F	35.5	253.0	1.00	1.41	2.14	3.6
All Vehicles		6638	2.7	1.082	165.1	LOS F	143.9	1032.7	1.00	1.44	1.74	10.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	76.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	76.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	76.6	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	76.6	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-HV-DEV2a-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 165 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	10.5	km/h	1.2	km/h	10.5	km/h
Travel Distance (Total)	3839.5	veh-km/h	0.6	ped-km/h	4608.0	pers-km/h
Travel Time (Total)	366.3	veh-h/h	0.5	ped-h/h	440.0	pers-h/h
Demand Flows (Total)	6638	veh/h	17	ped/h	7983	pers/h
Percent Heavy Vehicles (Demand)	2.7	%				
Degree of Saturation	1.082		0.023			
Practical Spare Capacity	-16.8	%				
Effective Intersection Capacity	6135	veh/h				
Control Delay (Total)	304.34	veh-h/h	0.36	ped-h/h	365.57	pers-h/h
Control Delay (Average)	165.1	sec	76.6	sec	164.9	sec
Control Delay (Worst Lane)	255.4	sec				
Control Delay (Worst Movement)	257.2	sec	76.6	sec	257.2	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	164.1	sec				
Idling Time (Average)	159.4	sec				
Intersection Level of Service (LOS)	LOS F		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	143.9	veh				
95% Back of Queue - Distance (Worst Lane)	1032.7	m				
Queue Storage Ratio (Worst Lane)	4.29					
Total Effective Stops	9545	veh/h	16	ped/h	11470	pers/h
Effective Stop Rate	1.44		0.96		1.44	
Proportion Queued	1.00		0.96		1.00	
Performance Index	1275.2		0.6		1275.7	
Cost (Total)	13516.26	$/h	13.00	$/h	13529.26	$/h
Fuel Consumption (Total)	943.4	L/h				
Carbon Dioxide (Total)	2227.7	kg/h				
Hydrocarbons (Total)	0.253	kg/h				
Carbon Monoxide (Total)	2.212	kg/h				
NOx (Total)	2.794	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 6.5 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 19.7% 7.6% 6.5%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	3,186,240	veh/y	8,160	ped/y	3,831,648	pers/y
Delay	146,082	veh-h/y	174	ped-h/y	175,472	pers-h/y
Effective Stops	4,581,387	veh/y	7,866	ped/y	5,505,532	pers/y
Travel Distance	1,842,940	veh-km/y	293	ped-km/y	2,211,821	pers-km/y
Travel Time	175,808	veh-h/y	236	ped-h/y	211,206	pers-h/y
Cost	6,487,807	$/y	6,241	$/y	6,494,047	$/y
Fuel Consumption	452,850	L/y				
Carbon Dioxide	1,069,309	kg/y				
Hydrocarbons	121	kg/y				
Carbon Monoxide	1,062	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-HV-DEV2b-PM Opt 1a-2.7 FSR + Future Growth 2021 Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	2.0	1.004	116.3	LOS F	105.4	756.5	1.00	1.39	1.58	4.7
11	T1	2895	3.0	1.004	110.1	LOS F	105.4	756.5	1.00	1.39	1.58	15.8
12	R2	255	0.0	1.090	255.7	LOS F	38.3	268.1	1.00	1.48	2.65	4.3
Approach		3156	2.8	1.090	121.9	LOS F	105.4	756.5	1.00	1.39	1.66	14.1
East: Carnarvon Street (east)												
1	L2	136	0.0	0.319	32.6	LOS C	5.4	37.8	0.87	0.77	0.87	20.8
2	T1	74	2.0	1.121	298.3	LOS F	31.0	220.9	1.00	1.96	2.97	3.2
3	R2	112	2.0	1.121	302.8	LOS F	31.0	220.9	1.00	1.96	2.97	7.3
Approach		322	1.2	1.121	187.7	LOS F	31.0	220.9	0.95	1.46	2.08	7.4
North: Silverwater Road (north)												
4	L2	64	2.0	1.105	269.7	LOS F	156.8	1125.0	1.00	2.12	2.55	8.4
5	T1	2724	3.0	1.105	263.5	LOS F	156.8	1125.0	1.00	2.15	2.56	7.5
6	R2	131	2.0	1.073	227.8	LOS F	18.0	127.9	1.00	1.43	2.63	8.0
Approach		2919	2.9	1.105	262.1	LOS F	156.8	1125.0	1.00	2.12	2.56	7.6
West: Carnarvon Street (west)												
7	L2	49	2.0	1.067	204.8	LOS F	32.9	234.2	1.00	1.53	2.44	7.9
8	T1	36	2.0	1.067	200.2	LOS F	32.9	234.2	1.00	1.53	2.44	4.3
9	R2	418	2.0	1.067	212.5	LOS F	32.9	234.2	1.00	1.57	2.45	3.0
Approach		503	2.0	1.067	210.9	LOS F	32.9	234.2	1.00	1.57	2.45	3.6
All Vehicles		6900	2.7	1.121	190.8	LOS F	156.8	1125.0	1.00	1.71	2.12	9.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	61.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	61.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	61.7	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	61.7	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-HV-DEV2b-PM Opt 1a-2.7 FSR + Future Growth 2021 Silverwater Rd and Carnarvon St]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 135 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values

Performance Measure	Vehicles		Pedestrians		Persons	
Travel Speed (Average)	9.3	km/h	1.4	km/h	9.3	km/h
Travel Distance (Total)	4003.7	veh-km/h	0.6	ped-km/h	4805.1	pers-km/h
Travel Time (Total)	430.6	veh-h/h	0.4	ped-h/h	517.2	pers-h/h
Demand Flows (Total)	6900	veh/h	17	ped/h	8297	pers/h
Percent Heavy Vehicles (Demand)	2.7	%				
Degree of Saturation	1.121		0.019			
Practical Spare Capacity	-19.7	%				
Effective Intersection Capacity	6157	veh/h				
Control Delay (Total)	365.61	veh-h/h	0.29	ped-h/h	439.02	pers-h/h
Control Delay (Average)	190.8	sec	61.7	sec	190.5	sec
Control Delay (Worst Lane)	301.0	sec				
Control Delay (Worst Movement)	302.8	sec	61.7	sec	302.8	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	189.9	sec				
Idling Time (Average)	181.6	sec				
Intersection Level of Service (LOS)	LOS F		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	156.8	veh				
95% Back of Queue - Distance (Worst Lane)	1125.0	m				
Queue Storage Ratio (Worst Lane)	4.18					
Total Effective Stops	11833	veh/h	16	ped/h	14215	pers/h
Effective Stop Rate	1.71		0.96		1.71	
Proportion Queued	1.00		0.96		1.00	
Performance Index	1376.0		0.5		1376.5	
Cost (Total)	15827.93	$/h	11.13	$/h	15839.06	$/h
Fuel Consumption (Total)	1079.0	L/h				
Carbon Dioxide (Total)	2547.7	kg/h				
Hydrocarbons (Total)	0.292	kg/h				
Carbon Monoxide (Total)	2.461	kg/h				
NOx (Total)	3.248	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 2 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 0.3% 30.7% 0.1%

Intersection Performance - Annual Values

Performance Measure	Vehicles		Pedestrians		Persons	
Demand Flows (Total)	3,312,000	veh/y	8,160	ped/y	3,982,561	pers/y
Delay	175,492	veh-h/y	140	ped-h/y	210,730	pers-h/y
Effective Stops	5,679,672	veh/y	7,800	ped/y	6,823,407	pers/y
Travel Distance	1,921,779	veh-km/y	293	ped-km/y	2,306,428	pers-km/y
Travel Time	206,702	veh-h/y	202	ped-h/y	248,244	pers-h/y
Cost	7,597,406	$/y	5,344	$/y	7,602,750	$/y
Fuel Consumption	517,942	L/y				
Carbon Dioxide	1,222,883	kg/y				
Hydrocarbons	140	kg/y				
Carbon Monoxide	1,181	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-DEV3-AM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation Slip Lane]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 145 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	10	3.0	0.820	44.7	LOS D	42.2	303.3	0.95	0.87	0.96	9.1
11	T1	2035	3.0	0.820	38.9	LOS C	42.4	304.3	0.95	0.87	0.96	31.8
12	R2	80	0.0	0.781	86.4	LOS F	6.1	42.7	1.00	0.86	1.25	11.5
Approach		2125	2.9	0.820	40.8	LOS C	42.4	304.3	0.95	0.87	0.97	30.6
East: Carnarvon Street (east)												
1	L2	112	0.0	0.200	22.7	LOS B	4.0	28.2	0.59	0.69	0.59	26.0
2	T1	51	3.0	0.644	79.7	LOS F	3.8	27.6	1.00	0.79	1.11	10.6
3	R2	38	3.0	0.505	83.2	LOS F	2.8	20.3	1.00	0.73	1.00	19.3
Approach		201	1.3	0.644	48.6	LOS D	4.0	28.2	0.77	0.72	0.80	18.7
North: Silverwater Road (north)												
4	L2	140	3.0	0.843	30.0	LOS C	54.1	388.2	0.87	0.83	0.87	40.2
5	T1	2672	3.0	0.843	23.2	LOS B	54.6	391.9	0.84	0.79	0.84	40.6
6	R2	274	3.0	0.662	61.6	LOS E	17.7	127.1	0.97	0.84	0.97	22.3
Approach		3086	3.0	0.843	26.9	LOS B	54.6	391.9	0.86	0.80	0.86	38.0
West: Carnarvon Street (west)												
7	L2	45	3.0	0.769	69.6	LOS E	10.7	76.5	1.00	0.90	1.20	19.1
8	T1	60	3.0	0.769	65.1	LOS E	10.7	76.5	1.00	0.90	1.20	11.9
9	R2	195	3.0	0.769	75.6	LOS F	10.7	76.5	1.00	0.89	1.16	8.0
Approach		300	3.0	0.769	72.6	LOS F	10.7	76.5	1.00	0.89	1.18	10.8
All Vehicles		5712	2.9	0.843	35.2	LOS C	54.6	391.9	0.90	0.83	0.91	32.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	66.6	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	66.6	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	66.7	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	66.6	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-DEV3-AM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation Slip Lane]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 145 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values

Performance Measure	Vehicles		Pedestrians		Persons	
Travel Speed (Average)	32.2	km/h	1.4	km/h	32.1	km/h
Travel Distance (Total)	3420.9	veh-km/h	0.6	ped-km/h	4105.7	pers-km/h
Travel Time (Total)	106.2	veh-h/h	0.4	ped-h/h	127.8	pers-h/h
Demand Flows (Total)	5712	veh/h	17	ped/h	6871	pers/h
Percent Heavy Vehicles (Demand)	2.9	%				
Degree of Saturation	0.843		0.020			
Practical Spare Capacity	6.8	%				
Effective Intersection Capacity	6777	veh/h				
Control Delay (Total)	55.90	veh-h/h	0.31	ped-h/h	67.39	pers-h/h
Control Delay (Average)	35.2	sec	66.6	sec	35.3	sec
Control Delay (Worst Lane)	86.4	sec				
Control Delay (Worst Movement)	86.4	sec	66.7	sec	86.4	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	34.4	sec				
Idling Time (Average)	29.9	sec				
Intersection Level of Service (LOS)	LOS C		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	54.6	veh				
95% Back of Queue - Distance (Worst Lane)	391.9	m				
Queue Storage Ratio (Worst Lane)	1.68					
Total Effective Stops	4715	veh/h	16	ped/h	5674	pers/h
Effective Stop Rate	0.83		0.96		0.83	
Proportion Queued	0.90		0.96		0.90	
Performance Index	439.0		0.5		439.5	
Cost (Total)	4052.63	$/h	11.76	$/h	4064.38	$/h
Fuel Consumption (Total)	478.0	L/h				
Carbon Dioxide (Total)	1130.1	kg/h				
Hydrocarbons (Total)	0.114	kg/h				
Carbon Monoxide (Total)	1.412	kg/h				
NOx (Total)	1.659	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 7.8 %
Number of Iterations: 5 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 11.2% 1.2% 11.2%

Intersection Performance - Annual Values

Performance Measure	Vehicles		Pedestrians		Persons	
Demand Flows (Total)	2,741,760	veh/y	8,160	ped/y	3,298,272	pers/y
Delay	26,832	veh-h/y	151	ped-h/y	32,349	pers-h/y
Effective Stops	2,263,261	veh/y	7,825	ped/y	2,723,738	pers/y
Travel Distance	1,642,027	veh-km/y	293	ped-km/y	1,970,726	pers-km/y
Travel Time	50,961	veh-h/y	214	ped-h/y	61,367	pers-h/y
Cost	1,945,260	$/y	5,643	$/y	1,950,903	$/y
Fuel Consumption	229,460	L/y				
Carbon Dioxide	542,424	kg/y				
Hydrocarbons	55	kg/y				
Carbon Monoxide	678	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future Mitigation-DEV3-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation Slip Lane]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	0.950	67.0	LOS E	74.2	532.8	1.00	1.13	1.26	7.1
11	T1	2760	3.0	0.950	61.0	LOS E	74.2	532.8	1.00	1.13	1.26	24.3
12	R2	255	0.0	1.050	191.5	LOS F	31.6	221.1	1.00	1.38	2.34	5.7
Approach		3021	2.7	1.050	72.0	LOS F	74.2	532.8	1.00	1.15	1.35	21.0
East: Carnarvon Street (east)												
1	L2	136	0.0	0.776	64.5	LOS E	10.2	71.2	1.00	1.08	1.50	13.7
2	T1	74	3.0	1.086	238.5	LOS F	13.4	96.4	1.00	1.59	2.87	4.0
3	R2	112	3.0	1.086	243.4	LOS F	13.4	96.4	1.00	1.58	2.88	8.7
Approach		322	1.7	1.086	166.7	LOS F	13.4	96.4	1.00	1.37	2.29	8.2
North: Silverwater Road (north)												
4	L2	64	3.0	1.017	134.1	LOS F	101.7	729.8	1.00	1.49	1.74	15.4
5	T1	2597	3.0	1.017	128.1	LOS F	101.7	729.8	1.00	1.51	1.74	14.1
6	R2	131	3.0	0.851	79.2	LOS F	9.2	65.9	1.00	0.93	1.35	18.8
Approach		2792	3.0	1.017	125.9	LOS F	101.7	729.8	1.00	1.48	1.72	14.3
West: Carnarvon Street (west)												
7	L2	49	3.0	1.001	119.9	LOS F	24.1	172.7	1.00	1.30	1.93	12.0
8	T1	36	3.0	1.001	115.4	LOS F	24.1	172.7	1.00	1.30	1.93	6.8
9	R2	418	3.0	1.001	126.5	LOS F	24.1	172.7	1.00	1.32	1.95	4.9
Approach		503	3.0	1.001	125.1	LOS F	24.1	172.7	1.00	1.32	1.95	5.9
All Vehicles		6638	2.8	1.086	103.3	LOS F	101.7	729.8	1.00	1.31	1.60	15.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	59.2	LOS E	0.0	0.0	0.95	0.95
P2	North Full Crossing	2	59.1	LOS E	0.0	0.0	0.95	0.95
P3	West Full Crossing	10	59.2	LOS E	0.0	0.0	0.95	0.95
All Pedestrians		17	59.2	LOS E			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

INTERSECTION SUMMARY

Site: 101 [Future Mitigation-DEV3-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation Slip Lane]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values

