396 Lane Cove Road - Paramics Modelling Report

November 2011

Winten Property Group

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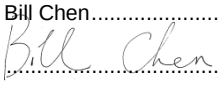
Signed: 

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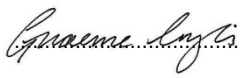
Signed: 

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1. Introduction

1.1 Background

Winten Property Group is currently planning to redevelop the existing site at 396 Lane Cove Road in Macquarie Park, located on the western corner of the Lane Cove Road/Waterloo Road intersection.

Colston, Budd, Hunt and Kafes (CBHK) are currently engaged by Winten to investigate the traffic related impacts of the proposed re-development. Parsons Brinckerhoff has been engaged to provide Paramics Microsimulation traffic modelling inputs into the traffic impact assessment process.

1.2 City of Ryde Modelling guidelines

The proposed development site is within the City of Ryde (CoR) municipality. CoR has developed, in conjunction with Bitzios Consulting, guidelines for the use of their Paramics microsimulation models to assess all proposed developments within the Macquarie Park precinct.

The following documents have been taken into consideration when undertaking this traffic modelling exercise:

- *Traffic Impact Assessment Process for Macquarie Park Corridor Development Application (Reference document No. 1)*
- *Macquarie Park Corridor Paramics Model User Manual (Reference document No. 2)*
- Appendix C- Base Year Model validation statistics at key intersections (2008 data)
- Bitzios Responses to questions raised by Parsons Brinckerhoff about the MPPM modelling process (P0415.02)
- Letter from Sydney Regional Development Advisory Committee to Department of Planning dated 14 March 2011: *Exhibition of Environmental Assessment and Concept Plan for Retail and Commercial Development at 396 Lane Cove Road, 32-46 Waterloo Road and 1 Giffnock Avenue, Macquarie Park*.

Copies of the letter to the Department of Planning and Bitzios' response to Parsons Brinckerhoff are available in Appendix A.

1.2.1 CoR Guidelines methodology

The broad steps as outlined by CoR for the modelling assessment are:

Step 1: Notification by developer

Step 2: Information pack issued by council

Step 3: Local estimation and validation

Step 4: Calculate development traffic

Step 5: Create 'with development' Paramics network

Step 6: Impact Assessment

Step 7: Documentation and submission to Council.

Steps 1 and 2 were undertaken to enable the modelling assessment to occur. This report will outline the process undertaken from Steps 3–7 above to assess the proposed development based on the CoR modelling guidelines.

Step 8 will be the review of the modelling work undertaken by Parsons Brinckerhoff, before Step 9 which is the consideration of proposal application.

1.3 Supplied information

Parsons Brinckerhoff was supplied the following information by City of Ryde:

- AM and PM Macquarie Park Corridor Paramics Models (MPCPMs) Version 3. (the latest available set of CoR models at the time).

Note that the version of the models (V3) provided by CoR have been calibrated to 2008 traffic information.

Parsons Brinckerhoff corresponded with City of Ryde and Bitzios Consulting on some technical issues, to confirm the appropriate use of the model. This correspondence is provided in Appendix A.

CBHK provided the traffic attraction/generation figures for the proposed development to be assessed in the Paramics model. CBHK also provided the access arrangement layouts for the proposed development.

1.4 Paramics software

Parsons Brinckerhoff has used Paramics Version 6.7.1 to undertake this modelling exercise. Ceejazz plug-in software has also been used to aid the 'in-scope', model calibration/validation process.

1.5 MPCPM model review

The existing MPCPM models, includes all key roads and intersections within Macquarie Park including a 7 km section of the M2 Motorway.

The model covers the following peak time periods:

- AM peak (07.45–08.45)
- PM peak (16.45–17.45).

The model includes a 15 minute warm up period and a 1 hour cool down period.

The models provided are for Base Year only (calibrated to 2008 survey data). No future year models were provided to Parsons Brinckerhoff.

The model shows that the network is significantly congested during both peak periods. This reflects the on-ground traffic conditions within Macquarie Park.

The Paramics models use dynamic traffic assignment (feedback) in 2 minute intervals, which means that drivers recalculate their routes every two minutes to take account of queuing/delays in the network. In a network such as Macquarie Park, where there is considerable congestion and route choice options available to divers, the use of feedback can lead to significant switching between available routes, as Paramics tries to minimise delays in the network. This means that small changes to the network and/or demands can also have a significant impact to the wider network.

1.6 Modelling Summary

The modelling undertaken by Parsons Brinckerhoff has used the most up to date CoR models available at the time, and have undertaken the modelling assessment in accordance with the CoR modelling guidelines.

1.7 Proposed development site

Figure 1.1 shows the base model network (as provided by CoR) coverage indicating the location of the proposed development site between Lane Cove Road and Waterloo Road. The proposed site is located at existing zone 73.

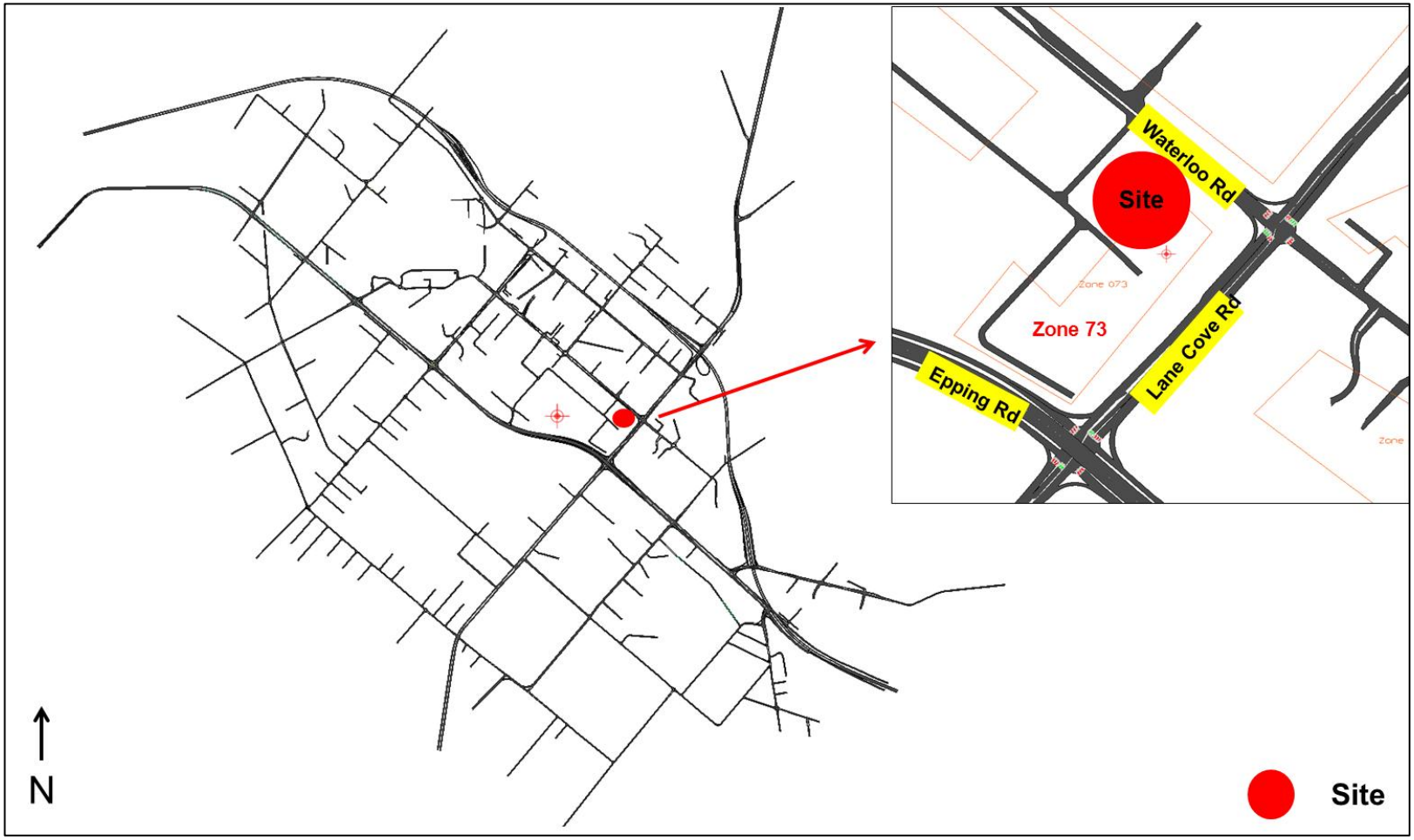


Figure 1.1 Development site

2. Local estimation and validation (Step 3)

To assess the proposed development, CoR's modelling guidelines require the identification of the 'scope of influence' of the development, i.e. the surrounding intersections which will be materially impacted by the proposed development. Once the 'in-scope' study area has been determined, this area is to undergo a localised calibration/validation process to existing conditions.

2.1 Creation of 'with-development' model network

In order to determine the scope of influence a new zone was created (zone 82) on the development site (in accordance with CoR Ref Document No.2). The base models were updated to include the existing access arrangements to the site, on Coolinga Street and Giffnock Avenue.

2.1.1 Traffic generation/distribution

To determine the scope of influence, Parsons Brinckerhoff used trip generation rates from a previous study undertaken by Arup (for this site), these are shown in Table 2.1. Note that revised trip generation rates were later provided by CBHK (based on up to date survey data), however for the purposes of identifying the 'in-scope' area the original Arup figures represent a worst case scenario.

Table 2.1 Traffic generation to determine 'in-scope' area

Time period	Forecast traffic generation (vehicle trips)					
	AM peak			PM peak		
	Inbound	Outbound	**Total**	Inbound	Outbound	**Total**
Proposed development	540	135	**675**	135	540	**675**

The distribution of traffic to and from the development (zone 82) for AM and PM peaks is in accordance with the distribution for the current model zone (zone 73) within which the development site sits, as required in the CoR guidelines.

Detailed traffic distribution to and from the development is provided in Appendix B.

2.2 Identification of 'in-scope' intersections

CoR's TIA process specifies the 'in-scope' intersections for the assessment of development impacts would typically relate to any access intersections onto the network as well as any intersections beyond these locations where the development traffic could be 10% or more of the traffic at the intersection once the development is completed.

Initially Parsons Brinckerhoff assigned the additional traffic (from the development) onto the network with background traffic in place. However because the network is heavily congested and dynamic (feedback) assignment is being used, it is not possible to distinguish between impacts resulting from the additional development and impacts resulting from congestion /rerouting in the network resulting from the additional trips.

Therefore in order to determine the 'in-scope' study area, Parsons Brinckerhoff assigned the development traffic to the network, with no background traffic in place, whereby minimising any rerouting of the development traffic within the model. The development volumes were then compared against the base model turning movements to determine which intersections would change by 10% or more.

The modelling indicates five intersections where development traffic flows are 10% or more of total traffic in the AM and/or PM peaks. These intersections are:

- Waterloo Road/Coolinga Street
- Giffnock Avenue /Kittys Street
- Coolinga Street/Access driveway to the site
- Giffnock Avenue/Access driveway to the site
- Giffnock Avenue/Coolinga Street.

To be conservative, the critical intersections in the vicinity of the development site were also included into the study scope. Therefore the following intersections are included in the study area for the assessment:

1. Lane Cove Road/Waterloo Road (signalised intersection)
2. Lane Cove Road/Hyundai Drive (Giffnock Avenue)
3. Lane Cove Road/Epping Road (signalised intersection)
4. Epping Road/Lyon Park Road
5. Giffnock Avenue/Hyundai Drive (roundabout)
6. Giffnock Avenue/Coolinga Street
7. Giffnock Avenue/Access driveway to the site
8. Coolinga Street/Access driveway to the site
9. Waterloo Road/Coolinga Street
10. Giffnock Avenue/Kittys Street.

Figure 2.1 shows the study area and in scope intersections (numbers in figure correspond with list above).

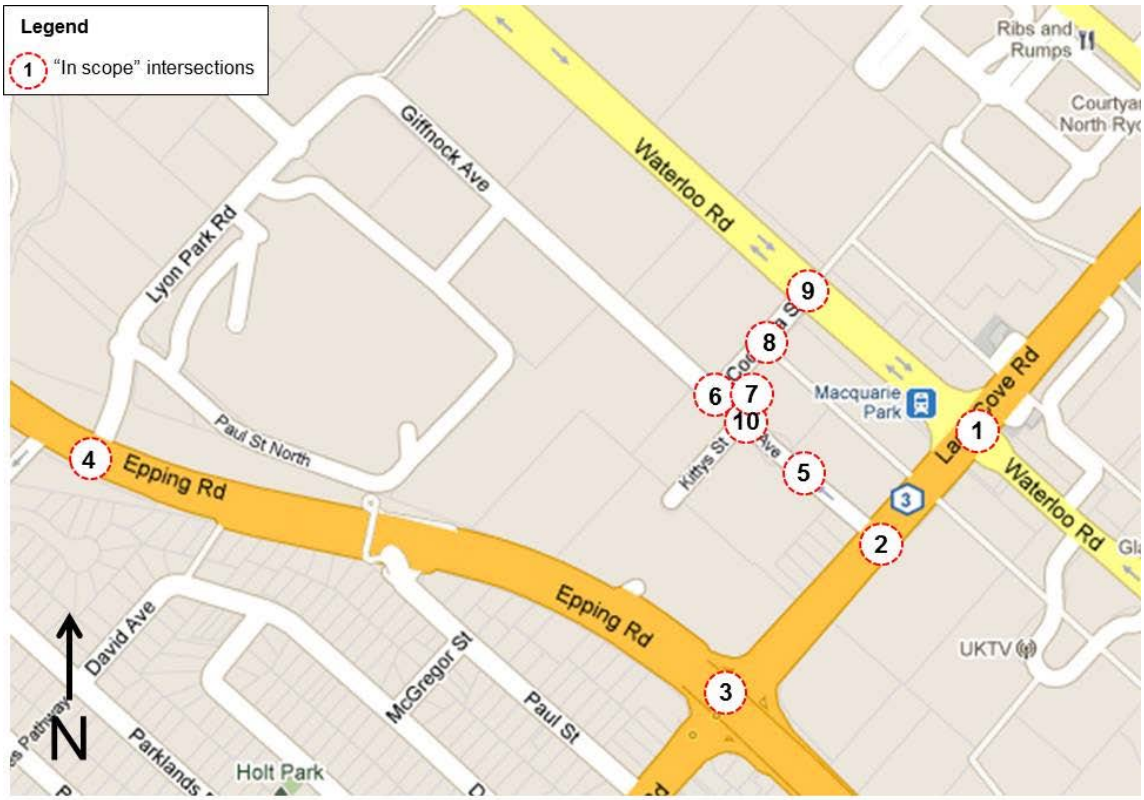


Figure 2.1 Study area and 'in scope' intersections

2.3 In-scope model calibration/validation

After identifying the study area, Parsons Brinckerhoff undertook localised calibration/validation of the model for the 'in-scope' study area. Model calibration entails matching observed traffic conditions with the Paramics model to provide confidence that the model is representative of existing traffic conditions. Validation has focused on observed network conditions and observed traffic volumes.

