STATEWIDE PLANNING PTY LTD

REPORT ON TRAFFIC AND PARKING ASSESSMENT FOR PROPOSED MASTERPLAN DEVELOPMENT AT 181 JAMES RUSE DRIVE, CAMELLIA

Prepared by:

Lyle Marshall & Associates Pty Ltd
Consulting Engineers,
Transportation and Environmental Planners

Suite 8,871 pacific Highway
CHATSWOOD NSW 2067

Phone: **(02) 9419-8191**
Fax: **(02) 9419-8107**

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1.0 INTRODUCTION

1.1 Background

This traffic and parking assessment report has been requested by Statewide Planning to accompany an Urban Design Report prepared by Stanisic Architects and supporting documentation for the redevelopment of the site at 181 James Ruse Drive. This assessment report assesses the parking and traffic effects of the **Masterplan Development Scenario (Option C).** The sites are shown in **Figure 1, Locality Map.**

A Gateway conditional approval for the site was granted on 8th August 2014 by NSW Planning and Environment. In summary the proposal seeks to amend the following planning controls of the Parramatta LEP 2011 Amend. 14 to rezone the land from B5 Business Development to B4 Mixed Use and part RE1 Public Recreation, increase the maximum building height of buildings from 9-12m to 0-86m (i.e a range of highest from 'nil' metres above the proposed underground containment cells to a maximum of 28 storeys elsewhere; increase the maximum FSR from 1:5:1 to 5:1; remove the 30m foreshore Building Line and insert a specific clause to restrict development above the proposed underground containment cells.

1.2 Scope of Report

This report addresses the following issues:

1. Existing Road Inventory
2. RMS Pinch Point Roadworks Program Works
3 Existing Peak Hour Intersection Traffic Volumes
4. Intersection Capacity Analysis and Comparison with Intersection Performance
5. Origins of Workforce by LGA to Workplace Destination Zone Rosehill-Camellia TZ 1713 and 1721
6. Travel Modes of Workforce to Rosehill
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8. Parking Assessment for Masterplan Development Scenario
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SUBJECT SITE
181 JAMES RUSE DRIVE

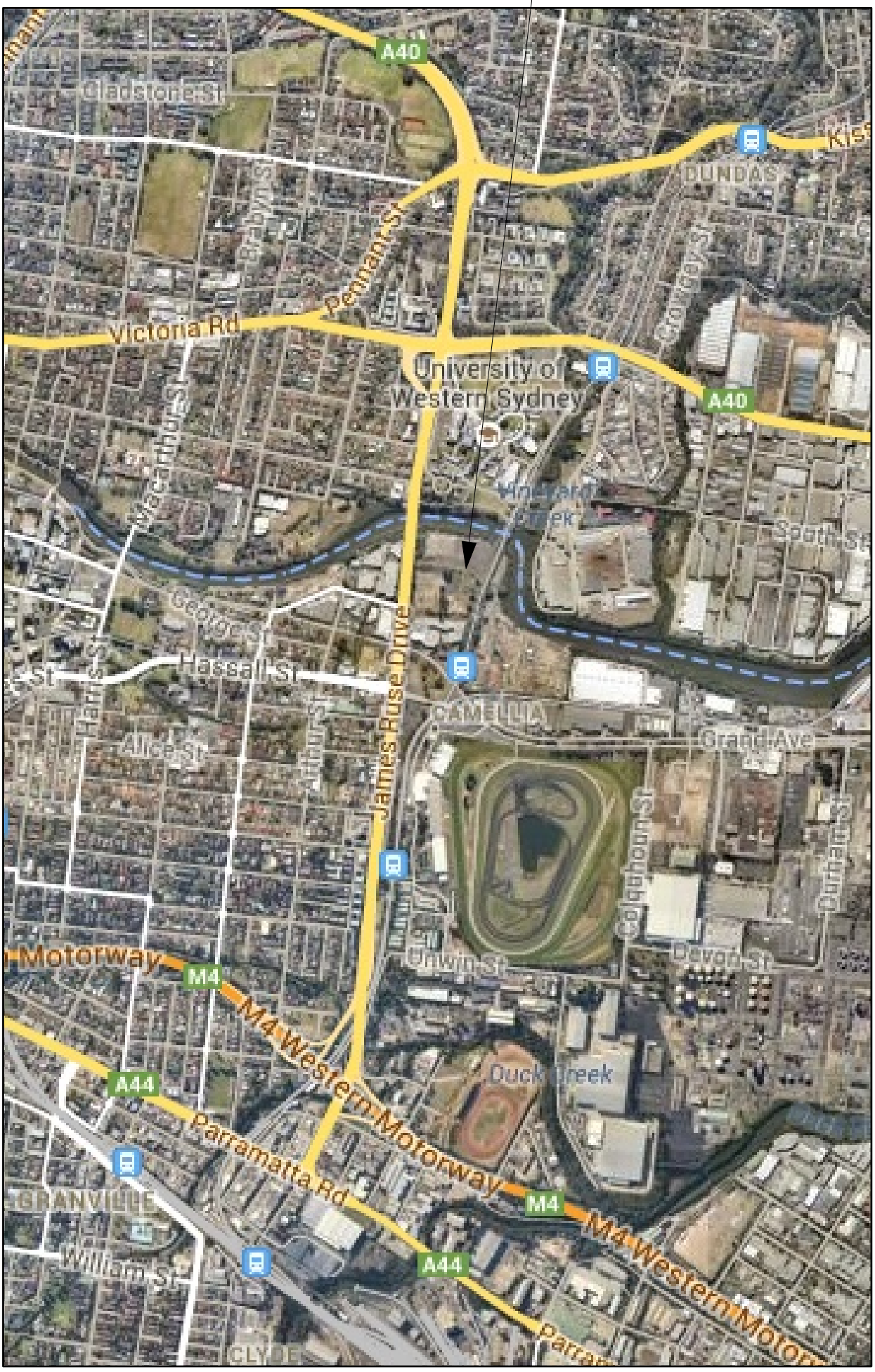


FIGURE 1
LOCALITY PLAN

1.3 Supporting Documents

The following documents were reviewed in preparation of this report.

1.3.1 Camellia – 21st Century Business, Industry and Entertainment Precinct – Discussion Paper Version 1.

The paper states that Camellia is in urgent need of renewal to support the rapid growth of Parramatta. The paper also states that *"an early proposed action is to model upgraded and potential new access parts and benefits through a Transport, Traffic and Access Study*".

1.3.2 Western Sydney Light Rail Network. Unlocking Western Sydney's Potential with Light Rail Part 2 Feasibility Report August 2013.

A proposed light rail link on the Macquarie Park line and another line to Castle Hill are proposed to link Camellia with Parramatta and Castle Hill.

The proposal assumes that the heavy rail line from Clyde to Rydalmere will remain operational.

Our preliminary discussions with Transport for NSW verifies that this line will continue to operate until future studies are carried out.

1.3.3 NSW Long Term Transport Masterplan 2021

The 2021 Transport Masterplan identified key objectives required for the future urban greater travel demands in Sydney.

- Increase parking and cycling for short local trips.
- Providing people with opportunities to use public transport to fully integrate future land care planning with transport planning.
- Improving public transport facilities.

1.4 Discussions with Stakeholders

A meeting was held on the 19th September at Parramatta City Council with key representatives from the RMS, Transport For NSW, Parramatta City Council, Statewide Planning Pty Ltd and this firm. From this meeting clear directions for the transport objectives from this study were given.

1.4 (Continued)

Objectives

- Allow for light rail transfer links and future alignment options. Intermodel connection to bicycle/cycling and pedestrian facilities and heavy rail.

- Site travel plan to incorporate walking routes, footpath upgrade works to James Ruse Drive, cycling routes and connections to University of Western Sydney Campus. Allow for bicycle interchange facilities.

- Integrate short term shuttle bus options until light rail is operational.

- Use MESO model (if available) to 2036 for future traffic modelling projections.

- RMS have recommended a re-alignment upgrade to intersection of River Road West / Tasman Avenue and James Ruse Drive with signalised intersection.

- Model future site connections to Grand Avenue with left turn out only from Grand Avenue North.

2.0 EXISTING TRAFFIC CONDITIONS

2.1 Road Inventory

The site is located on the eastern side of James Ruse Drive south of the overbridge to Parramatta River north of Tasman Street. The site frontage as detailed in the Urban Design report is approximately 292 metres long and includes Tasman Street. Tasman Street is currently closed and blocked to traffic from James Ruse Drive.

Table 2.1 Road Hierarchy

Road Name	Classification
James Ruse Drive A6	State Road A route
Parramatta Road A4	State Road A route
Victoria Road A40	State Road A Route
Kissing Point Road	State Road
Hassel Street	Regional Road
Grand Avenue	Major Collector
River Road West	Local Collector
Grand Avenue North	Local
Tasman Street	Local

Vehicular access to the site is currently closed from Tasman Street. It has been recommended on the Masterplan to have the main site access from Tasman Street with a left turn in and out. There is potential to have a second site access from the access handle south of the subject site which connects into Grand Avenue North east of James Ruse Drive. Discussions with Stakeholders RMS and Transport For NSW and Parramatta Council will be undertaken in determining other site vehicular and pedestrian access and egress.

A Site Context Plan and Site Micro Context Plan are included as Drawing Sheets **3342-14 Sheets 1** and **2** in **Appendix A** of this report.

2.2 Traffic Volumes (Average Annual Daily Traffic Volumes AADT) Camellia Area.

The *AADT volumes* published by the RTA (RMS) for State Roads in the vicinity of the subject site include Parramatta Road, James Ruse Drive, Hassall Street, off-ramp James Ruse Drive, Victoria Road, Kissing Point Road. The AADT traffic volumes in, 1999 and 2002 and 2005 and annual changes compound in the periods 2002 to 2005 are shown in **Table 2.1**. The interactive counts for these roads are not available for 2012.

TABLE 2.2 A.A.D.T. Volumes State Roads Camellia Area 1999 - 2005

Roads & Location	1999	2002	2005	Annual Change 2002 - 2005
James Ruse Drive A6 (Mr309)				
Station No 49095 On Bridge	63099	63346	64085	+1.5%
Station No 49022 M4 Off Ramp	17919	17276	21363	+16.1%
Station No 49011 Parramatta North of Parramatta Road	31899	32478	32171	+0.008
Station No50038 Rydalmere North of Victoria Rd	57624	58625	59873	+3.7%
Parramatta Road A4 (SH5)				
Station No 49002 Granville at Duck River Bridge				
Kissing Point Road (MR 574)				
Station No 50037 Rydalmere East of James Ruse Drive	35948	38249	34168	-10.6%
Station No 50382 Pennant ST W of James Ruse Drive	13000	12142	8521	-29.0%
Hassall Street				
Station No 49126 Camellia W of James Ruse Dr	21343	20855	19221	-0.09%
Station No 50081 Parramatta E of Harris St	28671	29337	27873	-4.0%
Victoria Road A40(MR165)				
Station No 50207 Rydalmere E of Vineyard Ck	56621	24103	24832	+2.0%
Station No 50380	24597	24103	24832	+2.0%

2.2 (Continued)

Heavy Truck Volumes in Peak Periods

The RMS heavy vehicle route map is included in **Appendix D.** The RMS Road Hierarchy map is shown in **Appendix E.**

2.3 Intersection Volume Surveys

Intersection traffic volume counts were carried out by the firm Mott Macdonald in 2012 at the following intersections between 7:00am and 9:30am and 4:00pm to 7:00pm on Monday 30th July.

- James Ruse Drive/ Hassall Street/ Grand Avenue
- James Ruse Drive/Grand Avenue North
- James Ruse Drive/ River Road West

The existing traffic volumes are shown in **Figure 2.**

The following periphery Intersections have also been included in the study as shown in **Figure 3a.**

These intersections include:-

- Parramatta Road/James Ruse Drive
- Kissing Point Road/ James Ruse Drive
- Parkes Street/ Harris Street
- Wentworth Avenue / Parramatta Road

The peak hour volumes are shown in **Figure 3b.**

2.4 Intersection Capacity Analysis

The capacity of each of the intersections listed in Section 2.2 has been analysed by Mott Macdonald in 2012 using SCATES. The peak traffic periods were 7:45-8:45am and 4:45- 5:45pm. The intersection of Hassell Street and James Ruse drive was operating at level of service F in the AM and PM peak hours. The RMS pinch point program of works which has not been completed at this intersection and may improve the performance at this intersection.

The periphery intersection traffic counts carried out by R.O.A.R. Data on the 15th October 2014 are included in the Strategic Network Model prepared by Road Relay Solutions.

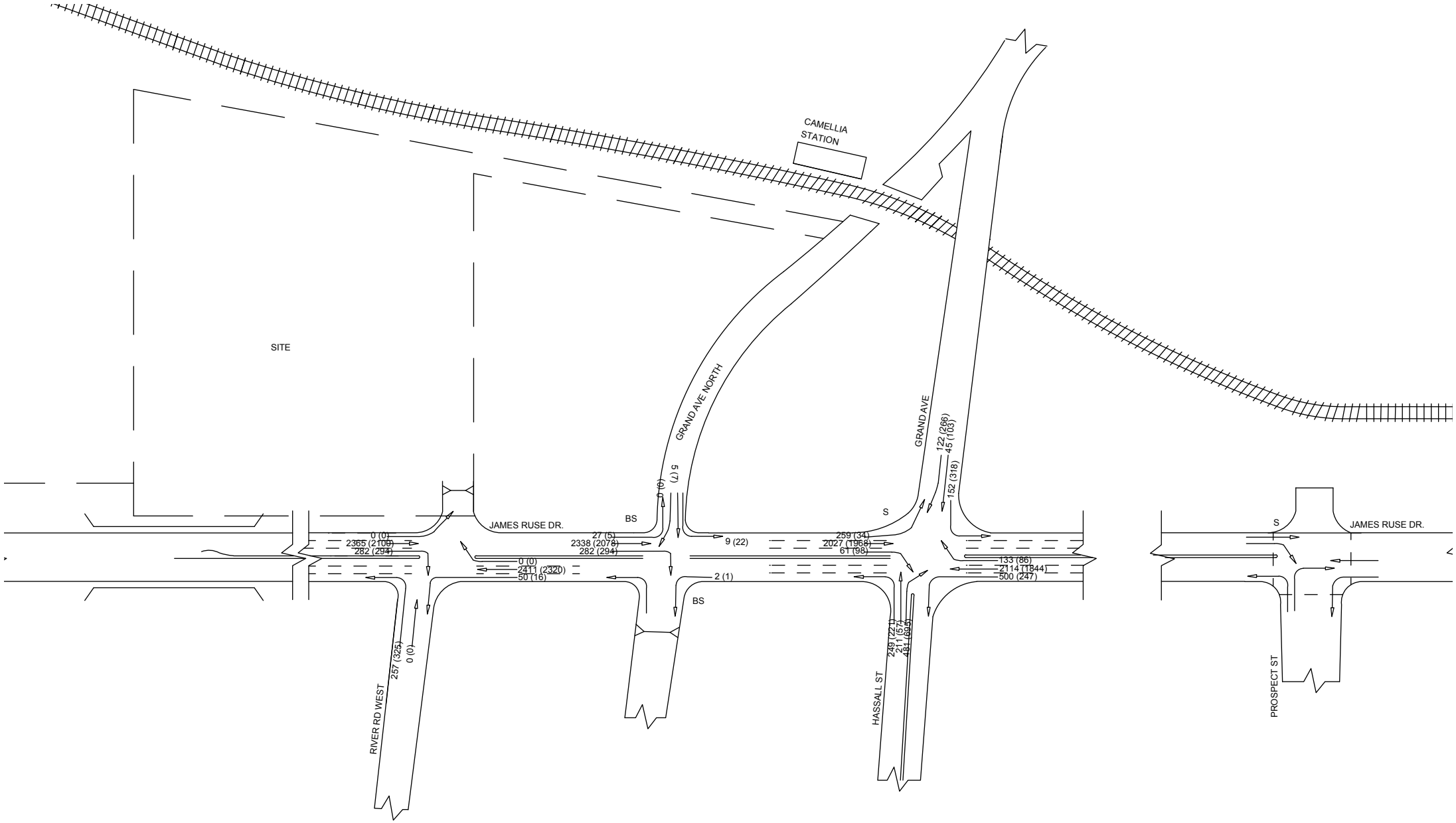


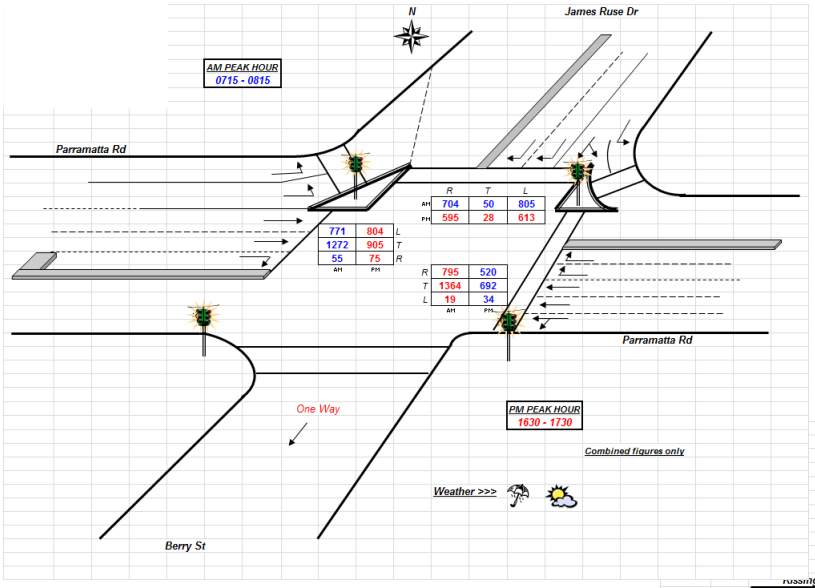
FIGURE 2
EXISTING TRAFFIC VOLUMES
30.07.2012 SOURCE MOTT MACDONALD REPORT

SUBJECT SITE
181 JAMES RUSE DRIVE

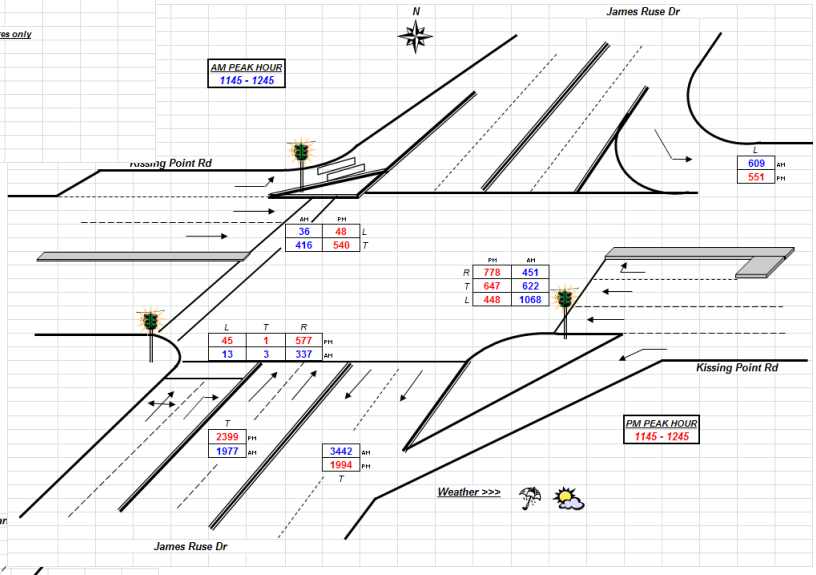
Additional Intersections To Be Counted

Intersections counted and included in Mott Macdonald Report 30/7/2012

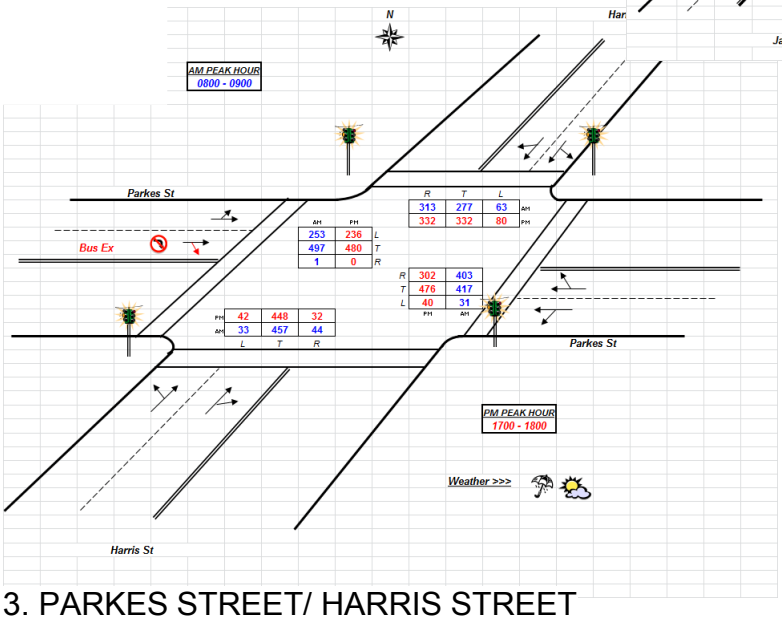
FIGURE 3a
SURROUNDING ROAD NETWORK



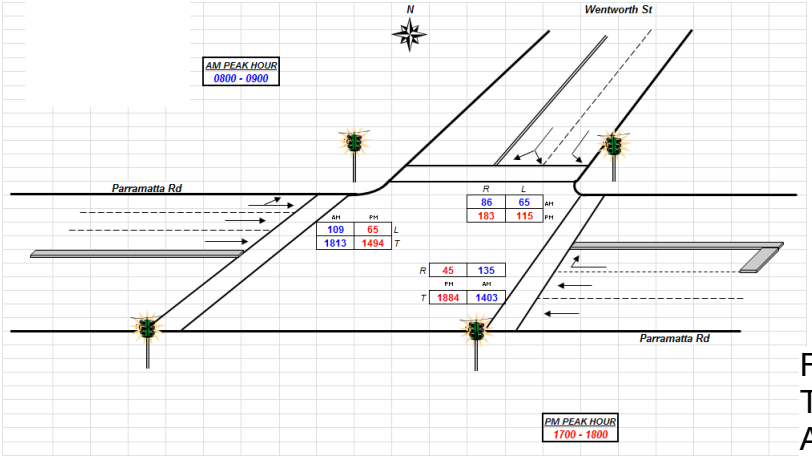
1. PARRAMATTA ROAD/ JAMES RUSE DRIVE



2. JAMES RUSE DRIVE/ KISSING POINT ROAD



3. PARKES STREET/ HARRIS STREET



4. WENTWORTH STREET/ PARRAMATTA ROAD

FIGURE 3B: PREAK HOUR TRAFFIC VOLUME COUNTS AT PERIPHERY INTERSECTIONS CARRIED OUT ON WEDNESDAY 15/10/14

James Ruse Drive concept design for your comment

James Ruse Drive, Rosehill to Clyde

FIGURE 3c
RMS PINCH POINT PROGRAM
JAMES RUSE DRIVE

2.4 (Continued)

The peak intersection performance times are:

	AM	PM
Parramatta Road / James Ruse Drive	7.15-8.15	4.30-5.30
Kissing Point Road / James Ruse Drive	7.30-8.30	4.45-5.45
Parkes Street / Harris Street	8.00-9.00	5.00-6.00
Parramatta Road / Wentworth Street	8.00-9.00	5.00-6.00

The traffic count results are located in **Appendix C** of this report.

2.5 Proposed Road Upgrade Works

RMS Pinch Point Program:
The works to be carried out as part of the Pinch Point Program. A map detailing the program is included in **Figure 3c** include the following:-

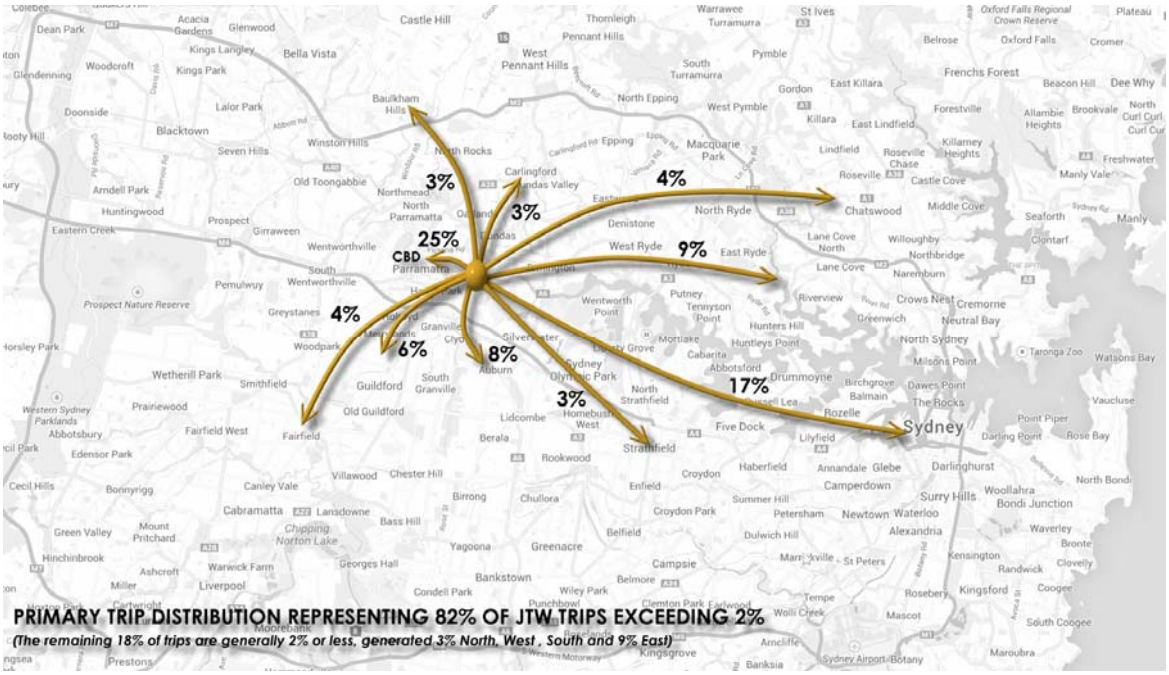
- A dedicated left turn lane from James Ruse Drive to Grand Avenue.
- A third right turn lane from Hassell Street to James Ruse Drive.
- Extension to Right Hand Turn Lane from James Ruse Drive northbound to Hassell Street.
- Extend right hand turn bay from James Ruse Drive southbound to Prospect Street.
- Extend right hand turn bay southbound in James Ruse Drive to Parramatta Road - Work Completed
- Close the central median to prevent right hand turns into and out of Hope Street and Rosehill Racecourse opposite Hope Street- Work Completed
- Reinstate kerbs to facilitate truck access
- A New pedestrian pathway on the eastern side of James Ruse Drive from Grand Avenue.
- New and improved pedestrian access into Rosehill Racecourse.

2.6 Travel Modes to Workforce to

The Journey to Work data to Origins of Workforce by LGA to Workplace Destination Zone Rosehill- Camellia TZ 1713 and 1721.

2.6.1 Origins of Workforce by LGA

The same 2006 travel zones, 1713 and 1721, exhibit a Journey to Work (JTW) trip distribution within the strategic Netanal model is in accordance with the 2009 BTS published trip The 2009 Harris Park Residential Precinct JTW Trip Distribution.



Note: Total excludes balance of NSW and other States.

2.7 Major Access Routes to Site

North-west This route provides access to the site from the north west via Windsor Road and James Ruse Drive and then via James Ruse Drive to Tasman Street (currently closed) or Grand Avenue North.