Performance Measure	Vehicles		Pedestrians		Persons	
Travel Speed (Average)	15.5	km/h	1.5	km/h	15.4	km/h
Travel Distance (Total)	3858.9	veh-km/h	0.6	ped-km/h	4631.3	pers-km/h
Travel Time (Total)	249.6	veh-h/h	0.4	ped-h/h	299.9	pers-h/h
Demand Flows (Total)	6638	veh/h	17	ped/h	7983	pers/h
Percent Heavy Vehicles (Demand)	2.8	%				
Degree of Saturation	1.086		0.018			
Practical Spare Capacity	-17.2	%				
Effective Intersection Capacity	6110	veh/h				
Control Delay (Total)	190.49	veh-h/h	0.28	ped-h/h	228.86	pers-h/h
Control Delay (Average)	103.3	sec	59.2	sec	103.2	sec
Control Delay (Worst Lane)	243.5	sec				
Control Delay (Worst Movement)	243.4	sec	59.2	sec	243.4	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	102.4	sec				
Idling Time (Average)	95.1	sec				
Intersection Level of Service (LOS)	LOS F		LOS E			
95% Back of Queue - Vehicles (Worst Lane)	101.7	veh				
95% Back of Queue - Distance (Worst Lane)	729.8	m				
Queue Storage Ratio (Worst Lane)	2.94					
Total Effective Stops	8715	veh/h	16	ped/h	10474	pers/h
Effective Stop Rate	1.31		0.95		1.31	
Proportion Queued	1.00		0.95		1.00	
Performance Index	882.7		0.5		883.2	
Cost (Total)	9299.75	$/h	10.82	$/h	9310.57	$/h
Fuel Consumption (Total)	780.1	L/h				
Carbon Dioxide (Total)	1842.9	kg/h				
Hydrocarbons (Total)	0.201	kg/h				
Carbon Monoxide (Total)	1.968	kg/h				
NOx (Total)	2.555	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 40.1% 8.5% 0.0%

Intersection Performance - Annual Values

Performance Measure	Vehicles		Pedestrians		Persons	
Demand Flows (Total)	3,186,240	veh/y	8,160	ped/y	3,831,648	pers/y
Delay	91,433	veh-h/y	134	ped-h/y	109,854	pers-h/y
Effective Stops	4,183,213	veh/y	7,786	ped/y	5,027,642	pers/y
Travel Distance	1,852,267	veh-km/y	293	ped-km/y	2,223,014	pers-km/y
Travel Time	119,785	veh-h/y	197	ped-h/y	143,939	pers-h/y
Cost	4,463,878	$/y	5,195	$/y	4,469,073	$/y
Fuel Consumption	374,449	L/y				
Carbon Dioxide	884,615	kg/y				
Hydrocarbons	96	kg/y				
Carbon Monoxide	945	kg/y				

INTERSECTION SUMMARY

Site: 101 [Future DEV-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation combined]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Intersection Performance - Hourly Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Travel Speed (Average)	22.4	km/h	1.3	km/h	22.4	km/h
Travel Distance (Total)	3860.9	veh-km/h	0.6	ped-km/h	4633.7	pers-km/h
Travel Time (Total)	172.0	veh-h/h	0.5	ped-h/h	206.9	pers-h/h
Demand Flows (Total)	6638	veh/h	17	ped/h	7983	pers/h
Percent Heavy Vehicles (Demand)	2.8	%				
Degree of Saturation	1.003		0.022			
Practical Spare Capacity	-10.3	%				
Effective Intersection Capacity	6619	veh/h				
Control Delay (Total)	114.99	veh-h/h	0.35	ped-h/h	138.34	pers-h/h
Control Delay (Average)	62.4	sec	74.1	sec	62.4	sec
Control Delay (Worst Lane)	145.7	sec				
Control Delay (Worst Movement)	145.5	sec	74.1	sec	145.5	sec
Geometric Delay (Average)	0.9	sec				
Stop-Line Delay (Average)	61.4	sec				
Idling Time (Average)	56.0	sec				
Intersection Level of Service (LOS)	LOS E		LOS F			
95% Back of Queue - Vehicles (Worst Lane)	87.5	veh				
95% Back of Queue - Distance (Worst Lane)	627.9	m				
Queue Storage Ratio (Worst Lane)	2.40					
Total Effective Stops	6650	veh/h	16	ped/h	7996	pers/h
Effective Stop Rate	1.00		0.96		1.00	
Proportion Queued	0.96		0.96		0.96	
Performance Index	592.0		0.6		592.6	
Cost (Total)	6445.58	$/h	12.88	$/h	6458.45	$/h
Fuel Consumption (Total)	639.8	L/h				
Carbon Dioxide (Total)	1512.2	kg/h				
Hydrocarbons (Total)	0.159	kg/h				
Carbon Monoxide (Total)	1.751	kg/h				
NOx (Total)	2.143	kg/h				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Intersection LOS value for Vehicles is based on average delay for all vehicle movements.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Site Model Variability Index (Iterations 3 to N): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Main (Timing-Capacity) Iterations: 6.0% 3.7% 0.0%

Intersection Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total)	3,186,240	veh/y	8,160	ped/y	3,831,648	pers/y
Delay	55,196	veh-h/y	168	ped-h/y	66,404	pers-h/y
Effective Stops	3,192,024	veh/y	7,856	ped/y	3,838,286	pers/y
Travel Distance	1,853,223	veh-km/y	309	ped-km/y	2,224,177	pers-km/y
Travel Time	82,555	veh-h/y	234	ped-h/y	99,300	pers-h/y
Cost	3,093,876	$/y	6,181	$/y	3,100,057	$/y
Fuel Consumption	307,109	L/y				
Carbon Dioxide	725,835	kg/y				
Hydrocarbons	76	kg/y				
Carbon Monoxide	840	kg/y				

MOVEMENT SUMMARY

Site: 101 [Future DEV-PM Opt 1a-2.7 FSR Silverwater Rd and Carnarvon St - MTE Mitigation combined]

15% Reduction on Silverwater Road
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 160 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road (south)												
10	L2	6	3.0	0.005	12.4	LOS A	0.1	0.9	0.29	0.63	0.29	27.3
11	T1	2760	3.0	0.866	32.2	LOS C	60.5	434.4	0.93	0.87	0.93	35.1
12	R2	255	0.0	0.955	112.1	LOS F	25.1	175.9	1.00	1.05	1.53	9.3
Approach		3021	2.7	0.955	38.9	LOS C	60.5	434.4	0.94	0.88	0.98	31.0
East: Carnarvon Street (east)												
1	L2	136	0.0	0.249	28.6	LOS C	6.0	41.8	0.64	0.72	0.64	23.1
2	T1	74	3.0	1.003	140.4	LOS F	10.4	74.8	1.00	1.27	2.00	6.6
3	R2	112	3.0	1.003	145.5	LOS F	10.4	74.8	1.00	1.27	2.01	13.3
Approach		322	1.7	1.003	95.0	LOS F	10.4	74.8	0.85	1.04	1.43	13.0
North: Silverwater Road (north)												
4	L2	64	3.0	0.959	79.3	LOS F	87.5	627.9	1.00	1.10	1.23	22.9
5	T1	2597	3.0	0.959	73.1	LOS F	87.5	627.9	1.00	1.11	1.23	21.5
6	R2	131	3.0	0.887	98.2	LOS F	11.4	82.0	1.00	0.96	1.40	16.2
Approach		2792	3.0	0.959	74.4	LOS F	87.5	627.9	1.00	1.10	1.24	21.2
West: Carnarvon Street (west)												
7	L2	49	3.0	0.298	53.3	LOS D	5.0	36.3	0.93	0.75	0.93	22.4
8	T1	36	3.0	0.298	48.7	LOS D	5.0	36.3	0.93	0.75	0.93	14.5
9	R2	418	3.0	0.980	128.4	LOS F	22.2	159.3	1.00	1.22	1.72	5.1
Approach		503	3.0	0.980	115.4	LOS F	22.2	159.3	0.99	1.14	1.58	6.7
All Vehicles		6638	2.8	1.003	62.4	LOS E	87.5	627.9	0.96	1.00	1.16	22.4

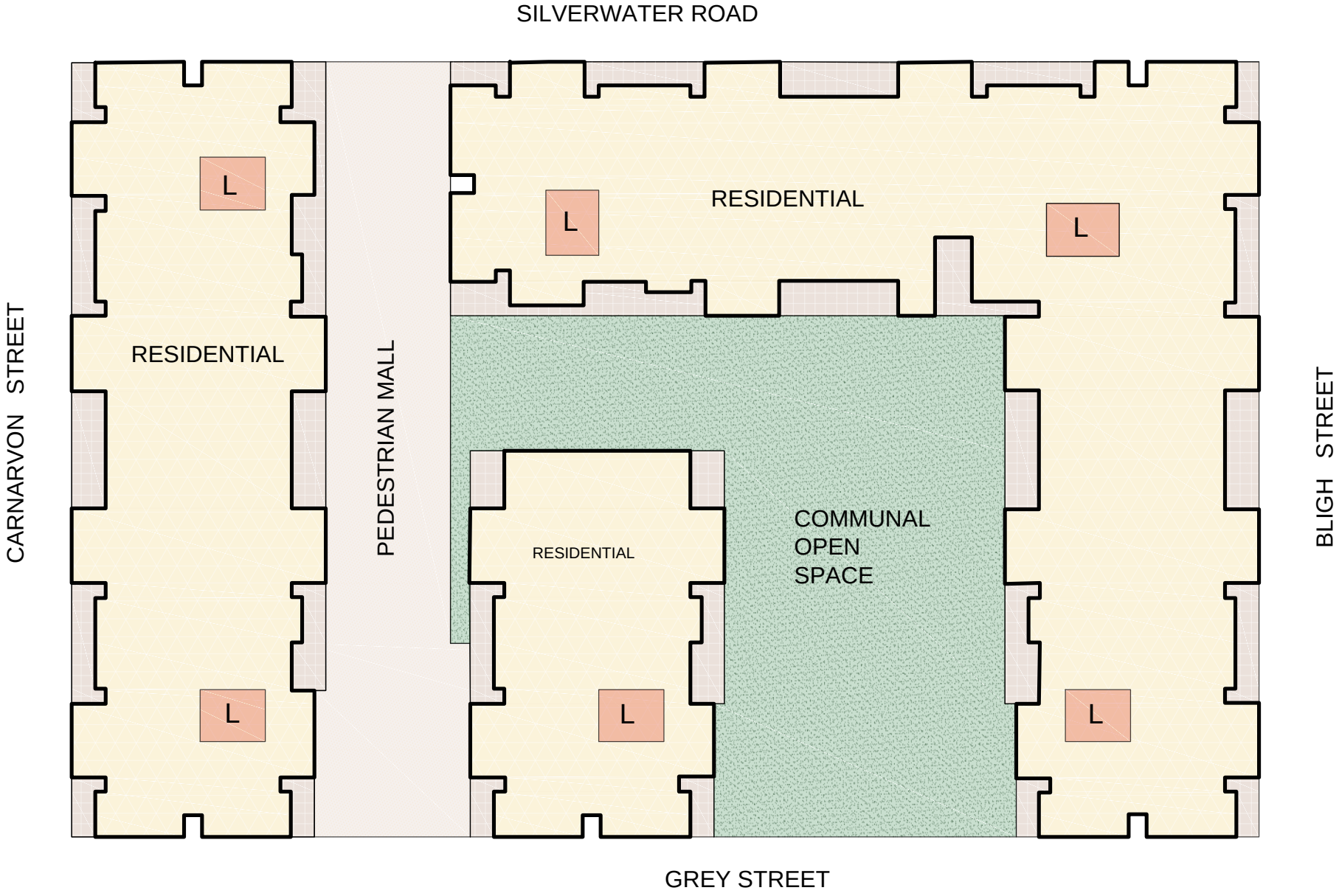
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	East Full Crossing	5	74.1	LOS F	0.0	0.0	0.96	0.96
P2	North Full Crossing	2	74.1	LOS F	0.0	0.0	0.96	0.96
P3	West Full Crossing	10	74.1	LOS F	0.0	0.0	0.96	0.96
All Pedestrians		17	74.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