In line with CoR's TIA process the results of the calibration/validation exercise were considered using a seed value of 5 (in accordance with CoR's modelling guidelines).

2.3.1 Traffic surveys

CBHK provided Parsons Brinckerhoff with intersection turning movement data for all 'in-scope' intersections, to assist in undertaking localised model calibration/validation exercise.

Detailed intersection turning movement data is provided in Appendix B.

2.3.2 Site inspection

Site inspections were undertaken by Parsons Brinckerhoff during AM and PM peaks to observe current traffic conditions in the study area.

Specific note was also made of the following:

- restrictions
- lane configuration
- driving behaviour
- lane usage
- pedestrian movements
- traffic signal phasing and timing.

2.3.3 Updating model network

The base models were updated to represent existing road network near the subject site. The changes made to the model network are provided in Appendix C.

A 24 hour bus lane has recently been implemented on the northbound carriageway of Lane Cove Road towards Waterloo Road. Observations on site suggested that all vehicles were using the bus lane as a general purpose lane; therefore it has not been coded as a bus lane in the updated Paramics model.

Figure 2.3 shows the updated model network near the proposed site.

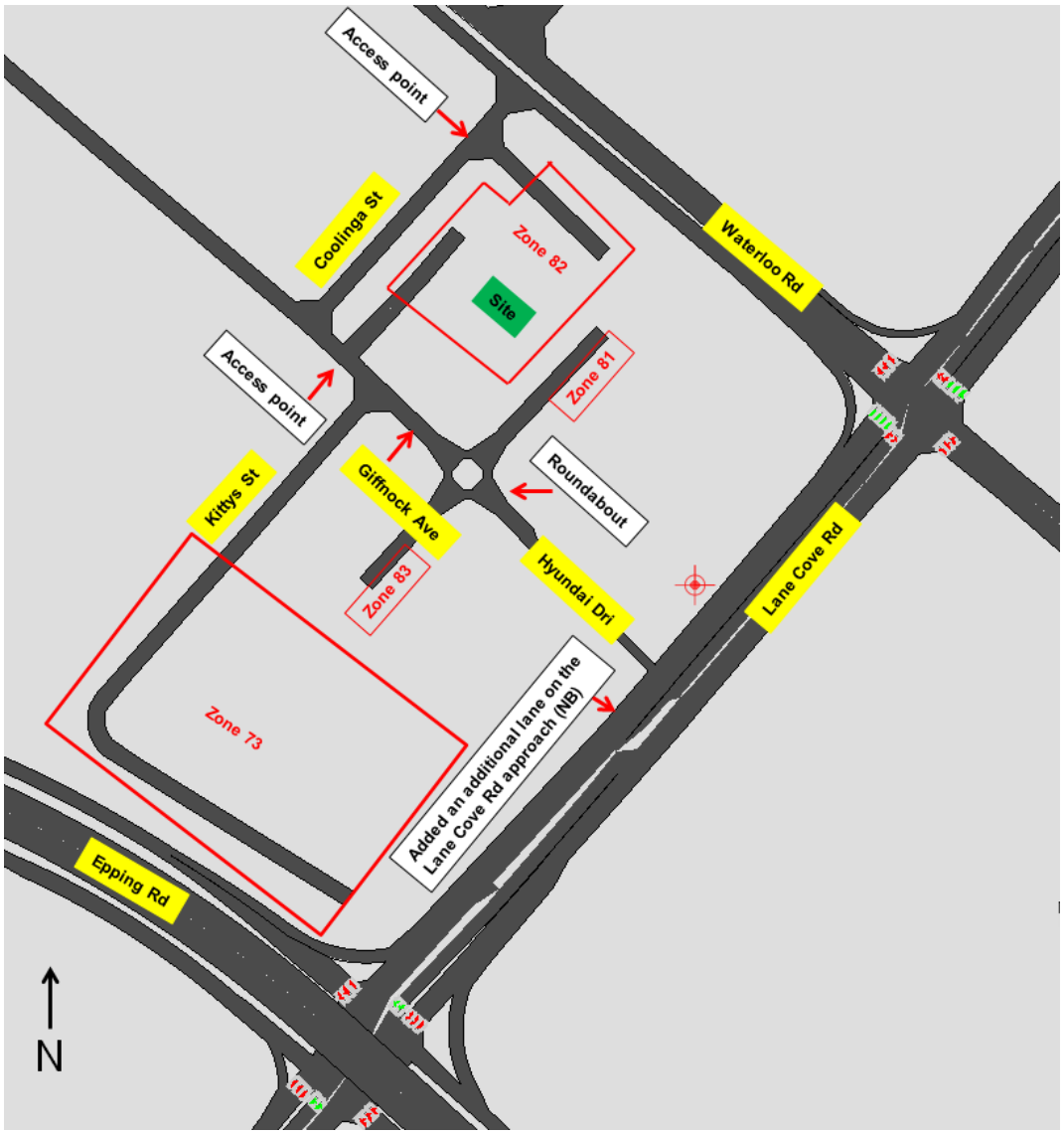


Figure 2.2 Updated model network in the vicinity of the proposed development

2.3.3.1 Matrix estimation

Base model trip matrix estimation was undertaken by manually adjusting trip volumes to match the observed traffic count information in the study area. Changes made to model trip matrices for each of the peak periods are provided in Appendix C1. Most of the changes made by Parsons Brinckerhoff were between External-Internal zones. This was done to maintain the integrity of the internal zones within Macquarie Park.

Table 2.2 provide a summary of the pre and post matrix estimation totals.

Table 2.2 Matrix Total (pre and post estimation)

	Matrix total (total number of vehicle trips)	
	AM peak	PM peak
Pre estimation	26,375	28,530
Post estimation	26,228	27,941

Note; the Base Matrix Totals differ from the matrix totals described in Reference Document No. 2

2.3.3.2 Signposting

The sign posting has been changed from the default model values at several points within the network in order to better replicate observed traffic conditions.

Signposting distances on several links were changed to allow for vehicles to make appropriate movements and decisions. Detailed modification of link signposting distances are provided in Appendix C2.

2.3.3.3 Lane discipline

Due to the limitations of the Paramics lane changing module, a lane choice plugin was developed to override the core code of Paramics to better replicate lane choice decisions.

The plugin module provides the capability to assign drivers to specific lanes at any point of the road network. The lane choice rules can be coded based on several variables such as vehicle type, origin zone and destination zone. This has been done at several locations in the model in order to ensure that drivers are making realistic lane choices as they travel through the network. Appendix C3 describes were lane choice has been applied and the reasons for including it in the model.

2.3.3.4 Link cost factor

In Paramics, link cost factor affects generalised cost for a link that either increases or decreases the cost for vehicles to use that link. The use of link cost factors on strategic links in the network can greatly influence route choice decisions through the network. Some link cost factors have been applied to the model to help replicate the existing road hierarchy/route choice behaviour. All changes made to the link cost factors are presented in Appendix C4.

2.3.3.5 Signal phase timing

Signal phase timings at some intersections in the AM and PM models were adjusted to help match the modelled movement flows with surveyed traffic volumes. All signal timings adjustments are described in Appendix C5.

2.3.3.6 Route choice

Paramics route choice was applied at some points within the network to better reflect the realistic routes selected by drivers. Appendix C6 presents the application of route choice in the AM and PM models in the study area.

2.4 Model validation

The model validation criteria specified in CoR's TIA process is shown as follows:

- GEH statistics for turn movements with no fewer than 85% less than 5
- GEH statistics for all turn movements less than 10.

GEH compares the differences between observed flows and modelled flows on a link by using the following formula:

$$GEH = \sqrt{(V_O - V_A)^2 / (0.5 \times (V_O + V_A))}$$

Where:

V_O = Observed traffic flow (vehicles/hour)

V_A = Assigned (or modelled) hourly traffic flow (vehicles/hour)

The following section provides the calibration results for each of the base models; more detailed results are provided in Appendix D.

In accordance with the CoR's TIA process, the model calibration was carried using the seed value of 5.

2.4.1.1 Validation assessment

Table 2.3 shows the calibration summary for each of the peak periods. As shown, the calibration criteria have been met for each of the base models.

Table 2.3 Model validation statistics

Criterion	AM peak	PM peak
GEH < 5	57 out of 67(85%)	57 out of 67(85%)
GEH < 10	67 out of 67(100%)	67 out of 67 (100%)

The Paramics models for each of the peak periods have been calibrated to intersection turning movement counts in accordance with the CoR's criteria.

2.4.2 Observed queuing

Observed queuing in the vicinity of the proposed development (within the 'in-scope' area) were found to broadly replicate the queuing observed on site during the AM peak hour.

In the PM peak the queuing in the model, was generally less than was observed on site, particularly on Lane Cove Road northbound from the Lane Cove Road/Waterloo Road intersection. Because the model is being run with feedback, route reassignment occurs within the model before the queuing can reach levels observed on site.

3. 2011 Existing intersection performance

Once the models had been calibrated and validated, the existing intersection performance was assessed. In order to do this the delays on each approach arm within the model was determined and a level of service was obtained.

Level of service (LoS) is a basic performance parameters used to describe the operation of an intersection. Levels of service range from A (indicating good intersection operation) to F (indicating conditions with long delays and queues). Table 3.1 outlines the RTA levels of service table obtained from the RTA '*Guide to Traffic Generating Developments'* document.

Table 3.1 RTA Level of Service

Level of Service	Average delay (seconds per vehicle)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause excessive delays. Roundabouts require other control mode	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: RTA Guide to Traffic Generating Developments

The delay and Level of Service for each approach was obtained for every intersection in the study area using the RTA Level of Service Plug-in.

Table 3.2 shows the existing intersection delay and Level of Service. Further details are available in Appendix E1.

Table 3.2 Delay and Level of Service for existing conditions

	AM peak		PM peak	
	Delay	LOS	Delay	LOS
Waterloo/Lane Cove	41	C	68	E
Lane Cove/Hyundai	10	A	7	A
Epping/Lane Cove	88	F	97	F
Epping/Lyon Park	11	A	15	B
Waterloo/Coolinga	6	A	7	A
Coolinga/Car Park	6	A	8	A
Coolinga/Giffnock	12	A	7	A
Giffnock/Car Park	7	A	9	A
Giffnock/Kittys	8	A	6	A
Hyundai/Giffnock RB	11	A	6	A

The results show that during the AM peak significant delays are experienced at the Epping Road/Lane Cove Road intersection.

In the PM peak, the intersection of Lane Cove Road and Epping Road operates at capacity. In addition, the Waterloo Road/Lane Cove Road intersection operates close to capacity.

The other intersections close to the development operate satisfactorily (LOS A or B) during the AM and PM peaks.

Intersection turning movement volumes for existing conditions are provided in Appendix B.

3.1 2011 Existing network conditions

Parsons Brinckerhoff has used the network evaluation plugin to extract network wide statistics for the base models.

The following data outputs were extracted for both the AM and PM peaks:

- total number of vehicles
- vehicles hours travelled
- vehicles kilometres travelled
- total number of vehicle stops
- average number of stops per vehicle.

This data provides base line results against which the ‘with development’ model performance can be compared.

The results for the base models are indicated in Table 3.3. The total number of stops in each model has been equated to an average number of stops per vehicle.

Table 3.3 Network parameters for AM and PM peaks

AM peak network parameters		
Parameters	**AM peak**	**PM peak**
Number of vehicles	30684	32121
Vehicle Hours Travelled	3962	4546
Vehicle Kilometres Travelled	128555	132475
Total Number of Stops	149342	174426
Average Number of Stops per vehicle	4.87	5.43

4. Calculate development traffic (Step 4)

4.1 Updated trip generation

Following the initial modelling exercise to identify the scope of influence for the proposed development, Parsons Brinckerhoff was provided updated traffic generation figures from CBHK.

The rates provided are based on recent surveys, indicated generation rates of 0.42 to 0.55 trips per parking space.

The trip generation rate of 0.55 (peak hour trips per parking space) has been used to assess the traffic impacts of proposed development. The forecast traffic generation is shown below:

- 440 inbound trips and 110 outbound trips in the AM peak
- 110 inbound trips and 440 outbound trips in the PM peak.

4.2 Trip distribution

The distribution of traffic to and from the development (zone 82) for AM and PM peak is in accordance with the distribution for the neighbouring model zone (zone 73).

Detailed traffic distribution to and from the development is provided in Appendix B.

5. Create 'with development' Paramics network (Step 5)

5.1 Access arrangements

The access arrangements have been included:

- priority intersection providing left-in/left-out from Coolinga Street
- priority intersection providing entry/exit from Giffnock Avenue.