North-east Access to the site via Victoria Road or Kissing Point Road to James Ruse Drive then to the site via Tasman Street(currently closed) or Grand Avenue North

South-west This route provides access to the site via the M4 link to James Ruse Drive or from Parramatta Road to James Ruse Drive. Vehicles travelling northbound can right turn into Grand Avenue North or into Tasman Street (currently closed)

South-east Access from the site only to Grand Avenue travelling eastbound and turn right at Colquhoun Street and right into Unwin Street-Kay Street and then right into Wentworth Street and turn right or left into Parramatta Road.

2.8 Public Transport Services

Camellia Station is located some 400 metres from the centre of the site travelling along the access handle along the eastern site boundary. Camellia Railway Station is on the T6 service line and services run every 45 minutes in peak times and once per hour in non-peak times. Passengers must change at Clyde for inner city services and services to Parramatta. Access to this station from the site is precarious and involves pedestrians crossing the railway lines with no warning system.

Sydney Buses provide regular peak hour and off peak services on **2** routes
M92 service from Sutherland to Parramatta every 30 minutes. The bus stop is located south of the subject site in Hassell Street.
Bus Route 909 Bankstown to Parramatta has a stops located on the corner of Hassell Street and Alfred Street some 730 metres from the subject site.

Sydney Bus Services
Service 521 Eastwood to Parramatta travels from Victoria Road to Parramatta. The bus stop is located near Pemberton Street and is a 10 minute walk north of the subject site.
Service 525 Chatswood to Parramatta. The stop is located

Public transport services to the site will need to be improved. This may occur with the implementation of the Western Sydney Light Rail Network which will connect Camellia to Parramatta.

3.0 THE PROPOSED DEVELOPMENT

3.1 Masterplan Development

The Urban Design Report has been prepared for the site by Stanisic Architects on behalf of Statewide Planning Pty Ltd. The report identifies a preferred building envelope form which is demonstrated in **Option C**.

The mixed use development shown in **Option C** attached in **Appendix A** of this report shows underground basement car parking for 4200 vehicles and contamination containment cells. On the ground floor 13180m^2 Gross Floor Area of retail is proposed. This retail comprises of a mini major retail space of 2100m^2 for a small supermarket such as Aldi or IGA and larger retail blocks within the central development block smaller retail tenancies configured around periphery of the development site. The development comprises of a number of built form character nodes. These nodes are described in the Urban Design report as **1.** Foreshore, **2** James Ruse Drive, **3,** Transport, **4** central.

Table 3.1 Development Summary

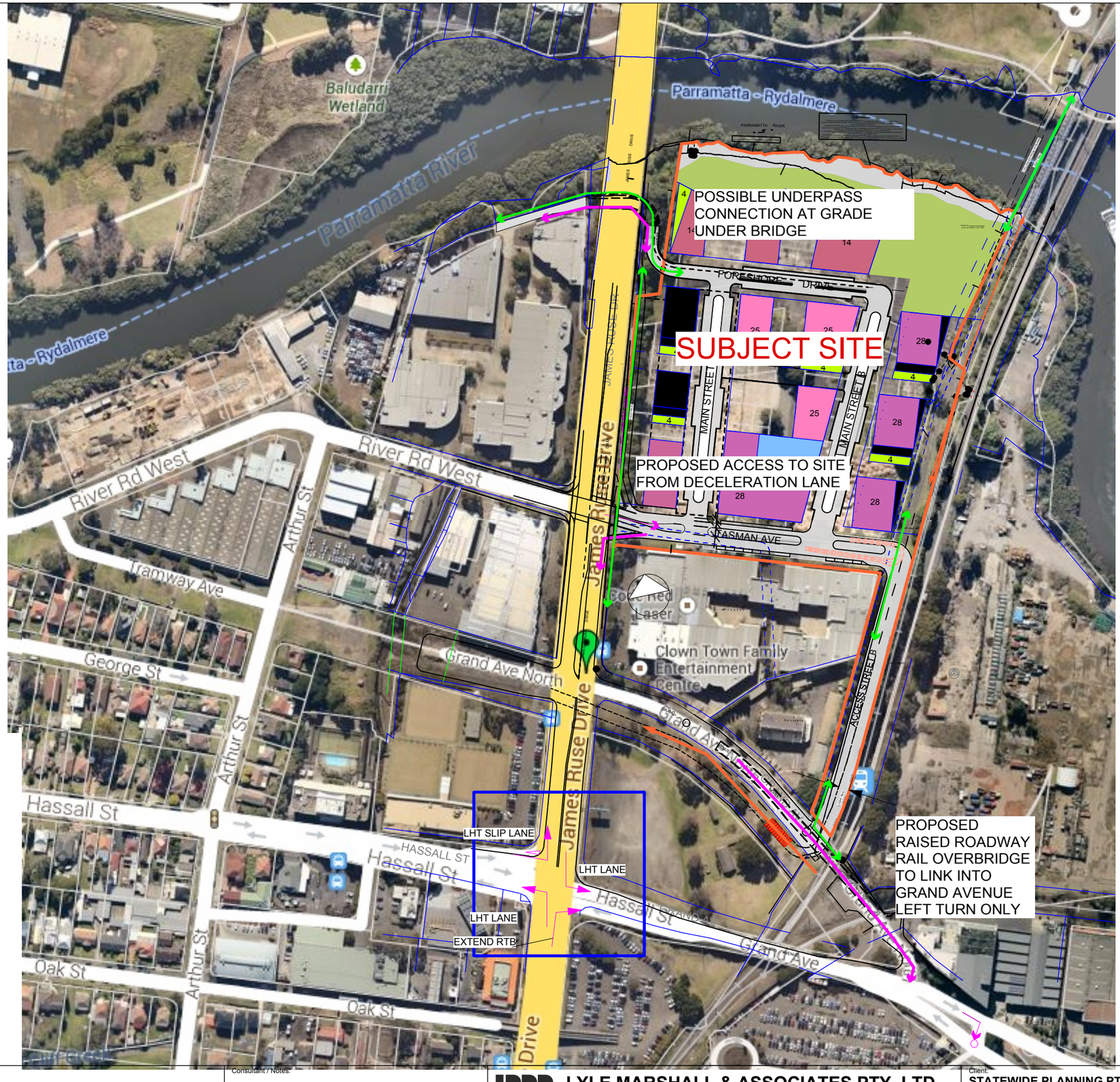
Land Use	Type	Number of Units	GFA
	1 Bed	569	
	2 Bed	1991	
	3 Bed	285	
			260788
Retail			13180
total			273,968

3.2 Site Access

A slip lane access of some 152 metres will provide access from James Ruse Drive into the central access street (Tasman Street) with a left turn slip lane. An additional egress/entry will occur from the access handle to Grand Avenue North. Refer to **Figure 4**.

3.3 Internal Road Layout

Tasman Street provides east and west link from James Ruse drive through the site to the access handle which runs along the Carlingford Railway corridor to the east. A local street runs around the central node connecting to the central access street (Tasman Street). The local street provides access egress and entry points into the car parking areas. A shared pedestrian zone runs west to east through the central character node. The proposed street road network plan is shown in **Figure 5.**



N

0m 50m 100m

RMS PINCH POINT PROGRAM

POSSIBLE SITE CONNECTIONS

SITE BOUNDARY

PEDESTRIAN AND CYCLE LINKS

FIGURE 4 POSSIBLE SITE CONNECTIONS AND MASTERPLAN STREET CONFIGURATION

No.	Date	Issue Notes

Consultant / Notes:

LYLE MARSHALL & ASSOCIATES PTY. LTD.
CONSULTING ENGINEERS, TRANSPORTATION, ENVIRONMENTAL PLANNERS & ARCHITECTS
NOMINATED ARCHITECT : ERICA MARSHALL-MCCLELLAND : NO. 6513
SUITE 8
871 PACIFIC HIGHWAY
CHATSWOOD N.S.W 2067
Member Australian Institute of Architects 2014
The Association of Consulting Engineers Australia
phone: (02) 9419 8191
fax: (02) 9419 8107
email: lylemarshall@ozemail.com.au
web: www.lylemarshallandassociates.info

Client: **STATEWIDE PLANNING PTY LTD**

TRAFFIC AND TRANSPORT ASSESSMENT
181 JAMES RUSE DRIVE CAMELLIA

SITE CONTEXT -SITE CONNECTIONS

Design By: EMMC	Job No.: 3342-14		
Drawn By: EMMC	Scale: 1:5000@A3		
Reviewed By: EMMC	Date: 26.08.14	Sheet No.: 03 of	Issue: A
Passed By: EMMC	Date of Issue: 26.08.14		

3.3 (Continued)

The intersection of Tasman Avenue and James Ruse Drive and River Road West will be aligned so that in the future a signalised intersection upgrade can be provided. Future locations of vehicular and pedestrian links and upgrade works are shown in **Figure 5.**

The alignment of Tasman Avenue with River Road West to provide a four-way signalised intersection was modelled in the strategic network model in Appendix B. The four-way intersection was deemed unsuccessful as operating capacity was F. The intersection was then modelled as a T signalised intersection with Tasman Avenue with dual right turn lanes from James Ruse Drive into Tasman Avenue and dual left turn out lanes into James Ruse Drive and proved satisfactory providing for future predicted growth.

The access handle (Access Street B) will provide a local street connection together with a light rail link to Grand Avenue North.

3.4 Future Alternative Access Investigations

Future alternative access points have been investigated as part of this study. The site at 14A River Road West will be a future development site. There is an opportunity to provide a local access road link together with a separated cycleway under James Ruse Drive into the development as shown in **Figure 4.**

A future elevated road link from the access handle to Grand Avenue has also been investigated. The elevated road link will travel east of the subject site over the heavy rail line together with a separated pedestrian link to the station and connect to Grand Avenue North with a left turn only.

An upgrade of a roundabout further east along Grand Avenue will provide vehicles wishing to travel back to James Ruse Drive a right turn facility and improve the existing intersection by preventing vehicles turning right at the Grand Avenue North / Grand Avenue intersection which has a restricted sight distance. A two way roundabout is proposed in Grand Avenue, refer to the Strategic Network Model Report in **Appendix B.**

The intersection upgrade to Hassell Street and James Ruse Drive are provided in the Strategic Network Model and this intersection has been modelled using Sidra included in **Appendix B**.

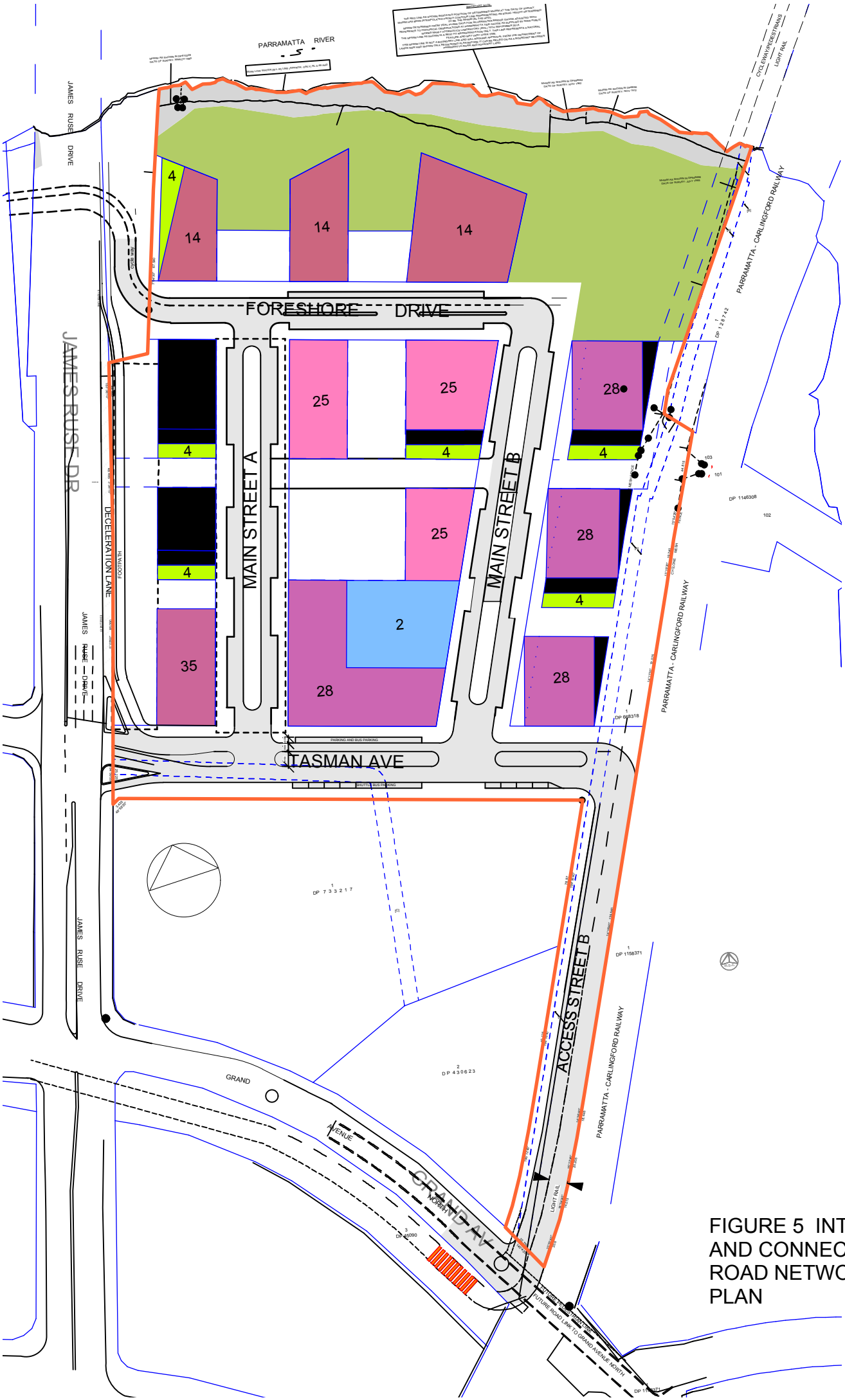


FIGURE 5 INTERNAL AND CONNECTING ROAD NETWORK PLAN

3.5 Green Travel Plan

A green travel plan will be implemented into the proposed car parking proposal.

The green travel plan will provide areas for bicycle parking, storage and changeover facilities together with transport way-finding maps to public transport facilities. A number of car share spaces for 'go get car share' or similar providers will be allocated within the development. These spaces will be provided at a rate of 1 space per 3 retail parking spaces in accordance with Parramatta City Council objectives.

Number of car share spaces to be provided:

No. of Rental Carparking Spaces	No. of Car Share
439	147

3.6 Shuttle Bus Services

The provision of a shuttle bus service similar to the type of service implemented at the "Sharkies" Cronulla/ Sutherland Leagues Club will be implemented in the short term 1-5 year operation of the site or until such time as the light rail is operational.

The service will provide a *20 seater shuttle bus* which will be a free service which will run from the Tasman Avenue to Victoria Road bus services and UNSW. The service frequency time will be *10 minutes*. The length of the operational route will be *3.2 Kilometres*. An option to extend the shuttle bus operation to include a left turn-out of James Ruse Drive and Pemberton Street and right-turn into Pennant Street and left-into Victoria Road would extend the route to **5km**.

.

The shuttle bus route is shown in **Figure 6.**

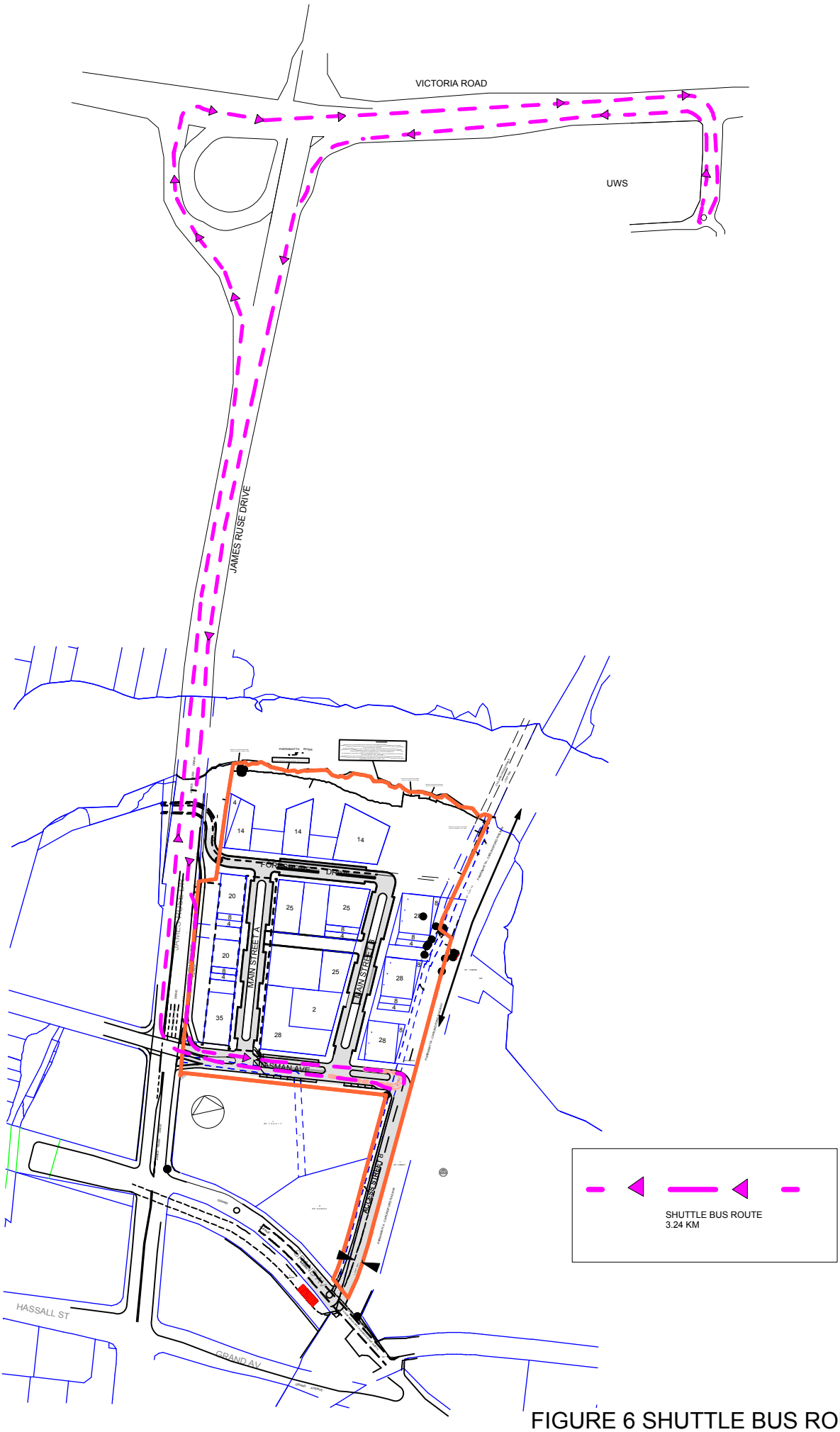


FIGURE 6 SHUTTLE BUS ROUTE

3.7 Pedestrian and Cyclist Facilities

Pedestrian and cyclists routes have been identified in the Masterplan study prepared by Stanisic Architects. Other future site connections for cyclists and pedestrians are shown in **Figure 4.**

- Pedestrian links to the University of Western Sydney via a pedestrian cycle bridge extension over the Parramatta River will be an important link for residents and workers from the proposed site.

- A footpath upgrade works along James Ruse Drive will also be important as recommend by the RMS.

- A on-grade separated cycleway access under James Ruse Drive will connect the site to the foreshore and to the site at 14A River Road West.

- Separate Pedestrian access to Camellia Railway Station will be provided along the Access Street B. A pedestrian stairway will connect to the vehicular and pedestrian overbridge which connects Grand Avenue North.

4.0 PARKING ASSESSMENT

4.1 Parking Code Requirement

The parking requirement for retail, commercial offices, café and the gymnasium has been calculated in accordance with the **Parramatta Council DCP Section 3.6.2.** The total required parking for the site is **4053** spaces. **4200 parking spaces** are provided.

Table 4.1 Required Car parking Provision

Land Use	Type	Number of Units	GFA	Parramatta DCP 2011	Parking Requirement	Actual Supply
	1 Bed	569		1 space/unit	569	
	2 Bed	1991		1 space/unit	1991	
	3 Bed	285		1.2/unit	342	
	visitor			0.25 per unit	711.25	
Retail			13180	1 space per 30	439	
total					**4052.25**	**4200**

4.2 Parking Provision

The provision of **4200** spaces is marginally higher than the **DCP** *parking requirement*.

The provision of car share spaces at the rate of **1 space per 3 spaces** for retail/commercial car parking is a requirement objective stated by Parramatta City Council. This has been accommodated in the total number of car parking spaces provided. A provision of **150 car share spaces** could be accommodated within the proposal.

5.0 TRAFFIC ASSESSMENT

5.1 Traffic Generation

Traffic Generation for each land use has been calculated in accordance with the RMS Technical Direction Note TDT 2013/04a.

Table 5.1a Traffic Generation for Residential Land Use

TOTAL UNITS	1 BEDROOM	2 BEDROOM	3 BEDROOM	RESIDENTIAL GFA
2845	20%	70%	10%	270155
2845	569	1991	285	
TRAFFIC GENERATION FOR HIGH DENSITY UNITS* REFER TO RMS TDT 2013/04a				
	Peak Hour Rate	NO OF UNITS	PEAK HOUR	
AM PEAK HOUR RATE	0.19	2845	540.55	
PM PEAK HOUR RATE	0.15	2845	426.75	

Table 5.1b Traffic Generation for Retail Land Use

RETAIL TRAFFIC GENERATION * REFER TO RMS TDT 2013/04a				
TOTAL GFA	13180M2			
ASSUMED GLFA	13180-15% CIRCULATION = GFLA		11203	
	DAY RATE PER 100M2			
PEAK HOUR RATE	THURSDAY	FRIDAY	SATURDAY	SUNDAY
	6.2	6.7	7.5	6.6
112.03	695	751	840	739

The Total Traffic Generation is calculated and shown in Table 5.1

Table 5.1c Trip Generation for Proposed Masterplan

Table 5.1c Trip Generation- Proposed Masterplan										
		Trip Generation rate			Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Pea	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
residential	2845	0.19	540.55		0.15	426.75	135	405	284	142
Retail	11203	6.75/100m2 Average	151.00	Note*		756.20	76	76	378	378
EMPLOYEES	162**		162.00	Note **			162	0	0	0
TOTAL			**854**			**1183**	**373**	**481**	**663**	**520**
Note: GLFA is referred to in RMS TDT 2013/04a not GFA										
AM peak hour for residential is based on 0.25 IN and 0.75 Out. PM peak hour is based on 0.66 IN and 0.33 OUT										
* AM Peak Hour Trips for Retail assume only 0.1 In and 0.1 Out Total Trips 0.2 x 756.2=151. PM peak hour is assumed 0.5 IN and Out.										
** Number of employees calculated by 11203/50 x car driver mode of 72.5%										

5.1 (Continued)

The number of employees and car travel mode has been determined from RMS RTA studies at other Westfield Shopping Centres and an average rate as 1 employees per 50m2 of Gross Floor Area. The car travel mode for Parramatta LGA area of 72.5% is then multiplied by the number of employees to obtain the traffic generated by the retail component.

Table 5.1d Number of Employees per m^2 at Shopping Centres.

Location	Number of employees per m^2
Miranda	1 per 79 m^2
Liverpool	1 per 60.5 m^2
St Ives	1 per 53 m^2
Hurstville	1 per 49.5 m^2
Fairfield West	1 per 50 m^2

Source: RTA Land Use Traffic Generating Data and Analysis 4 Shopping Centres.

5.2 Ingress and Egress

The ingress and egress paths are shown in Figures 4 and 5 and are explained as follows:-

1) Local Street Underpass (James Ruse Drive)

Foreshore Street to Site at 14A River Road West
A local street and separated cycleway underpass is shown as a future connection between Foreshore Street and runs under James Ruse Drive to connect to the future development site at 14A River Road West. This provides local traffic and cyclists with opportunities to connect to the foreshore and local residential developments. This existing connection location is shown in Photograph

2) Tasman Avenue/ James Ruse Drive Intersection Upgrade

A deceleration lane some 152 metres long will connect vehicles turning into the site from the north. A separate left turn lane out from Tasman Avenue will also be provided. The intersection alignment was originally configured to connect through to River Road West. This intersection was modelled in the Strategic Network Model in **Appendix B**. The intersection was then designed as a signalised T intersection which proved to perform satisfactory with spare capacity.

3) Connection to Grand Avenue North

Access Street B which runs north south along the Carlingford heavy rail alignment will have two way local traffic. Two roundabouts are proposed for Grand Avenue north top allow vehicle movements in and out from the site. 115 metres north west there is another roundabout which will permit vehicles up to 2 Tonne to use an overpass over the heavy rail line and connect to Grand Avenue North and left turn into Grand Avenue.

A new roundabout connection in Grand Avenue further east as shown in **Figure 4** will permit vehicles to turn right.

5.3 Distribution and Assignment of Traffic

In order to effectively model and distribute the traffic generated by this site and future adjoining development sites we have estimated the potential development GFA and summary mix. These development sites are shown in the MasterPlan Document prepared by Stanisic Architects.

In Table 5.3a the development mix and summary areas are shown for the two closest development sites in closest proximity, one at 14A River Road West and the other at (Bilbergia) Wentworth Marina Development Site in Grand Avenue North.

Table 5.3a Development Comparison Summary Tables

181 James Ruse Drive

Land Use		GFA m2	Car Parking Provision		No Of Units	No Of Beds	No Of Units	percentage of GFA	No of Car Spaces
residential	0.95	270155	3163.25		2845	1 bed	569	0.2	569
retail	0.05	13180	439.3333			2 bed	1991	0.7	1991
total GFA		283335				3 bed	285	0.1	342
Developed Site Area		69749.45				visitor			711.25
car parking			4200			retail			439

14A River Road West

Land Use		GFA	Car Parking Provision		No Of Units	No Of Beds	No Of Units	percentage of GFA	No of Car Spaces
residential	0.95	92063.57	1410		1390	1 bed	368	0.2	368
retail	0.05	4489.82	150			2 bed	920	0.7	920
total GFA		96555.33				3 bed	102	0.1	122
Developed Site Area		18932.42				Visitor			347.5
car parking			1560			retail			149.66

5.3 (Continued)

Wentworth Marina (Bilbergia) Site- Grand Avenue North

Land Use		GFA	Car Parking Provision		No Of Units
residential	0.95	284984.68	5659		4461
retail	0.05	13898.34	463		
total GFA		298889.00			
Developed Site Area		58609.75			
car parking			6122		

No Of Beds	No Of Units	percentage of GFA	No of Car Spaces
1 bed	1140	0.2	1140
2 bed	2989	0.7	2989
3 bed	332	0.1	398
Visitor			1132
retail			463

The Traffic generation has been calculated for the proposed development sites at 14A and Wentworth Marina (Bilbergia) sites as shown in Table 5.3b

Table 5.3b Traffic Generation Comparison Summary Development Sites

181 James Ruse Drive

		AM Trip Generation rate			PM Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Peak	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
residential	2845	0.19	540.55		0.15	426.75	135	405	284	142
Retail	11203	6.75/100m2 Average	151.00	Note*		756.20	76	76	378	378
EMPLOYEES	162**		162.00	Note*		0.00	162	0	0	0
TOTAL			**854**			**1183**	**373**	**481**	**663**	**520**

14A River Road West

		AM Trip Generation rate			PM Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Peak	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
residential	1390	0.19	264.10		0.15	208.50	66	198	138	69
Retail	4041.00	6.75/100m2 Average	54.55	Note*		272.77	27	27	136	136
EMPLOYEES	81		58.00	Note*		0.00	58			0
TOTAL			**377**			**481**	**151**	**225**	**274**	**205**

5.3 (Continued)

Wentworth Marina (Bilbergia) Site- Grand Avenue North

		AM Trip Generation rate			PM Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Peak	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
residential	4461	0.19	847.59		0.15	669.15	212	636	448	221
Retail	11814	6.75/100m2 Average	159.49	Note*		797.00	80	80	398	398
EMPLOYEES	236		236.00	Note*			171			342
TOTAL			**1243**			**1466**	**463**	**716**	**846**	**961**

5.4 Intersection Capacity Analysis and Modelling Base Scenario 2014.

The base model 2014 has been modelled using Netanal until such time as a MESO model becomes available. The modelling is included in the report prepared by Road Delay Solutions and is included in Appendix B of this report.