APPENDIX F

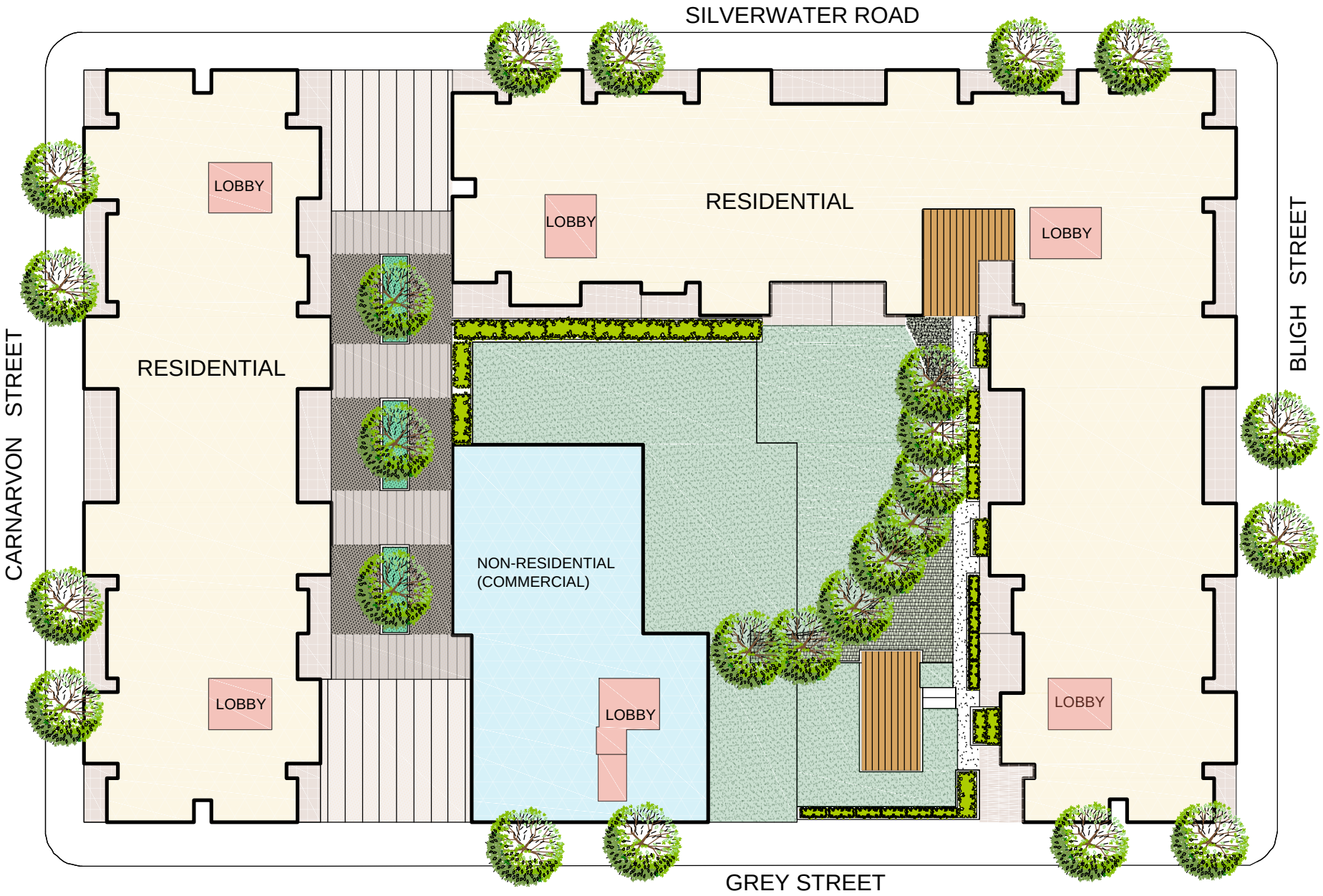


MIXED USE DEVELOPMENT

1-17 GREY ST SILVERWATER

TYPICAL FLOOR PLAN

SCALE 1:500 @ A4

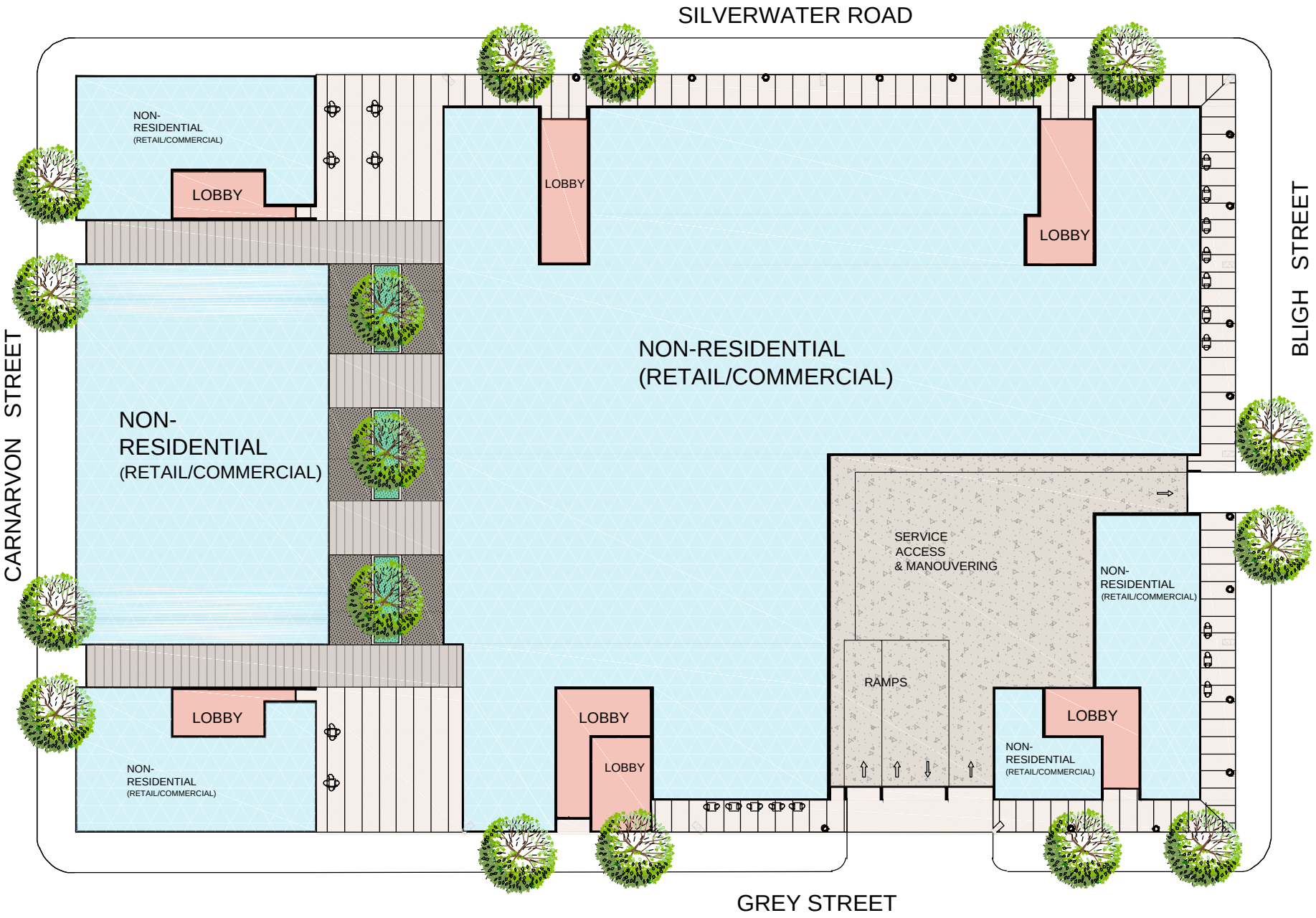


MIXED USE DEVELOPMENT

1-17 GREY ST SILVERWATER

LEVEL 1

SCALE 1:500 @ A4

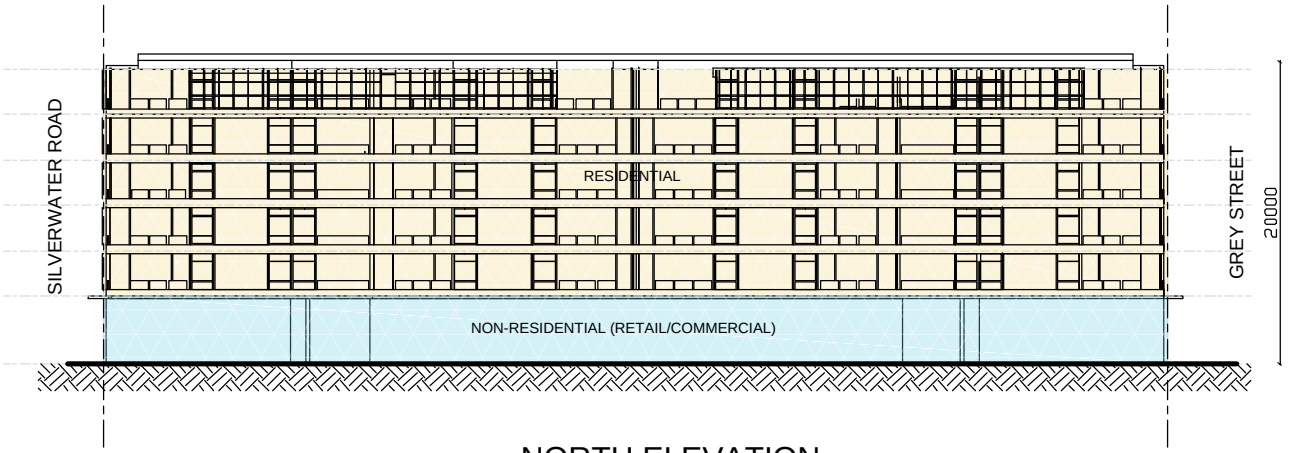


MIXED USE DEVELOPMENT

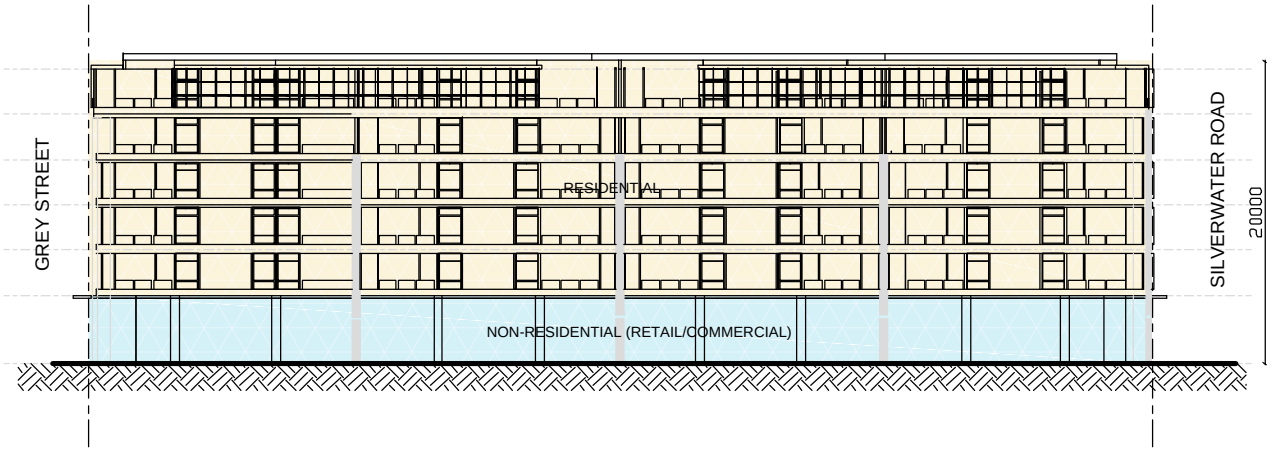
1-17 GREY ST SILVERWATER

GROUND FLOOR

SCALE 1:500 @ A4



NORTH ELEVATION
(CARNARVON STREET)



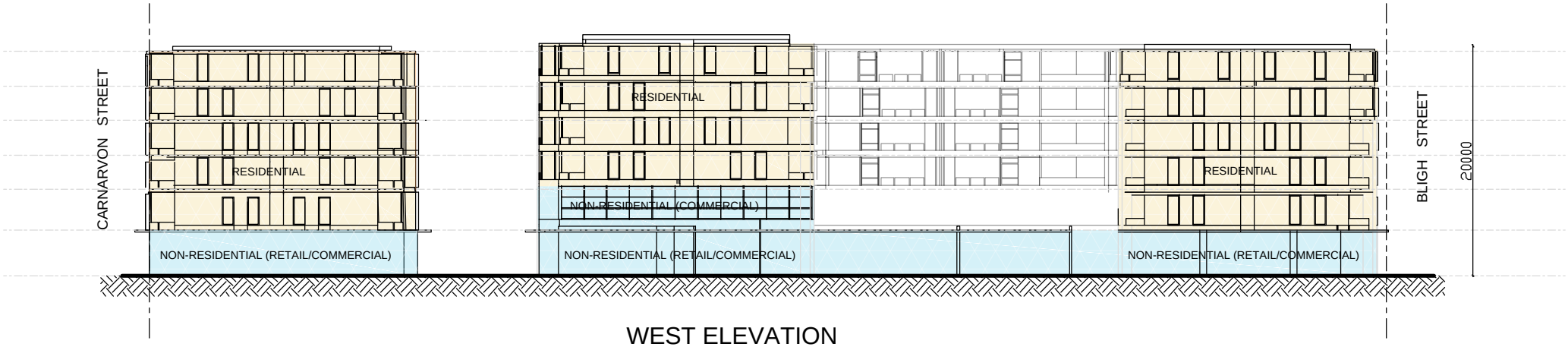
SOUTH ELEVATION
(BLIGH STREET)

MIXED USE DEVELOPMENT

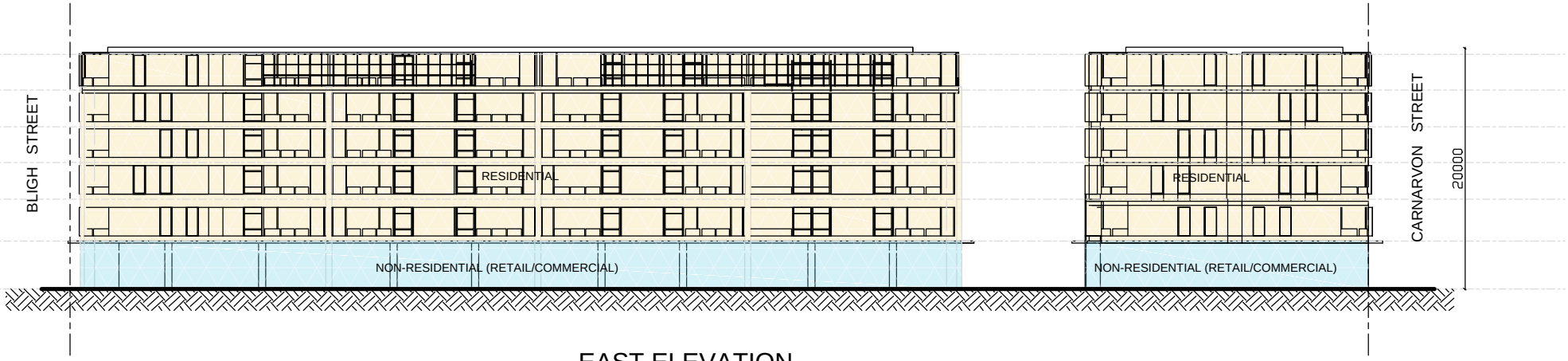
1-17 GREY ST SILVERWATER

ELEVATIONS

SCALE 1:500 @ A4



WEST ELEVATION
(GREY STREET)



EAST ELEVATION
(SILVERWATER ROAD)

MIXED USE DEVELOPMENT

1-17 GREY ST SILVERWATER

ELEVATIONS

SCALE 1:500 @ A4

APPENDIX G

HILFOR PROJECT PTY LTD

TRANSPORT REPORT FOR PROPOSED REZONING, 32-48 SILVERWATER ROAD & 1-17 GREY STREET, SILVERWATER

MAY 2014

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1. INTRODUCTION

1.1 Colston Budd Hunt and Kafes Pty Ltd has been commissioned by Hilfor Project Pty Ltd to prepare a report assessing the transport implications of a proposed rezoning at 32-48 Silverwater Road and 1-17 Grey Street at Silverwater. The site location is shown on Figure 1.

1.2 The site is occupied by a commercial building previously used by a dry cleaner, a café and residential dwellings. It is proposed to rezone the site to B2 local centre. A potential scale of development includes some 3,500m^2 retail, 500m^2 commercial plus 250 residential apartments.

1.3 The planning proposal was originally submitted in June 2013. A Council resolution of 4 December 2013 included the following:

> *1. That Council prepare a Planning Proposal in accordance with Section 55 of the Environmental Planning and Assessment Act 1979 (EP&A Act), to amend Auburn Local Environmental Plan 2010 to:*
>
> *a) Rezone land at 1-17 Grey Street and 32-48 Silverwater Road, Silverwater to B2 Local Centre;*
> *b) Prior to sending to Gateway undertake and complete the following studies;*
>
> *i) Revise the current Transport Study as per the RMS' and Council's Preliminary comments;*

1.4 The Council and RMS preliminary comments referred to in the resolution are included in section 4.3.1 and appendix 12 of the Council report considered at the meeting of 20 November 2013, and are as follows:

Council's engineering and planning units have assessed the above study submitted by the applicant as part of this application, and have provided the following comments:

- *The study should take into account that there are residential properties in Grey Street west of the subject site which would be directly affected by the planning proposal;*
- *The traffic signals at the intersection of Carnarvon Street and Silverwater Road need to be analysed to assess whether extension of right turn lanes in Carnarvon Street approaching west and Silverwater Road northern approach is required. Any extension would require RMS approval.*
- *Carnarvon Street currently experiences excessive traffic queue lengths during peak hours and the proposed mix use development would aggravate this;*
- *The peak hour traffic entering the intersection from the western approach of Carnarvon Street would increase by approximately 50% as a result of this planning proposal;*
- *The queue length of vehicles on Carnarvon Street would adversely affect the operation of the Grey and Carnarvon Street intersection;*
- *The study does not consider existing traffic impacts of the Silverwater Road-Parramatta Road intersection located 530 metres south, and the M4 Motorway access ramps located on Silverwater Road approximately 300 metres south of the subject site;*
- *The subject site is not well serviced by cycle routes (as shown in Figure 1 of this report) and is located away from current on road, off road and proposed cycle routes;*
- *The subject site is serviced by Sydney bus routes 540 and 544. The 544 route operates between Auburn Railway Station and Macquarie Shopping Centre, and route 540 operates between Auburn Railway Station and Newington Village. The two bus routes operate at 20 to 30 minute intervals from Monday to Friday during morning and afternoon peak times, and have limited (ie hourly) bus services throughout the day during weekdays and weekends. It takes approximately 15-20 minutes to travel from the subject site to Auburn Railway Station during peak times. The closest bus stops to the subject site are at Carnarvon/Stanley Street and Carnarvon/Vore Street approximately 2 to 10 minutes walking distance from the subject site (refer Figure 1);*

- *The M92 metro and Veolia bus routes operate between Parramatta Railway Station and Sutherland Railway Station and Bankstown Railway Station via Parramatta Road. The nearest bus stops to access these routes are located approximately 650 metres from the subject site, approximately 15 – 20 minutes walking distance away.*

Reference is made to Council's correspondence dated 19 July 2013 and associated traffic models received on 26 August 2013 with regard to the abovementioned rezoning proposal, which was referred to Roads and Maritime Services (RMS) for comment.

RMS appreciates this opportunity and provides the following preliminary comments to Council to the traffic models:

Silverwater Road/Carnarvon Street intersection

- *The maximum cycle time for the intersection is 130 seconds.*
- *The length of kerbside lane on Carnarvon Road West is incorrectly coded.*
- *The heavy vehicle percentage for all the movements in the existing weekday AM is 5%. However, it decreases to 3% in the weekday AM with the development.*
- *There is no additional traffic on Carnarvon Street West approach in the Weekday AM+Dev model compared to the traffic volume in the Weekday AM model. In addition, only total 60 additional vehicles are in the Weekday PM+Dev model compared to the total traffic volume in the model for Weekday PM, which is inconsistent with the estimated traffic generation in the Transport Report for the Proposed Mixed Use Rezoning, 32-34 & 38-46 Silverwater Road. In this regard, the impact of the additional traffic generated from the development is not correctly modelled at this intersection. The traffic volume input data in the models needs to be reviewed and revised.*
- *The adjacent signalised intersection of Silverwater Road and Fariola Street, north to the intersection is approximately 685 metre apart from this intersection which is larger than 500m. The arrival type for Silverwater Road North approach should be type 4-favourable.*

Silverwater Road/Fariola Road intersection

- *The maximum cycle time for the intersection is 130 seconds.*
- *The length of the right turn bays on Silverwater Road is incorrectly coded. The taper area of the right turn bays should not be included.*
- *The length of the kerbside lane on Fariola Street East approach is incorrectly coded. The adjacent signalised intersection of Silverwater Road and Carnarvon Road, south to the intersection is approximately 685 metre apart from this intersection which is larger than 500 m. The arrival type for Silverwater Road South approach should be type 4-favourable.*

As a result of the above, the SIDRA models should be revised and re-submitted to RMS for review.