5.1.1 Roundabout on Coolinga Street/Giffnock Street

With the existing road network, vehicles exiting from the Coolinga Street access and wishing to access Waterloo Road will need to perform a U-turn at the Hyundai roundabout to turn onto the Coolinga Street (northbound) before heading onto Waterloo Road. To facilitate this movement, it's proposed to convert the 3-arm priority intersection of Coolinga Street and Giffnock Avenue into a roundabout. In this case, vehicles exiting from the Coolinga Street will perform a U-turn at the proposed roundabout before accessing Waterloo Road.

Each of the 'with-development' options includes the proposed Coolinga Street/Giffnock Avenue roundabout.

5.2 G-turn scenario

In addition to assessing the proposed development with the existing road network, Parsons Brinckerhoff was requested by the New South Wales Roads and Traffic Authority (RTA) to model a G-turn scenario around the Lane Cove Road/Waterloo Road intersection. Figure 5.1 shows how G-turn was modelled were modelled.

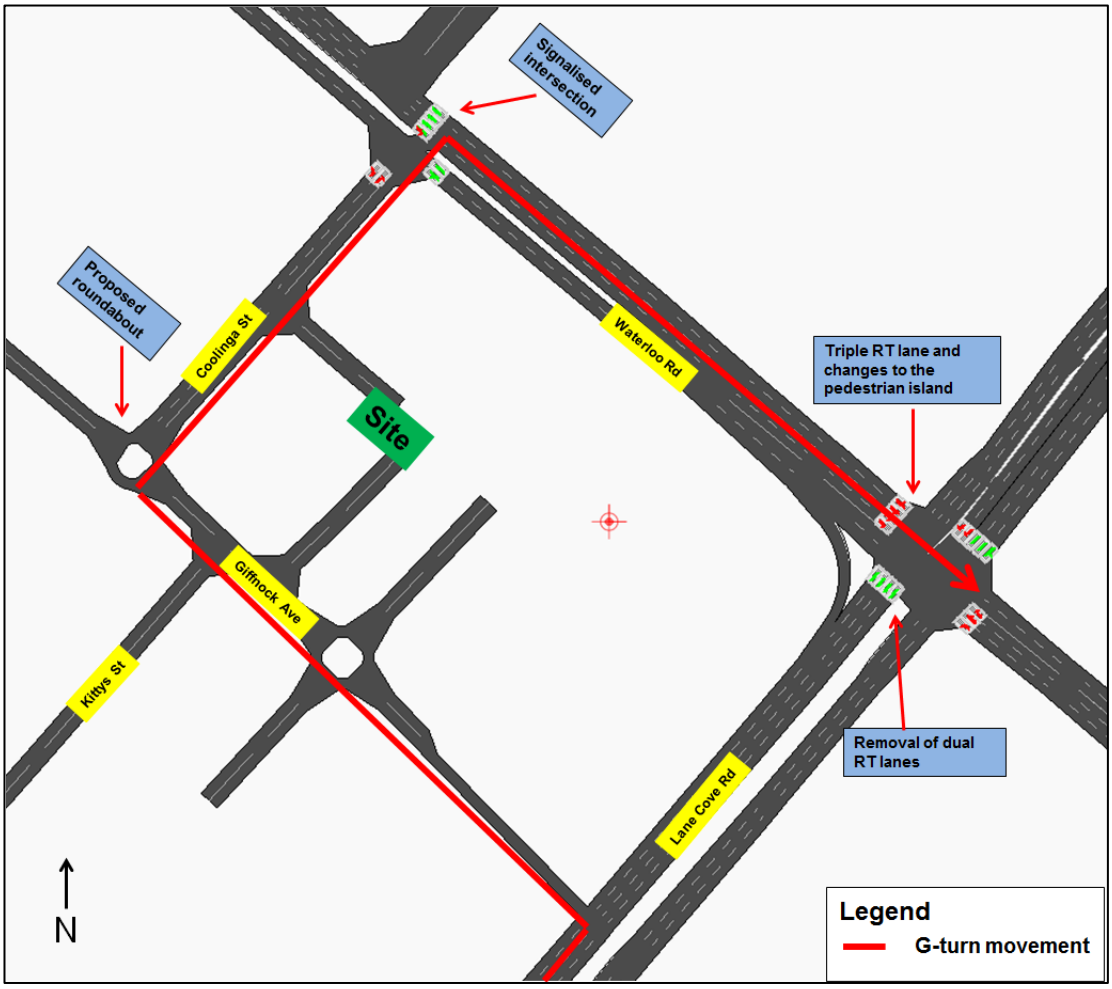


Figure 5.1 Proposed G-turn scenario

The basic components of the G-turn configuration include:

- removal of the dual right turn lane on the Lane Cove Road approach (northbound) at Waterloo Road/Lane Cove Road. All vehicles wishing to head east onto Waterloo Road from Lane Cove Road will be re-directed onto Giffnock Avenue and Coolinga Street
- installation of a triple right turn from Waterloo Road into Lane Cove Road (South)
- signalise the intersection of Waterloo Road/Giffnock Avenue to facilitate all movements at this intersection.

6. Impact assessment (Step 6)

The following section provides information on the outcomes of the options testing. All results have been collected using seed value of 5. The following information has been extracted from each model:

- intersection approach delay and LOS for 'In Scope' intersections
- network wide statistics (vehicle hours travelled, vehicle kilometres travelled etc…)
- unreleased vehicles

The following section provides a summary of the model results, further details are available in Appendix E.

6.1 AM peak model results

6.1.1 Intersection Level of Service

Intersection level of service was determined for each of the 'in-scope' intersections for each modelled scenario. Table 6.1 summarises the results. It shows that with the proposed development, there are some minor increases in delay. The Waterloo Road/Lane Cove Road intersection goes from LOS C in existing conditions to LOS D with the development. However; the implementation of the G-turn will improve this intersection back to LOS C.

The results show that the access arrangement to/from the proposed development will operate at LOS C or better with the development in place.

Delays at Epping Road/Lane Cove Road increase marginally with the development in place.

The results indicate that in the G-turn option the delay at intersections along Coolinga Street increase as a result of the diverted right turners; however they are still within the acceptable range.

Delays and LOS by approach and turning movement volumes are available in Appendix E.

Table 6.1 AM peak intersection performance

	Base		with Development		with Development & G-turn	
Intersection	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
Waterloo/Lane Cove	41	C	55	D	35	C
Lane Cove/Hyundai	10	A	9	A	7	A
Epping/Lane Cove	88	F	100	F	104	F
Epping/Lyon Park	11	A	14	A	14	A
Waterloo/Coolinga	6	A	7	A	15+	B
Coolinga/Car Park	6	A	14	A	30	C
Coolinga/Giffnock	12	A	14*	A	16*	B
Giffnock/Car Park	7	A	8	A	7	A
Giffnock/Kitty	8	A	15	B	13	A
Hyundai/Giffnock RB	11	A	35	C	7	A

N.B At priority controlled intersections; intersection delay/LOS is based on the average delay for the worst approach. Symbol the '+' indicates the Waterloo Road/Coolinga Street intersection is converted to a signalised intersection in the G-turn option. Symbol '*' indicates the Coolinga Street/Giffnock Avenue intersection is converted to a roundabout intersection in the 'with-development' and G-turn scenarios.

6.1.2 Global network statistics

Table 6.2 shows a summary of the global network operation for the AM peak in each modelled scenario. It shows that the proposed development has minimal impacts on total network operations with average travel times and kilometres travelled staying relatively consistent. Overall network travel times and kilometres travelled increase due to the additional vehicles in the network from the proposed development.

Table 6.2 AM peak global network statistics

AM peak global network statistics	07.45–08.45		
Parameter	**Base**	**Development**	**G-turn**
Number of vehicles	30,684	31,212	31,198
Vehicle Hours Travelled	3,962	4,026	4,022
Vehicle Kilometres Travelled	128,555	130,126	129,918
Total Number of Stops	149,342	157,354	155,596
Average minutes travelled per vehicle	7.7	7.7	7.7
Average kilometres travelled per vehicle	4.2	4.2	4.2
Average Number of Stops per vehicle	4.9	5.0	5.0

6.1.3 Unreleased vehicles

Table 6.3 shows a summary of the total unreleased vehicles in the network in each scenario. Unreleased vehicles are vehicles that cannot enter the model network due to prevailing congestion; the numbers in Table 6.3 represents the unreleased vehicles at the end of the model period. There are minor increases in unreleased vehicles with the proposed development.

Table 6.3 AM peak unreleased vehicles from All Zones

AM peak unreleased vehicles	07.45–08.45		
	Base	Development	G-turn
Total unreleased vehicles	167	203	218

During the AM [peak hour not all trips (55 trips) wishing to access new development (at zone 82) are able to do so within the peak hour. This is largely because of congestion in the wider network. In reality this is likely to lead to peak spreading, meaning that the proposed number of trips will arrive over a longer period, either side of the peak hour.

In addition, the 15 minute warm up period used in the model is insufficient for a network of this size and may also contribute to why not all trips can reach the development. Note that all trips reach the development during the model cool down period. Table 6.4 shows the number of vehicles unable to reach the proposed development zone in the AM peak hour.

Note that the warm up period was not extended by Parsons Brinckerhoff as this could have significant impact the model results.

Table 6.4 AM peak trips to/from development

Trips to/from the development site (veh/hr)					
		Trips which enter/exit the development in the AM peak hour		Trips which are not able to enter/exit the development in the AM peak hour	
	Forecast	With-development	G-turn	Diff (Forecast – with-development)	Diff (Forecast – G-turn)
Trips to the site	440	385	381	55	59
Trips from the site	110	110	110	0	0
Total	**550**	**495**	**491**	**55**	**59**

6.1.4 AM peak model results summary

The AM peak modelling results indicate the following:

- the access arrangements to/from the development are able to cater for development traffic
- the G-turn provides some improvements to the operation of the Waterloo Road/Lane Cove Road Intersection

- a small number of trips (55 trips) do not reach the development during the AM peak due to congestion in the wider network
- the global network statistics shows that the overall impact of the development is relatively minor.

6.2 PM peak model results

6.2.1 Intersection Level of Service

Table 6.5 shows the intersection level of service results for the PM peak. Delays and LOS remain relatively consistent with the proposed development. There is an increase in overall delay at the Epping Road/Lane Cove Road intersection; however that intersection is already at LOS F in the base model. With the G-turn in place, the Waterloo Road/Lane Cove Road Intersection goes from LOS E to LOS F, however; the overall delay at the intersection increases by 1 second, (however this happens to be on the threshold for LOS E/LOS F).

Table 6.5 PM peak intersection performance

	Base		with Development		with Development & G-turn	
Intersection	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
Waterloo/Lane Cove	68	E	70	E	71	F
Lane Cove/Hyundai	7	A	7	A	10	A
Epping/Lane Cove	97	F	109	F	120	F
Epping/Lyon Park	15	B	14	A	13	A
Waterloo/Coolinga	7	A	11	A	25+	B
Coolinga/Car Park	8	A	7	A	8	A
Coolinga/Giffnock	7	A	10*	A	18*	B
Giffnock/Car Park	9	A	7	A	7	A
Giffnock/Kitty	6	A	9	A	10	A
Hyundai/Giffnock RB	6	A	7	A	6	A

N.B At priority controlled intersections; intersection delay/LOS is based on the average delay for the worst approach. Symbol '+' indicates the Waterloo Road/Coolinga Street intersection is converted to a signalised intersection in the G-turn option. Symbol '*' indicates the Coolinga Street/Giffnock Avenue intersection is converted to a roundabout intersection in the 'with-development' and G-turn scenarios.

Delays and LOS by approach and turning movement volumes are available in Appendix E.

6.2.2 Global network statistics

Table 6.6 shows the global network statistics for the PM peak. It shows that the average travel time, and average number of vehicle stops increase marginally with the proposed development. These increase further with the G-turn in place.

Table 6.6 PM peak global network statistics

PM peak global network statistics	16.45–17.45		
Parameter	**Base**	**Development**	**G-turn**
Number of vehicles	32,121	32,644	32,501
Vehicle Hours Travelled	4,546	4,903	5,109
Vehicle Kilometres Travelled	132,475	134,558	133,727
Total Number of Stops	174,426	190,057	199,019
Average minutes travelled per vehicle	8.5	9.0	9.4
Average kilometres travelled per vehicle	4.1	4.1	4.1
Average Number of Stops per vehicle	5.4	5.8	6.1

6.2.3 Unreleased vehicles

Table 6.7 shows a summary of the total unreleased vehicles in the network in each scenario. With the development in place the number of unrealised vehicles drops marginally while the number of unreleased vehicles in the PM peak increases by more than 100 vehicles with the G-turn in place.

Table 6.7 PM peak unreleased vehicles

PM peak unreleased vehicles	16.45–17.45		
	Base	**Development**	**G-turn**
Total unreleased vehicles	764	738	881

In the PM peak some trips wishing to access the development are unable to do so during the PM peak hour, this is due to congestion in the wider network. Table 6.8 shows the number of vehicles unable to reach the proposed development zone in the PM peak hour.

Table 6.8 PM peak trips to/from development

Trips to/from the development site (veh/hr)					
		Trips which reach the development in the PM peak hour		Trips which are not able to enter/exit the development in the PM peak hour	
	Forecast	With-development	G-turn	Diff (Forecast – with-development)	Diff (Forecast – G-turn)
Trips to the site	110	85	89	25	21
Trips from the site	440	436	436	4	4
Total	**550**	**521**	**525**	**29**	**25**

6.2.4 PM peak model results summary

The PM peak modelling results indicate the following;

- in general the delays/congestion are greater in the PM peak compared with the AM peak
- the access arrangements to/from the development are able to cater for development traffic operating at LOS C or better
- a small number of trips (25 trips) do not reach the development during the PM peak due to congestion in the wider network
- the global network statistics shows that the overall impact of the development is relatively minor. The overall impact of the development in the PM peak is greater than in the AM peak, particularly for the G-turn option.

6.3 Screenline analysis

Parsons Brinckerhoff undertook a screenline analysis to help determine if there are wider rerouting affects caused by the introduction of the proposed development.