5.5 Future Strategic Network Modelling 2036

The future model 2036 has been modelled using Netanal until such time as a MESO model becomes available. The traffic generation from surrounding future development sites shown in the Masterplan prepared by Stanisic Architects have been included in the future model. Future upgrades to the intersections of Tasman Avenue/James Ruse Drive and Hassell Street James Ruse Drive have been provided in the modelling as well as a two way roundabout in Grand Avenue.

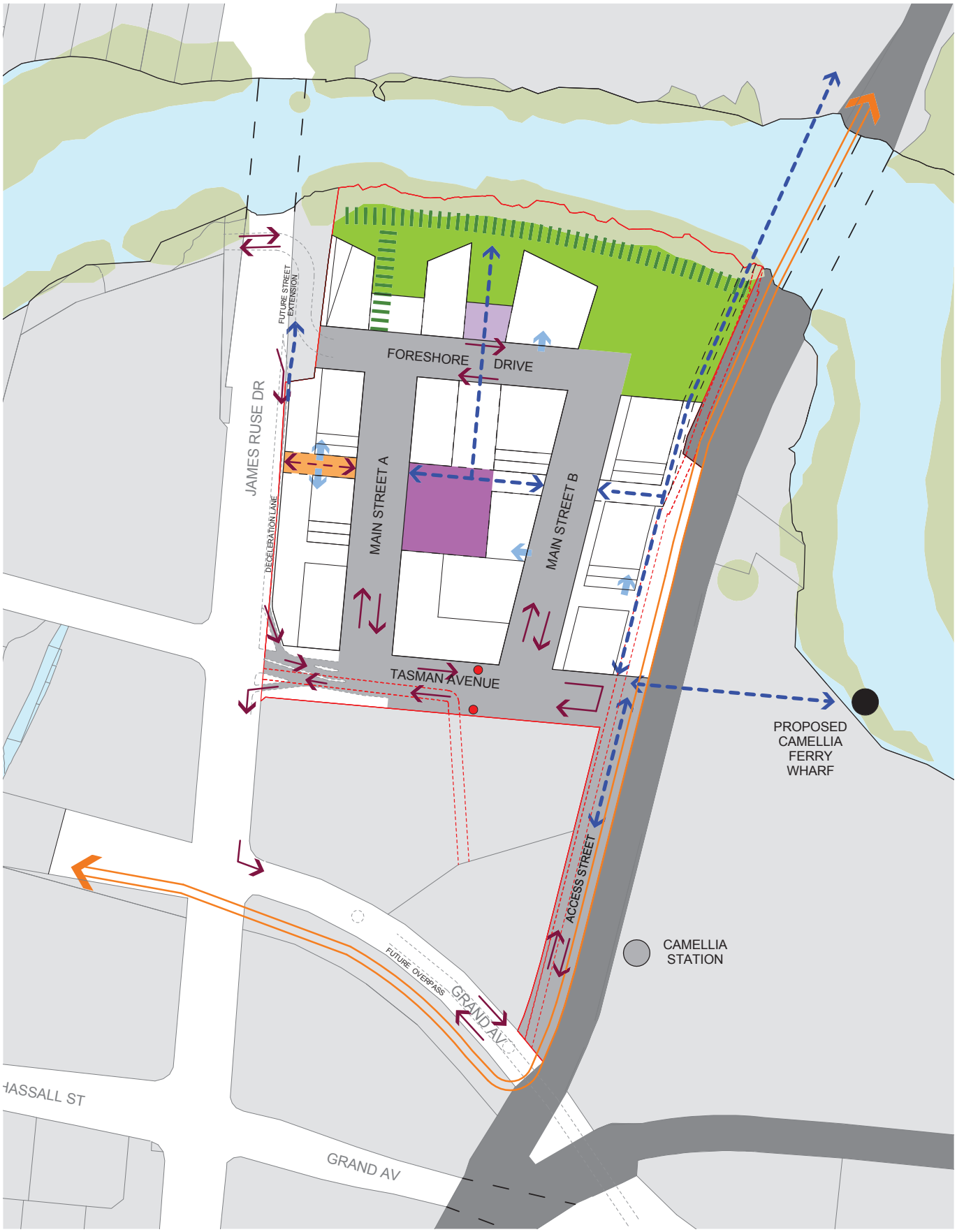
The proposed development can be supported as demonstrated in the Netanal Model provided in Appendix B.

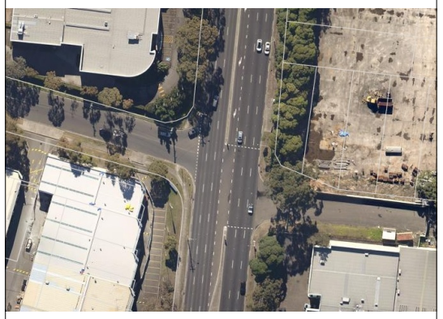
APPENDICES

APPENDIX A

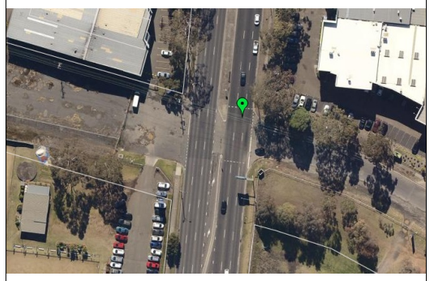
OPTION C (PREFERRED) - TOWER + CENTRAL PARK

FIGURE 12: VEHICLE ACCESS, ENTRIES + CIRCULATION





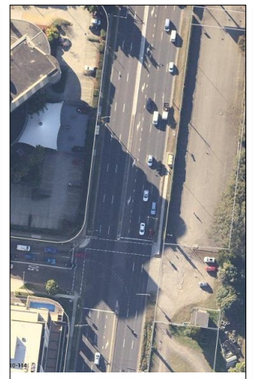
RIVER ROAD WEST AND SITE ACCESS ROAD



GRAND AVENUE NORTH AND JAME RUSE DRIVE

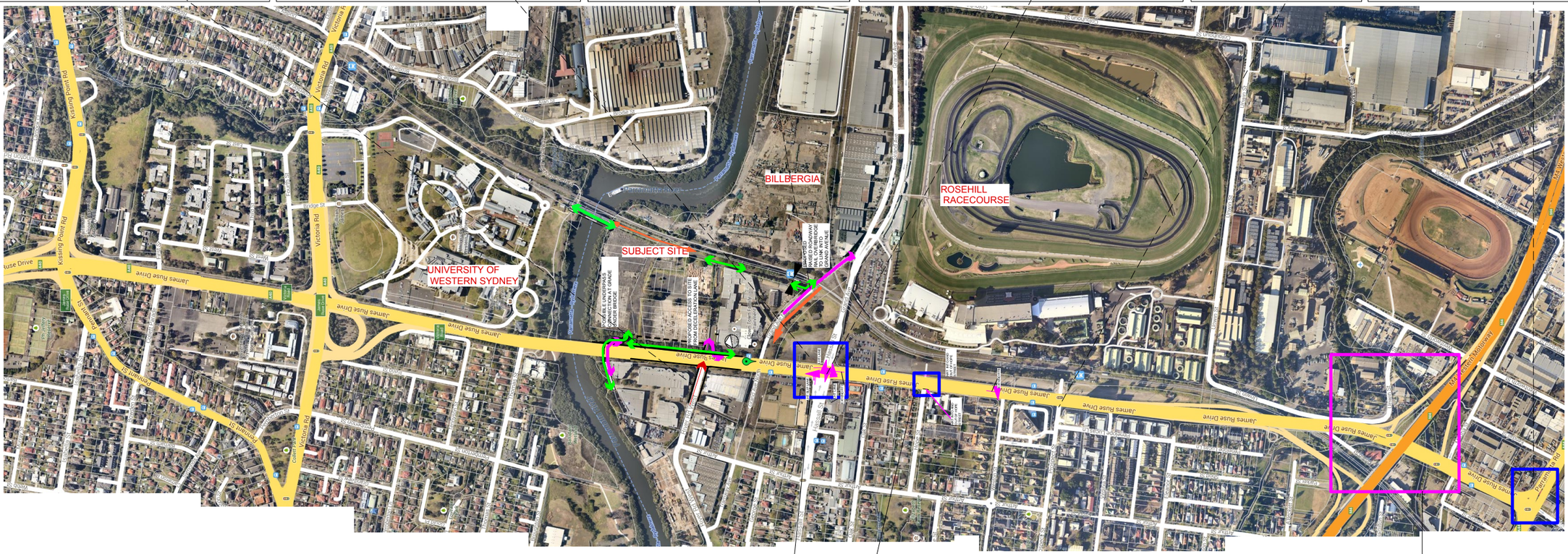
GRAND AVENUE NORTH AND CAMELLIA RAILWAY STATION: SITE ACCESS

HASSELL STREET AND JAMES RUSE DRIVE INTERSECTION



PROSECT STREET AND JAMES RUSE DRIVE INTERSECTION

JAMES RUSE DRIVE AND PARRAMATTA ROAD INTERSECTION



WEST CONNEX

RMS PINCH POINT PROGRAM WORKS

N

0m 50m 100m

No.	Date	Issue Notes

Consultant / Notes:

Date: 3/9/14
File name: 3342-14-DRAWINGS_KC.vwx

LYLE MARSHALL & ASSOCIATES PTY. LTD.
CONSULTING ENGINEERS, TRANSPORTATION, ENVIRONMENTAL PLANNERS & ARCHITECTS
NOMINATED ARCHITECT : ERICA MARSHALL-MCCLELLAND : NO. 6513

SUITE 8
871 PACIFIC HIGHWAY
CHATSWOOD N.S.W 2067

Member Australian Institute of Architects 2014
The Association of Consulting Engineers Australia

phone: (02) 9419 8191
fax: (02) 9419 8107
email: lylemarshall@ozemail.com.au
web: www.lylemarshallandassociates.info

Client:
STATEWIDE PLANNING PTY LTD

TRAFFIC AND TRANSPORT ASSESSMENT
181 JAMES RUSE DRIVE CAMELLIA

SITE CONTEXT PLAN

Design By	EMMC
Drawn By	EMMC
Reviewed By	EMMC
Passed By	EMMC
Job No.	3342-14
Scale	1:10000@A3
Date	26.08.14
Date of Issue	26.08.14
Sheet No.	01 of
Issue	A

N

0m 50m 100m

RMS PINCH POINT PROGRAM

POSSIBLE SITE CONNECTIONS

SITE BOUNDARY

PEDESTRIAN AND CYCLE LINKS

No.	Date	Issue Notes

Consultant / Notes:

LYLE MARSHALL & ASSOCIATES PTY. LTD.
CONSULTING ENGINEERS, TRANSPORTATION, ENVIRONMENTAL PLANNERS & ARCHITECTS
NOMINATED ARCHITECT : ERICA MARSHALL-MCCLELLAND : NO. 6513
SUITE 8
871 PACIFIC HIGHWAY
CHATSWOOD N.S.W 2067
Member Australian Institute of Architects 2014
The Association of Consulting Engineers Australia
phone: (02) 9419 8191
fax: (02) 9419 8107
email: lylemarshall@ozemail.com.au
web: www.lylemarshallandassociates.info

Client: **STATEWIDE PLANNING PTY LTD**

TRAFFIC AND TRANSPORT ASSESSMENT
181 JAMES RUSE DRIVE CAMELLIA

SITE CONTEXT PLAN-MICRO

Design By: EMMC	Job No.: 3342-14		
Drawn By: EMMC	Scale: 1:5000@A3		
Reviewed By: EMMC	Date: 26.08.14	Sheet No.: 02 of	Issue: A
Passed By: EMMC	Date of Issue: 26.08.14		

APPENDIX B

ROAD DELAY SOLUTIONS

181 James Ruse Drive
Camellia
Master Plan
Preliminary Strategic Network Model 2036
for the Purpose of Rezoning

for...

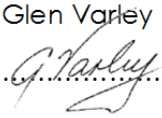
Lyle Marshall & Associates

Reference: 20140207
October 2014

DOCUMENT STATUS

C:\Users\Glen\Documents\Camellia\Report\Camelia Strategic Model for the Purpose of Rezoning.docx

Author Glen Varley (Road Delay Solutions Pty Ltd)……..

Signed  ……

Reviewed Erica Marshall ……..……..

Date 20 October 2014……..……..

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DISCLAIMER

Road Delay Solutions Pty Ltd assumes no responsibility or liability for the predictive nature of any traffic volumes, and resultant conclusions, detailed in this document and the accompanying preliminary strategic model. The modelling projections are subject to significant uncertainties and unanticipated change, without notice. While all source data, employed in the preparation of this document, has been diligently collated, the limited timeframe afforded during the model development over only three (3) weeks means Road Delay Solutions Pty Ltd is unable to assume responsibility for any errors resulting from the presented vehicle projections.

CONTENTS

FIGURES

TABLES

1 INTRODUCTION

Road Delay Solutions has been engaged by Lyle Marshall & Associates Pty Ltd to undertake the preparation of a Strategic Transport Model in support of the residential rezoning for the Camellia Development.

This assessment has critically analysed the operational characteristics of James Ruse Drive, River Road West and Grand Avenue.

From this assessment a raft of infrastructure mitigation has been developed to sustain the planned level of development.

2 EXISTING CONDITIONS

LOCATION

The development site at 181 James Ruse Drive, commonly known as Camellia, is generally bounded by the Parramatta River to the north, the Westpoint Marinas Development to the east, Rosehill Gardens to the south and James Ruse Drive to the west, as shown in *Figure 2*.

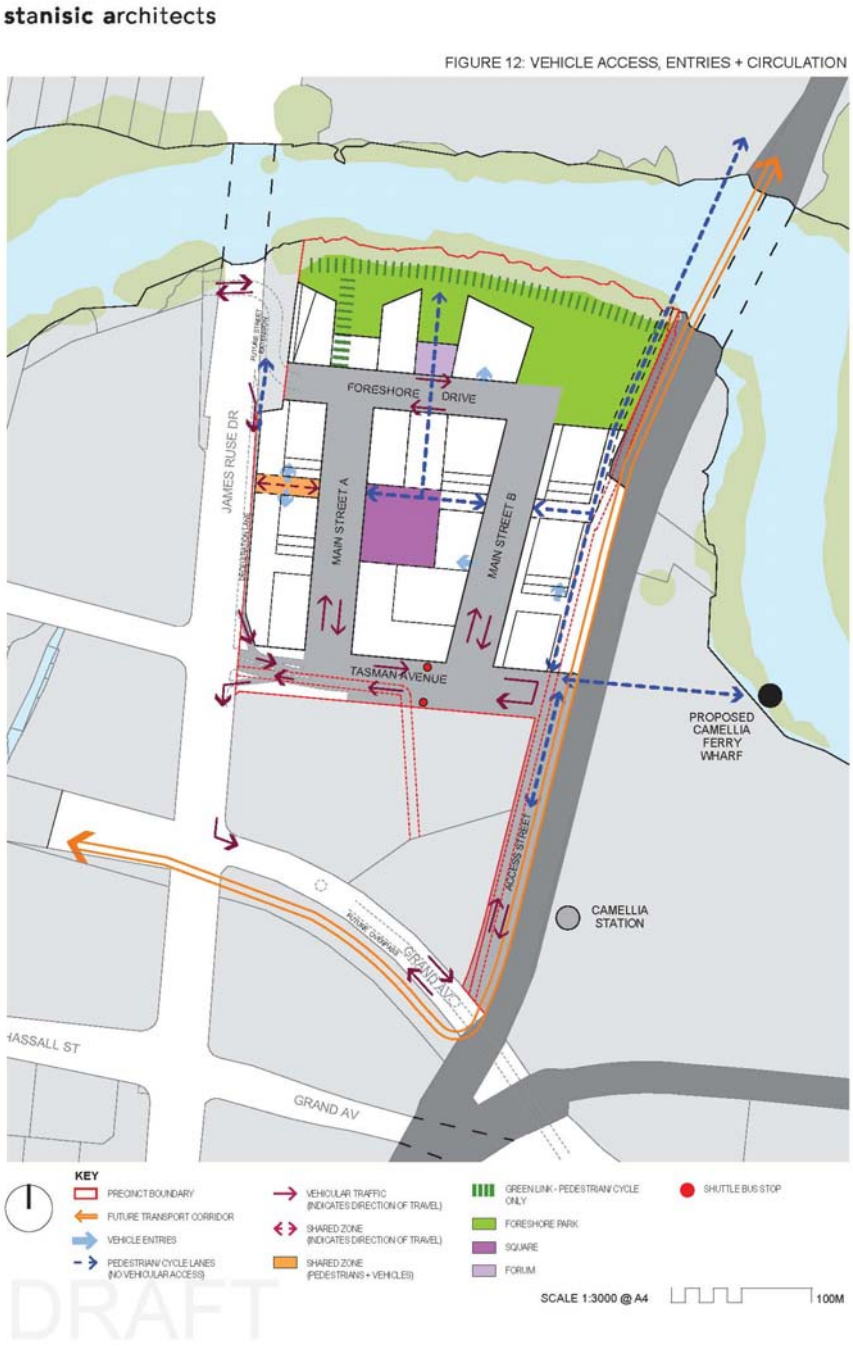


Figure 1 **Camelia Development Site**
Source *Stanisic Architects - 2014*

Figure 2 **Site Context**
Source *Google Maps, 2014*

CURRENT YEAR TRIP MATRIX

The geographic region modelled (*Sydney Statistical Division or Sydney SD*) is represented by a trip matrix (*trip table*), that details the individual travel demands between origin and destination pairs. Each distinct area representing a trip origin or end is called a '*Zone*'. The Sydney Netanal model contains some 960 zones, following disaggregation. These elements define areas of homogenous land use (*eg. residential, industrial, retail, commercial, education, airports, hospitals*) enclosed and linked by physical features such as major roads, railways and rivers. The trip table specifies the number of car trips travelling from each zone to every other zone in the modelled area.

The boundaries of these zones for the Sydney Metropolitan Area were defined in 1996, by the NSW Department of Transport's (*TPDC*), and have been generic across all traffic and transport modelling activities undertaken in Sydney. New boundaries were defined by TPDC in 2006 and again in 2011, with an equivalency table, prepared by the DoP, employed to rationalise the current projected land use and trip distribution patterns with the zonal structure presented in 1996.

The assignment process, described above, essentially determines the anticipated route selection made by motorists between the '*origin*' and '*destination*' zone during a designated time period. The total number of trips between all the zonal pairs produces the projected traffic volumes reported by the model. Netanal models the road network assignment over a 1hr period.

The base year 2014 trip matrix was originally developed by BTS in October 2009. Disagregation of the generation and distribution of trip demand between zonal pairs has been undertaken by *Road Delay Solutions* to the one (1) hour morning and evening peak travel trip tables to accurately reflect and assimilate the operation of the Sydney Metropolitan road network.

The land use assumptions adopted in the year 2014 trip matrices, conform with those published by BTS and have been further advanced through numerous calibration processes throughout the Sydney Metropolitan area.

3 MODEL CALIBRATION

This section provides a concise framework for the verification, validation and calibration of the base year 2014 traffic model, assimilating the current study area road network and it's operational conditions.

DATA COLLATION

Intersection traffic count data has been utilised in the calibration procedure to align the projected model volumes with the current traffic flow and distribution, within the study area.

Field data, specifically intersection turn movements, were collected, at select intersection sites.

A detailed audit and catalogue of the study area road network, and surrounds, has been undertaken ensuring the accuracy of the network platform onto which the developed morning and evening peak trip matrices have been assigned.

Generally, the network characteristics catalogued were...

- *Road hierarchy,*
- *Road alignment,*
- *Number of lanes by peak period,*
- *Transit corridors,*
- *Regulated link speeds,*
- *Intersection control modes, and*
- *Toll collection locations on motorways.*

All major infrastructure projects, to the future model date, have been employed in the future year modelled road networks, including the West Connex Project.

JAMES RUSE DRIVE

A state road under the auspices of the Roads and Maritime Services (RMS), the corridor carries on average some 66,000 vehicles per weekday. With a mid-block capacity of six (6) lanes, James Ruse Drive is a critical transport link skirting the Parramatta CBD.

James Ruse Drive serves as a radial connection between the key arterial roads of Parramatta Road, The M4 Motorway, Kissing Point Road, Victoria Road and Windsor Road.

Currently the corridor between Parramatta Road to the south and Victoria Road to the north, experiences high levels of congestion during the morning and evening peak commuter periods.

The intersection of James Ruse Drive and Hassall Street reports an unsatisfactory Level of Service (LoS) 'F' during both the AM and PM peak periods. Queue lengths in excess of 600m are reported and have been observed on site in the peak flow directions during the peak periods.

A pinch point study was undertaken by the *RMS* sought to address these high congestion levels along the corridor. Mitigation measures were proposed to reduce the impost of the current vehicle demands. With the advent of future developments and the West Connex project, it has been found that further measures are required to increase mid-block and intersection capacity in order to sustain the fore mentioned planned developments, particularly at the intersection with Hassall Street.

GRAND AVENUE

Grand Avenue is a major collector road serving the eastern catchment of the Rosehill precinct.

Currently averaging some 7,000 vehicles per weekday, vehicle demands on the corridor are set to rise in the future with the Camellia and Westpoint Marina developments. These predominately residential developments are planned to yield some 7,300 units and place considerable duress on the Hassall Street intersection.

RIVER ROAD WEST

A classified local collector road with an average weekday traffic volume of some 2,600 vehicles, the route serves as an alternate access point for the Parramatta CBD.

River Road West will be subjected to the future impacts associated with the residential development of site 14A which will yield some 1,390 units.

VERIFICATION

Verification is the process of determining if the computer code, that implements the modelling logic, produces the desired output for a given set of input data and/or parameters.

A model is considered successful if the outputs are consistent, in terms of both magnitude and direction, with results from the direct application of the logic on which the code within the Netanal software is based.

The Netanal software package produces traffic forecasts generally based upon travel time rather than distance or gravity principles. Netanal determines the invoked link and intersection delays, during a model assignment run, to effectively produce travel times between origin and destination.

Based on these times, route selection within the model is influenced by the determined travel times on each modelled or alternate route. Preferred travel routes will be those yielding the lowest travel times, with a direct correlation to the vehicle operating costs.

The Netanal model has been verified by the former *RTA*, with reference found in *Part 2* of the '*Economic Analysis Manual'*[1].

[1] '*Economic Assessment Manual'* Roads and Traffic Authority, N.S.W., 1999 – Revised May 2006.

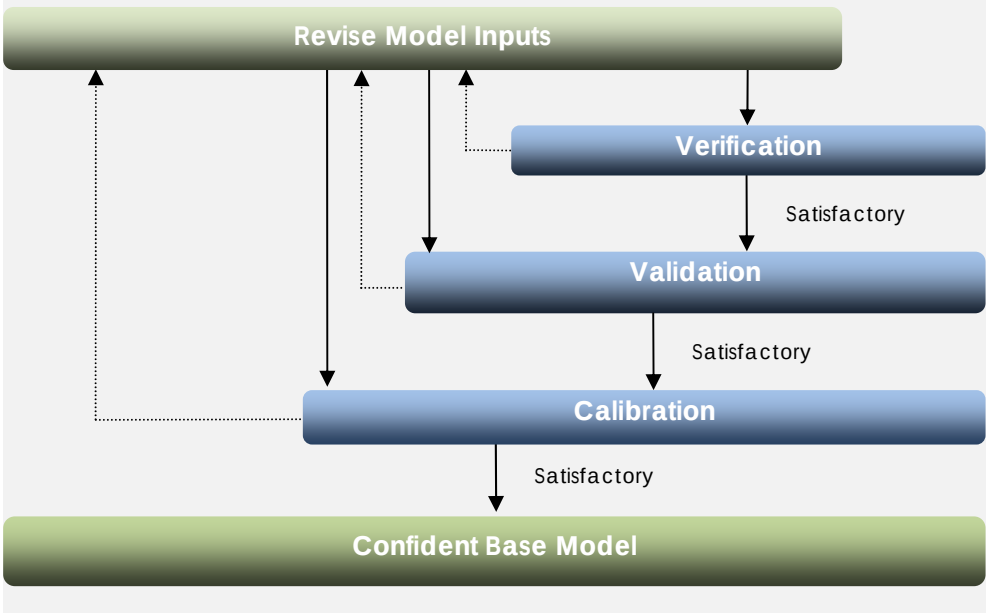


Figure 3 **The Correctness Procedure**
Source *Road Delay Solutions Pty Ltd, 2011*

VALIDATION

The term applied to the fundamental method of assessing the effectiveness of the calibration procedure and its underlying principles in achieving an acceptable level of calibration.

To assess the model calibration, a formula known as the 'GEH Statistic'[2] has been employed to rationalise the differential between the modelled and actual counted traffic volumes, on selected links.

Links with low volumes and a higher differential between the modelled and counted volumes, while possibly exhibiting a high percentage of inaccuracy, are considered less critical than links accommodating higher volumes. The GEH Statistic balances the relative priority of each link based on the counted volume, during the model calibration process. The GEH statistic is computed by the Netanal program, as depicted in *Figure 6*.

[2] The GEH Statistic named after Geoffrey E. Havers, who invented it in the 1970s while working as a transport planner in London, England. In a mathematical form it is similar to a chi-squared test, but is not considered a true statistical test. Rather, it is an empirical formula that proves useful for a variety of traffic analysis purposes.

$$GEH = \sqrt{\frac{(E-V)^2}{(E+V)/2}}$$

where... E = Predicted model volume V = Actual field counted volume

Figure 4 The GEH Statistic

A range of GEH targets have been realistically set to achieve the prescribed LoA, noted in the following section, '*Calibration*'. The targets highlight the percentage and weighted degree of difference between modelled volumes and the collected field data.

The figure below describes the components of the GEH Statistic and the targets employed in the calibration of the base year models.

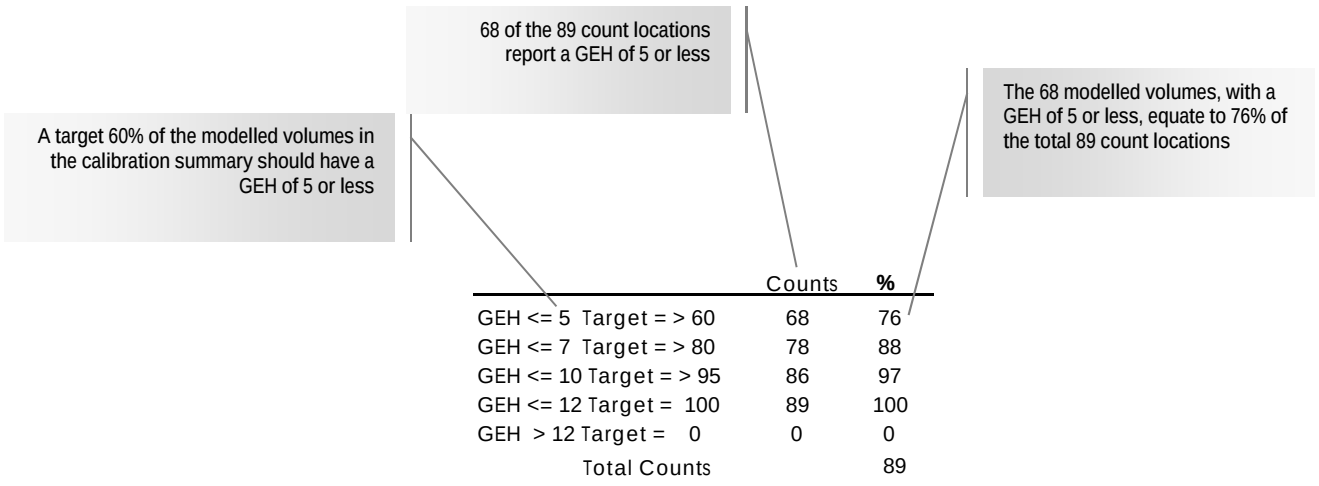


Figure 5 Typical GEH Targets

CALIBRATION

Defined as the process of model parameter and input manipulation to achieve a prescribed differential between actual local traffic volumes and those modelled.