1.5 In addition, Council officers, in a letter dated 9 January 2014, have provided the following comments in relation to part 1(b)i) of the Council resolution:

Applicant to revise the current Transport Study (prepared by Colston Budd Hunt and Kafes Pty Ltd) as per Roads and Maritime Services' (RMS) comments included under Appendix 12 and Council's preliminary comments included under section 4.3.1 of Council's Planning Proposal Application Assessment.

1.6 This report assesses the transport implications of the potential scale of development through the following chapters:

- Chapter 2 - describing the existing conditions; and
- Chapter 3 - assessing the transport implications of the proposed development, including the matters raised by the authorities.

2. EXISTING CONDITIONS

Site Location and Road Network

2.1 The site is located at 32-48 Silverwater Road and 1-17 Grey Street at Silverwater, as shown on Figure 1. It occupies the entire block bounded by Silverwater Road, Carnarvon Street, Bligh Street and Grey Street. The site is occupied by a commercial building previously used by a dry cleaner, a café and residential dwellings. Vehicular access to the site is provided from all of the streets noted above.

2.2 Surrounding land use includes industrial and commercial development along Silverwater Road, and north of the site. There is residential development to the south and east. The M4 Motorway is south of the site. To the west are residential properties, industrial properties, open space and a church.

2.3 Silverwater Road is a major road which forms part of a north-south route connecting Hornsby, Pennant Hills and Carlingford in the north with Auburn, Bankstown and the southern suburbs of Sydney in the south. In the vicinity of the site it provides a six lane divided carriageway with three traffic lanes in each direction and a 70 kilometre per hour speed limit. Clearways operate in both directions during weekday peak periods. Major intersections are signalised with additional lanes for turning traffic.

2.4 Carnarvon Street intersects Silverwater Road at a signalised intersection, adjacent to the site, with all turns permitted. It provides for one traffic lane and one parking lane in each direction, clear of intersections. Carnarvon Street provides access to industrial development. There are bus stops west of the site.

2.5 Bligh Street connects to Silverwater Road, south of the site, at an unsignalised t-intersection. Turns at the intersection are restricted to left in/left out by the median in Silverwater Road. Bligh Street provides access to industrial and residential development. It provides for one traffic lane and one parking lane in each direction, clear of intersections.

2.6 Grey Street connects Carnarvon Street with Bligh Street. Both intersections are unsignalised t-intersections, with all turns permitted. Grey Street provides access to industrial properties and the subject site. It provides for one traffic lane and one parking lane in each direction, clear of intersections, and has a three tonne load limit.

Traffic Flows

2.7 Traffic generated by the proposed development will have its greatest effects during weekday morning and afternoon peak periods when it combines with commuter traffic on the surrounding road network. In order to gauge traffic conditions, counts were undertaken during weekday morning and afternoon peak periods at the following intersections:

- Silverwater Road/Carnarvon Street;
- Silverwater Road/Bligh Street;
- Grey Street/Carnarvon Street; and
- Grey Street//Bligh Street.

2.8 The results of the surveys are shown in Figures 2 and 3, and summarised in Table 2.1.

Table 2.1: Existing two-way (sum of both directions) peak hour traffic flows			
Road	**Location**	**AM peak hour**	**PM peak hour**
Silverwater Road	North of Carnarvon Street	3,835	3,220
	North of Bligh Street	4,400	3,840
	South of Bligh Street	4,470	3,865
Carnarvon Street	East of Silverwater Road	530	555
	West of Silverwater Road	525	615
	West of Grey Street	545	595
Bligh Street	West of Silverwater Road	80	45
	West of Grey Street	65	50
Grey Street	South of Carnarvon Street	40	20
	North of Bligh Street	65	15

2.9 Table 2.1 shows that Silverwater Road carried some 3,200 to 4,500 vehicles per hour two-way during the weekday morning and afternoon peak hours. Carnarvon Street carried lower flows of some 500 to 600 vehicles per hour two-way. Flows on Bligh Street and Grey Street were less than 100 vehicles per hour two-way.

Intersection Operations

2.10 The capacity of the road network is largely determined by the capacity of its intersections to cater for peak period traffic flows. The surveyed intersections shown in Figures 2 and 3 have been analysed using the SIDRA program.

2.11 SIDRA simulates the operations of intersections to provide a number of performance measures. The most useful measure provided is average delay per vehicle expressed in seconds per vehicle. Based on average delay per vehicle, SIDRA estimates the following levels of service (LOS):

- For traffic signals, the average delay per vehicle in seconds is calculated as delay/(all vehicles), for roundabouts the average delay per vehicle in seconds is selected for the movement with the highest average delay per vehicle, equivalent to the following LOS:

0 to 14	=	"A"	Good
15 to 28	=	"B"	Good with minimal delays and spare capacity
29 to 42	=	"C"	Satisfactory with spare capacity
43 to 56	=	"D"	Satisfactory but operating near capacity
57 to 70	=	"E"	At capacity and incidents will cause excessive delays. Roundabouts require other control mode.
>70	=	"F"	Unsatisfactory and requires additional capacity

- For give way and stop signs, the average delay per vehicle in seconds is selected from the movement with the highest average delay per vehicle, equivalent to following LOS:

0 to 14	=	"A"	Good
15 to 28	=	"B"	Acceptable delays and spare capacity
29 to 42	=	"C"	Satisfactory but accident study required
43 to 56	=	"D"	Near capacity and accident study required
57 to 70	=	"E"	At capacity and requires other control mode
>70	=	"F"	Unsatisfactory and requires other control mode

2.12 It should be noted that for roundabouts, give way and stop signs, in some circumstances, simply examining the highest individual average delay can be misleading. The size of the movement with the highest average delay per vehicle should also be taken into account. Thus, for example, an intersection where all

movements are operating at a level of service A, except one which is at level of service E, may not necessarily define the intersection level of service as E if that movement is very small. That is, longer delays to a small number of vehicles may not justify upgrading an intersection unless a safety issue was also involved.

2.13 The SIDRA analysis found that the signalised intersection of Silverwater Road with Carnarvon Street is operating with average delays of less than 50 seconds per vehicle during peak periods. This represents levels of service D, a satisfactory level of service for a busy intersection during peak periods.

2.14 At the intersection of Silverwater Road with Bligh Street, observations indicate that traffic turns from Bligh Street when gaps are created in the traffic stream by the upstream traffic signals on Silverwater Road.

2.15 The intersections of Grey Street with Carnarvon Street and Bligh Street are operating with average delays for the highest delayed movements of less than 15 seconds per vehicle during peak periods. This represents levels of service A/B, a good level of service.

Public Transport

2.16 The closest railway station to the site is Auburn, which is some 20 minutes walking distance. Auburn is on the Western (Emu Plains/Richmond to North Sydney via the City) and South (Macarthur to City via Granville) Lines.

2.17 Services through Auburn are every 30 minutes in each direction on the Western Lines and every 15 to 30 minutes in each direction on the South Line. During weekday peak periods, services are every 10 to 15 minutes in each direction.

2.18 Local bus services are provided by Sydney Buses. As previously discussed, there are bus stops on Carnarvon Street, west of the site.

2.19 Route 544 connects Auburn, Silverwater, Ermington, Eastwood, Deniston East, Macquarie University and Macquarie Centre. Services are every 60 minutes in each direction, Monday to Saturday, and every 15 to 30 minutes during weekday peak periods. Services include a link to Auburn railway station.

2.20 Route 540 operates along Carnarvon Street and Vore Street and connects Auburn and Newington. It provides a weekday peak period service.

2.21 There is a north-south cycle route west of site which connects Auburn with Sydney Olympic Park. This route connects to the wider cycle network within the LGA.

2.22 The draft Metropolitan Strategy for Sydney identifies the need for a future viable and frequent public transport service along the Parramatta Road corridor, in which the site is located.

2.23 The site is therefore accessible by existing public transport services, and close to future planned services along Parramatta Road.

3. IMPLICATIONS OF PROPOSED DEVELOPMENT

3.1 It is proposed to rezone the site to B2 local centre. A potential scale of development includes some 3,500m^2 retail, 500m^2 commercial plus 250 residential apartments. Vehicular access is proposed from Grey Street.

3.2 Parking will be provided in accordance with appropriate Council and RMS controls at the time that a development application is made. This chapter assesses the transport implications of the proposed development through the following sections:

- policy context;
- public transport, walking and cycling;
- travel access guide;
- access, servicing and internal layout;
- traffic generation and effects;
- matters raised by authorities; and
- summary.

Policy Context

- Metropolitan Transport Plan

3.3 The Metropolitan Transport Plan – Connecting the City of Cities has four key policy objectives:

- commuting to work easily and quickly;

- transport and services accessible to all members of the community;
- an efficient, integrated and customer focused public transport system; and
- revitalized neighbourhoods with improved transport hubs.

3.4 It includes a target of 28 per cent of trips to work in the Sydney Metropolitan Region to be undertaken by public transport by 2016, compared to some 22 per cent in 2006.

3.5 To help achieve these objectives, it identifies, in conjunction with the metropolitan strategy, key areas of future housing and employment growth in Sydney to 2020 and 2036. Additionally, it outlines a 10 year funding program to 2020 for the following transport projects:

- rail line extensions for more platforms at CBD stations;
- rail lines to north west and south west Sydney;
- light rail in the CBD and further extension to the Inner West;
- more air conditioned train carriages;
- 1,000 additional buses;
- completion of the 43 strategic bus corridors across Sydney;
- completion of the highest priority missing links in the Sydney Strategic Cycleway Network.

- NSW 2021

3.6 NSW 2021: A Plan to Make NSW Number One sets targets to increase the proportion of commuter trips made by public transport for various areas within Sydney by 2016, including:

- 80 per cent in the Sydney CBD;
- 50 per cent in the Parramatta CBD;
- 20 per cent in the Liverpool CBD; and
- 25 per cent in the Penrith CBD.

3.7 It also has targets to:

- improve road safety and reduce fatalities to 4.3 per 100,000 population by 2016;
- double the mode share of bicycle trips made in the metropolitan area by 2016; and
- increase the proportion of the population living within 30 minutes by public transport of a city or major centre in the metropolitan area.

3.8 The following sections discuss how the proposed development satisfies these objectives and the measures proposed to achieve them.

Public Transport, Walking and Cycling

3.9 As previously discussed, the site is accessible by bus services which connect to surrounding areas including Auburn, Silverwater, Ermington, Newington, Eastwood, Deniston East, Macquarie University and Macquarie Centre. Services include a link to Auburn railway station. There are bicycle routes close to the site which connects to surrounding areas and the wider network within Auburn. The planned future provision of public transport along Parramatta Road will further improve the site's accessibility.

3.10 Existing public transport services will provide for people to access the development by public transport, walking and cycling, for residents, and for employees in the retail component. To support accessibility by bicycles, appropriate bicycle parking, in accordance with Council requirements, should be provided. Provision will be included for a bus stop on Silverwater Road, adjacent to the site.

3.11 The development will therefore satisfy the objectives of the Metropolitan Transport Plan and NSW 2021 as follows:

- enabling commuters to readily access trains and buses close to the site (Metropolitan Transport Plan objective);
- providing an appropriate level of on-site parking, with reference to appropriate Council and RMS requirements, to encourage public transport use and increase the proportion of trips by public transport (Metropolitan Transport Plan objective);
- providing residential development close to employment centres in Silverwater and Sydney Olympic Park, to reduce the need for travel; and
- improving pedestrian connectivity in the area by providing a through site pedestrian link between Grey Street and Silverwater Road.

Travel Access Guide

3.12 To encourage travel modes other than private vehicle, a travel demand management approach should be adopted, through a travel access guide to meet

the specific needs of future residents, employees and visitors. The specific requirements and needs of these groups should be incorporated in the travel access guide to support the objectives of encouraging the use of public transport.

3.13 The principles of the travel access guide, which should be developed as part of a future development application in consultation with Council, RMS, public transport providers and other stakeholders, would include the following:

- encourage the use of public transport, including rail and bus services close to the site;
- identify existing bus routes which stop near the site, including the location of bus stops and pedestrian crossings at signalised intersections;
- work with public transport providers to improve services;
- encourage public transport by residents and employees through the provision of information, maps and timetables in the travel access guide;
- raise awareness of health benefits of walking and cycling (including maps showing walking and cycling routes);
- encourage cycling by providing safe and secure bicycle parking, including the provision of lockers and rails;
- provide appropriate on-site parking provision, consistent with appropriate Council/RMS controls and the objective of reducing traffic generation.

3.14 The travel access guide should be developed in accordance with the principles identified by Transport for NSW and RMS, and distributed with marketing material for the site. The travel access guide would assist in delivering sustainable transport objectives by considering the means available for reducing dependence solely on cars for travel purposes, encouraging the use of public transport and supporting the efficient and viable operation of public transport services.

Access, Servicing and Internal Layout

3.15 Vehicular access to the proposed development would be provided from Grey Street. Driveways will provide for two-way traffic, with all movements permitted, and should be provided with widths and grades in accordance with the Australian Standard for Parking Facilities (Part 1: Off-street car parking), AS 2890.1:2004. The driveways will include maximum grades of 1:20 for six metres inside the property line for appropriate visibility between pedestrians and exiting vehicles.

3.16 A shared zone will be provided, running east-west through the site, for cars and pedestrians. It will provide vehicular access to buildings within the development, from Grey Street. It will not provide a vehicular connection to Silverwater Road. Pedestrians will be able to walk through the site between Grey Street and Silverwater Road.

3.17 At the development application stage, the parking space dimensions, aisle widths, column locations and height clearances should be provided in accordance with AS 2890.1:2004.

3.18 Appropriate provision for service vehicles should be included within the development. Service vehicles will include garbage collection and deliveries to the

retail and commercial components. The design should provide for service vehicles to enter and exit the site in a forward direction, with service vehicle areas to be provided in accordance with AS 2890.2 – 2002. The size of trucks will depend on final retail tenancies, but will likely include rigid trucks and semi-trailers.

Traffic Generation and Effects

3.19 Traffic generated by the proposed development will have its greatest effects during weekday morning and afternoon peak periods when it combines with commuter traffic. The RMS "Guide to Traffic Generating Developments" indicates that high density residential apartments in town centre locations close to public transport generate 0.29 vehicles per hour per dwelling, two-way, during peak hours. Medium density developments generate some 0.4 to 0.65 vehicles per hour two-way.

3.20 Based on the above, the proposed development would be likely to have a traffic generation of some 0.3 to 0.4 vehicles per hour per dwelling two-way at peak times. Therefore, traffic generation of the residential component would be some 75 to 100 vehicles per hour two-way at peak times.

3.21 The RMS guidelines suggest a traffic generation of some two vehicles per hour per 100m^2 for commercial development at peak times. Therefore, the commercial component would generate some 10 vehicles per hour two-way at peak times.

3.22 The RMS "Guide to Traffic Generating Developments" indicates that small retail developments generate some 12.3 vehicles per hour per 100m^2 two-way during weekday afternoon peak hours. During the weekday morning peak hour, the generation is significantly lower as trading is low and many shops are not open.

3.23 For the morning peak hour, we have assessed a generation of 20 per cent of the afternoon peak hour.

3.24 The retail component would therefore have a traffic generation of some 85 and 430 vehicles per hour two-way during morning and afternoon peak hours respectively. Total traffic generation would therefore be some 170 to 195 and 515 to 540 vehicles per hour two-way during morning and afternoon peak hours respectively.