Two screenlines (A and B) were assessed as shown in Figure 6.1 below.

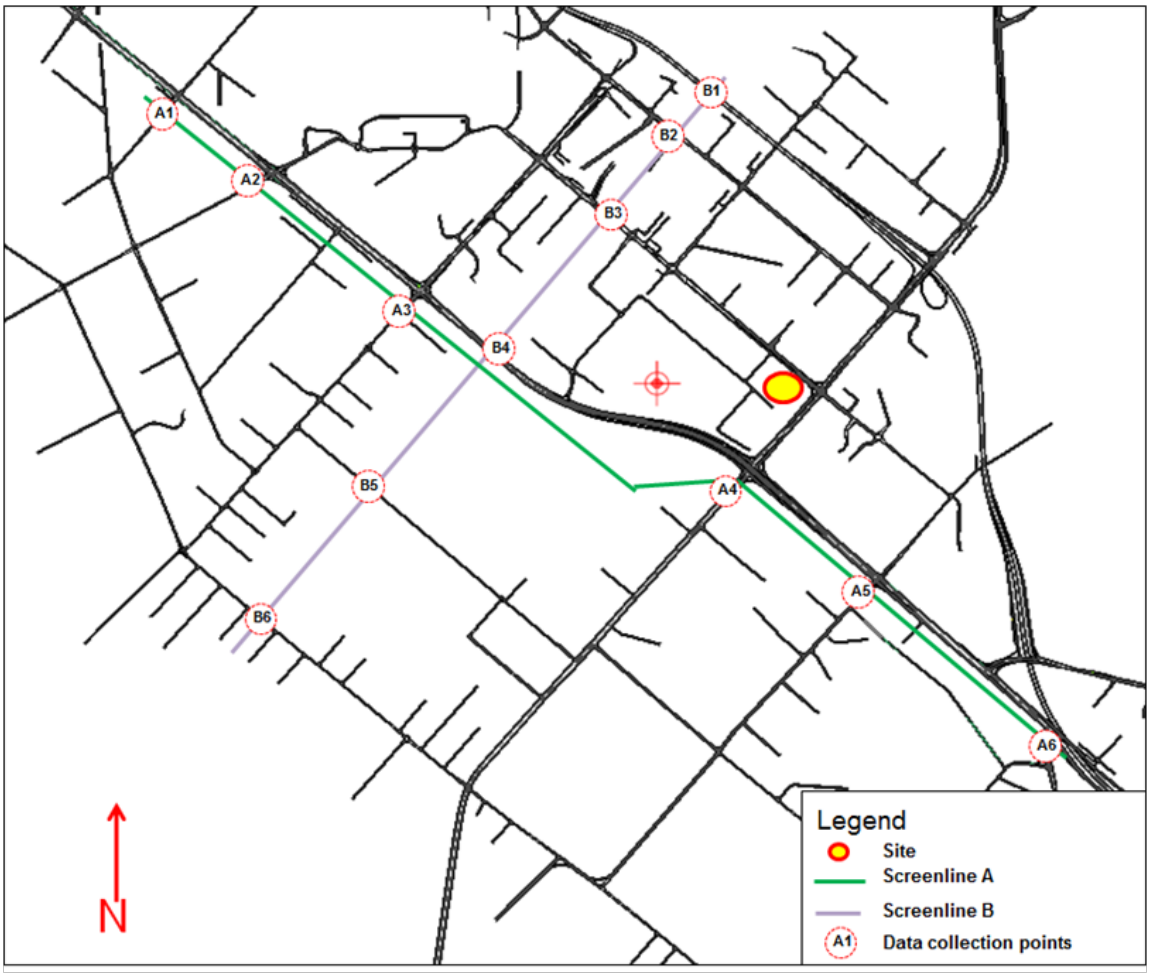


Figure 6.1 Screenline comparison

Screenline volumes in each direction across both screenlines (A & B) are presented in Tables 6.9 (AM peak) and 6.10 (PM peak).

Table 6.9 AM peak screenline results

Screenlines	Data collection points		Base	With-development	G-turn	Diff (With-development - Base)		Diff (G-turn - Base)	
						Absolute	Percenta	Absolute	Percenta
A	A1	Colluden Northbound	233	135	99	-98	-42%	-134	-58%
	A2	Balaclava Northbound	1187	1062	767	-125	-11%	-420	-35%
	A3	Herring Northbound	600	651	489	51	9%	-111	-19%
	A4	Lane Cove Northbound	2858	2851	2067	-7	0%	-791	-28%
	A5	Wicks Northbound	987	1003	765	16	2%	-222	-22%
	A6	Pittwater Northbound	1521	1451	1077	-70	-5%	-444	-29%
		Total	**7386**	**7153**	**5264**	**-233**	**-3%**	**-2122**	**-29%**
	A1	Colluden Southbound	264	104	72	-160	-61%	-192	-73%
	A2	Balaclava Southbound	309	370	263	61	20%	-46	-15%
	A3	Herring Southbound	190	230	190	40	21%	0	0%
	A4	Lane Cove Southbound	1678	1700	1284	22	1%	-394	-23%
	A5	Wicks Southbound	442	474	333	32	7%	-109	-25%
	A6	Pittwater Southbound	397	406	304	9	2%	-93	-23%
		Total	**3280**	**3284**	**2446**	**4**	**0%**	**-834**	**-25%**
B	B1	M2 Eastbound	2413	2418	1829	5	0%	-584	-24%
	B2	Talavera Eastbound	737	743	544	6	1%	-193	-26%
	B3	Waterloo Eastbound	1309	1358	1010	49	4%	-299	-23%
	B4	Epping Eastbound	2451	2662	1940	211	9%	-511	-21%
	B5	Kent Eastbound	453	462	312	9	2%	-141	-31%
	B6	Bridge Eastbound	274	301	223	27	10%	-51	-19%
		Total	**7637**	**7944**	**5858**	**307**	**4%**	**-1779**	**-23%**
	B1	M2 Westbound	1898	1905	1422	7	0%	-476	-25%
	B2	Talavera Westbound	805	835	604	30	4%	-201	-25%
	B3	Waterloo Westbound	516	539	373	23	4%	-143	-28%
	B4	Epping Westbound	2003	1916	1367	-87	-4%	-636	-32%
	B5	Kent Westbound	32	33	24	1	3%	-8	-25%
	B6	Bridge Westbound	183	172	117	-11	-6%	-66	-36%
		Total	**5437**	**5400**	**3907**	**-37**	**-1%**	**-1530**	**-28%**

The screenline analysis shows that the introduction of the new development does not significantly impact the wider network in the AM peak. However the results indicate that the introduction of the G-turn will significantly change travel patterns within the model and will lead to increased congestion in other parts of the network. The increased congestion reduces the number of trips crossing the screenline in the AM peak hour.

Table 6.10 PM peak screenline results

Screenlines		Data collection points	Base	With-development	G-turn	Diff (With-development - Base)		Diff (G-turn - Base)	
						Absolute	Percenta	Absolute	Percenta
A	A1	Colluden Northbound	50	53	63	3	6%	13	26%
	A2	Balaclava Northbound	567	581	581	14	2%	14	2%
	A3	Herring Northbound	351	292	288	-59	-17%	-63	-18%
	A4	Lane Cove Northbound	2118	2186	2171	68	3%	53	3%
	A5	Wicks Northbound	521	507	492	-14	-3%	-29	-6%
	A6	Pittwater Northbound	927	909	954	-18	-2%	27	3%
		Total	**4534**	**4528**	**4549**	**-6**	**0%**	**15**	**0%**
	A1	Colluden Southbound	49	43	38	-6	-12%	-11	-22%
	A2	Balaclava Southbound	938	940	924	2	0%	-14	-1%
	A3	Herring Southbound	696	663	663	-33	-5%	-33	-5%
	A4	Lane Cove Southbound	2475	2417	2400	-58	-2%	-75	-3%
	A5	Wicks Southbound	826	826	847	0	0%	21	3%
	A6	Pittwater Southbound	1133	1126	1106	-7	-1%	-27	-2%
		Total	**6117**	**6015**	**5978**	**-102**	**-2%**	**-139**	**-2%**
B	B1	M2 Eastbound	1686	1688	1700	2	0%	14	1%
	B2	Talavera Eastbound	1038	1122	1233	84	8%	195	19%
	B3	Waterloo Eastbound	860	843	635	-17	-2%	-225	-26%
	B4	Epping Eastbound	2052	1979	1988	-73	-4%	-64	-3%
	B5	Kent Eastbound	494	490	494	-4	-1%	0	0%
	B6	Bridge Eastbound	148	126	137	-22	-15%	-11	-7%
		Total	**6278**	**6248**	**6187**	**-30**	**0%**	**-91**	**-1%**
	B1	M2 Westbound	2349	2324	2336	-25	-1%	-13	-1%
	B2	Talavera Westbound	1100	1041	956	-59	-5%	-144	-13%
	B3	Waterloo Westbound	1200	1447	1485	247	21%	285	24%
	B4	Epping Westbound	2398	2380	2345	-18	-1%	-53	-2%
	B5	Kent Westbound	153	158	164	5	3%	11	7%
	B6	Bridge Westbound	403	437	439	34	8%	36	9%
		Total	**7603**	**7787**	**7725**	**184**	**2%**	**122**	**2%**

In the PM peak the introduction of the proposed development has a minimal impact to the wider road network, in terms of rerouting traffic.

In the PM peak the impact of the G-turn has a less pronounced impact on the wider network.

6.4 Impact of boom gate operations

As part of the Paramics modelling assessment, Parsons Brinkerhoff was requested to assess the traffic impacts of the boom gate arrangements at site access points. Figure 6.2 shows the proposed access layout and the location of the boom gates.

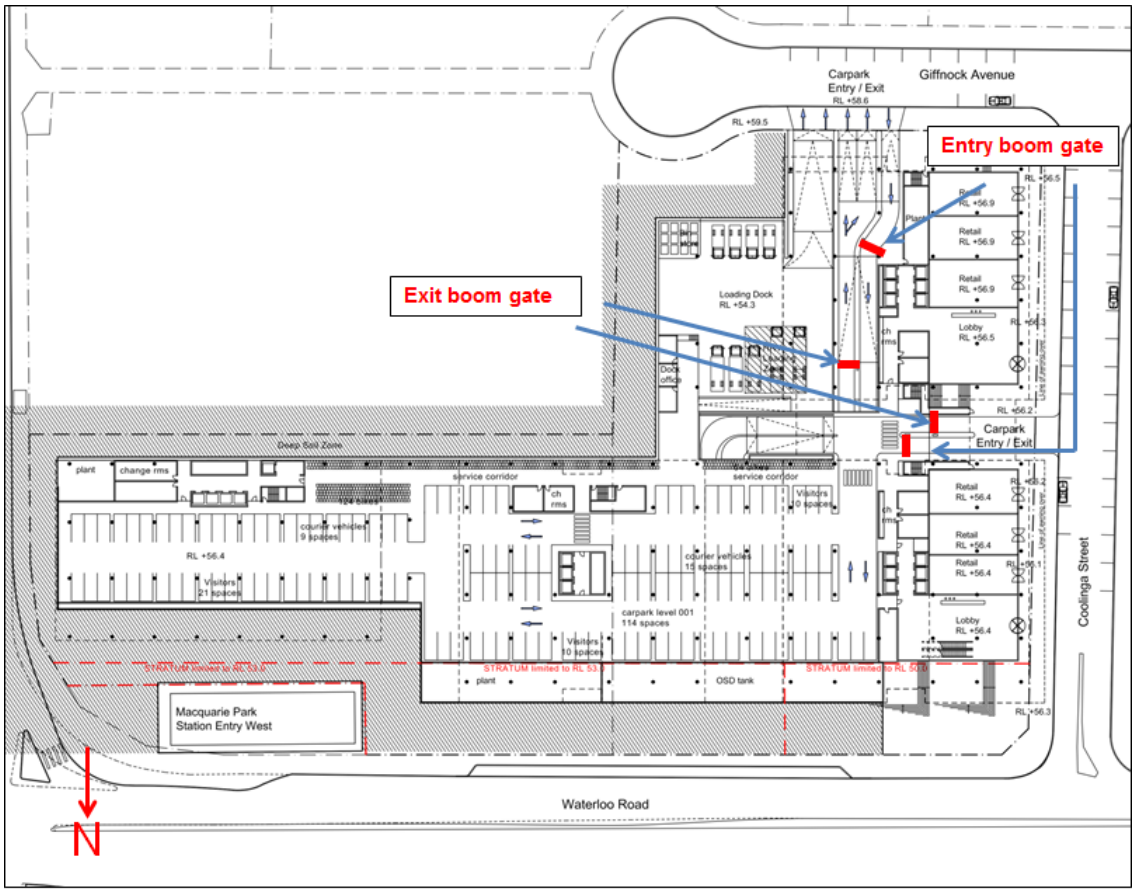


Figure 6.2 Access plans for proposed development

The boom gate arrangements were input into Paramics model by including a delay of 8 seconds for all vehicles entering/exiting the site to replicate boom gates operations. Eight seconds in considered a conservative approach as most users of the car park will be very familiar with the parking arrangements and are also likely to use a swipe pass which would speed up the boom gates operations considerably. Figure 6.3 shows the boom gate arrangements in the Paramics Model.