Calibration is, fundamentally, the transparent production of output, controlled by the value of input parameters on the basis of available field data. The success or failure of the calibration process, is determined by the accurate and logical evaluation of the collected and available field data employed in the selected input parameters.

From the collected intersection counts, all turn movements have been calibrated, individually, to ensure the integrity of the trip distribution and volume flows within the study area and surrounds.

The calibration report of traffic flows, on key routes, was used as output for the base Year 2014.

The trip matrices, currently employed in the base Netanal models, were originally developed by BTS, based upon the Year 2006 Census Data published as *LGA Community Profiles* by the *Australian Bureau of Statistics*.

The zonal information, contained within the matrices, has been disaggregated in accordance with data collated during studies conducted by *Sims Varley Traffic Systems Pty Ltd* and *Road Delay Solutions Pty Ltd*, generally yielding a mean absolute screen line calibration LoA of some 15-20%.

The traffic volume calibration process for this project has adopted a standard deviation of 15% of the absolute mean, constituting an accepted LoA within the study area, while a deviation of 25% defines the LoA through the Sydney SD.

It should be noted that the Netanal program is in fact a demand model, which reflects the total volume of traffic on a link, including queued traffic at the end of the modelled one-hour time period. This is in contrast to the counted volume, collected in the field data, which only records those vehicles passing a given point during the same period. Therefore, it is safe to assume, that a count location will report a lower traffic volume than those reported in the Netanal model, significant vehicle queues exist at a site.

Discrepancies between adjacent intersection counts are to be expected and an error of some 3% recorded in a number of locations.

CALIBRATION SYNOPSIS

Calibration Summary for Model 14AM50
Network = 2014 Trip Table = 14AM50
2014 AM Peak CALIBRATED BASE MODEL
Observed Counts versus Modelled Volumes

Location.....	Node	Node	Count	Model	Diff	Diff%	GEH
GWH EB W JAMES RUSE	4062	4059	2276	2138	-138	-6	3
GWH WB E JAMES RUSE	1116	4059	1562	1527	-35	-2	1
JAMES RUSE SB N GWH	4058	4059	1591	1600	9	1	0
JAMES RUSE NB S HASSAL	4055	4056	1823	1672	-151	-8	4
JAMES RUSE SB S HASSAL	4056	4055	2970	2943	-27	-1	0
JAMES RUSE SB N HASSAL	1347	4056	2798	2649	-149	-5	3
JAMES RUSE NB N HASSAL	4056	1347	1882	1728	-154	-8	4
GRAND EB E JAMES RUSE	4056	4084	362	358	-4	-1	0
GRAND WB E JAMES RUSE	4084	4056	230	228	-2	-1	0
GRAND EAST EB	4084	4085	610	609	-1	-0	0
GRAND EAST WB	4085	4084	320	319	-1	-0	0
KISSING PT EB E JAMES	3609	1354	2681	2864	183	7	3
KISSING PT WB E JAMES	1354	3609	2239	2372	133	6	3
KISSING PT EB W JAMES	3611	3610	402	514	112	28	5
KISSING PT WB W JAMES	3610	3611	1016	947	-69	-7	2
RIVER EB W JAMES RUSE	10074	4034	389	311	-78	-20	4
HASSALL EB W JAMES RUS	10073	4056	998	1048	50	5	2
HASSALL WB W JAMES RUS	4056	10073	643	568	-75	-12	3
PARKES WB E HARRIS	7774	4027	1484	1404	-80	-5	2
HARRIS NB S PARKES	7046	4027	245	201	-44	-18	3
HARRIS SB N PARKES	10030	4027	653	663	10	2	0
WENTWORTH NB N GWH	1116	1159	244	218	-26	-11	2
WENTWORTH SB N GWH	1159	1116	151	123	-28	-19	2

Summary of GEH Calibration Validation

	Counts	**%**
GEH <= 5 Target = > 60%	23	100
GEH <= 7 Target = > 80%	23	100
GEH <= 10 Target = > 95%	23	100
GEH <= 12 Target = 100%	23	100
GEH > 12 Target = 0%	0	0
Total Counts	23	

Mean, Mean Absolute Difference (MAD) & +/- 10% MAD Analysis - Model 14AM50

Note.... A Mean, a Mean Absolute Difference (MAD) & a MAD +/- 10% Count Variability Analysis is calculated and the results given below. The 10% MAD count variation endeavours to cater for the known 20% variation in daily traffic volumes, errors and discrepancies in SCATS and other count methods.

Observed Count Range	Mean	MAD ABS	MAD +-10%	Counts
	%	%	%	
0001 to 0500	3.03	12.59	2.59	8
0501 to 1000	0.55	4.68	0.00	4
1001 to 1500	5.96	5.96	0.00	2
1501 to 2000	7.33	5.09	0.00	4
2001 to 2500	0.11	6.00	0.00	2
2501 to 3000	-0.08	4.25	0.00	3
3001 to 3500	0.00	0.00	0.00	0
3501 to 4000	0.00	0.00	0.00	0
4001 to 5000	0.00	0.00	0.00	0
5001 to Maximum	0.00	0.00	0.00	0
Total of Counts 0001 to Maximum Range	2.05	5.65	0.00	23
Total of Counts 0501 to Maximum Range	1.96	5.01	0.00	15

Table 1 Morning Peak Calibration Report

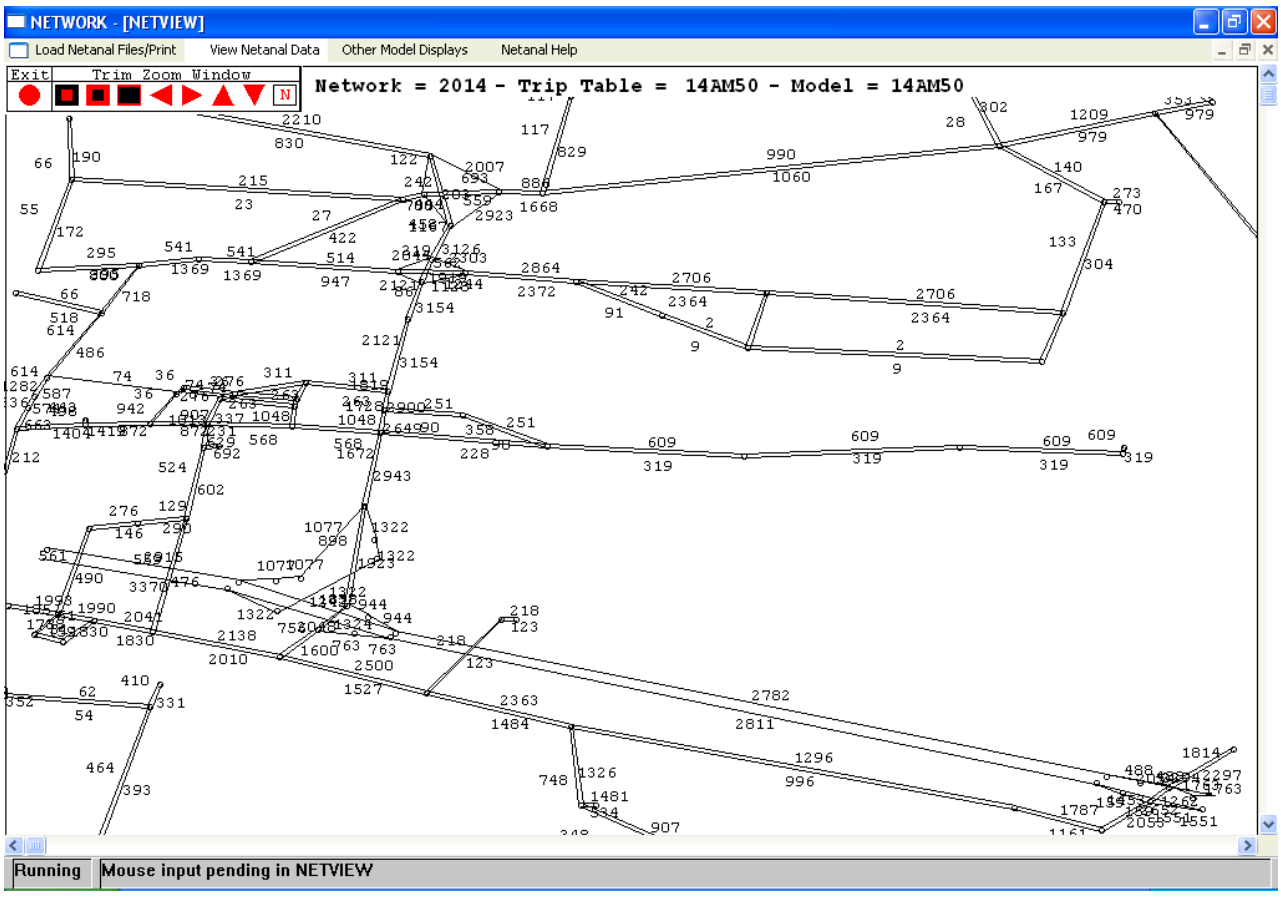


Table 2 Evening Peak Calibration Report

Calibration Summary for Model 14PM50
Network = 2014 Trip Table = 14PM50
2014 PM Peak CALIBRATED BASE MODEL
Observed Counts versus Modelled Volumes

Location.....	Node	Node	Count	Model	Diff	Diff%	GEH
GWH EB W JAMES RUSE	4062	4059	1587	1518	-69	-4	2
GWH WB E JAMES RUSE	1116	4059	2593	2628	35	1	1
JAMES RUSE SB N GWH	4058	4059	653	656	3	0	0
JAMES RUSE NB S HASSAL	4055	4056	2485	2365	-120	-5	2
JAMES RUSE SB S HASSAL *	4056	4055	1591	1723	132	8	3
JAMES RUSE SB N HASSAL	1347	4056	1711	1679	-32	-2	1
JAMES RUSE NB N HASSAL *	4056	1347	2497	2575	78	3	2
GRAND EB E JAMES RUSE	4056	4084	129	119	-10	-8	1
GRAND WB E JAMES RUSE	4084	4056	420	414	-6	-1	0
GRAND EAST EB	4084	4085	175	172	-3	-2	0
GRAND EAST WB	4085	4084	692	686	-6	-1	0
KISSING PT EB E JAMES *	3609	1354	2439	2705	266	11	5
KISSING PT WB E JAMES *	1354	3609	2598	2809	211	8	4
KISSING PT EB W JAMES *	3611	3610	926	986	60	6	2
KISSING PT WB W JAMES	3610	3611	761	742	-19	-2	1
RIVER EB W JAMES RUSE	10074	4034	348	301	-47	-14	3
HASSALL EB W JAMES RUS	10073	4056	562	590	28	5	1
HASSALL WB W JAMES RUS	4056	10073	653	631	-22	-3	1

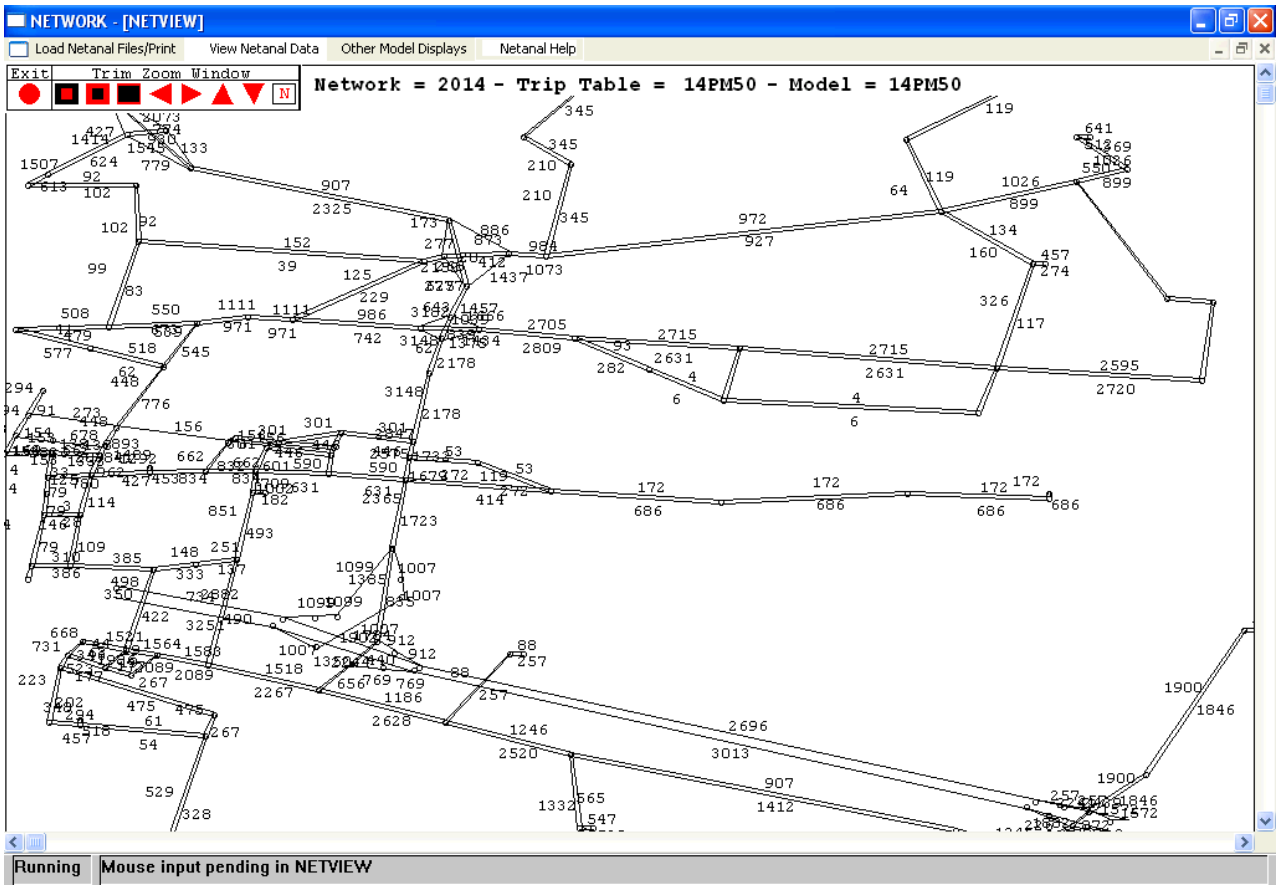
Summary of GEH Calibration Validation

	Counts	%
GEH <= 5 Target = > 60%	18	100
GEH <= 7 Target = > 80%	18	100
GEH <= 10 Target = > 95%	18	100
GEH <= 12 Target = 100%	18	100
GEH > 12 Target = 0%	0	0
Total Counts	18	

Mean, Mean Absolute Difference (MAD) & +/- 10% MAD Analysis - Model 14PM50

Note.... A Mean, a Mean Absolute Difference (MAD) & a MAD +/- 10% Count Variability Analysis is calculated and the results given below. The 10% MAD count variation endeavours to cater for the known 20% variation in daily traffic volumes, errors and discrepancies in SCATS and other count methods.

Observed Count Range	Mean	MAD ABS	MAD +-10%	Counts
	%	%	%	
0001 to 0500	6.16	6.16	0.00	4
0501 to 1000	-1.04	3.25	0.00	6
1001 to 1500	0.00	0.00	0.00	0
1501 to 2000	5.42	4.77	0.00	3
2001 to 2500	-3.02	6.25	0.00	3
2501 to 3000	-4.74	4.74	0.00	2
3001 to 3500	0.00	0.00	0.00	0
3501 to 4000	0.00	0.00	0.00	0
4001 to 5000	0.00	0.00	0.00	0
5001 to Maximum	0.00	0.00	0.00	0
Total of Counts 0001 to Maximum Range	-2.10	5.03	0.00	18
Total of Counts 0501 to Maximum Range	-2.51	4.97	0.00	14



4 FUTURE CONDITIONS

The transport planning assessment for the Camellia Development Site has considered the implications of future traffic demand under full urban renewal.

Each road link and intersection has been diligently assessed, under differing control methods, to achieve a safe and efficient outcome under the burden of future traffic demands in year 2036.

PLANNING POLICIES AND GUIDELINES

A review of the strategic and statutory planning documents shaping the Camellia Development have been reviewed and considered in determining an acceptable approach to infrastructure recommendation associated with development. These include the *Sydney Metropolitan Strategy* and subregional planning documents, as well as the current local planning strategies, environmental planning instruments and guidelines, the *Local Environmental Plan* and relevant development control plan(s).

The focus here will be on the policies, strategic directions and development provisions that have direct implications for the development and will influence land use, transport services and facilities in the future. This information will be used as the basis for the development of the precinct plan and successful integration of land use and transport planning.

PLANNING PROVISIONS - SEPP NO. 59

CENTRAL WESTERN SYDNEY ECONOMIC AND EMPLOYMENT AREAS

State Environmental Planning Policy No.59 (SEPP 59) presents guiding principles for sustaining efficient transport with future developments and the requirements to be met in the preparation of a long-term transport plan. The aims of the policy include...

- *"promote economic development and the creation of employment in Western Sydney by providing for the development of major warehousing, industrial, high technology, research or ancillary facilities with good access to the existing and proposed road freight network, including the M4 motorway and the Westlink M7".*
- *"provide for the optimal environmental and planning outcomes for the land to which the policy applies by helping to achieve the goals set out in Action for Air, to contain the per capita growth in VKT (vehicle kilometres travelled) by achieving higher than normal public transport usage."*

The policy states that in developing Precinct plans, attention must be given to the following relevant issues that expand on the foregoing general provisions...

> *"A transport plan should be prepared that addresses the following...*
>
> *i) roads, transit ways, and provision for walking and cycling, both within the Precinct and off site linkages,*
>
> *ii) freight transport provisions, including initiatives for integrating freight handling within the precinct, and maximising opportunities for synergies between industries with regard to materials handling,*
>
> *iii) the relationship between the staging of development and the provision of transport infrastructure,*
>
> *iv) ways, including the design and layout of the proposal, in which the mode split to public transport, cycling and walking is to be increased above levels typical of areas surrounding the development. It is expected as a minimum that the proposal demonstrates that...*
>
> *iv) the mode split of "cars as driver" for the journey to work can be reduced by at least 10% (eg from 75% down to 65%) compared to existing surrounding areas, and*
>
> - *the total VKT (vehicle kilometres travelled) to be generated by the proposed development should be reduced by at least 5% below that which would be generated by a 'conventional' approach to development, and*
>
> *v) funding proposals for the development of transport infrastructure."*

DRAFT SEPP 66 – INTEGRATION OF LAND USE AND TRANSPORT

This policy provides guiding provisions that aim to ensure the urban structure, building forms, land use locations, development design, subdivision and street layouts help achieve the following planning objectives...

- Improving accessibility to housing, employment and services by walking, bicycling and public transport,
- Improving the choice of transport and reducing the dependency on private vehicle usage,
- Moderating growth in the demand for travel and the distances travelled, especially by car,
- Supporting the efficient and viable operation of public transport services, and
- Providing for the efficient movement of freight.

METROPOLITAN PLANNING STRATEGIES

EMPLOYMENT LANDS FOR SYDNEY ACTION PLAN, 2007

The strategic framework in *'City of Cities Metropolitan Strategy, a Plan for Sydney's Future'*, dictates transport systems and urban structures with equitable access to jobs, services and leisure.

It also identifies the priority outcomes and presents the key policies and actions to achieve them. The regional strategy bridges the gap between local area needs and opportunities and the broader goals of the '*City of Cities'* strategy.

The purpose of the Employment Lands Action Plan is to create more job opportunities and stimulate economic growth, providing a cleaner environment, an improved transport network, safe community neighbourhoods and affordable housing. Further, it aims to reduce the growth of private vehicle use and curb urban sprawl.

THE DEVELOPMENT FOOTPRINT

The proposed development comprises 2,845 residential units and 13,180m² of retail floor space.

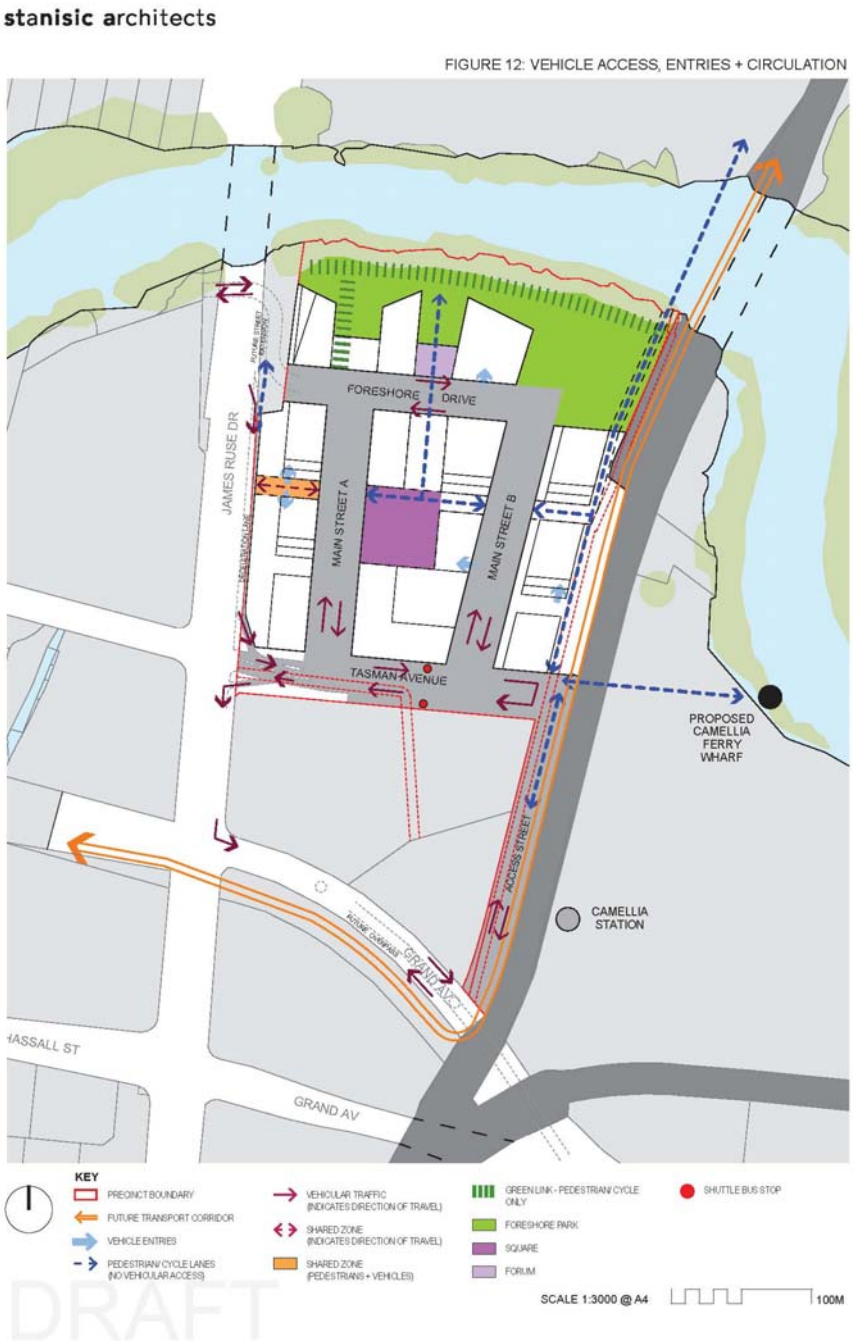


Figure 6 **The Camellia Development Footprint**
Source *Stanisic Architects, 2014*

The planned Camellia Development is defined by the 2006 *Bureau of Transport Statistics* (BTS) as part Zone 1701, within the Parramatta LGA.

Figure 7 **Projected Growth Levels**
Source *JTW, 2014*

While the theoretical vehicle generation rate will not be significantly higher with the transformation of the commercial/industrial lands to residential, trip distribution and flow patterns will be impacted.

Formally, traffic generally accessed the site inbound during the morning and departed during the evening. With the planned development, this condition will reverse with residential traffic generally leaving the site in the morning and returning in the evening. This is reflected in the strategic modelling with the majority of morning peak vehicle trips from the precinct travelling to Sydney and the Eastern Suburbs, Macquarie Park, Homebush Bay and select key regional centres.

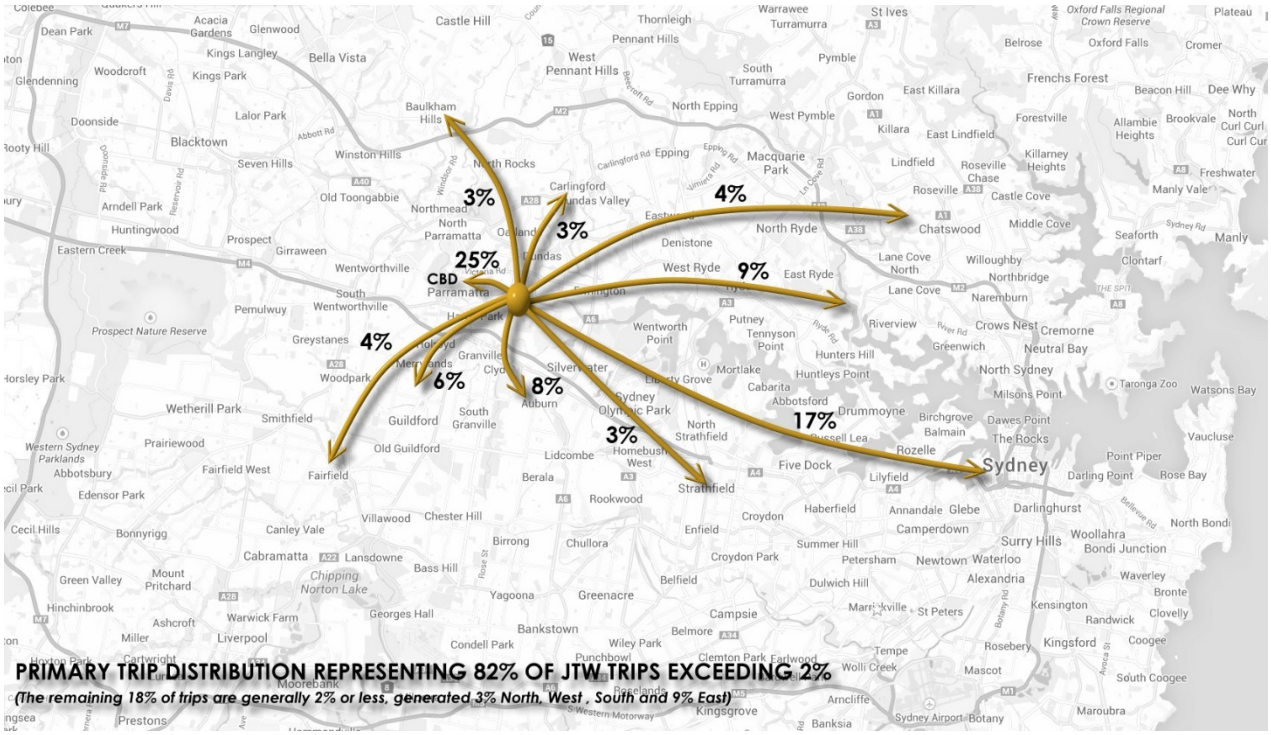


Figure 8 **Trip Distribution**

Source *Strategic Netanal Model, Road Delay Solutions, 2014*

PUBLIC TRANSPORT CHOICE

This assessment has reviewed the current, predominant, available transport mode choices for JTW as determined by the Department of Planning and Infrastructure. These have been formulated manually, external to the Netanal model, for all the available modes within, or adjacent to, the Camellia precinct as defined within the combined Harris Park BTS TZs 1713 and 1722.