3.25 The RMS guidelines indicate that some 25 per cent of retail traffic is passing trade (customers who would have driven past the site regardless of their visit to the site). Our assessment is based on 25 per cent of retail traffic being passing trade.

3.26 The additional traffic has been assigned to the road network. Existing traffic flows plus the additional development traffic are shown in Figures 2 and 3, and summarized in Table 3.1.

Table 3.1: Existing two-way peak hour traffic flows plus development traffic

Road	Location	AM peak hour		PM peak hour	
		Existing	Plus development	Existing	Plus development
Silverwater Road	North of Carnarvon Street	3,835	+50	3,220	+130
	North of Bligh Street	4,400	+25	3,840	+65
	South of Bligh Street	4,470	+50	3,865	+130
Carnarvon Street	East of Silverwater Road	530	+20	555	+50
	West of Silverwater Road	525	+105	615	+315
	West of Grey Street	545	+20	595	+60
Bligh Street	West of Silverwater Road	80	+35	45	+135
	West of Grey Street	65	+20	50	+60
Grey Street	South of Carnarvon Street	40	+125	20	+375
	North of Bligh Street	65	+60	15	+130

3.27 Table 3.1 shows that traffic increases on Silverwater Road, Carnarvon Street, Bligh Street and Grey Street would be some 20 to 125 vehicles per hour two-way during morning peak hours and some 50 to 375 vehicles per hour two-way during afternoon peak hours.

3.28 The intersections previously analysed in Chapter 2 have been re-analysed with SIDRA for the additional development traffic flows shown in Figures 2 and 3.

3.29 The analysis found that the intersection of Silverwater Road with Carnarvon Street would operate with average delays of less than 50 seconds per vehicle during peak periods. This represents levels of service D, a satisfactory level of service for a busy intersection during peak periods.

3.30 The modest additional traffic turning from Bligh Street into Silverwater Road would not have significant implications on its operation. Traffic will continue to turn from Bligh Street when gaps are created in the traffic stream by the upstream traffic signals on Silverwater Road.

3.31 The intersections of Grey Street with Carnarvon Street and Bligh Street will continue to operate with average delays for the highest delayed movements of less than 15 seconds per vehicle during peak periods. This represents levels of service A/B, a good level of service.

3.32 Therefore, the road network will be able to cater for the additional traffic from the proposed development.

Matters Raised by Authorities

o Council matters

- *The study should take into account that there are residential properties in Grey Street west of the subject site which would be directly affected by the planning proposal;*

3.33 As noted in Chapter 2, there is a variety of surrounding land uses, including industrial, residential, open space and a church. The site adjoins Silverwater Road which is an arterial road with a variety of industrial and other uses and fronts Carnarvon Street which serves the adjacent industrial area.

3.34 There are seven residential properties on the western side of Grey Street. As noted in our previous report, there would be additional traffic in Grey Street, from where vehicular access to the development would be provided. The intersections of Grey Street with Carnarvon Street and Bligh Street will operate at good levels of service with the additional development traffic.

- *The traffic signals at the intersection of Carnarvon Street and Silverwater Road need to be analysed to assess whether extension of right turn lanes in Carnarvon Street approaching west and Silverwater Road northern approach is required. Any extension would require RMS approval.*

3.35 The SIDRA analysis indicates that with the additional development traffic, the 95th percentile queue length for vehicles turning right from Silverwater Road into Carnarvon Street would be some 66 and 108 metres during weekday morning and afternoon peak periods respectively. These queues will be readily accommodated in the existing right turn bay which is more than 170 metres long.

- *Carnarvon Street currently experiences excessive traffic queue lengths during peak hours and the proposed mix use development would aggravate this;*

3.36 The analysis indicates that with the additional development traffic, the 95th percentile queue length for vehicles turning right from Carnarvon Street into Silverwater Road would be some 74 and 113 metres during the morning and afternoon peak hours respectively. The morning queue length queue length would be accommodated between Silverwater Road and Grey Street. To accommodate the afternoon queue, the no parking restrictions on the northern side of Carnarvon Street could be extended to Stanley Street.

- *The peak hour traffic entering the intersection from the western approach of Carnarvon Street would increase by approximately 50% as a result of this planning proposal;*

3.37 The SIDRA modelling includes the additional development traffic using the Carnarvon Street approach to the Silverwater Road intersection.

- *The queue length of vehicles on Carnarvon Street would adversely affect the operation of the Grey and Carnarvon Street intersection;*

3.38 This matter relates to the ability for vehicles to turn right from Grey Street into Carnarvon Street, if the queue on Carnarvon Street from the Silverwater Road traffic signals extends to Grey Street. This could be addressed by implementing 'keep clear' controls at the intersection.

- *The study does not consider existing traffic impacts of the Silverwater Road-Parramatta Road intersection located 530 metres south, and the M4 Motorway access ramps located on Silverwater Road approximately 300 metres south of the subject site;*

3.39 The study has considered the intersections closest to the site which would be most affected by traffic from the proposed development. The intersections of Silverwater Road with Parramatta Road and the M4 Motorway ramps are further from the site than those assessed in the traffic study and the effects of the development traffic on these intersections would be modest.

3.40 The additional traffic through the intersections of Silverwater Road/Parramatta Road and Silverwater Road/M4 ramps would be up to some 50 and 130 vehicles per hour two-way during weekday morning and afternoon peak hours respectively. We note that existing flows on Silverwater Road are some 4,500 vehicles per hour two-way and Parramatta Road and the M4 ramps carry in the order of up to 4,000 vehicles per hour two-way. The modest increases as a result of the proposed development would not have noticeable effects on the operations of these intersections.

- *The subject site is not well serviced by cycle routes (as shown in Figure 1 of this report) and is located away from current on road, off road and proposed cycle routes;*

3.41 As noted in Chapter 2, there is a cycle route close to and west of the site which connects Auburn with Sydney Olympic Park. The route is less than 100 metres from the site, and connects to the wider cycle network within the LGA. The existing cycle network in the area will therefore be readily accessible to residents in the proposed development.

- *The subject site is serviced by Sydney bus routes 540 and 544. The 544 route operates between Auburn Railway Station and Macquarie Shopping Centre, and route 540 operates between Auburn Railway Station and Newington Village. The two bus routes operate at 20 to 30 minute intervals from Monday to Friday during morning and afternoon peak times, and have limited (ie hourly) bus services throughout the day*

during weekdays and weekends. It takes approximately 15-20 minutes to travel from the subject site to Auburn Railway Station during peak times. The closest bus stops to the subject site are at Carnarvon/Stanley Street and Carnarvon/Vore Street approximately 2 to 10 minutes walking distance from the subject site (refer Figure 1);

3.42 These matters are noted. We note that the Carnarvon Street bus stops are some one to four minutes' walk from the site, based on a walking speed of 80 metres per minute.

- *The M92 metro and Veolia bus routes operate between Parramatta Railway Station and Sutherland Railway Station and Bankstown Railway Station via Parramatta Road. The nearest bus stops to access these routes are located approximately 650 metres from the subject site, approximately 15 – 20 minutes walking distance away.*

3.43 These matters are noted. We note that a 650 metre walk would generally take around eight minutes, based on a walking speed of 80 metres per minute.

o RMS Matters

Silverwater Road/Carnarvon Street intersection

- *The maximum cycle time for the intersection is 130 seconds.*

3.44 We have not incorporated this amendment to the SIDRA model for the Silverwater Road/Carnarvon Street intersection, as the cycle time of 130 seconds identified by RMS is shorter than that measured by ourselves. We note that the operation of the intersection is relatively sensitive to small changes in the cycle time.

- *The length of kerbside lane on Carnarvon Road West is incorrectly coded.*

3.45 The Carnarvon Street west approach to the Silverwater Road intersection has been modified to include parking within 60 metres for the kerb side lane.

- *The heavy vehicle percentage for all the movements in the existing weekday AM is 5%. However, it decreases to 3% in the weekday AM with the development.*

3.46 Heavy vehicle percentages have been amended to two per cent for all scenarios. The previous SIDRA file sent to RMS for this intersection was prepared in association with another project and inadvertently sent to RMS.

- *There is no additional traffic on Carnarvon Street West approach in the Weekday AM+Dev model compared to the traffic volume in the Weekday AM model. In addition, only total 60 additional vehicles are in the Weekday PM+Dev model compared to the total traffic volume in the model for Weekday PM, which is inconsistent with the estimated traffic generation in the Transport Report for the Proposed Mixed Use Rezoning, 32-34 & 38-46 Silverwater Road. In this regard, the impact of the additional traffic generated from the development is not correctly modelled at this intersection. The traffic volume input data in the models needs to be reviewed and revised.*

3.47 The additional traffic from the proposed development is included in the amended SIDRA file.

- *The adjacent signalised intersection of Silverwater Road and Fariola Street, north to the intersection is approximately 685 metre apart from this intersection which is larger than 500m. The arrival type for Silverwater Road North approach should be type 4-favourable.*

3.48 The approach distance for southbound traffic on Silverwater Road has been amended to 685 metres. The arrival type for this approach has been amended to type 4 favourable.

Silverwater Road/Fariola Road intersection

- *The maximum cycle time for the intersection is 130 seconds.*
- *The length of the right turn bays on Silverwater Road is incorrectly coded. The taper area of the right turn bays should not be included.*
- *The length of the kerbside lane on Fariola Street East approach is incorrectly coded. The adjacent signalised intersection of Silverwater Road and Carnarvon Road, south to the intersection is approximately 685 metre apart from this intersection which is larger than 500 m. The arrival type for Silverwater Road South approach should be type 4-favourable.*

3.49 The intersection of Silverwater Road with Fariola Street was not counted in association with the project and the file for this intersection was inadvertently sent to RMS.

As a result of the above, the SIDRA models should be revised and re-submitted to RMS for review.

3.50 With the amended parameters, we have re-run the SIDRA model for Silverwater Road/Carnarvon Street. Copies of the output summaries are attached in the appendix.

3.51 With the development traffic, the intersection would operate at LOS D which is a satisfactory level of service.

3.52 Importantly, the additional development traffic would not have significant effects on the operation of the intersection. This is due, at least in part, to the fact that traffic from the residential component would be in the counter-peak direction (outbound in the morning and inbound in the afternoon), compared to the generally industrial traffic in the precinct which is inbound in the morning and outbound during the afternoon.

3.53 Therefore, the road network will be able to cater for the additional traffic from the proposed development.

Summary

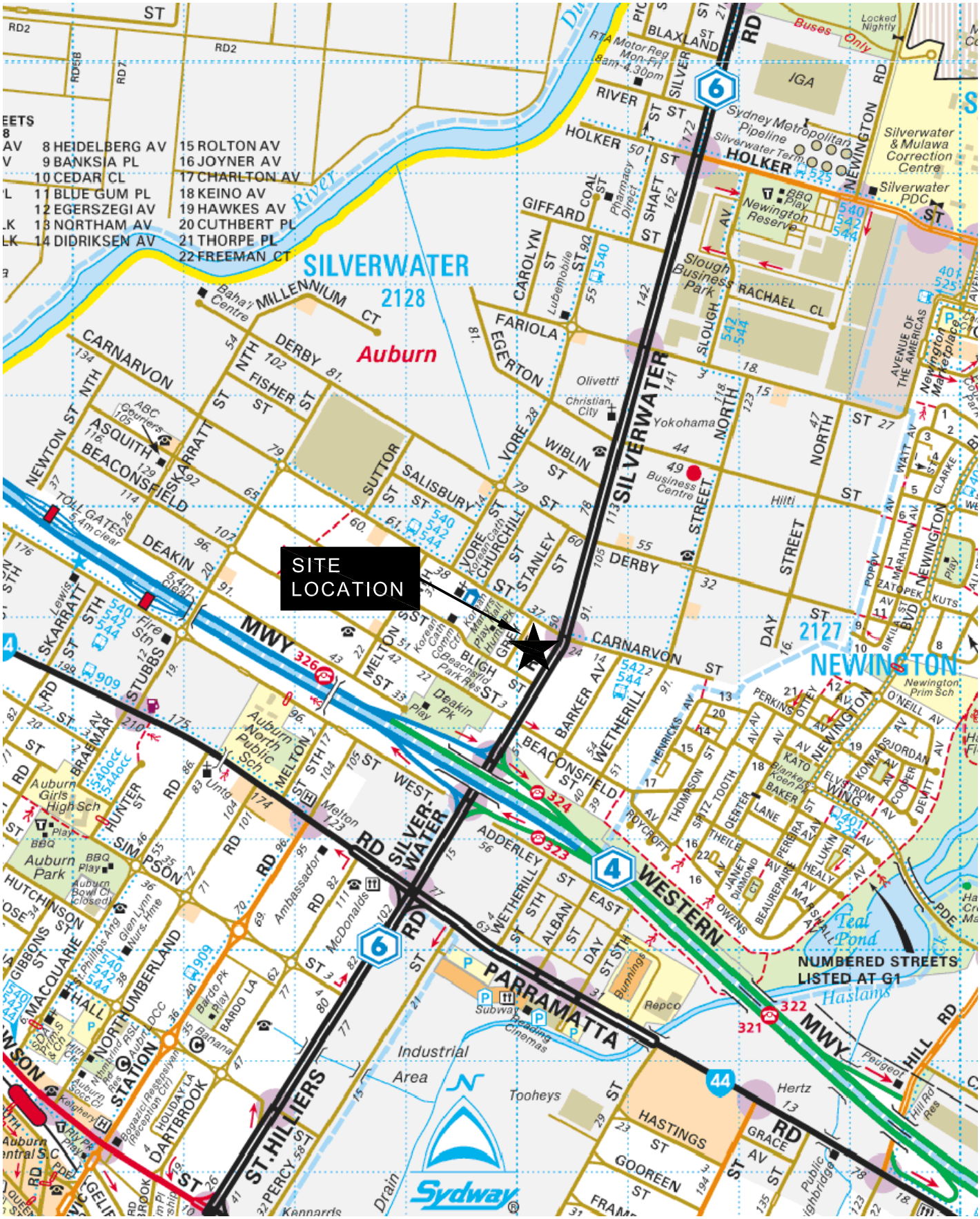
3.54 In summary, the main points relating to the transport implications of the proposed mixed use residential development are as follows:

i) the proposed development will be accessible by public transport;

ii) access, servicing and internal layout are considered appropriate;

iii) the road network will be able to cater for the additional traffic from the proposed development; and

iv) matters raised by the authorities are discussed in paragraphs 3.33 to 3.53.