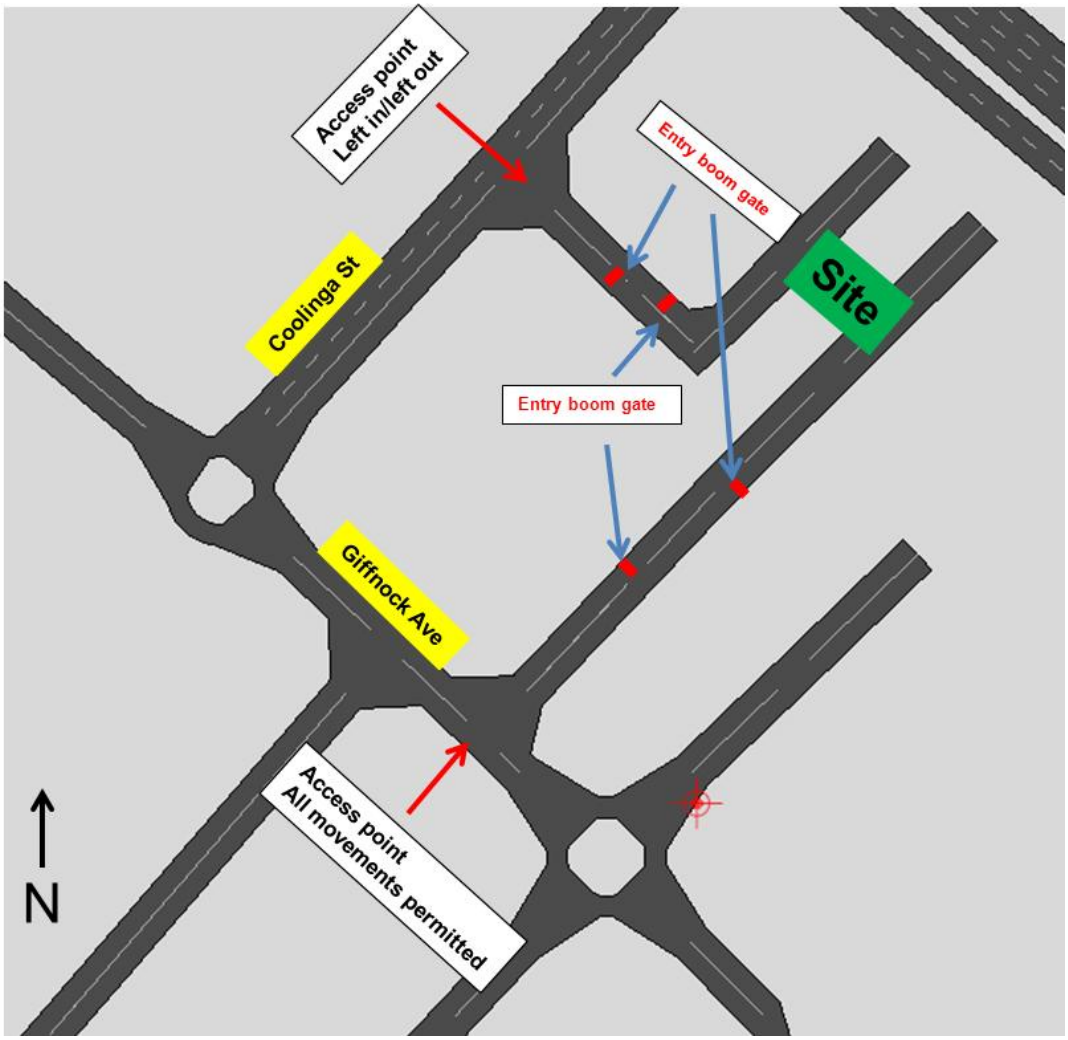


Figure 6.3 Boom gate access arrangements

The modelling results show that the access arrangements continue to operate satisfactorily with the boom gates in place.

In the AM peak queuing from the boom gates sporadically extends back from the boom gates to Giffnock Avenue, however this does not have a detrimental impact to the surrounding road network.

A model options with the boom gates in place will be supplied to CoR along with the other Paramics modelling files.

7. Summary and conclusions

7.1 Summary

Winten Property Group is currently planning to re-develop the existing site at 396 Lane Cove Road in Macquarie Park, located on the western corner of the Lane Cove Road/Waterloo Road intersection.

Colston, Budd, Hunt and Kafes (CBHK) are currently engaged by Winten to investigate the traffic related impacts of the proposed re-development. Parsons Brinckerhoff has been engaged to provide Paramics Microsimulation traffic modelling inputs into the traffic impact assessment process.

Parsons Brinckerhoff have undertaken the traffic modelling in accordance with City of Ryde's (CoR), traffic impact guidelines which outline the preferred use of their Paramics Models to assess new developments in Macquarie Park.

Parsons Brinckerhoff has undertaken the modelling assessment taking account of the following documents:

- *Traffic Impact Assessment Process for Macquarie Park Corridor Development Application (Reference document No. 1)*
- *Macquarie Park Corridor Paramics Model User Manual (Reference document No. 2).*

Parsons Brinckerhoff first identified the in-scope intersections to determine the modelling study area.

The models were then calibrated and validated for the in-scope area for both the AM and PM peak models.

The models were then updated to include the proposed infrastructure associated with the development. The models were then run with the proposed development in place. Two with-development scenarios were considered, with and without a G-turn road layout in place.

The modelling results show that the proposed access arrangements would be able to cater for the proposed development. However the modelling results also indicate that congestion in the wider network will prevent all development traffic being able to access the site within the peak hour.

The global network statistics indicate that the proposed development will have a minor impact to the network as a whole.

The G-turn helps to improve the operation of the Lane Cove Road/Waterloo Road Intersection in the AM peak, however could have result in significant rerouting and congestion in other parts of the network.

7.2 Conclusions

Parsons Brinckerhoff has adhered to CoR's modelling guidelines to determine the impacts of the proposed development at 396 Lane Cove Road.

The Paramics Modelling indicated that the access arrangements are able to cater for the development related traffic. However as some traffic is unable to reach the site due to congestion in other parts of the network, the satisfactory operation of the access arrangements has been confirmed by CBHK in the SIDRA analysis (as recommended in the CoR guidelines).

The additional trips will add some delays at key intersection in Macquarie Park with intersection LOS generally unchanged; however, the proposed access points to/from the development are proposed on roads which are currently operating significantly under capacity and are therefore able to cater for the proposed development traffic.

The modelling indicates that there may be some localised benefits from the introduction of the G-turn. The modelling also indicated that there will be significant rerouting and congestion in other parts of the network as a result of the G-turn. It is questionable as to whether the impacts of the G-turn would be so far reaching, or whether the traffic impacts are due to the way the models are set up with high level of route choice and dynamics assignment, in a congested network. The G-turn would provide some benefits to Waterloo Road/Lane Cove Road, which is one of the most critical intersections within Macquarie Park.

Appendix A

Project correspondence

RTA Ref: RDC 10M553 v2 SYD10/00243
Contact: Angela Malloch T 8849 2041
DoP Ref: MP09_0209

SRDAC

SYDNEY REGIONAL DEVELOPMENT ADVISORY COMMITTEE

Director
Metropolitan Projects
Department of Planning
GPO Box 39
SYDNEY NSW 2000

Attention: Shivesh Singh

EXHIBITION OF ENVIRONMENTAL ASSESSMENT AND CONCEPT PLAN FOR RETAIL AND COMMERCIAL DEVELOPMENT AT 396 LANE COVE ROAD, 32-46 WATERLOO ROAD AND 1 GIFFNOCK AVENUE, MACQUARIE PARK

Dear Sir/Madam

Reference is made to your correspondence dated 1 December 2010 concerning the abovementioned Major Project which was referred to the Roads and Traffic Authority (RTA) for comment in accordance with Clause 104 of State Environmental Planning Policy (Infrastructure) 2007. I wish to advise that the Sydney Regional Development Advisory Committee (SRDAC) considered the traffic impact of this application at its meeting on 16 December 2010.

The RTA does not support the proposed development for the following reasons:

1. The RTA is currently investigating a proposal to further improve bus network efficiency from Lane Cove Road across Waterloo Road. The attached plan is a strategic concept of the proposed works to lengthen the existing section of Northbound bus only lane on approach to Waterloo Road. This is to reduce the effect of left turning vehicles being interrupted by buses travelling in Bus Only lane.

   Therefore any proposed buildings or structures should be located clear of the land currently under investigation.

2. The traffic report uses Ryde Council 2007 Base Paramics Model which is outdated and no longer accurate. Ryde Council's updated 2010 Base Paramics model should have been used. Further an individual analysis (aaSIDRA) should have been undertaken of the intersections impacted by this development.

3. The traffic report needs to provide more detail on the calibration process of the Paramics model.

4. The Paramics modelling results show a minimal increase in delays on the signalised intersection of Lane Cove Road (average 4 seconds) and Lane Cove Road/Epping Road intersection (average 7 seconds) these figures are not supported considering the development will generate at least an additional 675 vehicles in the peak hour. This intersection currently operates at a level of service F, this large scale development has potential to cause gridlock.

5. The applicant is required to use Ryde Council's 2010 Base Paramics model and update it accordingly for the RTA to review. The traffic report is required to be amended and shall include aaSIDRA modelling on the surrounding impacted intersections.

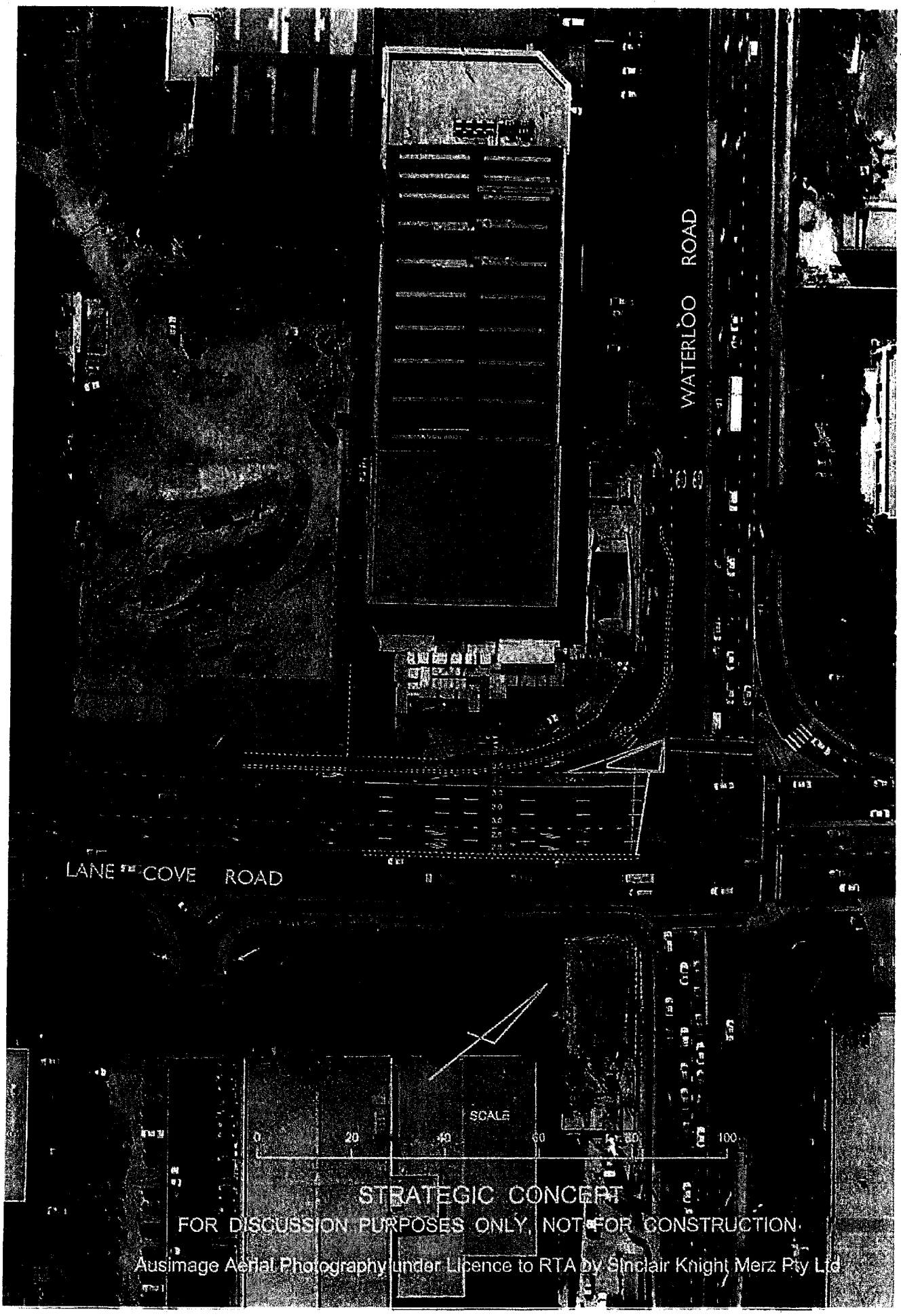
   The RTA requires the applicant to model a G-turn scenario around the intersection of Lane Cove Road/Waterloo Road, this has the potential to reduce delay and improve traffic efficiency. A G-turn area treatment will require the following upgrades to be executed concurrently:

   - Removal of the dual right turn on Lane Cove Road into Waterloo Road on the ~~northern~~ southern approach to Lane Cove Road.
   - All vehicles wishing to head east onto Waterloo Road from Lane Cove Road will be re-directed onto Giffnock Avenue and Coolinga Street.
   - Changes to the intersection of Giffnock Avenue and Coolinga Street are required to give priority to the new flow arrangement (G-turn). This will require the removal of some parking on Giffnock Avenue to improve sight distance, traffic flow and accessibility.
   - Traffic control signals are required at the intersection of Coolinga Street and Waterloo Road to facilitate all movements at this intersection.
   - Pedestrian crossings at the intersection of Coolinga Street and Waterloo Road are required on the western and southern side of the intersection.
   - Installation of a triple right turn from Waterloo Road into Lane Cove Road (South). This change will require adjustments to the signal stop lines on Lane Cove Road southern approach.
   - The lane configuration for the western approach to the intersection of Waterloo Road and Lane Cove Road shall be:
     - Lane 1 shared left turn and through lane
     - Lane 2 shared through and right turn lane
     - Lane 3 exclusive right
     - Lane 4 exclusive right
   - For the abovementioned configuration the shared left turn and through lane will require changes to the pedestrian island on the north western corner of the intersection, and changes to the angle of the northern pedestrian crossing.