The four (4) dominant mode choices available to the Camellia community are…

- *Private motor vehicle,*
- *Bus,*
- *Train, and*
- *Walking.*

Significant mode choice is available within the precinct with ready access to Camellia Railway Station on the Carlingford Line and frequent bus operations in James Ruse Drive and neighbouring Kissing Point Road and Victoria Road.

The year 2011 mode share has been derived from BTS data focusing on the on the BTS 2006 TZs 1713 and 1721.

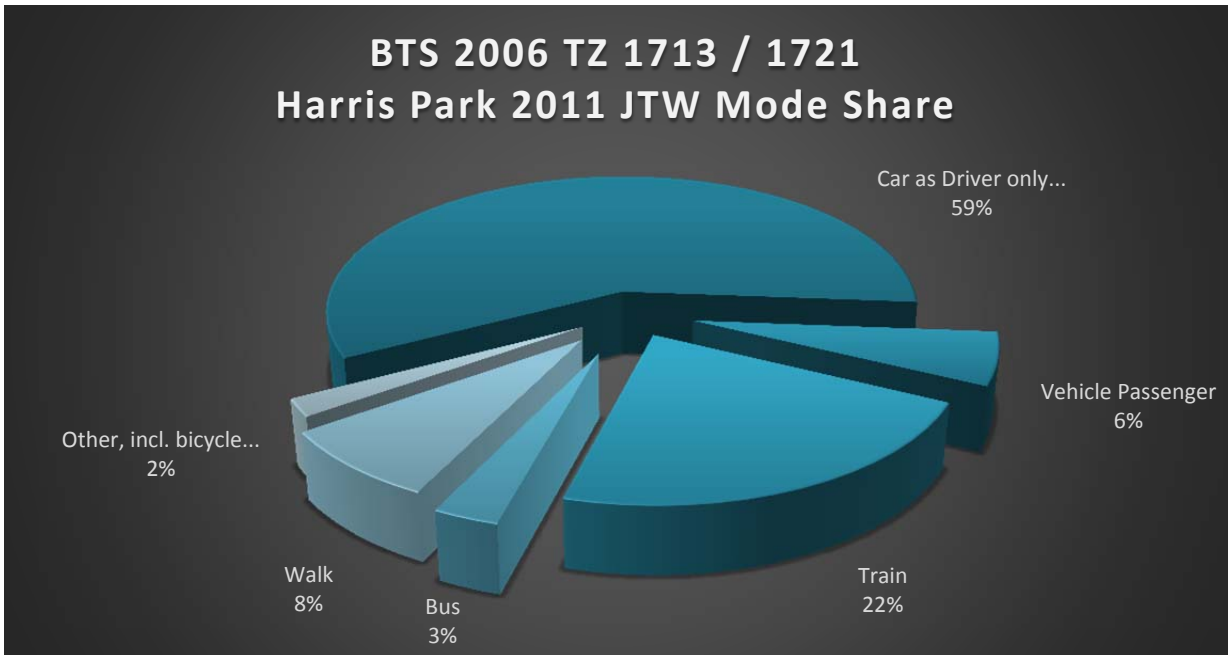


Figure 9 **2011 Harris Park Travel Mode Share**
Source *ABS Community Profile – BTS, 2011*

The high percentage of car drivers and passengers, is likely a result of one or a combination of any or all the following reasons…

- *Inability or perception that public transport fails to meet community needs,*
- *Lack of direct public transport services to employment centres,*
- *Inadequate frequency of public transport,*
- *Inadequate inter regional services,*
- *Congestion on major roads accommodating bus services,*
- *Poor modal interchange,*
- *The perception that private vehicle travel is more convenient,*
- *Access by motor vehicles to regional employment centres, is comparatively more convenient, and/or*
- *A significantly high proportion of self-employed and/or tradesmen are car dependent for business.*

Walking is considered a valid transport mode within the catchment, in consideration of multi modal JTW trips and particularly in close proximity to the Parramatta CBD and public transport provisions juxtaposed with medium to high density residential land use. The primary impact on road based transport movements from such pedestrian activity is generally concentrated at crossing points.

The latest Household Travel Survey (HTS) data shows that average weekday trips grew by 1.0% between 2009/10 and 2010/11, which was slower than the 1.6% rate of population growth in the Sydney Statistical Division.

In line with NSW 2021 targets, growth in public transport trips was higher than growth in passenger vehicle trips. Vehicle driver trips increased by 1.5%, while train and bus trips increased by 2.6% and 2.3%, respectively. These inherent increases can be attributed to increased frequency and improve intermodal provisions.

Results from the Sydney Cycling Survey, undertaken in November 2011, show that the cycling mode share for trips, up to ten kilometres, is currently 2%. The BTS conducts this survey annually to track performance against the NSW target which aims for a doubling of the cycling share by 2016.

The BTS trip matrices provide travel demand estimates based on trips (i.e. from origin to destination) by selected modes (car driver, rail and bus, etc…) for all travel purposes during the morning and evening commuter peak 2 hour periods. These have been factored to reflect the one (1) hour peak period by adopting a factor determined by calculating the percentage of actual or counted patrons, during the peak period, from the 2 hour BTS trip matrix.

The content of the files is as follows…

- Car, Rail and Bus Trips by time period, and
- Road assignment statistics by time period
  - including passenger cars and trucks (light, rigid and articulated trucks) in passenger car units (PCU).
  - total vehicle travel time in hours.
  - total vehicle travel distance in kilometres.

Note: The "auto" demand vehicle matrix demand is factored (59.6%) down to achieve the 1-hour commuter period for the Netanal assignment.

The Strategic Netanal model focuses on the peak, one hour, morning and evening commuter periods.

With the advent of the Camellia Residential Development, including retail floor space, the proposed growth pattern within Zone 1701 will differ from the data published by BTS. The general direction of traffic flow emminating from Zone 1701 during the peak commuter periods will change.

POPULATION FORECASTS

The future Year trip matrices, produced by BTS in October 2009, have been developed from a 4 step travel model and are based on forecast population and employment projections assigned to a computer based transport network. These trip tables form the basis for the Netanal future year trip demands and have been applied to the 2001 travel zone (TZ) system, through the employment of an equivalency table, prepared by the BTS.

Generally, the Netanal vehicle trip distribution for the future year trip tables of the Sydney Statistical Division has been retained from the BTS trip matrices. However, irregularities between the land use assumptions within the BTS matrices and available growth data, in particular BTS 2006 TZs 1713 and 1721, make it necessary to disaggregate the zone structure to better reflect the furture year demand generations associated with the Camellia Development and significant neighbouring developments.

181 James Ruse Drive

		Trip Generation rate			Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Peak	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
Residential	2845	0.19	540.55		0.15	426.75	135	405	284	142
Retail	11203	6.75/100m2 Average	151.00	Note*		756.20	76	76	378	378
EMPLOYEES	162**		162.00	Note *		0.00	162	0	0	0
TOTAL			853.55			1182.9525	372.7375	481.0125	662.5984	520.3498578

14A River Road West Development

		Trip Generation rate			Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Peak	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
Residential	1390	0.19	264.10		0.15	208.50	66	198	138	69
Retail	4041.00	6.75/100m2 Average	54.55	Note*		272.77	27	27	136	136
EMPLOYEES	81		58.00	Note *		0.00	58			0
TOTAL			376.6535			481.27	151.295	225.345	273.99	204.805

Wentworth Marina Development- Grand Avenue North

		Trip Generation rate			Trip Generation rate		Trip Generation AM Peak		Trip Generation PM Peak	
Land Use	No of units/GLFA	AM PEAK HOUR	TOTAL AM TRIPS	Notes	PM PEAK HOUR	TOTAL PM TRIPS	Inbound	Outbound	Inbound	Outbound
Residential	4461	0.19	847.59		0.15	669.15	212	636	448	221
Retail	11814.00	6.75/100m2 Average	159.49	Note*		797.00	80	80	398	398
EMPLOYEES	236		236.00	Note *			171			342
TOTAL			1243.079			1466.15	462.7	716	846	960.8195

Note: GLFA is referred to in the RMS Technical Direction TDT 2013/04a

AM peak hour residential trips assumed to be 25% in and 75% out. The PM peak is based on a 66% in and 34% out.
Note* AM peak hour Trips for Retail assume only 10% in and 10% out. Therefore, total trips can be calculated as 0.2 x 756.2 = 151. PM peak hour assumes 50% in and out.
Employees have been calculated to be 325.

Figure 10 **Calculated Development Vehicle Generations**
Source *Lyle Marshall & Associates, 2014*

MODE SHIFT

To readily identify the opportunity for mode shift, the primary destination(s) of the workforce JTW vehicle trip patterns, exceeding 2% to any given key employment centre, have been collated from the strategic model and are shown in *Figure ???*. The vehicular travel patterns adopted in the strategic model reflect those published by BTS in 2009. The model employs the BTS 2009 trip matrices, with considerable zone disaggregation in areas of planned high development.

To determine the potential for mode shift, a detailed assessment of the current public transport provisions has determined that interchange locations, particularly those pertaining to bus, offer limited opportunity for shift without revision of stop locations. This is evidenced by the reported 3% usage of buses by workers originating from the Harris Park travel zones. The current mode splits form the basis from which the future trip matrices for Camellia have been developed.

In addition to the following infrastructure upgrades, improvements and increases to current public transport services are required to sustain the anticipated growth within the precinct.

A future 5% mode shift to public transport away from private vehicle usage, within the Camellia Development site only, is considered conservative and achievable based on the level of current bus services and patronage levels, the potential introduction of light rail, the potential for a privately operated shuttle service to ferry passengers to bus provisions on Kissing Point Road and Victoria Road, anticipated bicycle usage and pedestrian activities leading to the Parramatta CBD.

No shift to ferry services on the Parramatta River is considered possible without an increase in the ferry fleet as any further stops on the current services would increase travel times and begin a self perpetuating precedence for other river frontage developments to request similar stops.

The STA has expressed no interest in increasing the ferry fleet size nor any consideration of introducing any further stops on the current service lines. The maintenance and improvement of current services is of highest priority. This mode shift has not been applied to the model's trip matrices, but rather, only offered for consideration at this time. The strategic model has adopted the full local development vehicle generations, as prescribed by the RMS *Guide to Traffic Generating Developments*, and includes all the recommended infrastructure improvements, presented in this report.

The model is considered a 'worst case' scenario with no mode shift applied to any of the neighbouring developments, as well.

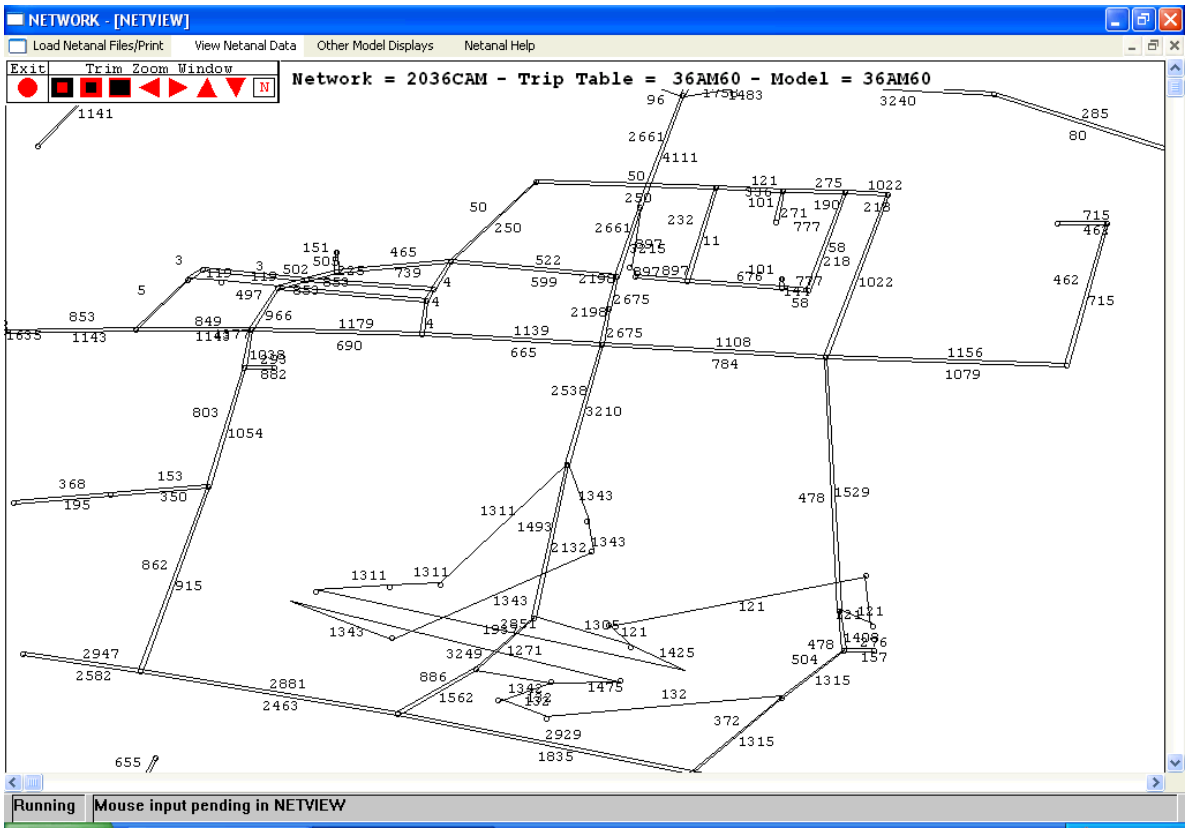


Figure 11 2036 AM Peak Traffic Projections James Ruse Drive

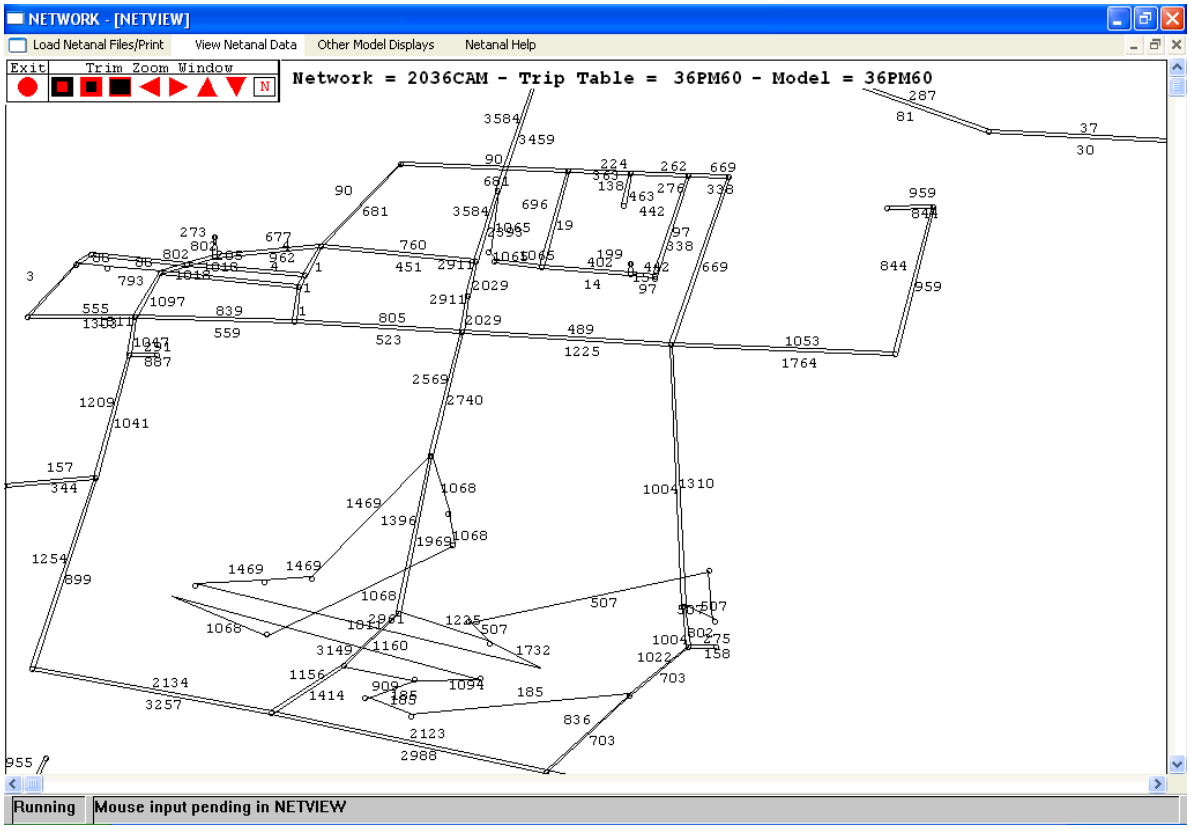


Figure 12 2036 PM Peak Traffic Projections James Ruse Drive

MODEL SCENARIOS

A number of modelling scenarios were necessary to achieve a sustainable road management system with the level of metropolitan growth in conjunction with the planned developments within the study area.

The scenarios tested were…

1) *Current road network with year 2036 vehicle projections,*
2) *Pinch point corridor recommendations with year 2036 projections,*
3) *Introduction of the recommended infrastructure and a Wentworth Road extension to Grand Avenue at the proposed Camellia Access roundabout (No ramps onto the M4 Motorway), and*
4) *Introduction of the recommended infrastructure and a Wentworth Road extension to Grand Avenue at the proposed Camellia Access roundabout with east facing ramps at the M4 Motorway.*

With the exception of Scenarios 3 and 4, all future modelled road networks failed to manage the resultant congestion levels. This was clearly evident at the James Ruse Drive intersection with Hassall Street.

Scenario 2, the pinch point infrastructure model, retains time inefficient split approach phasing between Hassall Street and Grand Avenue with a shared through and right turn lane shown in Hassell Street. It was considered that the pinch point study did not address the Wentworth Marina and River Road West developments to the vehicle generation levels tested in assessment.

It was found that the three right turn lanes from Hassall Street were critical to manage the projected volumes but the intersection required double diamond overlap phasing. To achieve this, three (3) dedicated right turn lanes were required, along with dual right turn and left turn from Grand Avenue, as shown in *Figure 14.*

Scenario 3 was tested with the extension of Wentworth Street to Grand Avenue, without east facing ramps to and from the M4 Motorway. The extension was considered critical to remove a significant volume traffic (*some 1800vph during the PM peak*) from James Ruse Drive to permit the satisfactory LoS 'D' operation of the Hassall Street intersection. Without the extension, the intersection failed in its recommended configuration and queue lengths of over 1km were reported.

While Scenario 4 reported only 680vph utilising the M4 east facing ramps, the volume may reduce the imposition on the Parramatta Road intersection with Wentworth Street. The Wentworth Street intersection with Parramatta Road was not modelled but will require consideration at a later time.

To assess the performance of the modelled year 2036 road network, all planned arterial infrastructure has been incorporated.

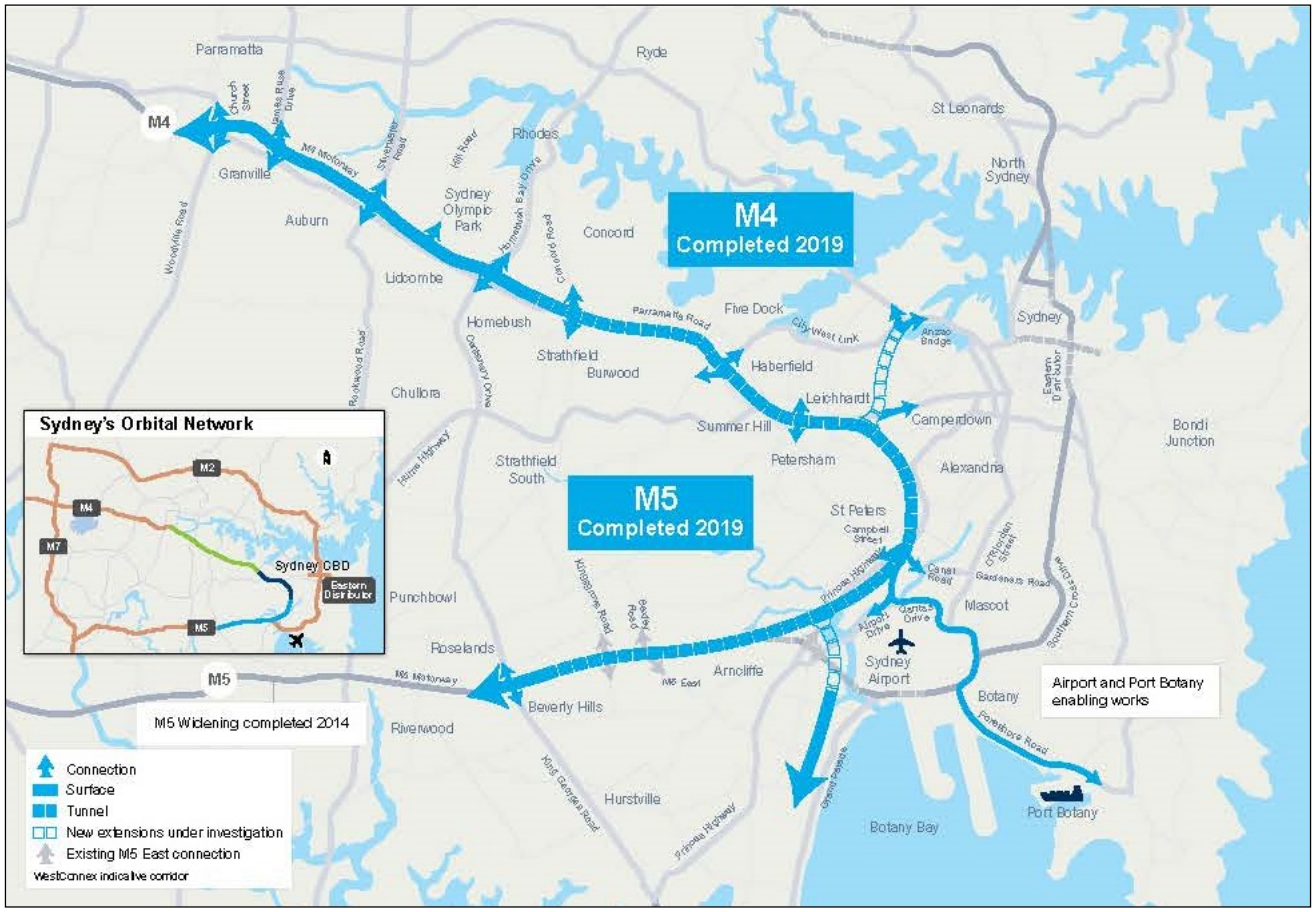


Figure 13 **Principle Road Infrastructure Projects**
Source *Sydney Roads Renewal – Fact Sheet 4 – June 2014*

The 2036 Sydney Metropolitan Road Network incorporates State, Regional, Arterial, Sub-arterial, Collector and Sydney CBD roads, as classified by the RMS and Local Government Councils. Some Local Roads, which carry significant amounts of traffic, have also been included in the networks for both the base and future year models.

MODEL FILE NAMES & DESCRIPTION
14AM50 = 2014 AM PEAK CALIBRATED BASE MODEL
14PM50 = 2014 PM PEAK CALIBRATED BASE MODEL
36AMC1 = 2036 AM PEAK CAMELLIA-14A RIVER RD-MARINAS M4 CONNECT MODEL
36PMC1 = 2036 PM PEAK CAMELLIA-14A RIVER RD-MARINAS M4 CONNECT MODEL
36AM60 = 2036 AM PEAK CAMELLIA-14A RIVER RD-MARINAS MODEL (Preferred Option)
36PM60 = 2036 PM PEAK CAMELLIA-14A RIVER RD-MARINAS MODEL (Preferred Option)

1	1	3	3	3	3
4	4	6	6	6	6
A	P	A	P	A	P
M	M	M	M	M	M
5	5	C	C	6	6
0	0	1	1	0	0

LOCATION	VEHICLE PROJECTIONS (All vehicles)					
GWH EB W JAMES RUSE	2138	1518	2948	2129	2881	2134
GWH WB E JAMES RUSE	1527	2628	1893	3025	1835	2988
JAMES RUSE SB N GWH	1600	656	1559	1320	1562	1414
JAMES RUSE NB S HASSALL	1672	2365	2613	2650	2538	2569
JAMES RUSE SB S HASSALL	2943	1723	3268	2951	3210	2740
JAMES RUSE SB N HASSALL	2649	1679	2902	1922	2675	2029
JAMES RUSE NB N HASSALL	1728	2575	2265	2899	2198	2911
GRAND EB E JAMES RUSE	358	119	1151	483	1108	489
GRAND WB E JAMES RUSE	228	414	794	1431	784	1225
GRAND EAST EB	609	172	1156	1053	1156	1053
GRAND EAST WB	319	686	1079	1764	1079	1764
KISSING PT EB E JAMES RUSE	2864	2705	3542	3466	3505	3509
KISSING PT WB E JAMES RUSE	2372	2809	3200	4556	3240	4642
KISSING PT EB W JAMES RUSE	514	986	757	911	769	899
KISSING PT WB W JAMES RUSE	947	742	1472	1733	1465	1721
RIVER EB W JAMES RUSE	311	301	486	690	522	760
HASSALL EB W JAMES RUSE	1048	590	1069	893	1182	840
HASSALL WB W JAMES RUSE	568	631	694	562	665	523
PARKES WB E HARRIS	1404	427	395	425	390	462
HARRIS NB S PARKES	201	125	561	1033	602	1051
HARRIS SB N PARKES	663	962	1113	1267	1087	1293
WENTWORTH NB N GWH	218	88	619	964	619	944
WENTWORTH SB N GWH	123	257	1100	549	1101	551

Table 3 Year 2036 Modelled Vehicle Projections

Source Road Delay Solutions Pty Ltd, 2014

JAMES RUSE DRIVE

It is anticipated that James Ruse Drive will carry in excess 5000 vehicles per hour (vph) during the commuter peak periods with the advent of developments and impacts of through traffic generated by the West Connex Project.

Select link modelling suggests that some 250vph will be generated in each direction through the study area by the West Connex Project in year 2036.

The intersection of Hassall Street exhibits considerable constraint to traffic with increases to year 2036. The pinch point upgrade recommendations for the intersection were first modelled and resulted in unsatisfactory LoS 'F' during both the AM and PM peak periods. The through put capacity demanded high periods of green time which severely hampered the side streets of Hassall Street and Grand Avenue.

Dual right turn movements and a dual left turn movement from Grand Avenue were found to be the only configuration which could sustain the planned development levels.