Location Plan

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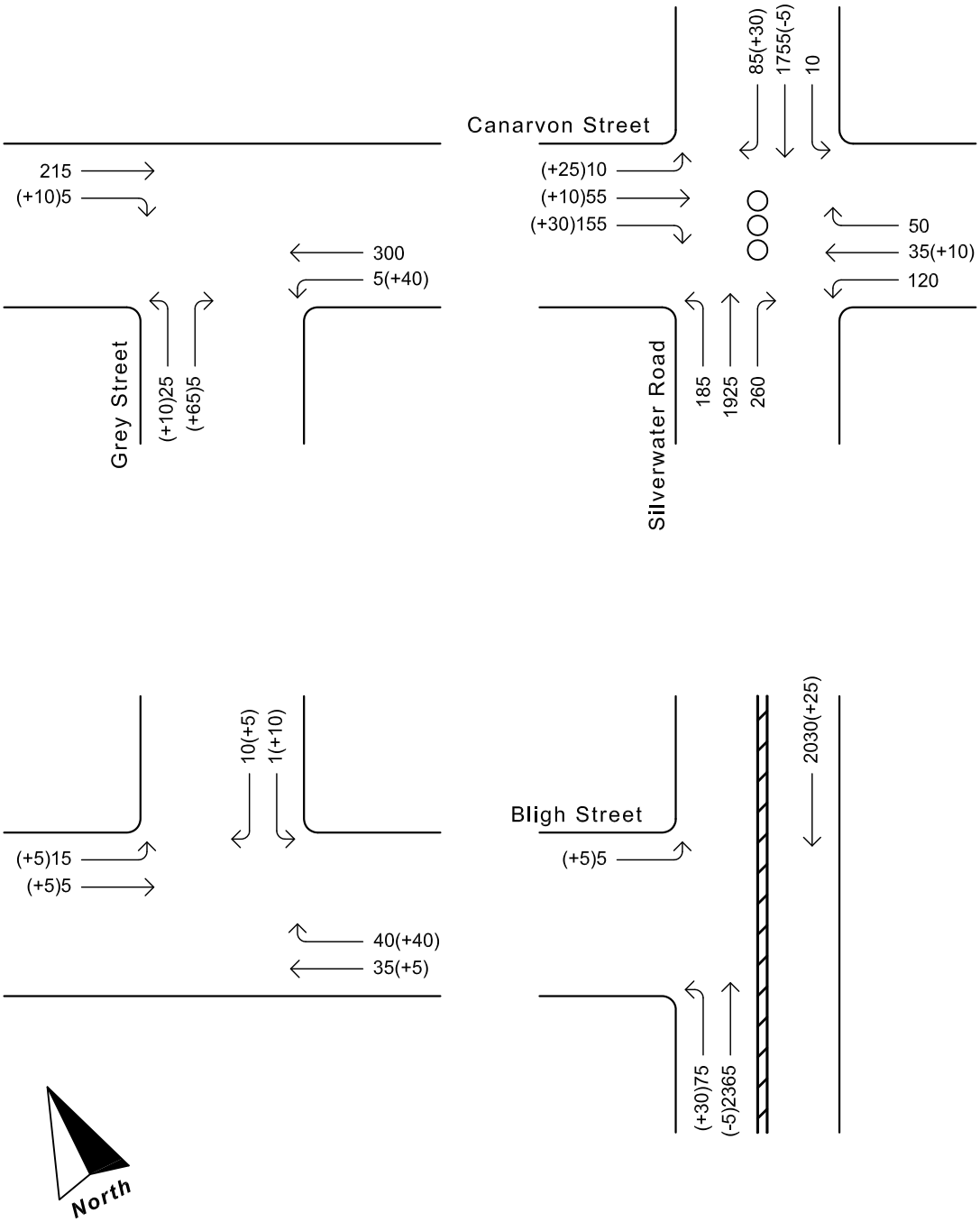
Figure 1



LEGEND

100 - Existing Peak Hour Traffic Flows
(+10) - Additional Development Traffic
- Traffic Signals

Existing weekday morning peak hour traffic flows plus development traffic

Colston Budd Hunt & Kafes Pty Ltd

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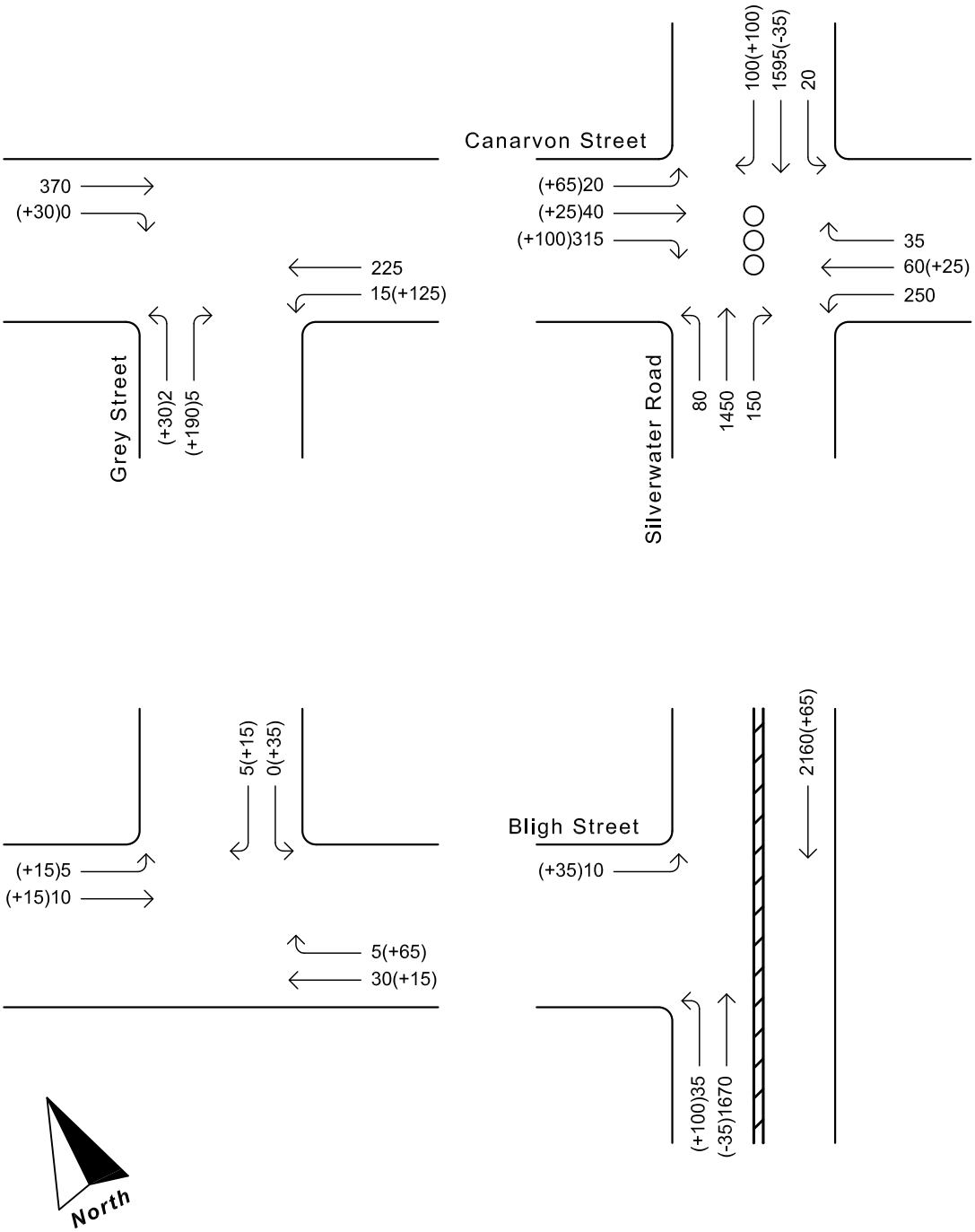
Figure 2



LEGEND

100 - Existing Peak Hour Traffic Flows
(+10) - Additional Development Traffic
- Traffic Signals

Existing weekday afternoon peak hour traffic flows plus development traffic

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Figure 3

APPENDIX

SIDRA OUTPUT SUMMARIES

MOVEMENT SUMMARY

Site: Ex AM

Silverwater Road & Carnarvon Street
Existing morning peak hour
Signals - Fixed Time Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Silverwater Road south											
1	L	185	2.0	0.978	63.1	LOS E	60.5	430.9	1.00	1.06	23.4
2	T	1925	2.0	0.979	54.8	LOS D	60.5	431.1	1.00	1.07	25.1
3	R	260	2.0	0.968	89.8	LOS F	23.0	163.6	1.00	0.96	17.3
Approach		2370	2.0	0.979	59.3	LOS E	60.5	431.1	1.00	1.06	23.9
East: Carnarvon Street east											
4	L	120	2.0	0.189	44.0	LOS D	7.7	54.9	0.74	0.77	26.1
5	T	35	2.0	0.246	56.8	LOS E	7.0	49.5	0.90	0.71	20.2
6	R	50	2.0	0.246	64.4	LOS E	7.0	49.5	0.90	0.78	21.5
Approach		205	2.0	0.246	51.2	LOS D	7.7	54.9	0.81	0.76	23.8
North: Silverwater Road north											
7	L	10	2.0	0.805	67.0	LOS E	45.2	322.0	0.91	0.97	22.6
8	T	1755	2.0	0.819	48.0	LOS D	45.2	322.0	0.91	0.84	27.4
9	R	85	2.0	0.317	71.0	LOS F	7.0	49.9	0.90	0.77	20.5
Approach		1850	2.0	0.819	49.1	LOS D	45.2	322.0	0.91	0.83	27.0
West: Carnarvon Street west											
10	L	10	2.0	0.411	42.8	LOS D	6.1	43.2	0.91	0.77	26.9
11	T	55	2.0	0.411	35.1	LOS C	6.1	43.2	0.91	0.71	25.7
12	R	155	2.0	0.411	63.2	LOS E	9.7	69.1	0.94	0.79	21.6
Approach		220	2.0	0.411	55.3	LOS D	9.7	69.1	0.93	0.77	22.6
All Vehicles		4645	2.0	0.979	54.7	LOS D	60.5	431.1	0.95	0.94	25.0

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop Queued	Effective Stop Rate per ped
P1	Across S approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
P3	Across E approach	53	34.0	LOS D	0.2	0.2	0.67	0.67
P5	Across N approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
P7	Across W approach	53	34.0	LOS D	0.2	0.2	0.67	0.67
All Pedestrians		212	51.6				0.82	0.82

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS F. LOS Method for individual pedestrian movements: Delay (HCM).

MOVEMENT SUMMARY

Site: Ex PM

Silverwater Road & Carnarvon Street
Existing afternoon peak hour
Signals - Fixed Time Cycle Time = 128 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Silverwater Road south											
1	L	80	2.0	0.788	36.0	LOS C	25.7	183.0	0.84	0.96	33.6
2	T	1450	2.0	0.789	27.8	LOS B	26.0	184.8	0.84	0.76	35.9
3	R	150	2.0	0.807	69.1	LOS E	11.3	80.3	1.00	0.85	20.9
Approach		1680	2.0	0.807	31.9	LOS C	26.0	184.8	0.86	0.78	33.8
East: Carnarvon Street east											
4	L	250	2.0	0.334	43.9	LOS D	11.2	79.7	0.81	0.80	26.2
5	T	60	2.0	0.334	46.3	LOS D	9.1	65.0	0.89	0.72	22.5
6	R	35	2.0	0.334	53.8	LOS D	9.1	65.0	0.89	0.80	23.8
Approach		345	2.0	0.334	45.3	LOS D	11.2	79.7	0.83	0.79	25.3
North: Silverwater Road north											
7	L	20	2.0	0.834	63.4	LOS E	31.3	222.7	0.94	0.97	23.6
8	T	1595	2.0	0.833	47.1	LOS D	31.4	223.4	0.94	0.89	27.6
9	R	100	2.0	0.538	69.7	LOS E	7.7	54.8	0.98	0.78	20.8
Approach		1715	2.0	0.833	48.6	LOS D	31.4	223.4	0.95	0.88	27.1
West: Carnarvon Street west											
10	L	20	2.0	0.548	32.5	LOS C	8.1	57.5	0.89	0.80	30.4
11	T	40	2.0	0.547	24.8	LOS B	8.1	57.5	0.89	0.73	29.2
12	R	315	2.0	0.547	48.2	LOS D	12.4	88.0	0.93	0.81	25.1
Approach		375	2.0	0.547	44.8	LOS D	12.4	88.0	0.93	0.80	25.7
All Vehicles		4115	2.0	0.833	41.2	LOS C	31.4	223.4	0.90	0.82	29.1

Level of Service (Aver. Int. Delay): LOS C. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS E. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	58.1	LOS E	0.2	0.2	0.95	0.95
P3	Across E approach	53	33.1	LOS D	0.1	0.1	0.72	0.72
P5	Across N approach	53	58.1	LOS E	0.2	0.2	0.95	0.95
P7	Across W approach	53	33.1	LOS D	0.1	0.1	0.72	0.72
All Pedestrians		212	45.6				0.84	0.84

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

MOVEMENT SUMMARY

Site: Ex AM + dev

Silverwater Road & Carnarvon Street
Existing morning peak hour + development
Signals - Fixed Time Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Silverwater Road south											
1	L	185	2.0	0.978	63.1	LOS E	60.5	430.9	1.00	1.06	23.4
2	T	1925	2.0	0.979	54.8	LOS D	60.5	431.1	1.00	1.07	25.1
3	R	260	2.0	0.968	89.8	LOS F	23.0	163.6	1.00	0.96	17.3
Approach		2370	2.0	0.979	59.3	LOS E	60.5	431.1	1.00	1.06	23.9
East: Carnarvon Street east											
4	L	120	2.0	0.189	44.0	LOS D	7.7	54.9	0.74	0.77	26.1
5	T	45	2.0	0.278	57.3	LOS E	7.7	54.7	0.91	0.72	20.1
6	R	50	2.0	0.278	64.8	LOS E	7.7	54.7	0.91	0.79	21.4
Approach		215	2.0	0.278	51.6	LOS D	7.7	54.9	0.81	0.76	23.5
North: Silverwater Road north											
7	L	10	2.0	0.805	66.8	LOS E	44.9	319.9	0.91	0.96	22.7
8	T	1750	2.0	0.816	47.8	LOS D	44.9	319.9	0.91	0.83	27.4
9	R	115	2.0	0.428	72.3	LOS F	9.2	65.5	0.92	0.79	20.3
Approach		1875	2.0	0.816	49.4	LOS D	44.9	319.9	0.91	0.83	26.9
West: Carnarvon Street west											
10	L	35	2.0	0.517	42.7	LOS D	7.8	55.8	0.92	0.79	26.9
11	T	65	2.0	0.517	35.0	LOS C	7.8	55.8	0.92	0.73	25.6
12	R	185	2.0	0.517	65.3	LOS E	11.9	84.7	0.96	0.80	21.1
Approach		285	2.0	0.517	55.6	LOS D	11.9	84.7	0.94	0.79	22.6
All Vehicles		4745	2.0	0.979	54.8	LOS D	60.5	431.1	0.95	0.94	24.9

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
P3	Across E approach	53	34.0	LOS D	0.2	0.2	0.67	0.67
P5	Across N approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
P7	Across W approach	53	34.0	LOS D	0.2	0.2	0.67	0.67
All Pedestrians		212	51.6				0.82	0.82

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS F. LOS Method for individual pedestrian movements: Delay (HCM).

MOVEMENT SUMMARY

Site: Ex PM + dev

Silverwater Road & Carnarvon Street
Existing afternoon peak hour + development
Signals - Fixed Time Cycle Time = 129 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Silverwater Road south											
1	L	80	2.0	0.835	40.5	LOS C	28.3	201.3	0.90	0.96	31.5
2	T	1450	2.0	0.833	32.4	LOS C	28.5	202.6	0.90	0.83	33.4
3	R	150	2.0	0.660	63.1	LOS E	10.7	75.9	0.97	0.81	22.2
Approach		1680	2.0	0.833	35.5	LOS C	28.5	202.6	0.91	0.83	32.0
East: Carnarvon Street east											
4	L	250	2.0	0.355	41.5	LOS C	12.2	87.2	0.79	0.80	27.0
5	T	85	2.0	0.354	47.9	LOS D	9.2	65.8	0.91	0.73	22.2
6	R	35	2.0	0.354	55.5	LOS D	9.2	65.8	0.91	0.80	23.5
Approach		370	2.0	0.355	44.3	LOS D	12.2	87.2	0.83	0.79	25.4
North: Silverwater Road north											
7	L	20	2.0	0.856	68.5	LOS E	32.6	232.3	0.97	0.98	22.4
8	T	1560	2.0	0.861	52.3	LOS D	32.7	232.8	0.97	0.94	26.0
9	R	200	2.0	0.881	77.9	LOS F	15.1	107.6	1.00	0.92	19.2
Approach		1780	2.0	0.881	55.3	LOS D	32.7	232.8	0.98	0.93	25.0
West: Carnarvon Street west											
10	L	85	2.0	0.820	40.3	LOS C	13.5	95.8	0.95	0.90	27.5
11	T	65	2.0	0.820	32.6	LOS C	13.5	95.8	0.95	0.87	26.1
12	R	415	2.0	0.820	58.7	LOS E	19.3	137.4	0.98	0.91	22.5
Approach		565	2.0	0.820	52.9	LOS D	19.3	137.4	0.97	0.91	23.5
All Vehicles		4395	2.0	0.881	46.5	LOS D	32.7	232.8	0.94	0.88	27.1

Level of Service (Aver. Int. Delay): LOS D. Based on average delay for all vehicle movements. LOS Method: Delay (RTA NSW).
Level of Service (Worst Movement): LOS F. LOS Method for individual vehicle movements: Delay (RTA NSW).
Approach LOS values are based on average delay for all vehicle movements.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	Across S approach	53	58.6	LOS E	0.2	0.2	0.95	0.95
P3	Across E approach	53	35.0	LOS D	0.1	0.1	0.74	0.74
P5	Across N approach	53	58.6	LOS E	0.2	0.2	0.95	0.95
P7	Across W approach	53	35.0	LOS D	0.1	0.1	0.74	0.74
All Pedestrians		212	46.8				0.84	0.84

Level of Service (Aver. Int. Delay): LOS E. Based on average delay for all pedestrian movements. LOS Method: Delay (HCM).
Level of Service (Worst Movement): LOS E. LOS Method for individual pedestrian movements: Delay (HCM).