6. The traffic report states that the proposed traffic generation rates for the development would be lower due to the site's close proximity to good public transport. The RTA would support a reduction in parking on-site.

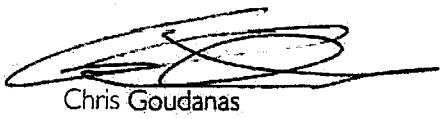
7. All works associated with the proposed development shall be at no cost to the RTA.

31.1


WATERLOO ROAD
LANE COVE ROAD
SCALE
0
20
40
60
80
100
STRATEGIC CONCEPT
FOR DISCUSSION PURPOSES ONLY, NOT FOR CONSTRUCTION
Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd

Should you require any further clarification in relation to this matter, please call the contact officer named at the top of this letter.

Yours faithfully



Chris Goudanas
Chairman, Sydney Regional Development Advisory Committee

21 December 2010

Issue History

File Name	Prepared by	Reviewed by	Issued by	Date	Issued to
P0415.01 Responses to PB Questions Raised for MPPM	D. Bitzios	A. Finlay	D.Bitzios	31 May 2011	hmuker@ryde.nsw.gov.au
P0415.02 Responses to PB Questions Raised for MPPM	D. Bitzios	A. Finlay	D.Bitzios	6 June 2011	hmuker@ryde.nsw.gov.au

1. BACKGROUND

PB sent a memo to Harry Muker from Ryde City Council on the 30th May 2011 seeking clarification of details within the MPPM Reference Documents and specifically seeking guidance on how to apply various methodologies in the documents.

This technical note responds to the questions raised.

2. RESPONSES TO QUESTIONS RAISED

1. The Macquarie Park Paramics Models (MPPMs) were created and validated in V6.4.1. Therefore, this is the version that should be used for testing any changes to the models.
2. The models' trip matrices were estimated and the models were subsequently validated based on year 2008 data. The validation outputs are contained in the traffic report on Council's web site and validation outputs are in Appendix C (see: http://www.ryde.nsw.gov.au/WEB/SITE/RESOURCES/DOCUMENTS/Planning/MacquarieCorridor/MacquarieParkTraffic_AppendixC.pdf). As this data is now three years old, additional surveys will be required in the area of influence of the development based on its size and location.
3. We understand the sensitive nature of "near capacity" simulation models when impacted by a large increase in traffic, such as would be the case with this development. We would prefer that the model is initially run, as suggested in the documentation, to determine the field of influence of the development. Whilst the area of influence of the development may be quite sparse, upgrades to the network closer to the development may then return the performance of these remote areas back to their "without development" conditions, thus mitigating the development's impacts. Should this process not produce intuitively reasonable results, then the alternative process suggested of using the start-up route choice and manual assignment could be considered.
4. When interpreting item 3 above and considering local re-estimation needs, re-estimation should only be undertaken for those intersections that, through manual calculation processes, would be expected to trigger the 10% threshold.
5. We understand the idea of using all of the previous counts, plus new counts near the development site to undertake matrix estimation. However, the matrix and assigned volumes already compare quite well to year 2008 data. The localised estimation is expected to be run over relatively few iterations of estimator as the matrix changes to achieve local validation are expected to be quite minor and quite localised, rather than resulting in major shifts in the matrix. Also, the MPPMs will be periodically re-estimated by Ryde City Council (as is currently being completed) to "smooth out" any minor influences made by matrix estimation near specific sites.
6. Local validation of the model is best achieved through (in priority order):
   - Modifications to signal timings (within reasonable bounds)
   - Modifications to matrix cells (within reasonable bounds)
   - Turn penalties (within reasonable bounds and clearly documented)
7. The models have been validated to one seed value. Users are free to use multiple seed values if desired as long as one of these values equals 5 and these results are reported separately.

8. The intention of the 40% discount to be applied to traffic generation is that there will be measures put in place to encourage greater public and active transport usage for access to the site. This could be demonstrated by:
    - The number of parking spaces proposed on site to reflect that a maximum of 60% of employees will arrive by car or be dropped off.
    - The public transport and active transport measures provided by the development, including what commitments will be made to creating and sustaining workplace travel plans.
9. The assessment process is to use the base year model only. The modelling has identified that almost all traffic growth expected in Macquarie Park is due to development in the area, progressively "pushing out" through traffic. That is, there is no need for future year modelling. The impact assessment modelling using the base year models should, however, select upgrade projects (or incremental stages of projects) from the Macquarie Park Traffic Study when mitigating development impacts. The purpose of this is to identify what works the development should fund or contribute towards that will return the network to the "without development" condition. That is, this work establishes the nexus between the impacts caused by development traffic and the upgrade required to be paid for (consistent with the Macquarie Park Traffic Study)
10. Use of the Ceejazz Plugin is acceptable for results extraction.

Appendix B

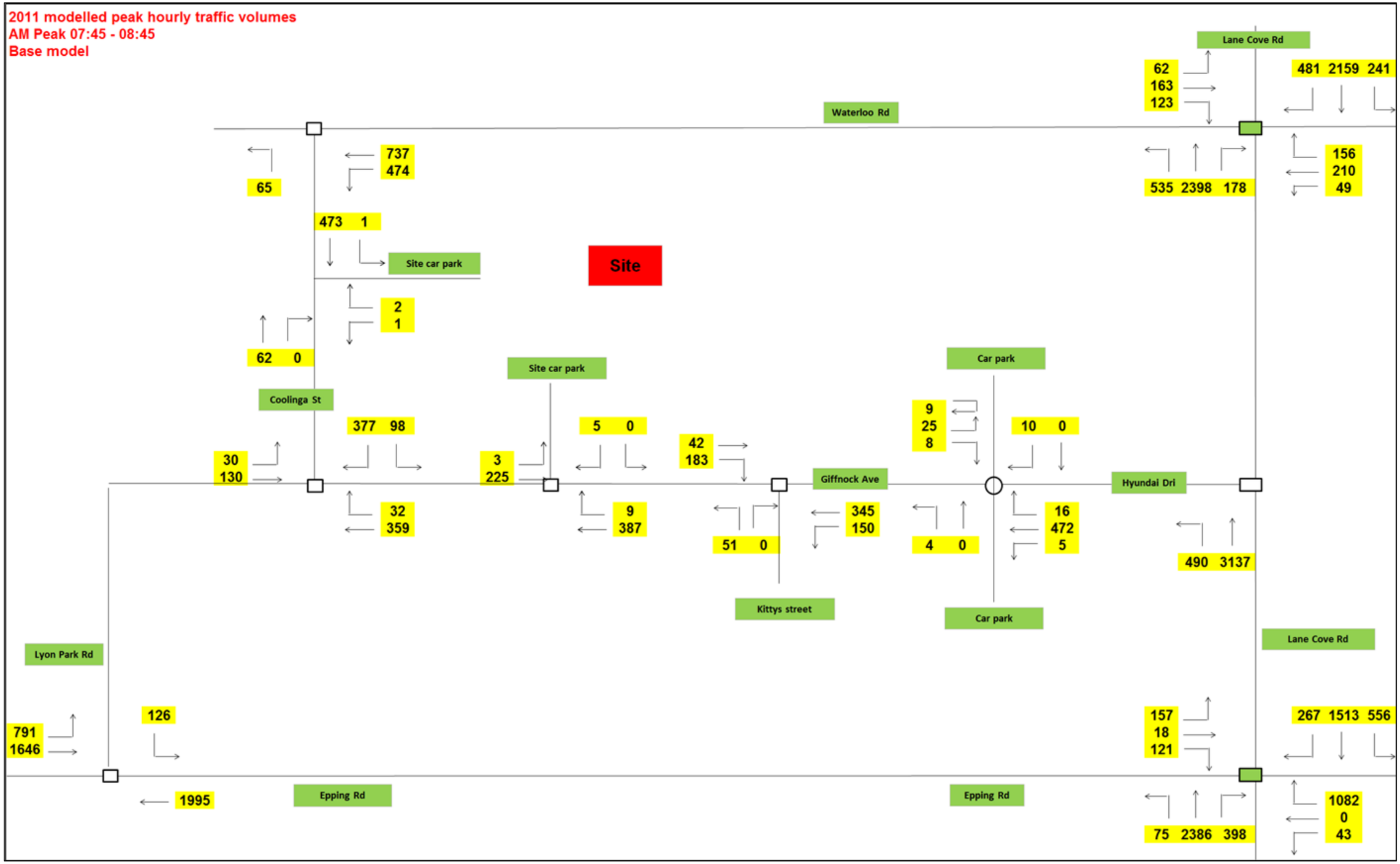
B1- Traffic distribution

B2- Intersection turning movement volumes for existing conditions

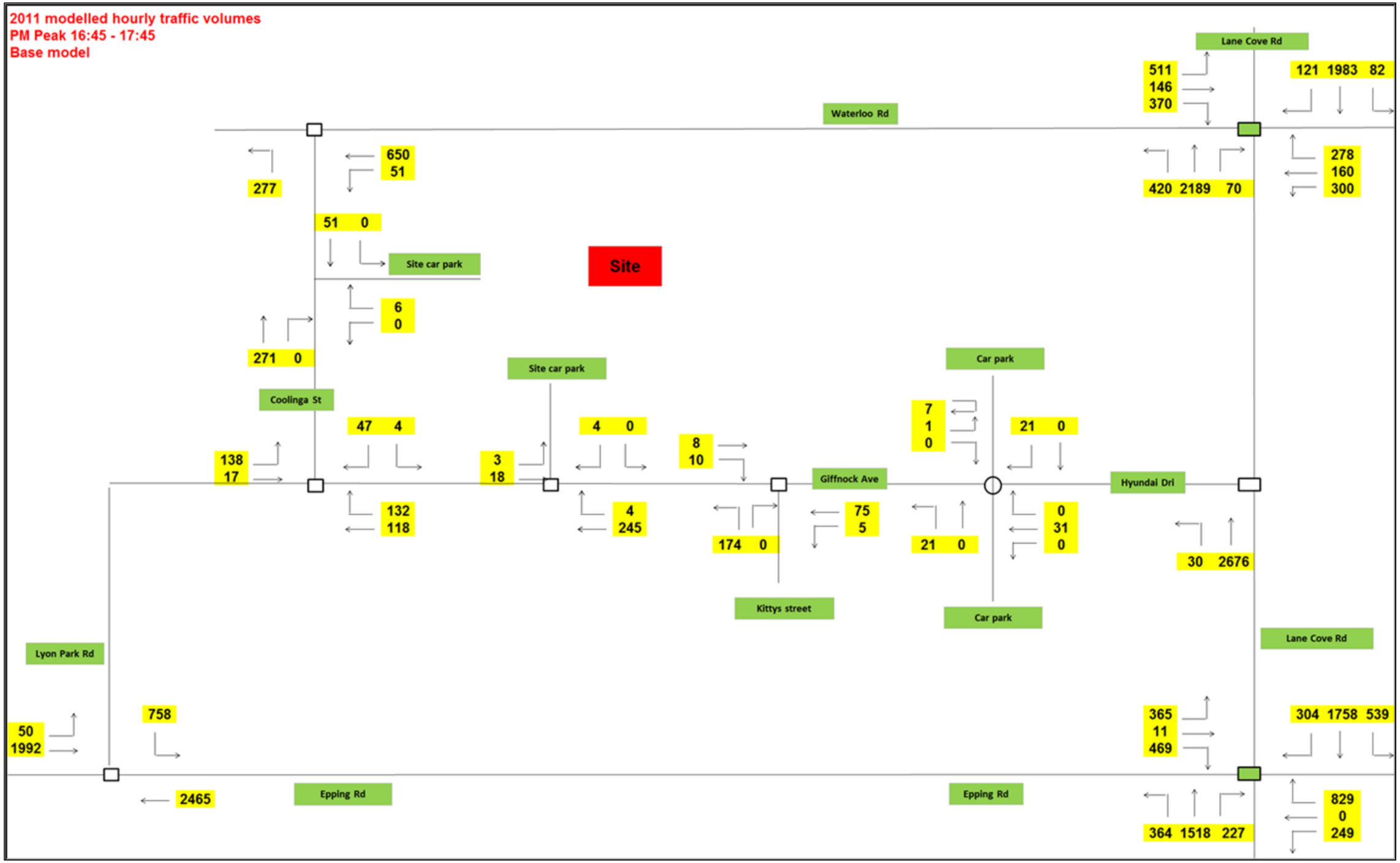
Appendix B1: Traffic distribution to and from the development for AM and PM peaks

lintial traffic distribution					Updated traffic distribution				
Time period	AM peak		PM peak		Time period	AM peak		PM peak	
Zone	From development to zone	To development from zone	From development to zone	To development from zone	Zone	From development to zone	To development from zone	From development to zone	To development from zone
1		2	2		1		1		
2		2	2		2		1		
3		12	3		3		9	3	
4	2	17	9	3	4		15	9	4
5	2	2		1	5		1		
6	17			9	6	13			5
13	2			9	13	2			8
14	2			4	14	2			4
19	22	24	3	9	19	17	22		8
20	7	2	2	5	20	7	1		4
21		2	2		21		1		
23	3	14	6	3	23	2	13	5	4
24	3	10	6	6	24	2	9	5	1
25		4	2		25		3		
26		2	2		26		1		
27	2	2	2	3	27	2	1		4
28			2		28		1		
29	2	2	5	4	29	2	9	5	4
30	2	12	11	4	30	2	8	8	4
31	2	10	2	1	31	2	1		
32	2	2		4	32	2			4
33	2			5	33	2			
34	2			3	34	2			4
36	2			3	36	2			4
38		2	2		38		1		
39		2			39		1		
40		13	2		40		9		
41		2	2		41		1	3	
42		2	2		42		1	3	
43		14	3		43		14	3	
44		4	5		44		3	5	
45	2	4	6		45	2	3	5	
46	4	35	39	3	46	2	18	33	
47		10	5		47		8	5	
48	2	18	12	3	48	2	15	11	4
49	2	28	24	7	49	2	25	22	8
51	2	24	33		51	2	21	30	8
52		10	8	8	52		8	5	
53		4	5		53		3	5	
54		4	3		54		3	3	
55		2	3		55		1	3	
56		2	3		56		1	3	
57		32	35		57		49	30	
58		2	2		58		1		
59		6	2		59		5	3	
60		12	18		60		9	16	
61		6	8		61		5	3	
62		8	23		62		7	19	
63		2	5		63		1	5	
64		69	62		64		58	51	
65		32	36		65		17	30	
66		2	5		66		1	5	
67		12	12		67		9	11	
68	7	14	25	12	68	7	13	22	12
69	11	4	8	8	69	10	3	5	8
70	6	10	6	5	70	7	8	5	
72	15	4	15	3	72	11	3	13	4
74	4	2	11	4	74	2	1	8	4
75		4	5		75		3	5	
76			5					5	
77		10	6		77		8	5	
78	4	4	11	6	78	2	3	8	
79		2	8		79		1	5	
80		2	14		80		1	12	
Total	**135**	**540**	**540**	**135**	83		1		
					Total	**110**	**440**	**440**	**110**

Appendix B2: Intersection turning movement volumes for existing conditions



2011 modelled hourly traffic volumes
PM Peak 16:45 - 17:45
Base model



Appendix C

Model update register

C1-Zones and Demands

C2- Hazards

C3- Next lanes/Lane choices

C4- Links and Nodes

C5- Priorities

C6- Route rules

Appendix C1: Demands

Zones file

Zone	Reasons for changes from default
73	Zone shapes adjusted to reflect actual coverage area
81	A new zone created to represent car park
82	A new zone created to represent car park of the site
83	A new zone created to represent car park

Note: the changes of zones file have been applied in AM and PM base models.