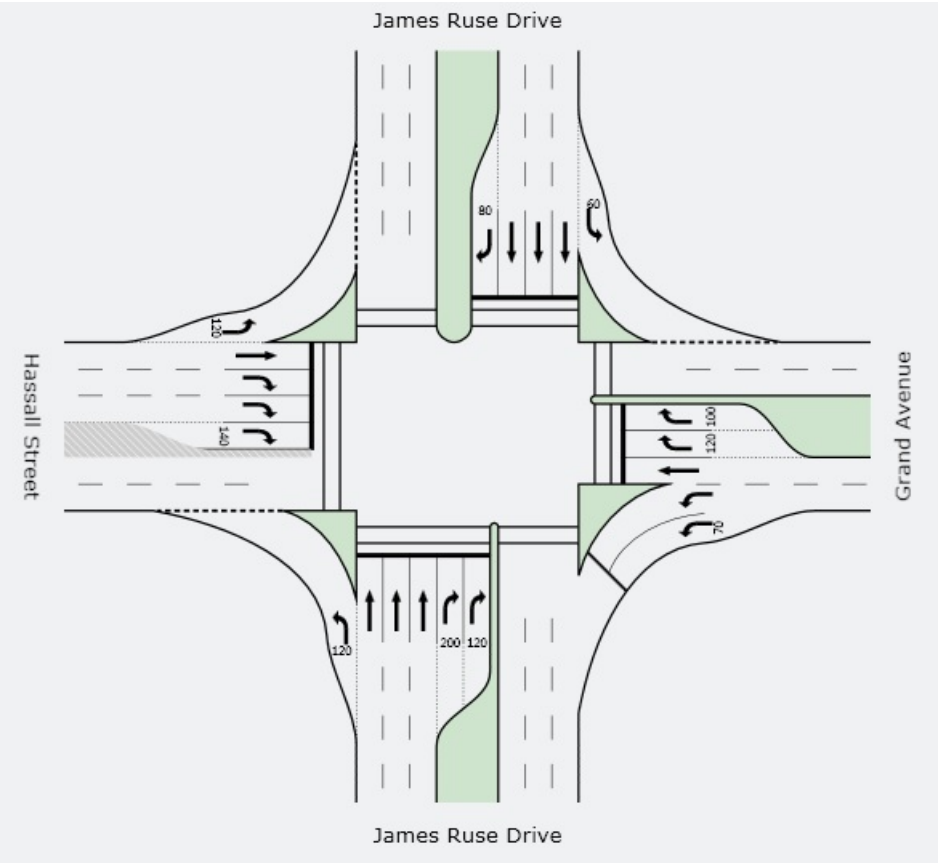


Figure 14 **2036 James Ruse Drive and Hassall Street Intersection Configuration**
Source *Road Delay Solutions Pty Ltd, 2014*

GRAND AVENUE

The combined Camellia and Wentworth Marina developments sees the traffic volumes on Grand Avenue escalate to over 2,700vph during the peak periods.

Access to the Camellia Development is proposed via Grand Avenue and in combination with the generation from the Wentworth Marina Project, two lane roundabout control is necessary to manage the peak flow projections.

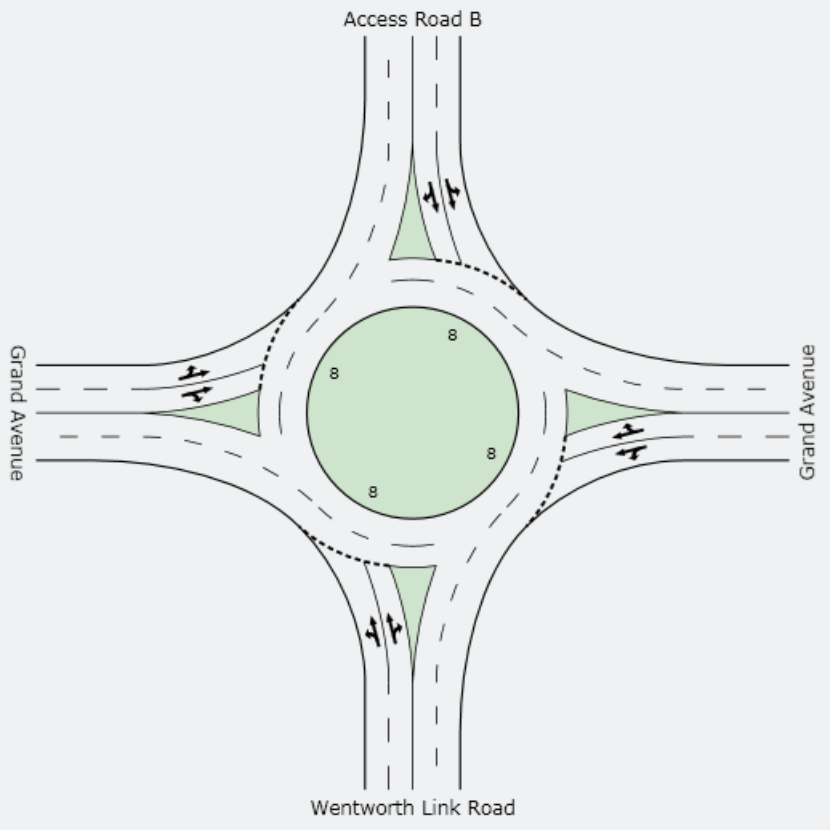


Figure 15 **2036 Grand Avenue, Wentworth Link Road and Access Road B Intersection**
Source *Road Delay Solutions Pty Ltd, 2014*

A dual lane circulating roundabout was found to manage the projected volume well returning a LoS 'B' during the peak periods. A number of single lane entries was tested through the roundabout but were found to fail. In particular, a single southbound lane from Access Road B was tested and found to return a LoS 'F' as the eastbound through traffic had priority through the intersection, preventing sufficient movement time.

RIVER ROAD WEST

River Road West was originally considered as a four (4) way intersection providing a further access point for the Camellia development.

Modelling was undertaken of the four way operation and found that the resultant LoS was 'F' with queue lengths in James Ruse Drive of over 900m.

Models were tested with simultaneous offset with the Hassell Street intersection but were found to cause excessive side street queuing in River Road West and also in James Ruse Drive. Queues in James Ruse Drive were reported in excess of 800m, in the peak flow directions, even with retention of the current right turn ban from River Road West.

It is considered the site is unsatisfactory serve as an alternate access to the Camellia Site and a 'T-Junction' configuration with retention of the right turn ban and the introduction of dual left turn and right turn lanes from River Road West and James Ruse Drive, respectively, affords motorists a viable intersection treatment to sustain the planned growth levels.

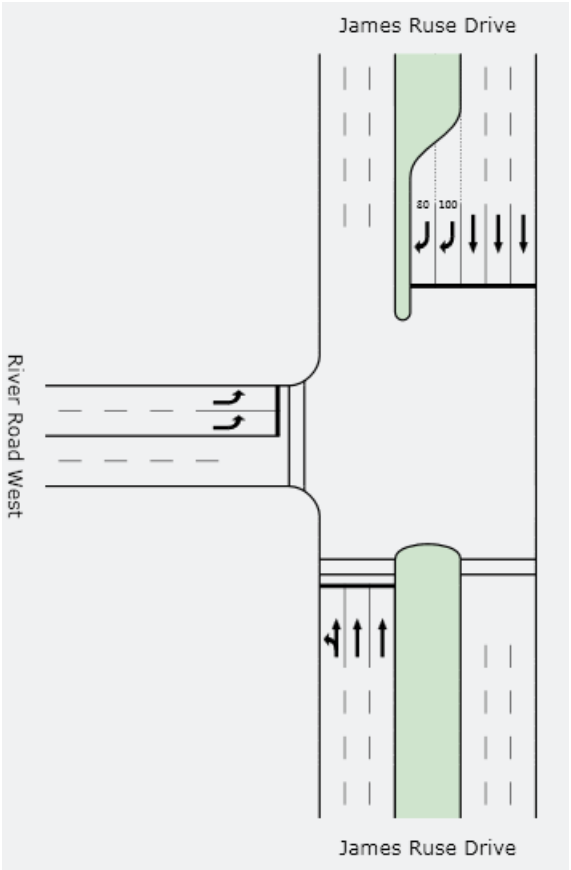


Figure 16 **2036 James Ruse Drive and River Road West Intersection Configuration**
Source *Road Delay Solutions Pty Ltd, 2014*

SIDRA MODELLING RESULTS				
	2010 Existing		*2036 Full Development	
	AM	PM	AM	PM
1. James Ruse Drive and Hassall Street (Traffic Signal Controlled)				
DS	1.130	1.052	0.918	0.917
AVD	120.6	87.1	53.4	52.5
LoS	F	F	D	D
2. James Ruse Drive and River Road West (Traffic Signal Controlled)				
DS	-	-	0.882	0.887
AVD	-	-	23.3	25.4
LoS	-	-	B	B
3. Grand Avenue, Access Road B and Wentworth Road Extension (Roundabout Controlled)				
DS	-	-	0.937	1.000
AVD	-	-	27.9	20.6
LoS	-	-	B	B

*Note * Full development including the impacts of the proposed mitigation infrastructure*

Table 4 Sidra Intersection Performance Chart

RECOMMENDED INFRASTRUCTURE TO SUSTAIN DEVELOPMENT

The following infrastructure upgrades have been rigorously assessed to ensure the planned level of development, presented in this report, can be sustained at a satisfactory level of service, and meet community demands and expectations.

	Location	Recommended Mitigation Treatment
1	Wentworth Street Extension	i) Construction of a four lane 60km/h collector road from the current northern end of Wentworth Road to Grand Parade. ii) The extension may include the construction of a four (4) lane bridge over Duck Creek, dependent upon the preferred route to be determined during DA preparation.
2	Parramatta Road and Wentworth Street	Reconstruction of the traffic signals at the intersection of Parramatta Road with Wentworth Street
3	Grand Avenue	Construction of a two (2) lane circulating roundabout at the intersection of Grand Avenue, Camellia Access Road B and the proposed Wentworth Street Extension.
4	James Ruse Drive, Hassall Street	iii) Reconstruction of the traffic signals to allow double diamond overlap phasing. iv) Construction of three exclusive right turn lanes and an exclusive through lane, eastbound in Hassall Street. v) Construction of dual right turn lanes and an exclusive left turn slip lane, northbound in James Ruse Drive. vi) Construction of dual right turn lanes and signalised dual left turn lanes westbound in Grand Avenue. vii) Construction of a dedicated left turn slip lane southbound in James Ruse Drive.
5	James Ruse Drive and River Road West	viii) Construction of traffic signals at the intersection of James Ruse Drive and River Road West. ix) Construction of two (2) signalised left turn lanes from River Road West. x) Construction of dual right turn lanes eastbound from River Road West. xi) Construction of dual right turn lanes southbound in James Ruse Drive. xii) Construction of pedestrian crossings across River Road West and James Ruse Drive south. xiii) Request be made to the RMS to consider an exception to omit a pedestrian crossing across James Ruse Drive north to maximise green time allocated to the left turn movement from River Road West.
6	James Ruse Drive Underpass	Construction of a two lane underpass below James Ruse Drive accessing the Camellia Development from the River Road West intersection with Arthur Street.

Table 5 Recommended Infrastructure

5 CONCLUSION

Road Delay Solutions has been engaged by Lyle Marshall & Associates Pty Ltd to undertake the preparation of a Strategic Transport Model in support of the residential rezoning for the Camellia Development

In conclusion, the planned growth on the Sydney Metropolitan road network poses significant challenges in managing the sustainability of development.

The Camellia Development, juxtaposed with the neighbouring developments on River Road West and Grand Avenue, created significant challenges in achieving an operational and satisfactory road transport solution.

It is recommended the following infrastructure be considered in achieving a satisfactory level of service 'D' when assessing the Camellia Site for rezoning...

- → *Construction and formalization of a four lane link road between Wentworth Street in the south and Grand Avenue, to the north,*
- → *Reconstruction of traffic signals at the intersection of Parramatta Road and Wentworth Street,*
- → *The construction of a two (2) lane circulating roundabout on Grand Parade to facilitate access to the camellia Development,*
- → *Substantial reconstruction of the traffic signals on James Ruse Drive at Hassall Street,*
- → *The installation of traffic signals on James Ruse Drive at River Road West,*
- → *The construction of an underpass beneath James Ruse Drive to facilitate access to the Camellia Development site.*

While not applied to the strategic modelling undertaken in this report, support is given to government strategies targeting a reduction in the dependence upon private vehicle usage and a future 5% mode shift to public transport, within the Camellia Development, is considered conservative and achievable based on...

- → *The current level, frequency and patronage levels of bus services,*
- → *The potential introduction of light rail,*
- → *The potential for a privately operated shuttle service convey commuters to bus provisions on Kissing Point Road and Victoria Road,*
- → *The anticipated bicycle usage, and*
- → *Provision for pedestrian mobility leading to the Parramatta CBD.*

APPENDIX A – THE NETANAL MODEL

THE STRATEGIC NETANAL MODEL

The Netanal model utilises defined travel demand between zonal pairs, represented as assimilated traffic movements, throughout the Sydney Metropolitan Area. The program incrementally assigns vehicular traffic onto a computer based road network, developing link demand forecasts on each modelled section of road. Netanal is an assignment model and not a gravity nor equilibrium model but rather utilises delay in the route selection choice.

ROUTE SELECTION

Route selection between zonal pairs is determined on the basis of the shortest travel cost ('time is money'), considering the inherent route delays incurred along possible link(s), the road hierarchy, various behavioural characteristics and a number of empirical social economic considerations. Parameters such as link capacity, speed and distance are coded into the model, by the user, from which the program determines the relative vehicular delays on each route, selecting, after undertaking a prescribed number of iterations, the route with the shortest travel time. Costs and travel time are relative within the Netanal model. Time penalties are applied to turn movements, stops and delays, etc... which in turn have a corresponding cost.

In the most general form, this 'cost' represents a combination of factors that drivers take into account when choosing routes through the road network the most important of these factors are time and distance. Also where tolls are charged for the use of a specific section of road, these costs are included in the driver's route choice and are based on a driver's willingness to pay the toll.

The process which Netanal employs to determine the 'cost' of travel on competing paths, equates heavily on travel time. Time penalties for turning manoeuvres, vehicle delays, and tolls increase the cost of travel on competing routes. Toll value, on a specific link, is included indirectly by converting the monetary toll value to time (in minutes) based on the driver's perceived value of time and socio economic proclivity to pay the toll. This 'time value of the toll' is applied as a 'penalty' to the link and is known as the Toll Diversion Penalty (TDP).

The premise on which the future year modelling has been based, specifically the route selection process, is the current value of time. Toll values, toll diversion penalties and socio economic decision making defaults, have not been increased with CPI or standard of living projections.

INCREMENTAL ASSIGNMENT

In order to reflect the impact of congestion on route selection, Netanal assigns the traffic from the trip table as a series of equal increments. This process is outlined below:

- *The process commences by identifying the routes with the shortest travel times, for each origin-destination pair, with no traffic using the roads (i.e. based on sign-posted speed limits, green lights, etc). Known colloquially as increment 0 (zero), the link and intersection delays, accumulated over the modelled 0ne hour, are tabulated for later reference.*
- *The first incremental run of the model imposes the time delays recorded during Increment 0 and adds the delays to the travel time of each link. During the increment, routes yielding the lowest travel time between zonal pairs are chosen. Again the resultant delays on each link, inclusive of intersection, are recorded by the program.*
- *Each subsequent increment performs ongoing route selection based on recorded delay and the resultant link travel times. As delays stabilise, so too does the route selection within the model, until the optimum number of increments are run.*
- *At the completion of the incremental runs, the optimum routes and vehicle demands, on each link, are reported.*

Incremental convergence is employed to determine the projective stability and optimum number of increments. The process of incremental convergence involves the running of sensitivity models reflecting a differing number of increments, with the projected volumes on a select number of key links, reported. Once the differential change between the projected volumes, on each reported link, minimises, the model is considered stable and the resultant number of increments are utilised in the project model runs.

For this project, 20 increments were found to provide stability in link demand.

ASSIGNMENT CALCULATIONS

Netanal calculates travel time on the basis of the capacity related, geometric and operational characteristics of roads and intersections defining the road network. The following are specifically incorporated in the calculations for the mid-block section of each link...

Speed-flow relationships. As traffic volume increases, speeds on roads decrease and the relationships within Netanal take this into account. The speed is based on the ratio of the traffic flow to the nominated road capacity. Netanal assumes free flow conditions on links up to a set value of degree of saturation (DS). This value is set to equal 90%. When traffic flows on a particular link exceeds the DS set value, the speed drops according to a speed flow relationship, to the power of four.

- ***Transit lanes***. *The proportion of traffic using the transit and non-transit lanes on a section of road is based on RTA surveys of Epping Road, Military Road and Victoria Road. This survey reported that the transit lanes operated to a maximum of 50% of the adjacent trafficable lane. Illegal use was reported as 25% while the DS of the adjacent lane was below 0.75.*

  With an increase above 0.75 in the adjacent lane, a proportionate increase in the illegal use of the transit lane results. Netanal applies this principle on all transit lanes, within the model.

  The program assumes a 40% maximum usage of T3 transit lanes while the DS of the adjacent lane remains below 0.75. The program assumes the illegal usage of a T3 lane is the same as that of a T2.

Bus lanes, and bus stops can be included as part of the network. Netanal can report on travel time changes on these routes.

- ***On-street parking***.
- ***Speed limits***.
- ***LATM devices*** *(e.g. speed humps, raised thresholds, road narrowings, etc...).*
- ***Pedestrian crossings***.
- ***Toll plazas*** *A delay of seven seconds per vehicle is applied at toll plazas that have manual payment collection. This delay is reduced as some manual collection is retained and the proportion of electronic tolling increases. Electronic tolling invokes no toll plaza delay.*
- ***Toll fees*** *Tolls are collected in dollars but have the effect of making a route less attractive. Therefore the toll has to be converted to a time value that can be attributed to the relevant link in Netanal to reflect additional travel time in the route selection process. This conversion factor is the TDP, and is expressed in minutes per dollar.*

Those network characteristics which may vary across a 24hr time of day operation, such as transit lanes, bus lanes, parking restrictions, toll fees, turn prohibitions, etc... are included in the network definition and further impact on the assignment route selection.

Intersection delay, calculated within the model, employs the *Austroad's* and *AARB* established formulae for the control of intersections operating as Give Way or Stop Sign, Roundabout or Traffic signals. For the latter the benefits of Sydney's coordinated signal control system, SCATS, on improved traffic flow is incorporated. SCATES is run to dynamically emulate the SCATS operation at all intersections so designated within the model. A 'cost' penalty is added to the travel time to represent the delay that is associated with pedestrian conflict at a marked crossing and/or any left turns and/or opposing traffic for right turns.

Netanal specifically calculates both road mid-block and intersection performance. The model is therefore able to calculate queues when traffic demand exceeds capacity and incorporate the queuing delay in the calculation of travel time for each route.

If the travel time remains lower on a particular route with queues, Netanal will continue to assign traffic to that route until such time as the queue results in a time delay that makes an alternative route more attractive.

INTERSECTION TURNING MOVEMENT VOLUMES

Netanal is capable of projecting the hourly intersection turn movement demands at each node *(intersection)* within the strategic model. These specific outputs have been employed in this project to provide the critical projected turn movements, within the Camellia precinct, to enable the operational micro analysis, utilising the Sidra program, at key intersections.

Inherently, the predictive nature of strategic modelling and the location of zone generators is one of the primary factors impacting on the volume of traffic reported at each intersection. Zones harbour vehicle generation based on land use within a precinct boundary, generally representing several hectares. Zones are often located within the model based upon, but not limited to…

- *Their context within the precinct in relation to the primary direction of traffic flow to and from the zone,*
- *Generally, central within a zone boundary (subject to finer disaggregation as land use dictates),*
- *Representation of a major vehicle generator within the precinct, such as school, large apartment block, shopping centre, car park, significant commercial operation, recreational grounds, etc… , and*
- *To allow the even distribution of traffic onto the arterial road network while limiting the intrusion of through traffic within local communities, unless identified from field observations.*

In some instances, the zone location may propagate errors at some intersections, in close proximity to the vehicle generation. A zone may be located so as to avoid the unwanted

diversion or ‘rat run’ of vehicles within a local precinct attempting to access the arterial road network.

Significant effort is placed on locating the zones within the model to effectively assign vehicles onto the road network. Zone disaggregation or ‘splitting’ allows a finer distribution of traffic but requires an iterative adjustment process which inadvertently increases the project duration, resources and costs, quite often is beyond the scope of a project.

The zone locations selected within the Camellia precinct have been allocated in accordance with the access and car parking provisions identified from preliminary architectural drawings of the proposed development.

APPENDIX B – PERFORMANCE INDICATORS

LEVEL OF SERVICE (LOS)

Intersection performance is best measured by the indicators of Level of Service (LoS), Average Vehicle Delay (AVD) and the Degree of Saturation (DS) during peak hours.

This is defined as the assessment of a qualitative effect of factors influencing vehicle movement through the intersection. Factors such as speed, traffic volume, geometric layout, delay and capacity are qualified and applied to the specific intersection control mode, as shown in *Table 1*.

The measure of average delay assessed for traffic signal operation is over all movements. For roundabouts and priority controlled intersections, the critical criterion for assessment is the movement with the highest delay per vehicle.

AVERAGE VEHICLE DELAY (AVD)

The AVD is a measure of the operational performance of a road network or an intersection. AVD is determined globally over a road network or within a cordon during an assignment model run. The AVD exhibited on comparable network models, for analogous peak periods, forms the basis of comparing the operational performance of the road network.

AVD is used in the determination of intersection Level of Service. Generally, the total delay incurred by vehicles through an intersection is averaged to give an indicative delay on any specific approach. Longer delays do occur but only the average over the peak hour period is reported.

DEGREE OF SATURATION (DS)

The DS of an intersection is generally taken as the highest ratio of traffic volume on an approach compared with its theoretical capacity, and is a measure of the utilisation of available green time.

The DS reported is generally of a critical movement through the intersection rather than the DS of the intersection unless equal saturation occurs on all approaches.

For intersections controlled by traffic signals, generally both queue length and delay increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its DS is kept below 0.875. When the DS exceeds 0.9, extensive queues can be expected.

Intersection Control	Performance Measure [Unit]
Sign or Priority Control	Delay of critical movement(s) [seconds/vehicle] Average Vehicle Delay [seconds/vehicle] Queue length of critical movement(s) [metres]
Traffic Signal Control	Delay of critical movement(s) [seconds/vehicle] Degree of Saturation [ratio of vehicles to capacity] Average Vehicle Delay [seconds/vehicle] Cycle Length [seconds] Queue length of critical movement(s) [metres]
Roundabout Control	Delay of critical movement(s) [seconds/vehicle] Degree of Saturation[ratio of vehicles to capacity] Average Vehicle Delay [seconds/vehicle] Queue length of critical movement(s) [metres]

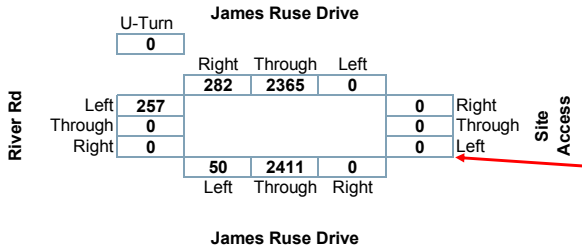
Table 6 Performance Indicators by Control Method

LOS	AVD *secs*	Traffic Signals and Roundabout	Give Way and Stop Sign Priority Control
A	1 to 14	Good operation.	Good operation
B	14 to 28	Good operation with acceptable delays and spare capacity.	Good operation with acceptable delays and spare capacity.
C	28 to 42	Satisfactory.	Satisfactory but accident study and operational analysis required.
D	42 to 56	Operating near capacity.	Near capacity. Acceptable LOS for new developments. Accident study and operational analysis required.
E	56 to 70	Unsatisfactory. Traffic signals incidence will cause excessive delays. Requires additional capacity. Roundabouts require alternative control mode.	At capacity. Requires alternative control mode.
F	>70	Unsatisfactory. Over capacity and unstable operation.	Over capacity. Unstable and unsafe operation.