HILFOR PROJECT PTY LTD

TRANSPORT REPORT FOR PROPOSED MIXED USE REZONING, 32-34 & 38-46 SILVERWATER ROAD & 1-13 GREY STREET, SILVERWATER

MAY 2013

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1. INTRODUCTION

1.1 Colston Budd Hunt and Kafes Pty Ltd has been commissioned by Hilfor Project Pty Ltd to prepare a report assessing the transport implications of a proposed mixed use development at 32-34 and 38-46 Silverwater Road and 1-13 Grey Street at Silverwater. The site location is shown on Figure 1.

1.2 The site is occupied by a commercial building previously used by a dry cleaner, a café and 13 residential dwellings. It is proposed to rezone the site to B4 mixed use. A potential scale of development includes some 3,550m^2 retail, 350m^2 commercial plus 220 residential apartments.

1.3 This report assesses the transport implications of the potential scale of development through the following chapters:

- Chapter 2 - describing the existing conditions; and
- Chapter 3 - assessing the transport implications of the proposed development.

2. EXISTING CONDITIONS

Site Location and Road Network

2.1 The site is located at 32-34 and 38-46 Silverwater Road and 1-13 Grey Street at Silverwater, as shown on Figure 1. It occupies the entire block bounded by Silverwater Road, Carnarvon Street, Bligh Street and Grey Street. The site is occupied by a commercial building previously used by a dry cleaner, a café and 13 residential dwellings. Vehicular access to the site is provided from all of the streets noted above.

2.2 Surrounding land use includes industrial and commercial development along Silverwater Road, and north of the site. There is residential development to the south and east. The M4 Motorway is south of the site. To the west are residential properties, industrial properties, open space and a church.

2.3 Silverwater Road is a major road which forms part of a north-south route connecting Hornsby, Pennant Hills and Carlingford in the north with Auburn, Bankstown and the southern suburbs of Sydney in the south. In the vicinity of the site it provides a six lane divided carriageway with three traffic lanes in each direction and a 70 kilometre per hour speed limit. Clearways operate in both directions during weekday peak periods. Major intersections are signalised with additional lanes for turning traffic.

2.4 Carnarvon Street intersects Silverwater Road at a signalised intersection, adjacent to the site, with all turns permitted. It provides for one traffic lane and one parking lane in each direction, clear of intersections. Carnarvon Street provides access to industrial development. There are bus stops west of the site.

2.5 Bligh Street connects to Silverwater Road, south of the site, at an unsignalised t-intersection. Turns at the intersection are restricted to left in/left out by the median in Silverwater Road. Bligh Street provides access to industrial and residential development. It provides for one traffic lane and one parking lane in each direction, clear of intersections.

2.6 Grey Street connects Carnarvon Street with Bligh Street. Both intersections are unsignalised t-intersections, with all turns permitted. Grey Street provides access to industrial properties and the subject site. It provides for one traffic lane and one parking lane in each direction, clear of intersections, and has a three tonne load limit.

Traffic Flows

2.7 Traffic generated by the proposed development will have its greatest effects during weekday morning and afternoon peak periods when it combines with commuter traffic on the surrounding road network. In order to gauge traffic conditions, counts were undertaken during weekday morning and afternoon peak periods at the following intersections:

- Silverwater Road/Carnarvon Street;
- Silverwater Road/Bligh Street;
- Grey Street/Carnarvon Street; and
- Grey Street//Bligh Street.

2.8 The results of the surveys are shown in Figures 2 and 3, and summarised in Table 2.1.

Table 2.1: Existing two-way (sum of both directions) peak hour traffic flows			
Road	**Location**	**AM peak hour**	**PM peak hour**
Silverwater Road	North of Carnarvon Street	3,835	3,220
	North of Bligh Street	4,400	3,840
	South of Bligh Street	4,470	3,865
Carnarvon Street	East of Silverwater Road	530	555
	West of Silverwater Road	525	615
	West of Grey Street	545	595
Bligh Street	West of Silverwater Road	80	45
	West of Grey Street	65	50
Grey Street	South of Carnarvon Street	40	20
	North of Bligh Street	65	15

2.9 Table 2.1 shows that Silverwater Road carried some 3,200 to 4,500 vehicles per hour two-way during the weekday morning and afternoon peak hours. Carnarvon Street carried lower flows of some 500 to 600 vehicles per hour two-way. Flows on Bligh Street and Grey Street were less than 100 vehicles per hour two-way.

Intersection Operations

2.10 The capacity of the road network is largely determined by the capacity of its intersections to cater for peak period traffic flows. The surveyed intersections shown in Figures 2 and 3 have been analysed using the SIDRA program.

2.11 SIDRA simulates the operations of intersections to provide a number of performance measures. The most useful measure provided is average delay per vehicle expressed in seconds per vehicle. Based on average delay per vehicle, SIDRA estimates the following levels of service (LOS):

- For traffic signals, the average delay per vehicle in seconds is calculated as delay/(all vehicles), for roundabouts the average delay per vehicle in seconds is selected for the movement with the highest average delay per vehicle, equivalent to the following LOS:

0 to 14	=	"A"	Good
15 to 28	=	"B"	Good with minimal delays and spare capacity
29 to 42	=	"C"	Satisfactory with spare capacity
43 to 56	=	"D"	Satisfactory but operating near capacity
57 to 70	=	"E"	At capacity and incidents will cause excessive delays. Roundabouts require other control mode.
>70	=	"F"	Unsatisfactory and requires additional capacity

- For give way and stop signs, the average delay per vehicle in seconds is selected from the movement with the highest average delay per vehicle, equivalent to following LOS:

0 to 14	=	"A"	Good
15 to 28	=	"B"	Acceptable delays and spare capacity
29 to 42	=	"C"	Satisfactory but accident study required
43 to 56	=	"D"	Near capacity and accident study required
57 to 70	=	"E"	At capacity and requires other control mode
>70	=	"F"	Unsatisfactory and requires other control mode

2.12 It should be noted that for roundabouts, give way and stop signs, in some circumstances, simply examining the highest individual average delay can be misleading. The size of the movement with the highest average delay per vehicle should also be taken into account. Thus, for example, an intersection where all

movements are operating at a level of service A, except one which is at level of service E, may not necessarily define the intersection level of service as E if that movement is very small. That is, longer delays to a small number of vehicles may not justify upgrading an intersection unless a safety issue was also involved.

2.13 The SIDRA analysis found that the signalised intersection of Silverwater Road with Carnarvon Street is operating with average delays of less than 50 seconds per vehicle during peak periods. This represents levels of service D, a satisfactory level of service for a busy intersection during peak periods.

2.14 At the intersection of Silverwater Road with Bligh Street, observations indicate that traffic turns from Bligh Street when gaps are created in the traffic stream by the upstream traffic signals on Silverwater Road.

2.15 The intersections of Grey Street with Carnarvon Street and Bligh Street are operating with average delays for the highest delayed movements of less than 15 seconds per vehicle during peak periods. This represents levels of service A/B, a good level of service.

Public Transport

2.16 The closest railway station to the site is Auburn, which is some 20 minutes walking distance. Auburn is on the Western (Emu Plains/Richmond to North Sydney via the City) and South (Macarthur to City via Granville) Lines.

2.17 Services through Auburn are every 30 minutes in each direction on the Western Lines and every 15 to 30 minutes in each direction on the South Line. During weekday peak periods, services are every 10 to 15 minutes in each direction.

2.18 Local bus services are provided by Sydney Buses. As previously discussed, there are bus stops on Carnarvon Street, west of the site.

2.19 Route 544 connects Auburn, Silverwater, Ermington, Eastwood, Deniston East, Macquarie University and Macquarie Centre. Services are every 60 minutes in each direction, Monday to Saturday, and every 15 to 30 minutes during weekday peak periods. Services include a link to Auburn railway station.

2.20 Route 540 operates along Carnarvon Street and Vore Street and connects Auburn and Newington. It provides a weekday peak period service.

2.21 There is a north-south cycle route west of site which connects Auburn with Sydney Olympic Park. This route connects to the wider cycle network within the LGA.

2.22 The draft Metropolitan Strategy for Sydney identifies the need for a future viable and frequent public transport service along the Parramatta Road corridor, in which the site is located.

2.23 The site is therefore accessible by existing public transport services, and close to future planned services along Parramatta Road.

3. IMPLICATIONS OF PROPOSED DEVELOPMENT

3.1 It is proposed to rezone the site to B4 mixed use. A potential scale of development includes some 3,550m^2 retail, 350m^2 commercial plus 220 residential apartments. Vehicular access is proposed from Grey Street.

3.2 Parking will be provided in accordance with appropriate Council and RMS controls at the time that a development application is made. This chapter assesses the transport implications of the proposed development through the following sections:

- policy context;
- public transport, walking and cycling;
- travel access guide;
- access, servicing and internal layout;
- traffic generation and effects; and
- summary.

Policy Context

- Metropolitan Transport Plan

3.3 The Metropolitan Transport Plan – Connecting the City of Cities has four key policy objectives:

- commuting to work easily and quickly;

- transport and services accessible to all members of the community;
- an efficient, integrated and customer focused public transport system; and
- revitalized neighbourhoods with improved transport hubs.

3.4 It includes a target of 28 per cent of trips to work in the Sydney Metropolitan Region to be undertaken by public transport by 2016, compared to some 22 per cent in 2006.

3.5 To help achieve these objectives, it identifies, in conjunction with the metropolitan strategy, key areas of future housing and employment growth in Sydney to 2020 and 2036. Additionally, it outlines a 10 year funding program to 2020 for the following transport projects:

- rail line extensions for more platforms at CBD stations;
- rail lines to north west and south west Sydney;
- light rail in the CBD and further extension to the Inner West;
- more air conditioned train carriages;
- 1,000 additional buses;
- completion of the 43 strategic bus corridors across Sydney;
- completion of the highest priority missing links in the Sydney Strategic Cycleway Network.

- NSW 2021

3.6 NSW 2021: A Plan to Make NSW Number One sets targets to increase the proportion of commuter trips made by public transport for various areas within Sydney by 2016, including:

- 80 per cent in the Sydney CBD;
- 50 per cent in the Parramatta CBD;
- 20 per cent in the Liverpool CBD; and
- 25 per cent in the Penrith CBD.

3.7 It also has targets to:

- improve road safety and reduce fatalities to 4.3 per 100,000 population by 2016;
- double the mode share of bicycle trips made in the metropolitan area by 2016; and
- increase the proportion of the population living within 30 minutes by public transport of a city or major centre in the metropolitan area.

3.8 The following sections discuss how the proposed development satisfies these objectives and the measures proposed to achieve them.

Public Transport, Walking and Cycling

3.9 As previously discussed, the site is accessible by bus services which connect to surrounding areas including Auburn, Silverwater, Ermington, Newington, Eastwood, Deniston East, Macquarie University and Macquarie Centre. Services include a link to Auburn railway station. There are bicycle routes close to the site which connects to surrounding areas and the wider network within Auburn. The planned future provision of public transport along Parramatta Road will further improve the site's accessibility.

3.10 Existing public transport services will provide for people to access the development by public transport, walking and cycling, for residents, and for employees in the retail component. To support accessibility by bicycles, appropriate bicycle parking, in accordance with Council requirements, should be provided. Provision will be included for a bus stop on Silverwater Road, adjacent to the site.

3.11 The development will therefore satisfy the objectives of the Metropolitan Transport Plan and NSW 2021 as follows:

- enabling commuters to readily access trains and buses close to the site (Metropolitan Transport Plan objective);
- providing an appropriate level of on-site parking, with reference to appropriate Council and RMS requirements, to encourage public transport use and increase the proportion of trips by public transport (Metropolitan Transport Plan objective);
- providing residential development close to employment centres in Silverwater and Sydney Olympic Park, to reduce the need for travel; and
- improving pedestrian connectivity in the area by providing a through site pedestrian link between Grey Street and Silverwater Road.

Travel Access Guide

3.12 To encourage travel modes other than private vehicle, a travel demand management approach should be adopted, through a travel access guide to meet

the specific needs of future residents, employees and visitors. The specific requirements and needs of these groups should be incorporated in the travel access guide to support the objectives of encouraging the use of public transport.

3.13 The principles of the travel access guide, which should be developed as part of a future development application in consultation with Council, RMS, public transport providers and other stakeholders, would include the following:

- encourage the use of public transport, including rail and bus services close to the site;
- identify existing bus routes which stop near the site, including the location of bus stops and pedestrian crossings at signalised intersections;
- work with public transport providers to improve services;
- encourage public transport by residents and employees through the provision of information, maps and timetables in the travel access guide;
- raise awareness of health benefits of walking and cycling (including maps showing walking and cycling routes);
- encourage cycling by providing safe and secure bicycle parking, including the provision of lockers and rails;
- provide appropriate on-site parking provision, consistent with appropriate Council/RMS controls and the objective of reducing traffic generation.

3.14 The travel access guide should be developed in accordance with the principles identified by Transport for NSW and RMS, and distributed with marketing material for the site. The travel access guide would assist in delivering sustainable transport objectives by considering the means available for reducing dependence solely on cars for travel purposes, encouraging the use of public transport and supporting the efficient and viable operation of public transport services.

Access, Servicing and Internal Layout

3.15 Vehicular access to the proposed development would be provided from Grey Street. Driveways will provide for two-way traffic, with all movements permitted, and should be provided with widths and grades in accordance with the Australian Standard for Parking Facilities (Part 1: Off-street car parking), AS 2890.1:2004. The driveways will include maximum grades of 1:20 for six metres inside the property line for appropriate visibility between pedestrians and exiting vehicles.

3.16 A shared zone will be provided, running east-west through the site, for cars and pedestrians. It will provide vehicular access to buildings within the development, from Grey Street. It will not provide a vehicular connection to Silverwater Road. Pedestrians will be able to walk through the site between Grey Street and Silverwater Road.

3.17 At the development application stage, the parking space dimensions, aisle widths, column locations and height clearances should be provided in accordance with AS 2890.1:2004.

3.18 Appropriate provision for service vehicles should be included within the development. Service vehicles will include garbage collection and deliveries to the retail and commercial components. The design should provide for service vehicles to enter and exit the site in a forward direction, with service vehicle areas to be provided in accordance with AS 2890.2 – 2002. The size of trucks will depend on final retail tenancies, but will likely include rigid trucks and semi trailers.

Traffic Generation and Effects

3.19 Traffic generated by the proposed development will have its greatest effects during weekday morning and afternoon peak periods when it combines with commuter traffic. The RMS "Guide to Traffic Generating Developments" indicates that high density residential apartments in town centre locations close to public transport generate 0.29 vehicles per hour per dwelling, two-way, during peak hours. Medium density developments generate some 0.4 to 0.65 vehicles per hour two-way.

3.20 Based on the above, the proposed development would be likely to have a traffic generation of some 0.3 to 0.4 vehicles per hour per dwelling two-way at peak times. Therefore, traffic generation of the residential component would be some 65 to 90 vehicles per hour two-way at peak times.