Demands file

Peak period	Zone	Reasons for changes from default
AM peak	6	Vehicle trips to the zones adjusted to match surveyed traffic flows
	19	
	68	
	69	
	71	
	72	
	73	Vehicle trips to/from the zones adjusted to match surveyed traffic flows
	81	
	82	
	83	
PM peak	19	Vehicle trips to the zones adjusted to match surveyed traffic flows
	23	
	46	
	70	
	71	
	78	
	73	Vehicle trips to/from the zones adjusted to match surveyed traffic flows
	81	
	82	
	83	

Appendix C2: Hazards

Hazards file

Link	Reasons for changes from default
738:716	Link signposting distance adjusted to reflect observed traffic conditions
1007:727	

Note: the changes of hazards file have been applied in AM and PM base models.

Restrictions file

Link	Reasons for changes from default
729:1458	‘Heavy vehicles restriction’ applied to reflect observed traffic operation

Note: the changes of restrictions file have been applied in AM and PM base models.

Appendix C3: Next lanes/lane choices

Next lanes file

Start link	End link	Reasons for changes from default
736:737	737:738	Next lane coding adjusted to reflect observed traffic operations.
1025:1023	1023:1019	
1368:1309	1309:1025	
1375:1373	1373:1370	
1548:1432	1432:492	

Note: the changes of next lanes file have been applied in AM and PM base models.

RTA lane choice plugin

Link	Reasons for applying RTA lane choice plugin
991:992	Lane choice plugin applied to better replicate lane choice decisions
992:993	
994:1007	
1007:727	
727:729	
729:731	
737:738	
738:716	
767:768	
768:765	

Note: RTA lane choice plugin have been applied in AM and PM base models.

Appendix C4: Links

Links file

Link	Reasons for changes from default
978:1007	An additional lane added to reflect existing lane configuration. This new lane was coded as generic lane to reflect observed traffic operation from site inspection, despite that it is marked as bus lane on the road.
1007:727	
727:729	
729:731	
731:716	An additional lane added to reflect existing lane configuration. This new lane was coded as bus lane to reflect observed traffic operation.
716:734	An additional lane added to reflect existing lane configuration.
729:1458	A new link added to reflect existing road network
1458:707b	A new link added to reflect existing road network
1567:1565	New links added to represent access point to car park
1565:707c	
1566:1564	New links added to represent access point to car park
1564:707a	
1563:1559	New links added to represent access point to car park of the site
1559:1560	
1562:1561	New links added to represent access point to car park of the site
1561:446	
972:694	Link coding corrected in the **PM model** to reflect existing lane configuration

Note: the changes of links file have been applied in AM and PM base models, unless otherwise stated.

Link cost factors in links file

Peak period	Link	Reasons for changes from default
AM peak	729:1458	Link cost factors adjusted to help replicate the existing road hierarchy/route choice behaviour
	986:1007	
	727:1007	
	1007:994	
	1559:1563	
	425:444	
	444:446	
	446:444	
PM peak	729:1458	Link cost factors adjusted to help replicate the existing road hierarchy/route choice behaviour
	986:1007	
	727:1007	
	1007:994	
	1559:1563	
	707a:707b	

Nodes file

Node	Reasons for changes from default
707	Converted this node into a roundabout to reflect existing road network

Note: the changes of nodes file have been applied in AM and PM base models.

Junctions file

Link	Reasons for changes from default
1555:708	Lane configuration adjusted to reflect existing lane configuration

Note: the changes of junctions file have been applied in AM and PM base models.

Appendix C5: Priorities

Priorities file

Peak period	Node	Reasons for changes from default
AM peak	994	Signal phase timing adjusted to help match the modelled movement flows with surveyed traffic flows
	716	
	765	
	708	
	798	
	548	
	687	
PM peak	574	Signal phase timing adjusted to help match the modelled movement flows with surveyed traffic flows
	708	
	716	
	994	
	765	
	1315	
	635	

Appendix C6: Route rules

Route rules file

Peak period	Start link	End link	Reasons for changes from default
AM peak	18c:18d	729:1458	Paramics route choices applied to better reflect the realistic routes selected by drivers
	795:665	729:1458	
	494:574	1432:492	
	501:500	1432:492	
	500:502	1070:1076	
	18q:487	1070:1076	
	987:994	994:988	
	1459:363	397:402	
	501:500	500:1548	
	409:19q	19o:397	
PM peak	1081:1080	574:1432	Paramics route choices applied to better reflect the realistic routes selected by drivers
	768:767	767:981	
	992:993	993:994	
	974:975	975:976	
	729:731	731:716	
	501:500	500:1548	
	987:994	994:988	
	711:709	709:710	
	790:708	708:1032	
	711:709	709:710	
	790:708	708:1032	

Appendix D

Model validation

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		07:45-08:45				16:45-17:45			
Intersection	Movement	Observed	Modelled	Diff	GEH	Observed	Modelled	Diff	GEH
Waterloo Rd/Lane Cove Rd	Lane Cove NB LT	485	535	50	2.2	370	420	50	2.5
	Lane Cove NB Through	2215	2398	183	3.8	1824	2189	365	8.1
	Lane Cove NB RT	232	178	-54	3.8	16	70	54	8.2
	Waterloo EB LT	102	62	-40	4.4	610	511	-99	4.2
	Waterloo EB Through	300	163	-137	9.0	139	146	7	0.6
	Waterloo EB RT	176	123	-53	4.3	435	370	-65	3.2
	Lane Cove SB LT	331	241	-90	5.3	80	82	2	0.2
	Lane Cove SB Through	2100	2159	59	1.3	2019	1983	-36	0.8
	Lane Cove SB RT	495	481	-14	0.6	140	121	-19	1.7
	Waterloo WB LT	13	49	36	6.5	165	300	135	8.9
	Waterloo WB Through	170	210	40	2.9	125	160	35	2.9
	Waterloo WB RT	160	156	-4	0.3	384	278	-106	5.8
Lane Cove Rd/Hyundai Dr	Lane Cove NB LT	507	490	-17	0.8	70	30	-40	5.7
	Lane Cove NB Through	2930	3137	207	3.8	2205	2676	471	9.5
Epping Rd/Lane Cove Rd	Lane Cove NB LT	38	75	37	4.9	291	364	73	4.0
	Lane Cove NB Through	2260	2386	126	2.6	1189	1518	329	8.9
	Lane Cove NB RT	296	398	102	5.5	165	227	62	4.4
	Epping EB LT	247	157	-90	6.3	417	365	-52	2.6
	Epping EB Through	53	18	-35	5.9	28	11	-17	3.8
	Epping EB RT	79	121	42	4.2	293	469	176	9.0
	Lane Cove SB LT	516	556	40	1.7	594	539	-55	2.3
	Lane Cove SB Through	1609	1513	-96	2.4	1770	1758	-12	0.3
	Lane Cove SB RT	156	267	111	7.6	249	304	55	3.3
	Epping WB LT	127	43	-84	9.1	300	249	-51	3.1
	Epping WB Through	13	0	-13	5.1	10	0	-10	4.5
	Epping WB RT	930	1082	152	4.8	669	829	160	5.8
Epping Rd/Lyon Park Rd	Epping EB LT	796	791	-5	0.2	94	50	-44	5.2
	Epping EB Through	1698	1646	-52	1.3	1894	1992	98	2.2
	Lyon Park SB LT	136	126	-10	0.9	632	758	126	4.8
	Epping WB Through	1774	1995	221	5.1	2411	2465	54	1.1
Waterloo Rd/Coolinga St	Coolinga NB LT	52	65	13	1.7	327	277	-50	2.9
	Wateloo WB LT	423	474	51	2.4	63	51	-12	1.6
	Wateloo WB Through	716	737	21	0.8	560	650	90	3.7
Coolinga St/Giffnock Ave	Giffnock EB LT	20	30	10	2.0	142	138	-4	0.3
	Giffnock EB Through	140	130	-10	0.9	18	17	-1	0.2
	Collinga SB LT	86	98	12	1.3	10	4	-6	2.3
	Collinga SB RT	332	377	45	2.4	51	47	-4	0.6
	Giffnock WB Through	325	359	34	1.8	88	118	30	3.0
	Giffnock WB RT	33	32	-1	0.2	180	132	-48	3.8
Coollinga St/Car Park	Coolinga NB Through	52	62	10	1.3	321	271	-50	2.9
	Coolinga NB RT	0	0	0	0.0	1	0	-1	1.4
	Coolinga SB LT	7	1	-6	3.0	2	0	-2	2.0
	Coolinga SB Through	416	473	57	2.7	61	51	-10	1.3
	Car Park LT	2	1	-1	0.8	2	0	-2	2.0
	Car Park RT	4	2	-2	1.2	5	6	1	0.4
Giffnock Ave/Car park	Giffnock EB LT	3	3	0	0.0	1	3	2	1.4
	Giffnocl EB Through	223	225	2	0.1	27	18	-9	1.9
	Car Park SB LT	0	0	0	0.0	0	0	0	0.0
	Car Park SB RT	2	5	3	1.6	3	4	1	0.5
	Giffnock WB Through	356	387	31	1.6	268	245	-23	1.4
	Giffnock WB RT	3	9	6	2.4	1	4	3	1.9
Giffnock Ave/Kittys St	Kittys NB LT	55	51	-4	0.5	163	174	11	0.8
	Kittys NB RT	0	0	0	0.0	0	0	0	0.0
	Giffnock EB Through	40	42	2	0.3	3	8	5	2.1
	Giffnock EB RT	183	183	0	0.0	24	10	-14	3.4
	Giffnock WB LT	187	150	-37	2.9	3	5	2	1.0
	Giffnock WB Through	304	345	41	2.3	105	75	-30	3.2
Giffnock Ave/Hyundai Drive	Car Park S to Giffnock Ave W	2	4	2	1.2	15	21	6	1.4
	Car Park S to Car Park N	0	0	0	0.0	0	0	0	0.0
	Giffnock W to Car Park N	35	25	-10	1.8	1	1	0	0.0
	Giffnock W to Car Park S	0	8	8	4.0	0	0	0	0.0
	Giffnock W to Giffnock W	5	9	4	1.5	2	7	5	2.4
	Car Park N to Car Park S	0	0	0	0.0	0	0	0	0.0
	Car Park N to Giffnock Ave W	11	10	-1	0.3	24	21	-3	0.6
	Giffnock E to Car Park S	17	5	-12	3.6	2	0	-2	2.0
	Giffnock E to Giffnock W	478	472	-6	0.3	65	31	-34	4.9
	Giffnock E to Car Park N	12	16	4	1.1	1	0	-1	1.4

Appendix E

Model results

E1-Existing intersection performance

E2 – Intersection performance for the ‘with development’ and G-turn scenarios

E3- Intersection turning movement volumes

Appendix E1: Existing intersection performance

Intersection	Approach	AM peak		PM peak	
		Delay	LOS	Delay	LOS
Waterloo/Lane Cove	South	31	C	20	B
	West	55	D	54	D
	North	42	C	119	F
	East	105	F	112	F
Lane Cove/Hyundai	South	10	A	7	A
Epping/Lane Cove	South	98	F	64	E
	West	55	D	102	F
	North	32	C	104	F
	East	189	F	135	F
Epping/Lyon Park	West	11	A	15	B
	South	0	A	0	A
Waterloo/Coolinga	South	6	A	7	A
	East	4	A	3	A
Coolinga/Car Park	South	2	A	3	A
	North	2	A	1	A
	East	6	A	8	A
Coolinga/Giffnock	West	12	A	7	A
	North	1	A	0	A
	East	7	A	6	A
Giffnock/Car Park	West	4	A	4	A
	North	7	A	9	A
	East	3	A	4	A
Giffnock/Kittys	South	7	A	6	A
	West	8	A	4	A
	East	1	A	0	A
Hyundai/Giffnock	South	11	A	6	A
	West	6	A	5	A
	North	5	A	6	A
	East	6	A	5	A

Appendix E2: Intersection performance for the 'with-development' and G-turn scenarios