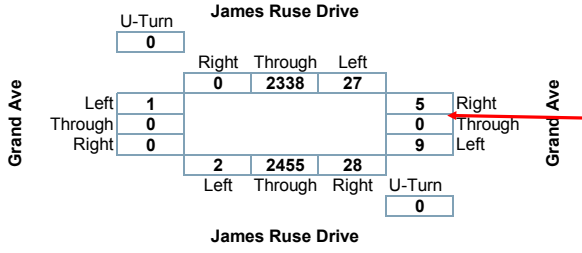
Table 7 Qualified Level of Service by Control Method

APPENDIX C

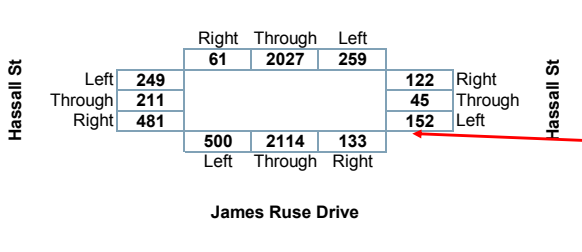
2012 Traffic Volumes Excluding the Proposed Development (AM Peak)



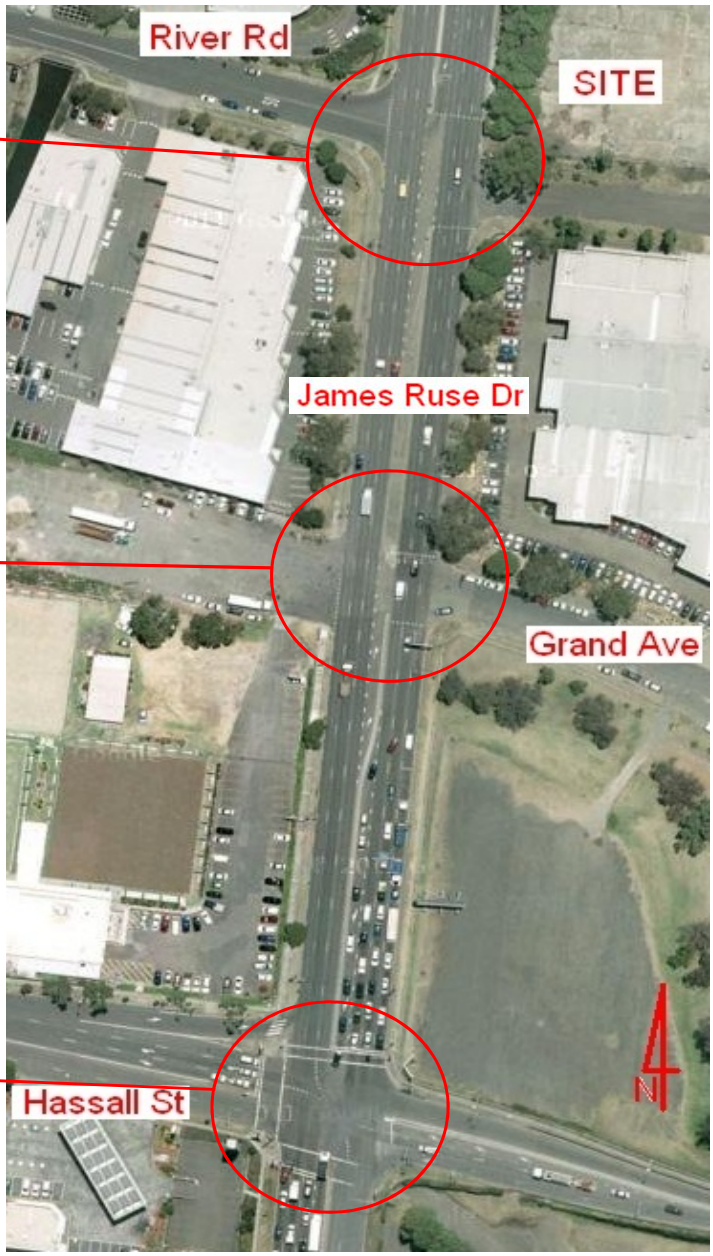
Road & Section	Travel Direction on Approach North	South	East	West	Total
James Ruse Drive					
North of River Rd	2668	2647			5315
South of River Rd	2461	2365			4826
River Rd					
East of James Ruse Drive			0	0	0
West of James Ruse Drive			257	332	589



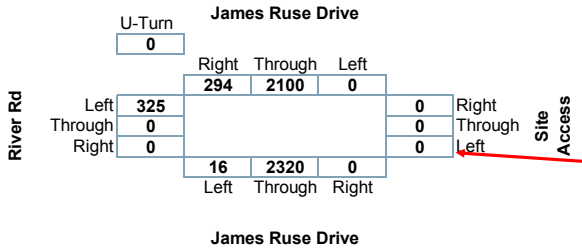
Road & Section	Travel Direction on Approach North	South	East	West	Total
James Ruse Drive					
North of Grand Ave	2461	2365			4826
South of Grand Ave	2485	2347			4832
Grand Ave					
East of James Ruse Drive			55	14	69
West of James Ruse Drive			1	2	3



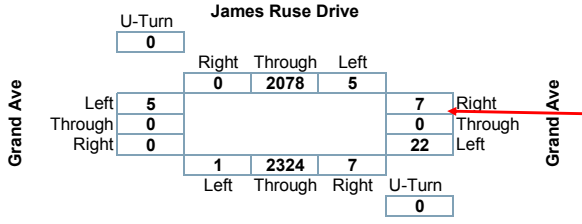
Road & Section	Travel Direction on Approach North	South	East	West	Total
James Ruse Drive					
North of Hassall St	2485	2347			4832
South of Hassall St	2747	2660			5407
Hassall St					
East of James Ruse Drive			603	319	922
West of James Ruse Drive			941	606	1547



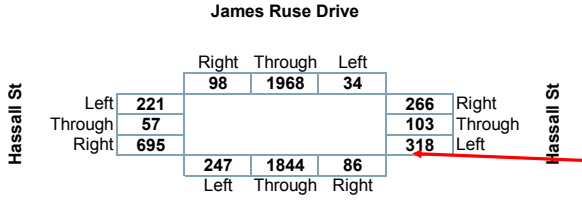
2012 Traffic Volumes Excluding the Proposed Development (PM Peak)



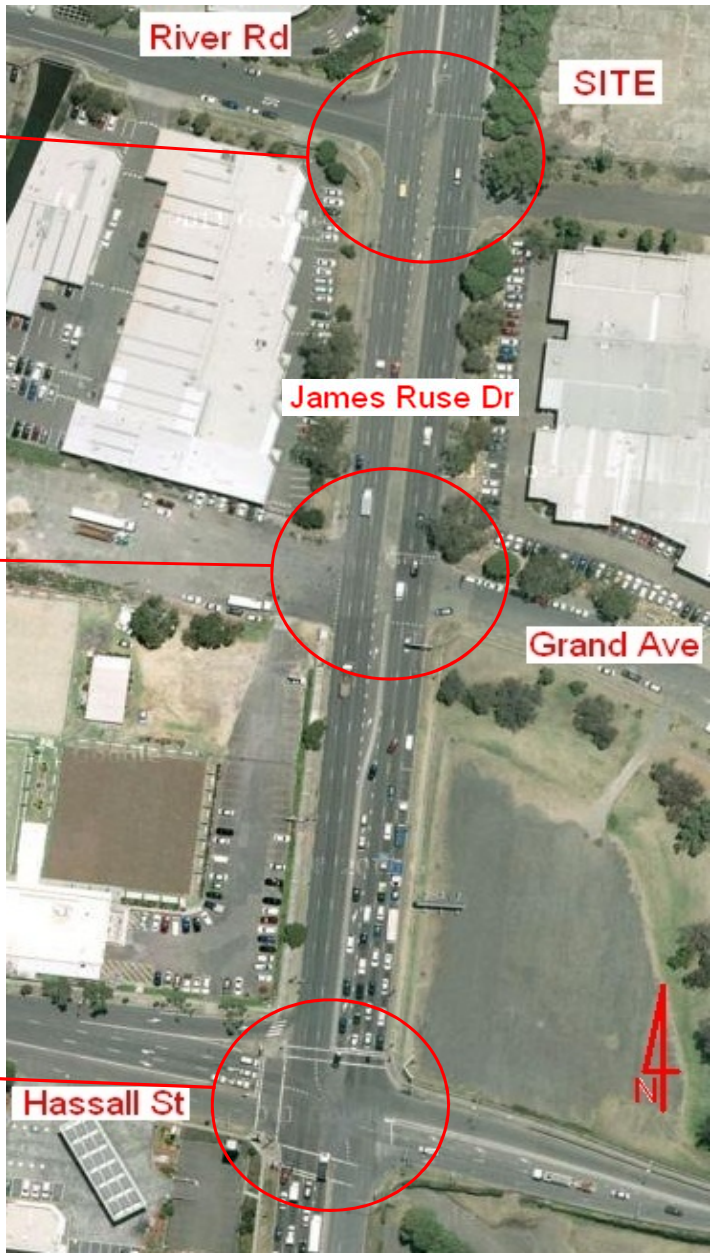
Road & Section	Travel Direction on Approach North	South	East	West	Total
James Ruse Drive					
North of River Rd	2645	2394			5039
South of River Rd	2336	2100			4436
River Rd					
East of James Ruse Drive			0	0	0
West of James Ruse Drive			325	310	635



Road & Section	Travel Direction on Approach North	South	East	West	Total
James Ruse Drive					
North of Grand Ave	2336	2083			4419
South of Grand Ave	2332	2100			4432
Grand Ave					
East of James Ruse Drive			12	29	41
West of James Ruse Drive			5	1	6



Road & Section	Travel Direction on Approach North	South	East	West	Total
James Ruse Drive					
North of Hassall St	2331	2100			4431
South of Hassall St	2177	2981			5158
Hassall St					
East of James Ruse Drive			177	687	864
West of James Ruse Drive			973	448	1421



R.O.A.R. DATA

Reliable, Original & Authentic Results

Ph.88196847, Fax 88196849, Mob.0418-239019

Client : Lyle Marshall & Associates Pty. Ltd.

Job No/Name : 5352 CAMELLIA Traffic Counts

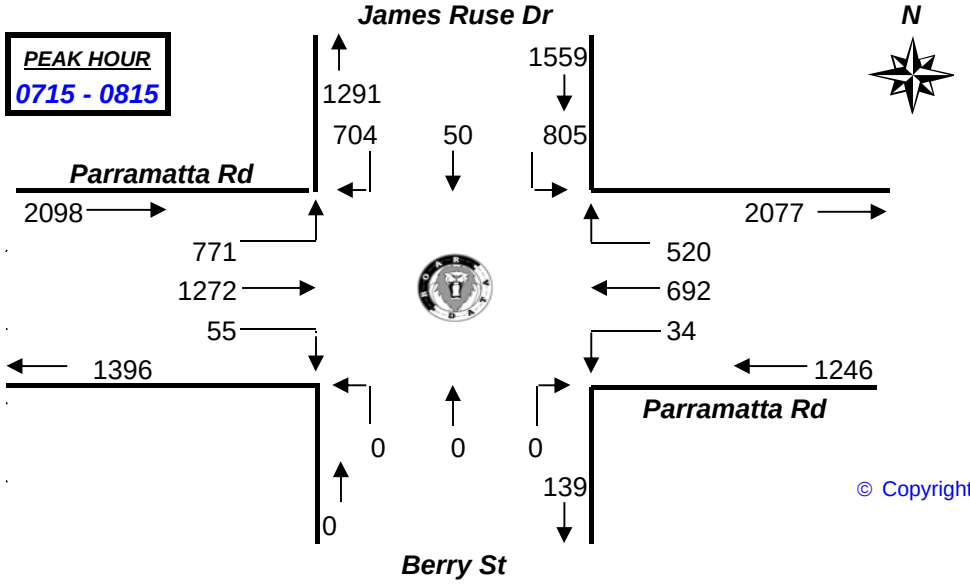
Day/Date : Wednesday 15th October 2014

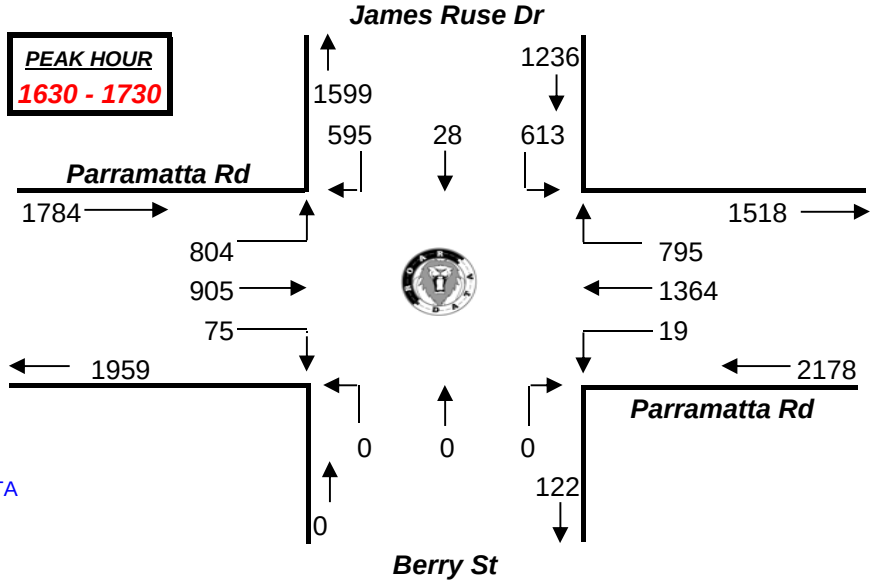
All Vehicles	NORTH James Ruse Dr			WEST Parramatta Rd			SOUTH Berry St			EAST Parramatta Rd			
Time Per	L	T	R	L	T	R	L	T	R	L	T	R	TOT
0700 - 0715	154	15	167	132	202	18				2	134	134	**958**
0715 - 0730	189	13	181	210	308	15				7	149	128	**1200**
0730 - 0745	242	15	184	189	297	12				7	171	141	**1258**
0745 - 0800	195	11	181	193	351	13				15	197	139	**1295**
0800 - 0815	179	11	158	179	316	15				5	175	112	**1150**
0815 - 0830	196	14	133	185	278	12				6	191	178	**1193**
0830 - 0845	213	9	153	197	340	11				7	202	108	**1240**
0845 - 0900	194	15	130	152	314	17				5	210	115	**1152**
Period End	**1562**	**103**	**1287**	**1437**	**2406**	**113**	**0**	**0**	**0**	**54**	**1429**	**1055**	**9446**

All Vehicles	NORTH James Ruse Dr			WEST Parramatta Rd			SOUTH Berry St			EAST Parramatta Rd			
Time Per	L	T	R	L	T	R	L	T	R	L	T	R	TOT
1600 - 1615	130	5	164	202	216	12				4	338	149	**1220**
1615 - 1630	121	7	142	209	182	18				11	328	167	**1185**
1630 - 1645	139	12	128	206	231	23				7	366	191	**1303**
1645 - 1700	156	5	170	191	202	21				5	313	201	**1264**
1700 - 1715	152	7	137	208	252	16				4	361	194	**1331**
1715 - 1730	166	4	160	199	220	15				3	324	209	**1300**
1730 - 1745	162	4	127	182	205	10				12	384	206	**1292**
1745 - 1800	161	4	145	157	208	7				8	266	128	**1084**
Period End	**1187**	**48**	**1173**	**1554**	**1716**	**122**	**0**	**0**	**0**	**54**	**2680**	**1445**	**9979**

Peak Time	NORTH James Ruse Dr			WEST Parramatta Rd			SOUTH Berry St			EAST Parramatta Rd			
	L	T	R	L	T	R	L	T	R	L	T	R	TOT
0700 - 0800	780	54	713	724	1158	58	0	0	0	31	651	542	**4711**
0715 - 0815	805	50	704	771	1272	55	0	0	0	34	692	520	**4903**
0730 - 0830	812	51	656	746	1242	52	0	0	0	33	734	570	**4896**
0745 - 0845	783	45	625	754	1285	51	0	0	0	33	765	537	**4878**
0800 - 0900	782	49	574	713	1248	55	0	0	0	23	778	513	**4735**
PEAK HOUR	**805**	**50**	**704**	**771**	**1272**	**55**	**0**	**0**	**0**	**34**	**692**	**520**	**4903**

Peak Time	NORTH James Ruse Dr			WEST Parramatta Rd			SOUTH Berry St			EAST Parramatta Rd			
	L	T	R	L	T	R	L	T	R	L	T	R	TOT
1600 - 1700	546	29	604	808	831	74	0	0	0	27	1345	708	**4972**
1615 - 1715	568	31	577	814	867	78	0	0	0	27	1368	753	**5083**
1630 - 1730	613	28	595	804	905	75	0	0	0	19	1364	795	**5198**
1645 - 1745	636	20	594	780	879	62	0	0	0	24	1382	810	**5187**
1700 - 1800	641	19	569	746	885	48	0	0	0	27	1335	737	**5007**
PEAK HOUR	**613**	**28**	**595**	**804**	**905**	**75**	**0**	**0**	**0**	**19**	**1364**	**795**	**5198**





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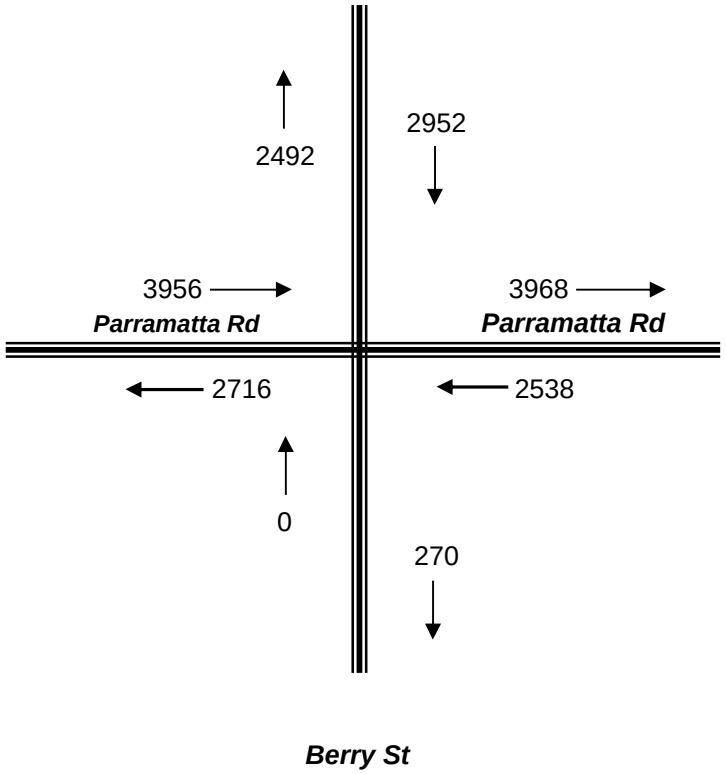
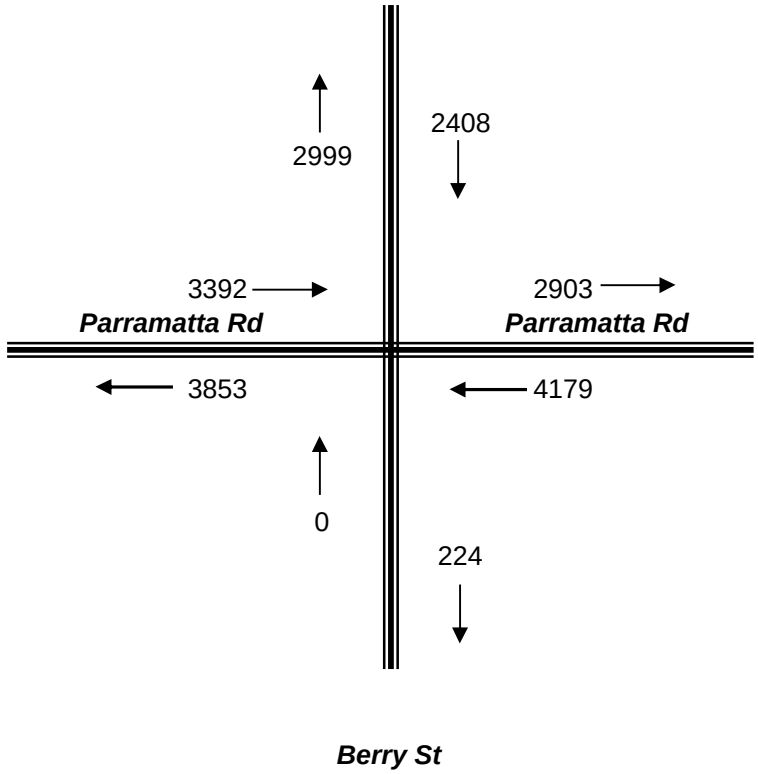
Client : Lyle Marshall & Associates Pty. Ltd.
Job No/Name : 5352 CAMELLIA Traffic Counts
Day/Date : Wednesday 15th October 2014

TOTAL VOLUMES FOR COUNT PERIODS

AM



PM



R.O.A.R. DATA

Reliable, Original & Authentic Results

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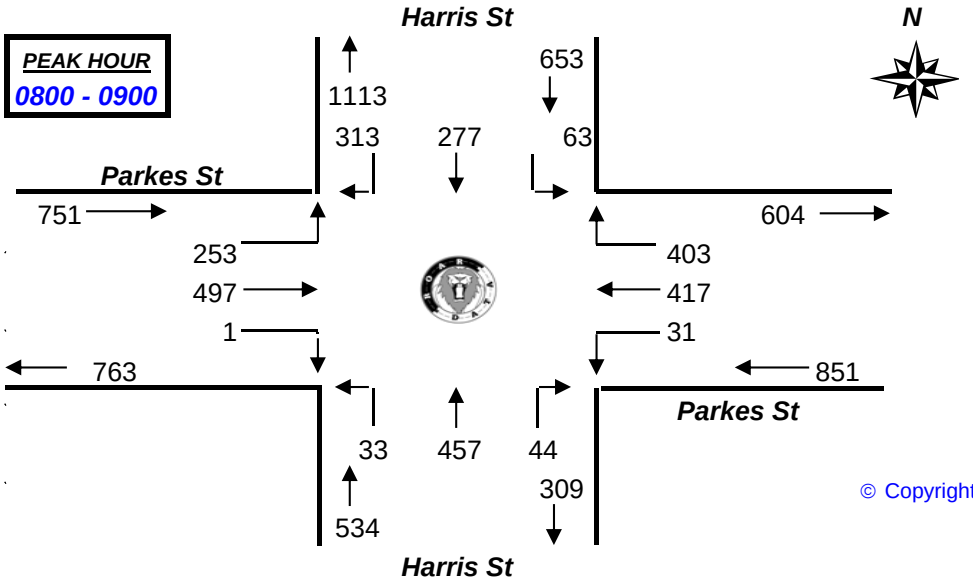
Client : Lyle Marshall & Associates Pty. Ltd.
Job No/Name : 5352 CAMELLIA Traffic Counts
Day/Date : Wednesday 15th October 2014

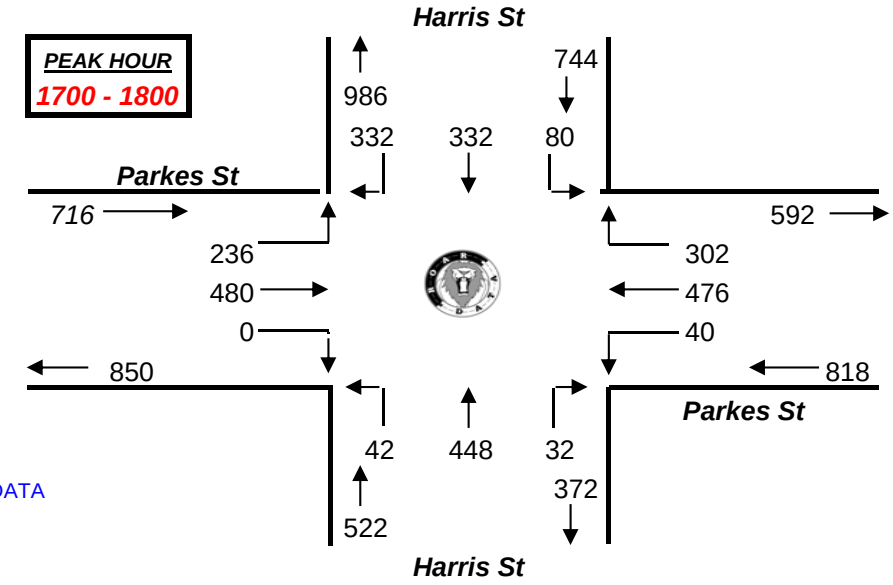
All Vehicles	NORTH Harris St			WEST Parkes St			SOUTH Harris St			EAST Parkes St			
Time Per	L	T	R	L	T	R	L	T	R	L	T	R	TOT
0700 - 0715	16	59	61	60	122	0	1	60	6	2	47	68	**502**
0715 - 0730	14	53	55	57	127	0	2	63	7	4	45	64	**491**
0730 - 0745	14	75	100	51	150	0	2	107	10	7	95	89	**700**
0745 - 0800	23	67	66	50	127	0	5	90	8	6	94	91	**627**
0800 - 0815	18	72	73	75	128	1	8	101	11	2	91	102	**682**
0815 - 0830	13	76	89	60	118	0	10	112	10	11	106	93	**698**
0830 - 0845	16	61	72	57	121	0	9	124	13	10	112	105	**700**
0845 - 0900	16	68	79	61	130	0	6	120	10	8	108	103	**709**
Period End	**130**	**531**	**595**	**471**	**1023**	**1**	**43**	**777**	**75**	**50**	**698**	**715**	**5109**

All Vehicles	NORTH Harris St			WEST Parkes St			SOUTH Harris St			EAST Parkes St			
Time Per	L	T	R	L	T	R	L	T	R	L	T	R	TOT
1600 - 1615	42	91	115	48	128	0	18	68	14	6	119	70	**719**
1615 - 1630	28	74	77	49	115	0	6	39	4	9	90	65	**556**
1630 - 1645	27	91	103	78	122	0	11	94	11	6	87	48	**678**
1645 - 1700	19	88	71	58	117	0	9	92	10	14	102	60	**640**
1700 - 1715	25	70	84	62	120	0	12	101	10	10	114	67	**675**
1715 - 1730	16	81	87	63	122	0	11	109	6	8	110	78	**691**
1730 - 1745	19	89	82	59	114	0	9	117	9	13	123	75	**709**
1745 - 1800	20	92	79	52	124	0	10	121	7	9	129	82	**725**
Period End	**196**	**676**	**698**	**469**	**962**	**0**	**86**	**741**	**71**	**75**	**874**	**545**	**5393**

	NORTH Harris St			WEST Parkes St			SOUTH Harris St			EAST Parkes St			
Peak Time	L	T	R	L	T	R	L	T	R	L	T	R	TOT
0700 - 0800	67	254	282	218	526	0	10	320	31	19	281	312	**2320**
0715 - 0815	69	267	294	233	532	1	17	361	36	19	325	346	**2500**
0730 - 0830	68	290	328	236	523	1	25	410	39	26	386	375	**2707**
0745 - 0845	70	276	300	242	494	1	32	427	42	29	403	391	**2707**
0800 - 0900	63	277	313	253	497	1	33	457	44	31	417	403	**2789**
PEAK HOUR	**63**	**277**	**313**	**253**	**497**	**1**	**33**	**457**	**44**	**31**	**417**	**403**	**2789**

	NORTH Harris St			WEST Parkes St			SOUTH Harris St			EAST Parkes St			
Peak Time	L	T	R	L	T	R	L	T	R	L	T	R	TOT
1600 - 1700	116	344	366	233	482	0	44	293	39	35	398	243	**2593**
1615 - 1715	99	323	335	247	474	0	38	326	35	39	393	240	**2549**
1630 - 1730	87	330	345	261	481	0	43	396	37	38	413	253	**2684**
1645 - 1745	79	328	324	242	473	0	41	419	35	45	449	280	**2715**
1700 - 1800	80	332	332	236	480	0	42	448	32	40	476	302	**2800**
PEAK HOUR	**80**	**332**	**332**	**236**	**480**	**0**	**42**	**448**	**32**	**40**	**476**	**302**	**2800**





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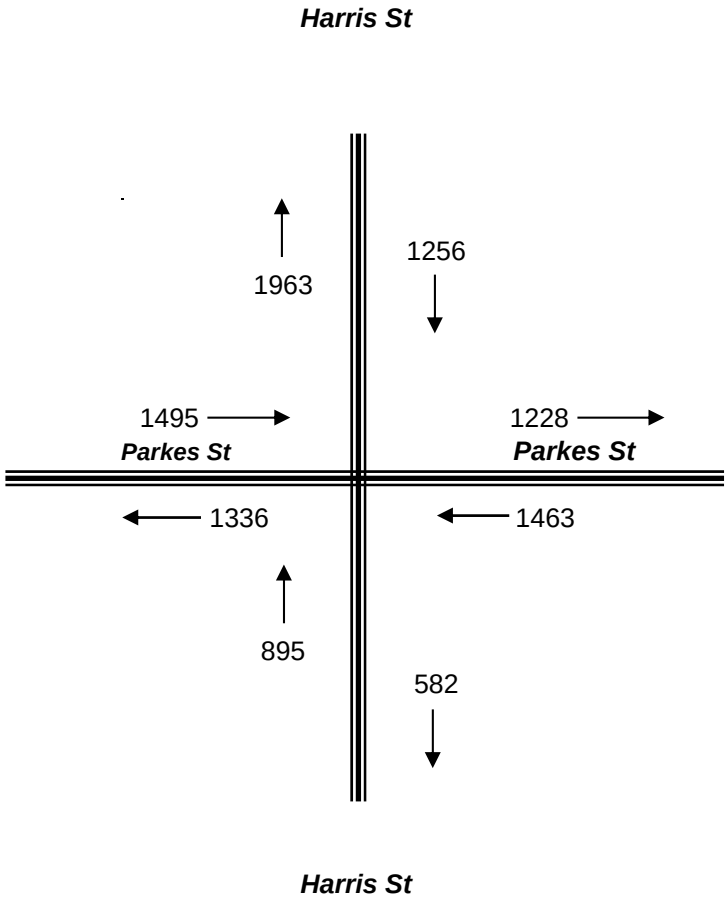
TOTAL VOLUMES FOR COUNT PERIODS

AM



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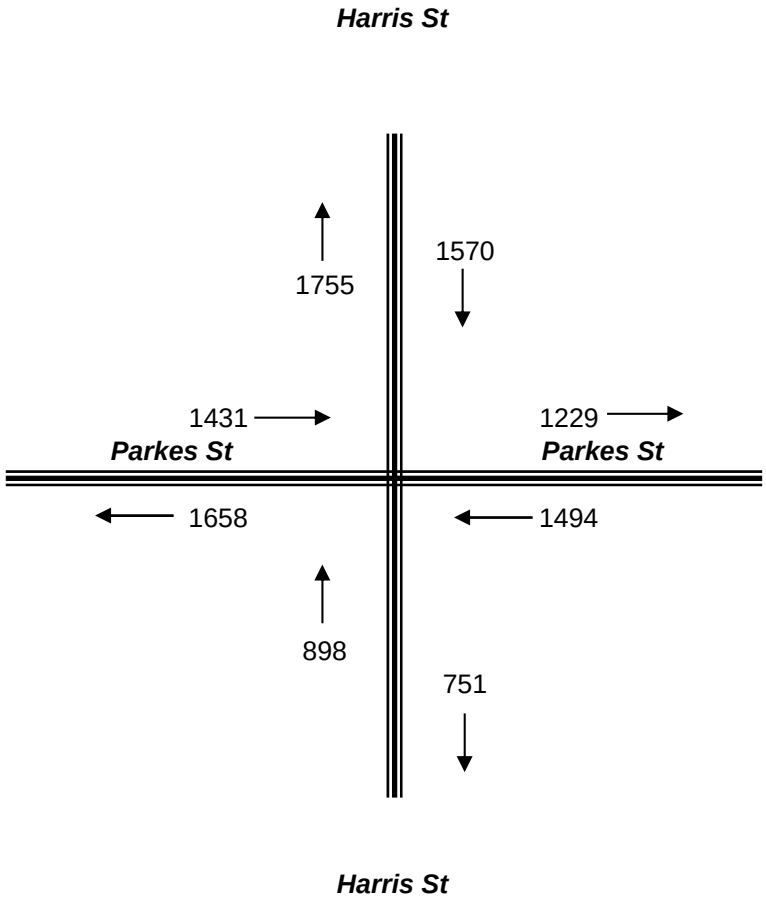

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Client : Lyle Marshall & Associates Pty. Ltd.