3.21 The RMS guidelines suggest a traffic generation of some two vehicles per hour per 100m^2 for commercial development at peak times. Therefore, the commercial component would generate some five to 10 vehicles per hour two-way at peak times.

3.22 The RMS "Guide to Traffic Generating Developments" indicates that small retail developments generate some 12.3 vehicles per hour per 100m^2 two-way during weekday afternoon peak hours. During the weekday morning peak hour, the generation is significantly lower as trading is low and many shops are not open. For the morning peak hour, we have assessed a generation of 20 per cent of the afternoon peak hour.

3.23 The retail component would therefore have a traffic generation of some 90 and 440 vehicles per hour two-way during morning and afternoon peak hours respectively. Total traffic generation would therefore be some 160 to 190 and 510 to 540 vehicles per hour two-way during morning and afternoon peak hours respectively.

3.24 The RMS guidelines indicate that some 25 per cent of retail traffic is passing trade (customers who would have driven past the site regardless of their visit to the site). Our assessment is based on 25 per cent of retail traffic being passing trade.

3.25 The additional traffic has been assigned to the road network. Existing traffic flows plus the additional development traffic are shown in Figures 2 and 3, and summarized in Table 3.1. Traffic increases on Silverwater Road, Carnarvon Street, Bligh Street and Grey Street would be some 20 to 125 vehicles per hour two-way during morning peak hours and some 50 to 375 vehicles per hour two-way during afternoon peak hours.

3.26 The intersections previously analysed in Chapter 2 have been re-analysed with SIDRA for the additional development traffic flows shown in Figures 2 and 3.

Table 3.1: Existing two-way peak hour traffic flows plus development traffic					
Road	**Location**	**AM peak hour**		**PM peak hour**	
		Existing	**Plus development**	**Existing**	**Plus development**
Silverwater Road	North of Carnarvon Street	3,835	+50	3,220	+130
	North of Bligh Street	4,400	+25	3,840	+65
	South of Bligh Street	4,470	+50	3,865	+130
Carnarvon Street	East of Silverwater Road	530	+20	555	+50
	West of Silverwater Road	525	+105	615	+315
	West of Grey Street	545	+20	595	+60
Bligh Street	West of Silverwater Road	80	+35	45	+135
	West of Grey Street	65	+20	50	+60
Grey Street	South of Carnarvon Street	40	+125	20	+375
	North of Bligh Street	65	+60	15	+130

3.27 The analysis found that the intersection of Silverwater Road with Carnarvon Street would operate with average delays of less than 50 seconds per vehicle during peak periods. This represents levels of service D, a satisfactory level of service for a busy intersection during peak periods.

3.28 The modest additional traffic turning from Bligh Street into Silverwater Road would not have significant implications on its operation. Traffic will continue to turn from Bligh Street when gaps are created in the traffic stream by the upstream traffic signals on Silverwater Road.

3.29 The intersections of Grey Street with Carnarvon Street and Bligh Street will continue to operate with average delays for the highest delayed movements of less than 15 seconds per vehicle during peak periods. This represents levels of service A/B, a good level of service.

3.30 Therefore, the road network will be able to cater for the additional traffic from the proposed development.

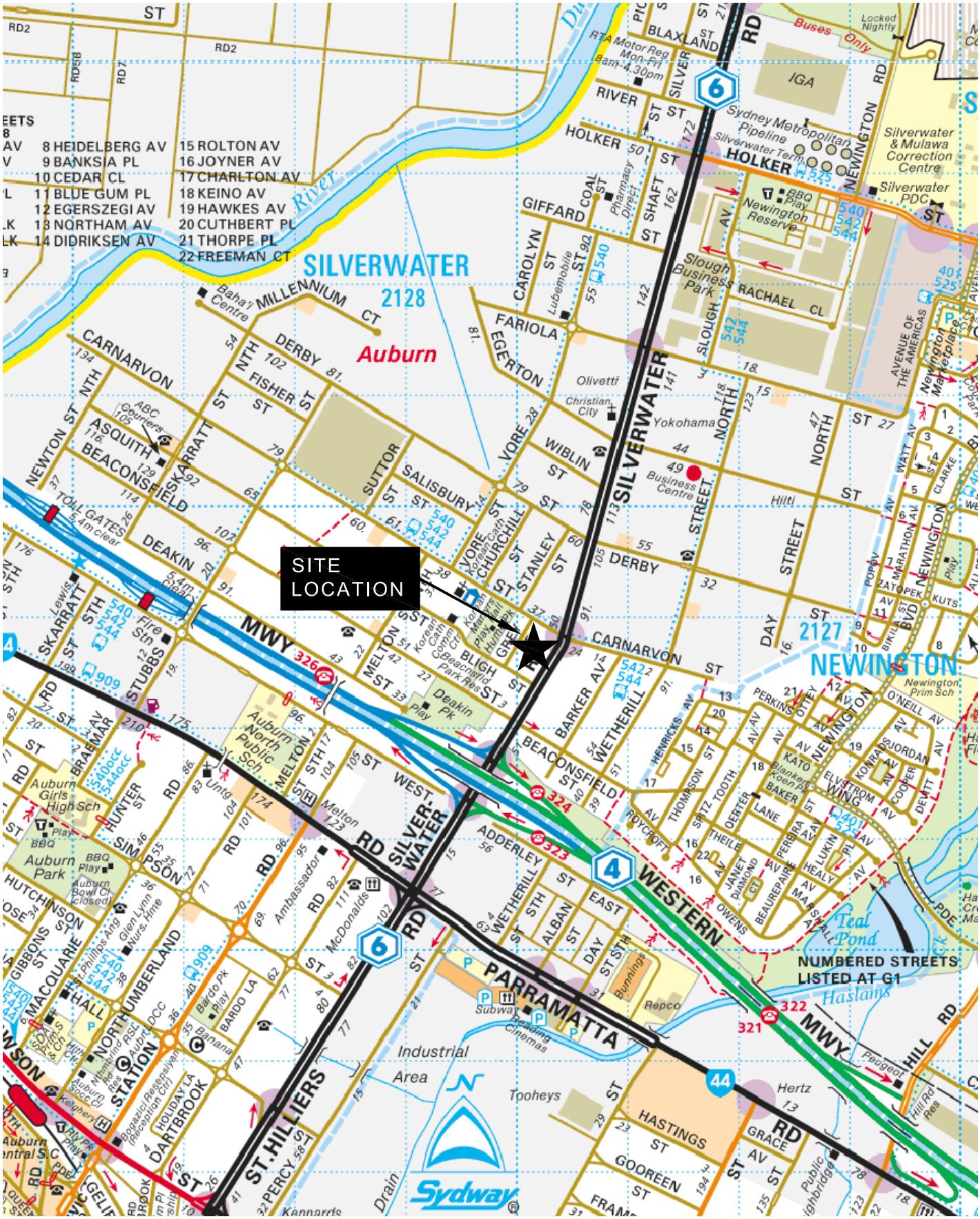
Summary

3.31 In summary, the main points relating to the transport implications of the proposed mixed use residential development are as follows:

i) the proposed development will be accessible by public transport;

ii) access, servicing and internal layout are considered appropriate; and

iii) the road network will be able to cater for the additional traffic from the proposed development.



Location Plan

Colston Budd Hunt & Kafes Pty Ltd

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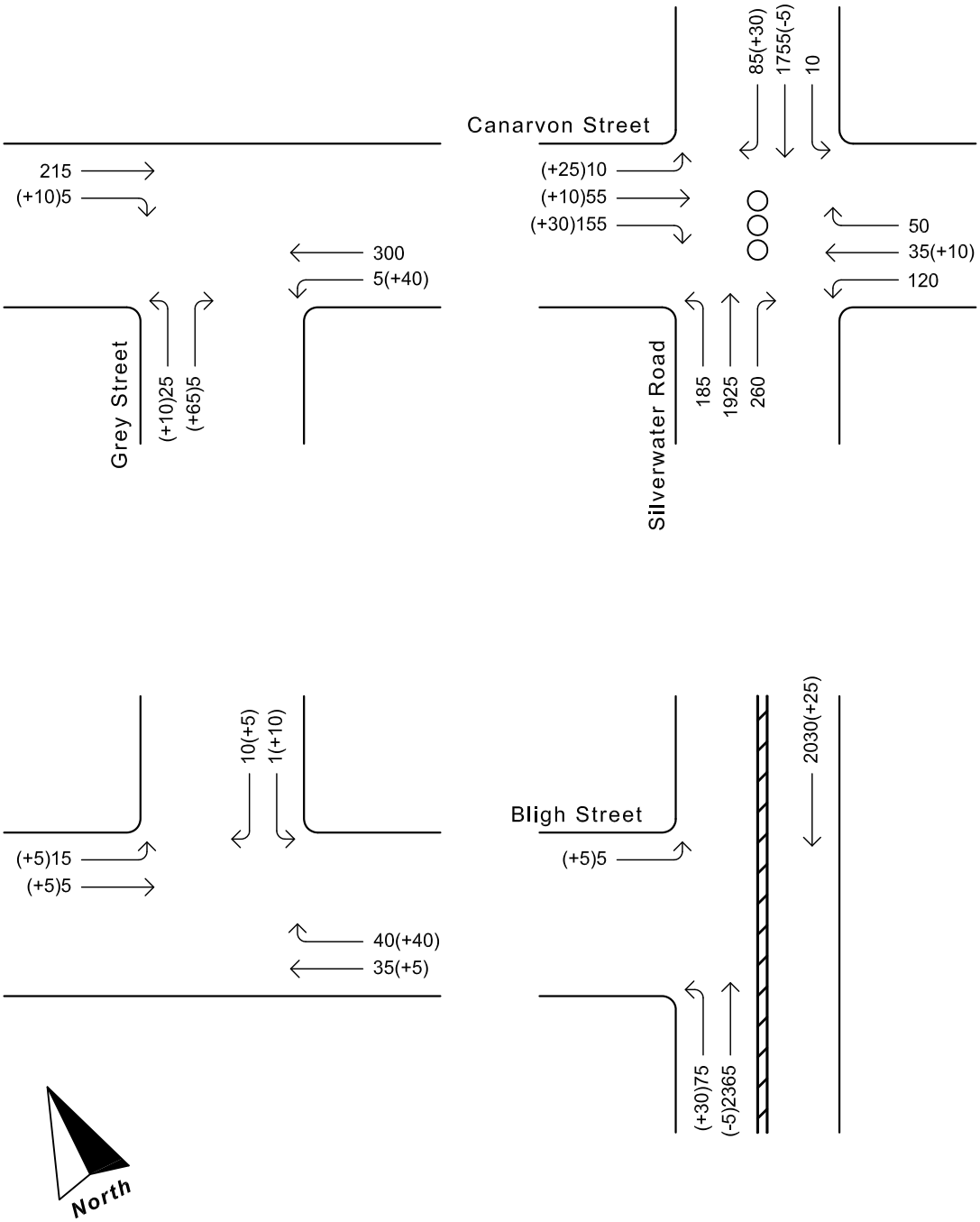
Figure 1



LEGEND

100 - Existing Peak Hour Traffic Flows
(+10) - Additional Development Traffic
- Traffic Signals

Existing weekday morning peak hour traffic flows plus development traffic

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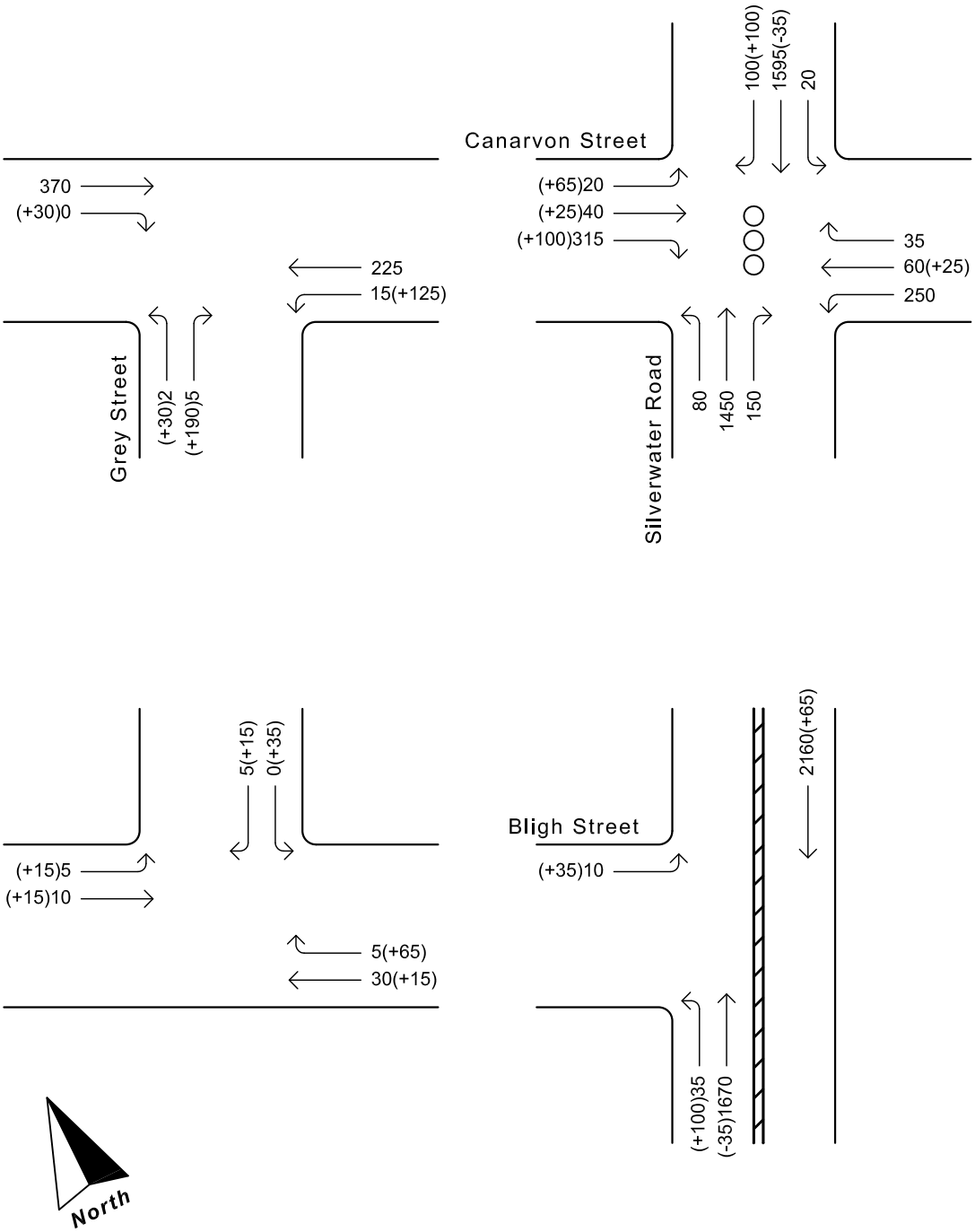
Figure 2



LEGEND

100 - Existing Peak Hour Traffic Flows
(+10) - Additional Development Traffic
- Traffic Signals

Existing weekday afternoon peak hour traffic flows plus development traffic

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Figure 3

MOVEMENT SUMMARY

Site: 102v [EX-PM Silverwater Rd-Bligh St]

New Site
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Silverwater Road												
1	L2	42	3.0	0.560	5.7	LOS A	0.0	0.0	0.00	0.02	0.00	57.8
2	T1	3169	3.0	0.560	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	59.7
Approach		3212	3.0	0.560	0.2	NA	0.0	0.0	0.00	0.01	0.00	59.7
North: Silvewater Road												
8	T1	3276	3.0	0.571	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.8
Approach		3276	3.0	0.571	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.8
West: Bligh Street												
10	L2	12	3.0	0.040	16.4	LOS C	0.1	0.9	0.79	0.91	0.79	46.2
Approach		12	3.0	0.040	16.4	LOS C	0.1	0.9	0.79	0.91	0.79	46.2
All Vehicles		6499	3.0	0.571	0.2	NA	0.1	0.9	0.00	0.01	0.00	59.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.