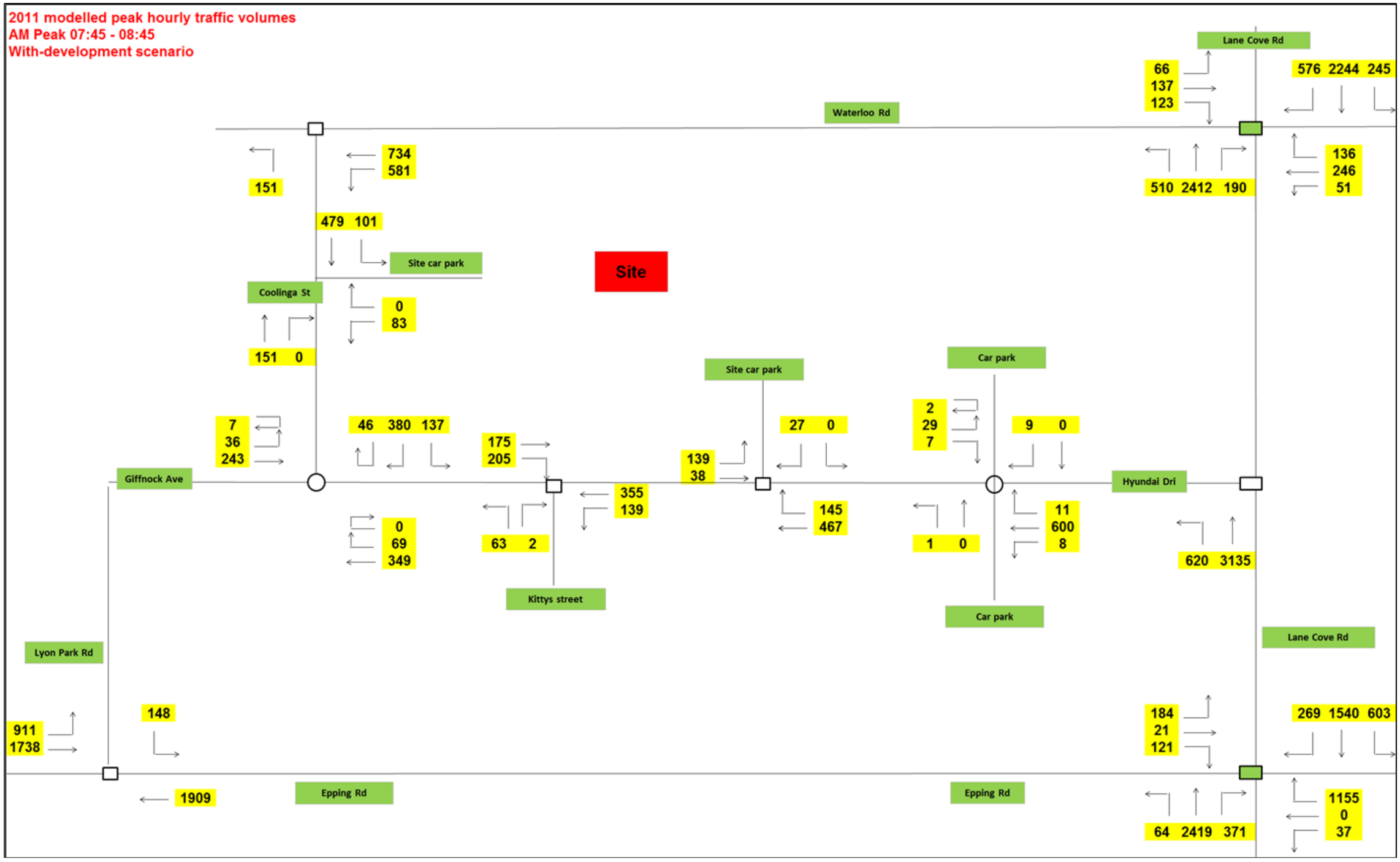
Intersection performance for AM peak

Intersection	Approach	With-development		G-turn	
		Delay	LOS	Delay	LOS
Waterloo/Lane Cove	South	29	C	25	B
	West	67	E	70	E
	North	69	E	24	B
	East	132	F	145	F
Lane Cove/Hyundai	South	9	A	7	A
Epping/Lane Cove	South	119	F	129	F
	West	76	F	45	D
	North	31	C	36	C
	East	199	F	211	F
Epping/Lyon Park	West	14	A	14	A
	South	0	A	0	A
Waterloo/Coolinga	South	7	A	49	D
	West			13	A
	East	5	A	11	A
Coolinga/Car Park	South	1	A	3	A
	North	5	A	6	A
	East	14	A	30	C
Coolinga/Giffnock	West	8	A	8	A
	North	14	A	16	B
	East	12	A	12	A
Giffnock/Car Park	West	1	A	1	A
	North	8	A	7	A
	East	4	A	3	A
Giffnock/Kittys	South	15	B	13	A
	West	7	A	8	A
	East	3	A	3	A
Hyundai/Giffnock	South	35	C	6	A
	West	7	A	6	A
	North	7	A	7	A
	East	8	A	7	A

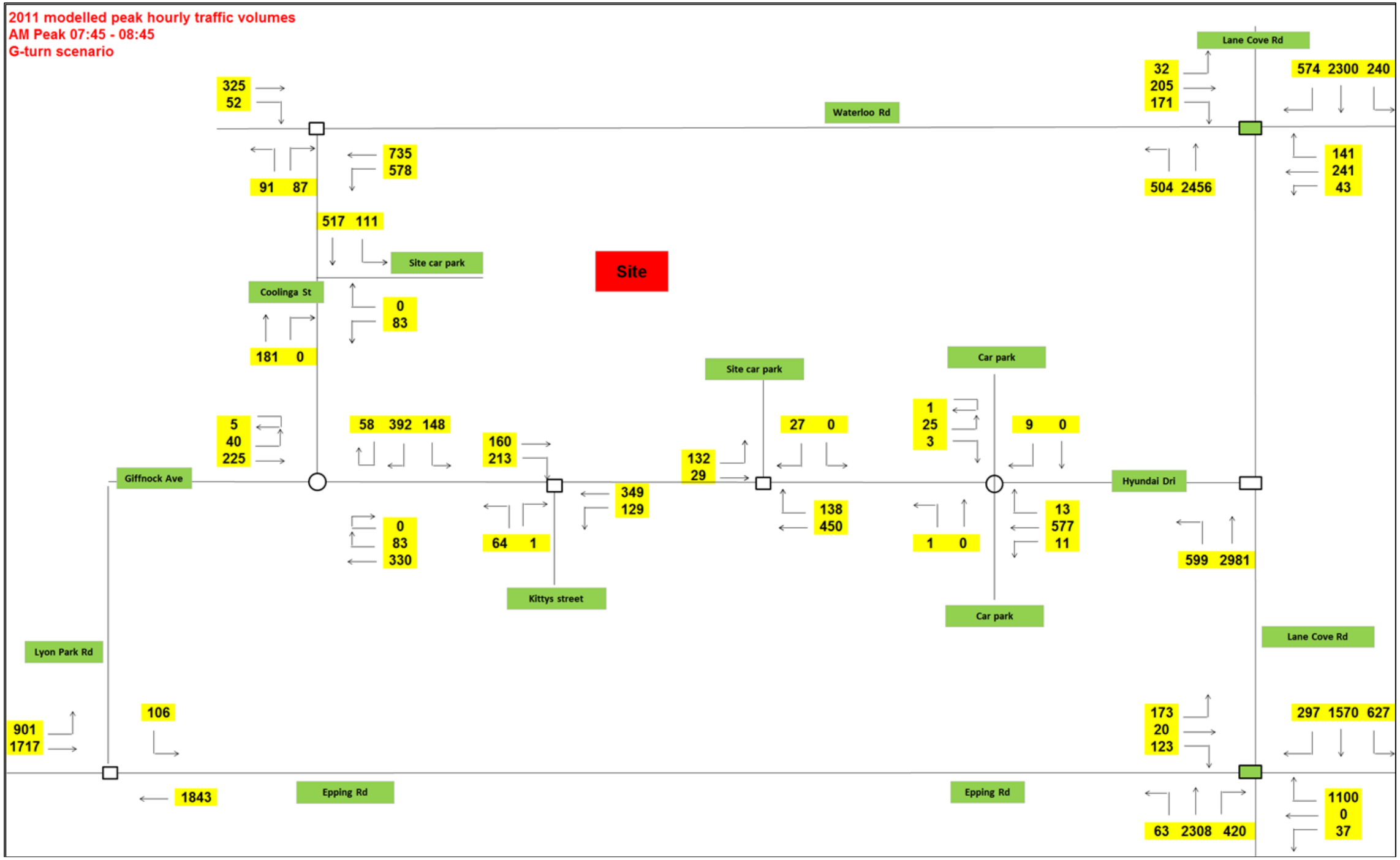
Intersection performance for PM peak

Intersection	Approach	With-development		G-turn	
		Delay	LOS	Delay	LOS
Waterloo/Lane Cove	South	18	B	13	A
	West	67	E	112	F
	North	120	F	108	F
	East	119	F	116	F
Lane Cove/Hyundai	South	7	A	10	A
Epping/Lane Cove	South	73	F	71	F
	West	128	F	173	F
	North	104	F	119	F
	East	176	F	180	F
Epping/Lyon Park	West	14	A	13	A
	South	0	A	0	A
Waterloo/Coolinga	South	11	A	21	B
	West			22	B
	East	4	A	32	C
Coolinga/Car Park	South	3	A	8	A
	North	1	A	3	A
	East	7	A	7	A
Coolinga/Giffnock	West	9	A	18	B
	North	7	A	7	A
	East	10	A	10	A
Giffnock/Car Park	West	0	A	0	A
	North	7	A	7	A
	East	3	A	3	A
Giffnock/Kittys	South	9	A	10	A
	West	4	A	5	A
	East	5	A	5	A
Hyundai/Giffnock	South	6	A	6	A
	West	5	A	3	A
	North	7	A	6	A
	East	4	A	5	A

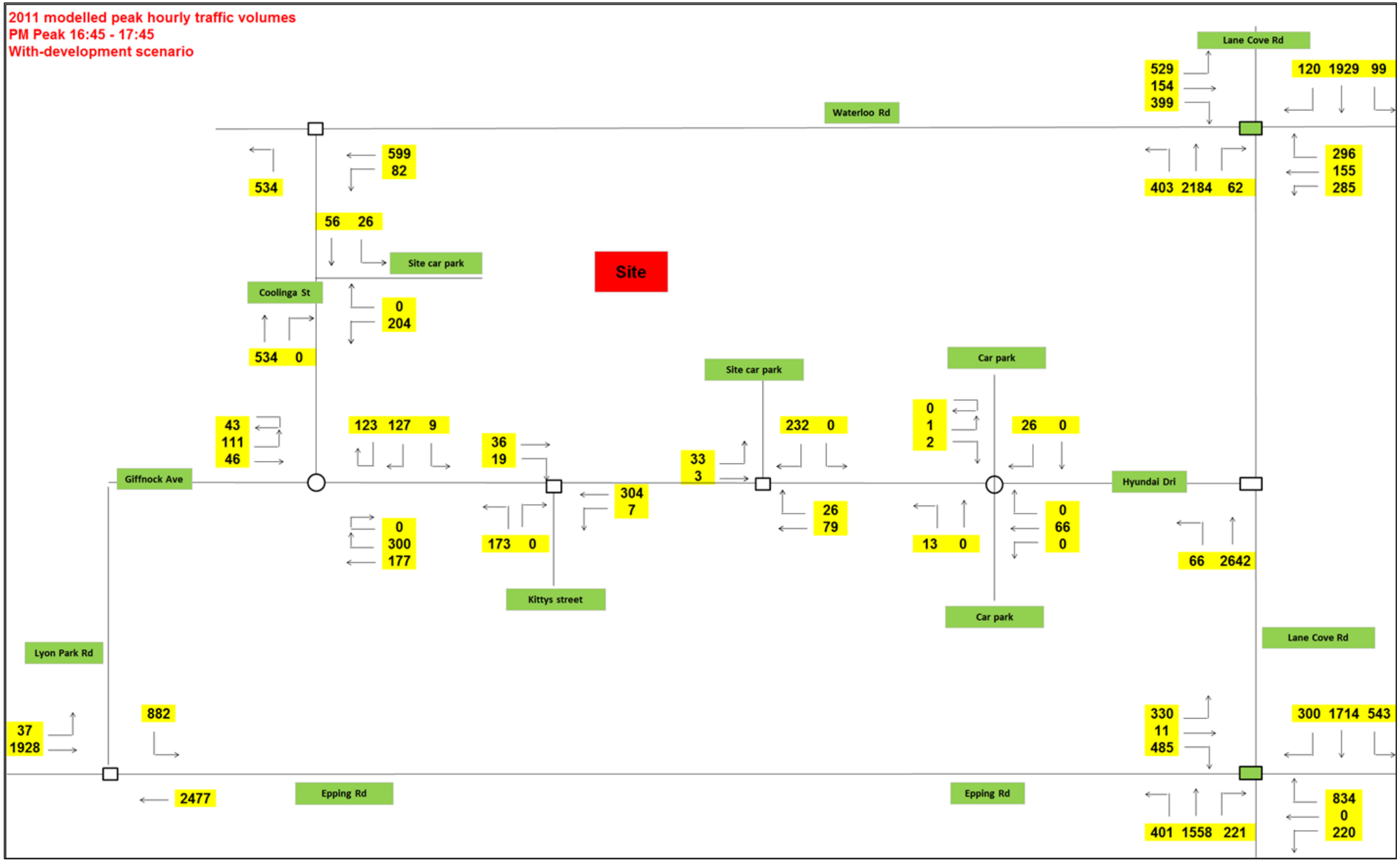
Appendix E3: Intersection turning movement volumes



2011 modelled peak hourly traffic volumes
AM Peak 07:45 - 08:45
G-turn scenario



2011 modelled peak hourly traffic volumes
PM Peak 16:45 - 17:45
With-development scenario



2011 modelled peak hourly traffic volumes
PM Peak 16:45 - 17:45
G-turn scenario