Job No/Name : 5352 CAMELLIA Traffic Counts

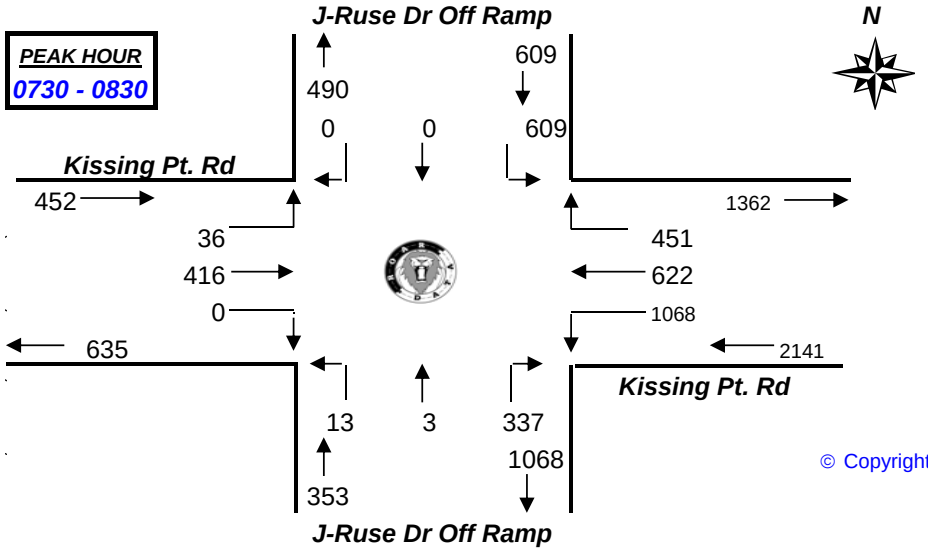
Day/Date : Wednesday 15th October 2014

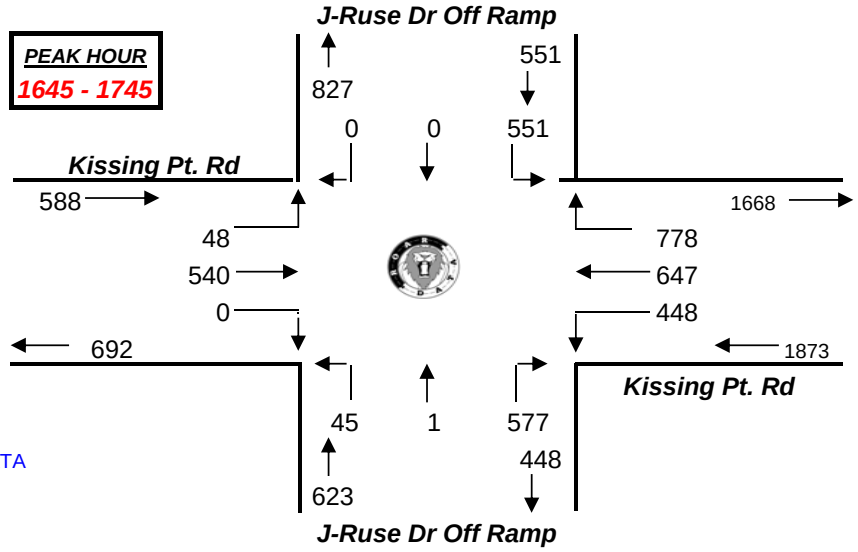
All Vehicles	NORTH J-Ruse Dr Off Ramp			WEST Kissing Pt. Rd			SOUTH J-Ruse Dr Off Ramp			EAST Kissing Pt. Rd			
Time Per	L	T	R	L	T	R	L	T	R	L	T	R	TOT
0700 - 0715	128			8	99		1	0	76	267	77	66	**722**
0715 - 0730	152			7	100		1	0	77	262	97	105	**801**
0730 - 0745	149			14	84		1	0	89	268	125	120	**850**
0745 - 0800	153			6	93		4	1	88	273	171	128	**917**
0800 - 0815	152			7	117		4	1	70	281	169	112	**913**
0815 - 0830	155			9	122		4	1	90	246	157	91	**875**
0830 - 0845	129			14	89		2	0	80	199	174	91	**778**
0845 - 0900	140			11	85		3	1	70	189	177	101	**777**
Period End	**1158**	**0**	**0**	**76**	**789**	**0**	**20**	**4**	**640**	**1985**	**1147**	**814**	**6633**

All Vehicles	NORTH J-Ruse Dr Off Ramp			WEST Kissing Pt. Rd			SOUTH J-Ruse Dr Off Ramp			EAST Kissing Pt. Rd			
Time Per	L	T	R	L	T	R	L	T	R	L	T	R	TOT
1600 - 1615	98			11	87		4	2	98	87	141	202	**730**
1615 - 1630	95			6	89		2	1	114	98	138	211	**754**
1630 - 1645	94			12	107		9	0	118	100	162	224	**826**
1645 - 1700	146			8	97		7	0	160	119	163	208	**908**
1700 - 1715	150			11	141		8	0	137	112	170	220	**949**
1715 - 1730	132			15	149		12	0	154	122	151	173	**908**
1730 - 1745	123			14	153		18	1	126	95	163	177	**870**
1745 - 1800	134			12	159		13	0	118	70	154	207	**867**
Period End	**972**	**0**	**0**	**89**	**982**	**0**	**73**	**4**	**1025**	**803**	**1242**	**1622**	**6812**

Peak Time	NORTH J-Ruse Dr Off Ramp			WEST Kissing Pt. Rd			SOUTH J-Ruse Dr Off Ramp			EAST Kissing Pt. Rd			
	L	T	R	L	T	R	L	T	R	L	T	R	TOT
0700 - 0800	582	0	0	35	376	0	7	1	330	1070	470	419	**3290**
0715 - 0815	606	0	0	34	394	0	10	2	324	1084	562	465	**3481**
0730 - 0830	609	0	0	36	416	0	13	3	337	1068	622	451	**3555**
0745 - 0845	589	0	0	36	421	0	14	3	328	999	671	422	**3483**
0800 - 0900	576	0	0	41	413	0	13	3	310	915	677	395	**3343**
PEAK HOUR	**609**	**0**	**0**	**36**	**416**	**0**	**13**	**3**	**337**	**1068**	**622**	**451**	**3555**

Peak Time	NORTH J-Ruse Dr Off Ramp			WEST Kissing Pt. Rd			SOUTH J-Ruse Dr Off Ramp			EAST Kissing Pt. Rd			
	L	T	R	L	T	R	L	T	R	L	T	R	TOT
1600 - 1700	433	0	0	37	380	0	22	3	490	404	604	845	**3218**
1615 - 1715	485	0	0	37	434	0	26	1	529	429	633	863	**3437**
1630 - 1730	522	0	0	46	494	0	36	0	569	453	646	825	**3591**
1645 - 1745	551	0	0	48	540	0	45	1	577	448	647	778	**3635**
1700 - 1800	539	0	0	52	602	0	51	1	535	399	638	777	**3594**
PEAK HOUR	**551**	**0**	**0**	**48**	**540**	**0**	**45**	**1**	**577**	**448**	**647**	**778**	**3635**





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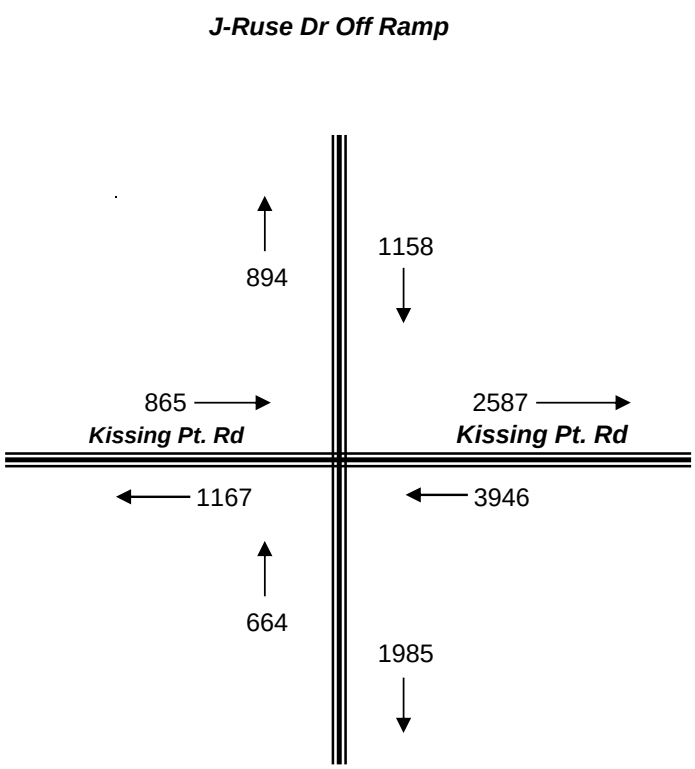
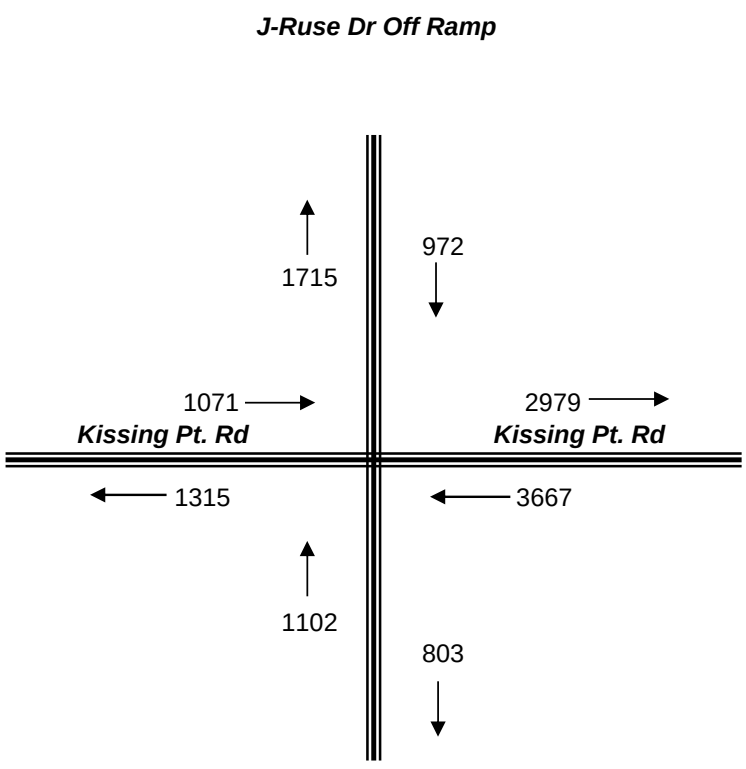
Job No/Name : 5352 CAMELLIA Traffic Counts
Day/Date : Wednesday 15th October 2014

AM

TOTAL VOLUMES FOR COUNT PERIODS

PM





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All Vehicles	Underpass James Ruse Dr		
Time Per	NB	SB	TOT
0700 - 0715	505	820	**1325**
0715 - 0730	573	905	**1478**
0730 - 0745	485	868	**1353**
0745 - 0800	414	849	**1263**
0800 - 0815	481	775	**1256**
0815 - 0830	423	777	**1200**
0830 - 0845	379	646	**1025**
0845 - 0900	375	636	**1011**
Period End	**3635**	**6276**	**9911**

	Underpass James Ruse Dr		
Peak Time	NB	SB	TOT
0700 - 0800	1977	3442	**5419**
0715 - 0815	1953	3397	**5350**
0730 - 0830	1803	3269	**5072**
0745 - 0845	1697	3047	**4744**
0800 - 0900	1658	2834	**4492**

PEAK HOUR	**1977**	**3442**	**5419**

All Vehicles	Underpass James Ruse Dr		
Time Per	NB	SB	TOT
1600 - 1615	618	430	**1048**
1615 - 1630	646	410	**1056**
1630 - 1645	641	425	**1066**
1645 - 1700	584	450	**1034**
1700 - 1715	593	515	**1108**
1715 - 1730	677	485	**1162**
1730 - 1745	545	544	**1089**
1745 - 1800	545	473	**1018**
Period End	**4849**	**3732**	**8581**

	Underpass James Ruse Dr		
Peak Time	NB	SB	TOT
1600 - 1700	2489	1715	**4204**
1615 - 1715	2464	1800	**4264**
1630 - 1730	2495	1875	**4370**
1645 - 1745	2399	1994	**4393**
1700 - 1800	2360	2017	**4377**

PEAK HOUR	**2399**	**1994**	**4393**

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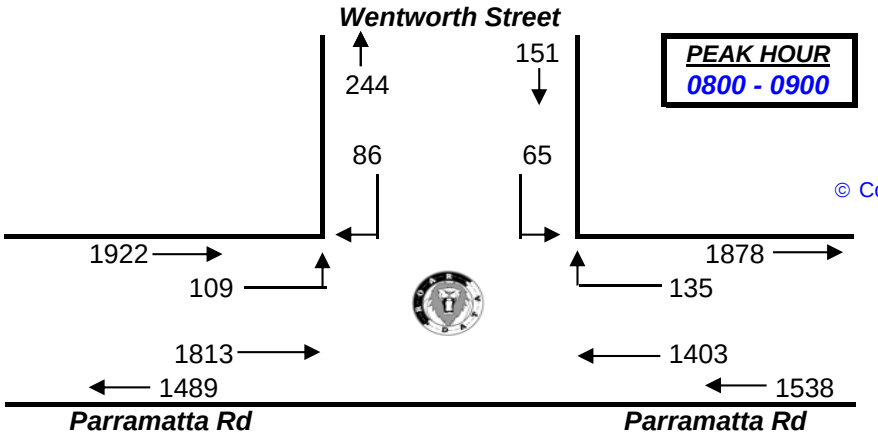
Day/Date : Wednesday 15th October 2014

All Vehicles

	WEST		NORTH		EAST		
	Parramatta		*Wenrworth*		*Parramatta*		
Time Per	**L**	**T**	**R**	**L**	**T**	**R**	**TOTAL**
0700 - 0715	36	318	12	18	226	26	**636**
0715 - 0730	29	415	13	22	257	28	**764**
0730 - 0745	42	480	15	10	301	26	**874**
0745 - 0800	38	487	20	15	332	28	**920**
0800 - 0815	28	476	14	20	301	41	**880**
0815 - 0830	26	467	25	17	371	32	**938**
0830 - 0845	22	427	18	11	341	18	**837**
0845 - 0900	33	443	29	17	390	44	**956**
Period End	**254**	**3513**	**146**	**130**	**2519**	**243**	**6805**

	WEST		NORTH		EAST		
	Parramatta		*Wenrworth*		*Parramatta*		
Peak Per	**L**	**T**	**R**	**L**	**T**	**R**	**TOTAL**
0700 - 0800	145	1700	60	65	1116	108	**3194**
0715 - 0815	137	1858	62	67	1191	123	**3438**
0730 - 0830	134	1910	74	62	1305	127	**3612**
0745 - 0845	114	1857	77	63	1345	119	**3575**
0800 - 0900	109	1813	86	65	1403	135	**3611**

PEAK HR	**109**	**1813**	**86**	**65**	**1403**	**135**	**3611**

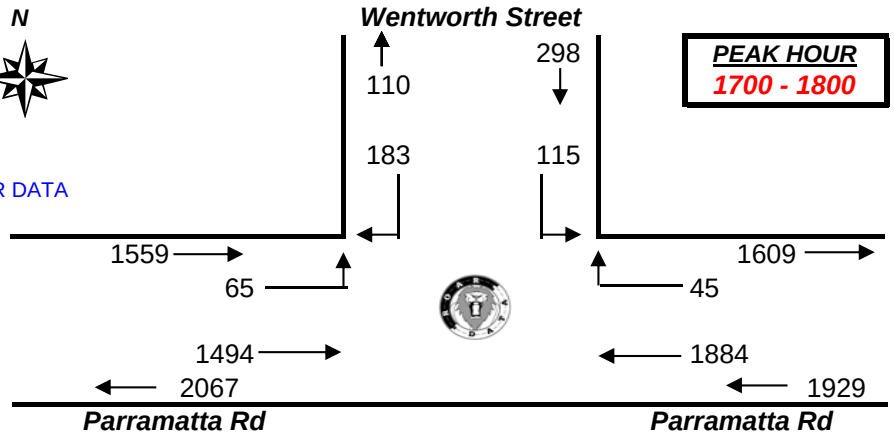


All Vehicles

	WEST		NORTH		EAST		
	Parramatta		*Wenrworth*		*Parramatta*		
Time Per	**L**	**T**	**R**	**L**	**T**	**R**	**TOTAL**
1600 - 1615	18	220	70	23	412	23	**766**
1615 - 1630	29	237	34	20	485	19	**824**
1630 - 1645	12	357	51	27	480	16	**943**
1645 - 1700	14	323	39	18	408	18	**820**
1700 - 1715	21	374	79	30	308	27	**839**
1715 - 1730	16	378	51	32	515	9	**1001**
1730 - 1745	15	346	30	33	629	2	**1055**
1745 - 1800	13	396	23	20	432	7	**891**
Period End	**138**	**2631**	**377**	**203**	**3669**	**121**	**7139**

	WEST		NORTH		EAST		
	Parramatta		*Wenrworth*		*Parramatta*		
Peak Per	**L**	**T**	**R**	**L**	**T**	**R**	**TOTAL**
1600 - 1700	73	1137	194	88	1785	76	**3353**
1615 - 1715	76	1291	203	95	1681	80	**3426**
1630 - 1730	63	1432	220	107	1711	70	**3603**
1645 - 1745	66	1421	199	113	1860	56	**3715**
1700 - 1800	65	1494	183	115	1884	45	**3786**

PEAK HOUR	**65**	**1494**	**183**	**115**	**1884**	**45**	**3786**



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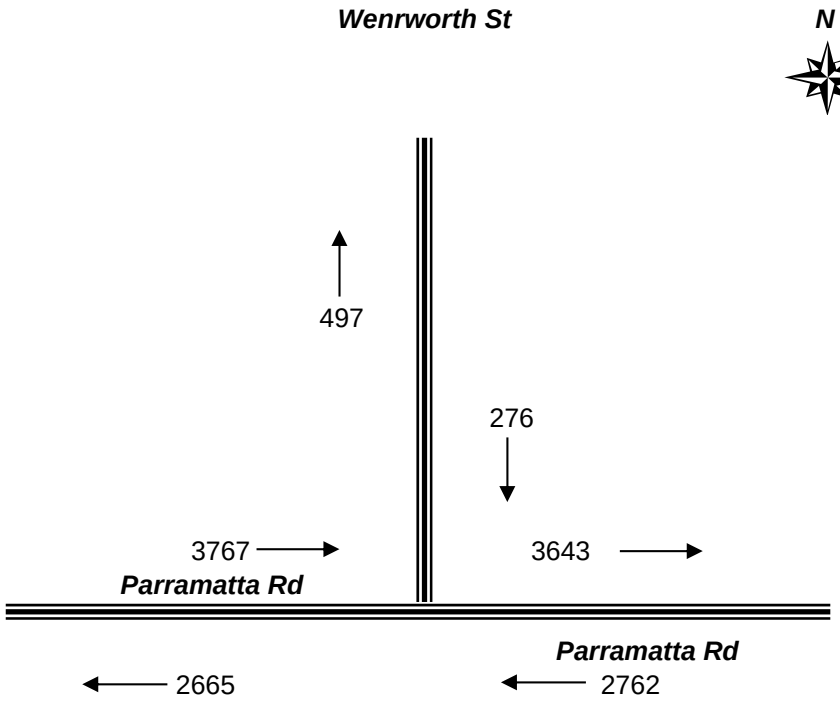

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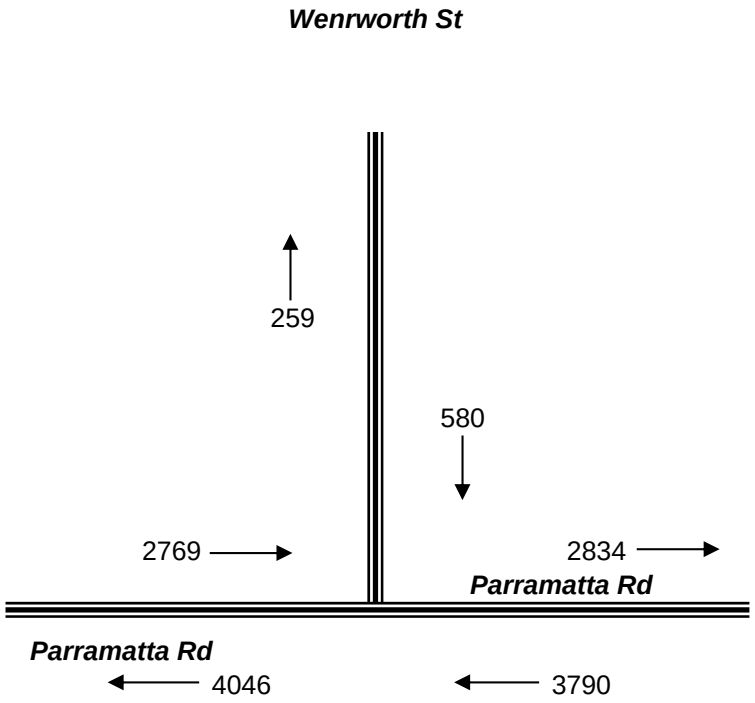
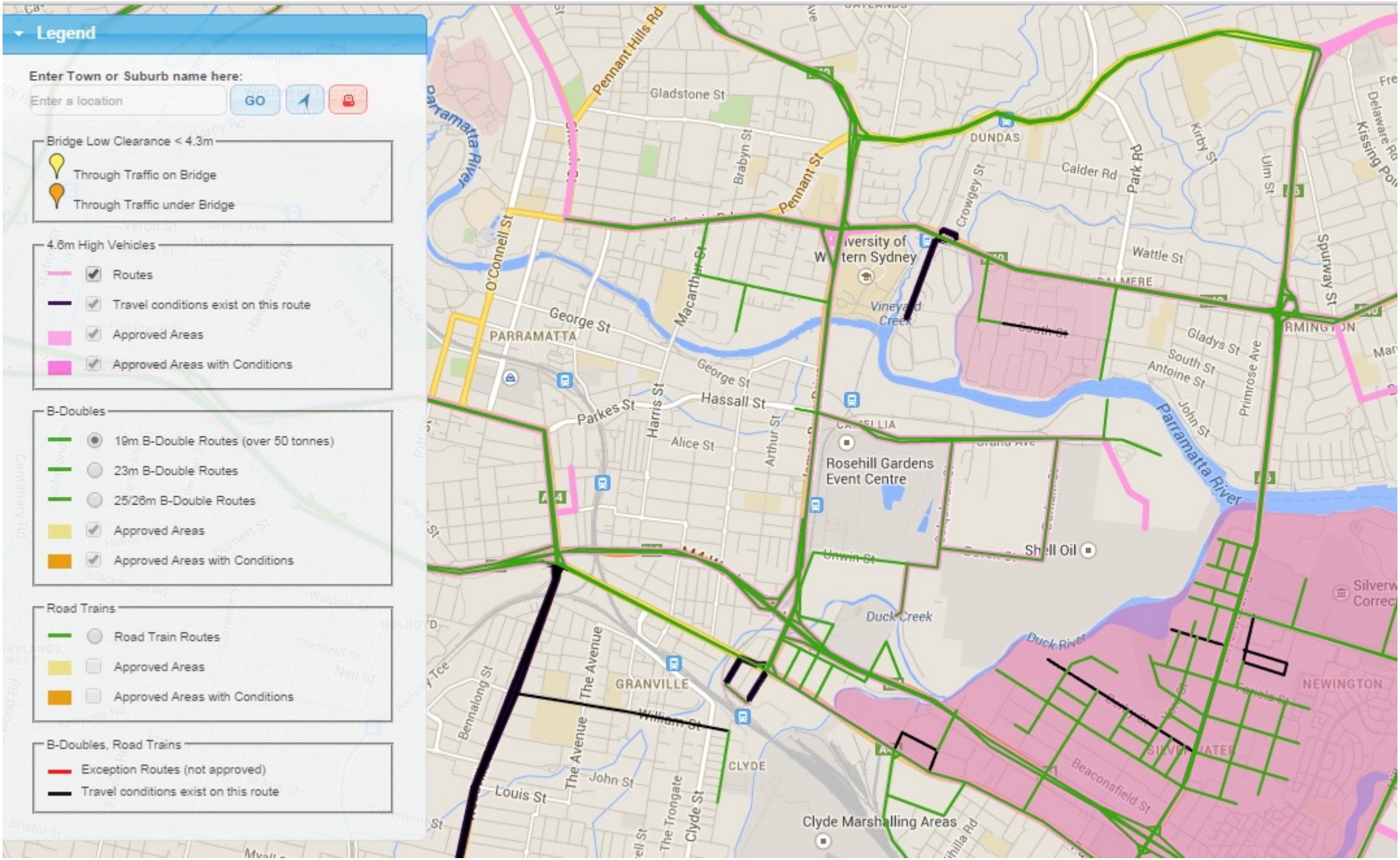


APPENDIX D



APPENDIX D: HEAVY VEHICLE ROUTES

APPENDIX E

SYDNEY

Blue Mountains National Park
Richmond
B59
Windsor
A9
A2
Windsor Road
Rouse Hill
Old Windsor Road
Castlereagh
Springwood
Great Western Highway
Linden
Emu Heights
A32
Penrith
A44
St Marys
M4
Western Motorway
The Northern Road
Mt Druitt
M7
Blacktown
A40
M2
Glenorie
Galston
Castle Hill
A28
Hornsby
M1
Pacific Highway
B83
Pacific Motorway
Berowra
Palm Beach
Terrey Hills
A3
Mona Vale Road
Mona Vale
Pittwater Road
A8
Dee Why
A1
Frenchs Forest
A38
Brookvale
Manly
Epping
Macquarie Park
Parramatta
Ryde
Chatswood
St Leonards
Crows Nest
Spit Road
North Sydney
Homebush Bay Drive
Victoria Road
A6
A4
City Westlink
Strathfield
Auburn
Fairfield
Cumberland Highway
Wetherill Park
Wallacia
Cabramatta
Liverpool
Hume Highway
Westlink
Prestons
Leppington
Bankstown
Padstow
Burwood
Newtown
SYDNEY
Bondi
Maroubra
Kogarah
Princes Highway
King Georges Road
Alfords Point Road
Hurstville
Botany Bay
Sutherland
Miranda
Cronulla
Heathcote Road
Heathcote
Camden
Narellan Road
Campbelltown
Hume Motorway
M31
B69

N

LEGEND

- M Route
- A Route
- B Route

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