Our Ref: 18138

19 July 2018

Walter Projects Pty Ltd
ATF/Walter Developments Trust
C/- Architecture Urbaneia Pty Ltd
1/53 Hume Street
CROWS NEST NSW 2065

Attention: Mr Mo Chehelnabi

Dear Mo,

RE: WALTER STREET MASTER PLAN
TRAFFIC AND PARKING REVIEW

The Transport Planning Partnership (TTPP) has been engaged by Walter Projects Pty Ltd to prepare this traffic statement to assess the traffic and parking effects of proposed master plan proposal for a string of properties at 3-31 Walter Street, Willoughby. The findings from this assessment are contained herein.

Project Background

In August 2017, a master plan seeking development uplift for a number of properties on the northern side of Walter Street, Willoughby as well as those on the western side of Willoughby Road, Willoughby was submitted to Willoughby City Council. Specifically, the master plan relates to Nos. 3-31 Willoughby Road and No. 462 Willoughby Road. The master plan proposes to change the zoning from the current R3 Medium Density Residential (include a 0.9:1 floor space ratio (FSR) and building height of 12m (four storeys)) to a R4 High Density Residential (with FSR of 2:1 and building height of 28m (eight storeys).

The master plan was accompanied by a traffic study (dated August 2017) prepared by TTPP.

The August 2017 TTPP traffic study finds that growth in the background traffic alone would result in the Willoughby Road intersection with Walter Street operating with poor performance. A new traffic signals at the Walter Street intersection with Willoughby Road would provide sufficient capacity to accommodate future development traffic in the area. A copy of the August 2017 traffic report is contained in Attachment One of this statement.

A revised master plan relating to properties Nos. 3-31 Walter Street is being prepared for submission to Willoughby Council. The revised masterplan seeks approval for the subject properties to be rezoned as R4 High Density Residential with maximum FSR of 1:5:1 (with building height varying from 24m (seven storeys) to 27m (eight storeys)).

This traffic statement accompanies the revised master plan.

Site Description

The revised master plan relates to properties located on the northern side of Walter Street, specifically Nos. 3 to 31 Walter Street. The site and its surrounds are shown in Figure 1.

Figure 1: Locality Map

Basemap Source: Architecture Urbaneia

All properties to which this master plan is related are currently zoned as R3 Medium Density Residential.

It is noted that the revised master plan does not includes properties located at Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road, and No. 462 Willoughby Road. These properties are the subject of a separate planning proposal.

Proposed Master Plan

The proposed revised master plan proposes to rezone the subject properties with a R4 High Density Residential with a maximum FSR of 1.5:1 and building height varying from 24m to 27m i.e. seven to eight storeys.

The revised master plan proposes to widen Walter Street to provide one traffic lane and parking lane in each direction. In addition, a new traffic signal is also proposed at the intersection of Walter Street with Willoughby Road.

The combined properties have been allocated into four distinct sites as shown in Figure 2.

Figure 2: Master Plan Sites

Basemap Source: Architecture Urbaneia

The proposed master plan is shown in Figure 3.

Figure 3: Proposed Master Plan

Image Source: Architecture Urbaneia

The proposed development schedule across the four sites is summarised in Table 1.

Table 1: Proposed Revised Masterplan Development Schedule

Apartment Mix	Site A	Site B	Site C	Site D	Total
1-Bedroom Units	22 Units	12 Units	9 Units	7 Units	50 Units
2-Bedroom Units	52 Units	26 Units	28 Units	23 Units	129 Units
3-Bedroom Units	2 Units	6 Units	6 Units	1 Units	15 Units
Total	**76 Units**	**44 Units**	**43 Units**	**31 Units**	**194 Units**

Planning Proposal for Nos. 1-1A Walter St & Nos. 450-460 Willoughby Rd, and No. 462 Willoughby Rd

There is a separate planning proposal relating to the properties at Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road, and No. 462 Willoughby Road. The traffic assessment of that planning proposal is covered in a separate traffic assessment report (Ref: 18138l01 Traffic Statement 180719 dated 19 July 2018).

In summary, the planning proposal for Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road, and No. 462 Willoughby Road will seek approval to rezone the site as R4 High Density Residential.

Table 2: Nos. 1-1A Walter St & Nos. 450-460 Willoughby Rd, and No. 462 Willoughby Rd Proposed Development Schedule

Apartment Mix	Site E	Site F	Total
1-Bedroom Units	8 Units	10 Units	18 Units
2-Bedroom Units	16 Units	28 Units	44 Units
3-Bedroom Units	2 Units	3 Units	5 Units
Total	**26 units**	**41 Units**	**67 Units**

Previous Traffic Assessment

The August 2017 TTPP traffic study assesses the traffic effects of the proposed R4 zoning together with the current R3 zoning with consideration to additional development traffic arising from the proposed childcare centre at Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road as well as the development traffic from the proposed redevelopment of the Channel 9 site on Artarmon Road.

The traffic allowance in the August 2017 traffic study is surprised in Table 3.

Table 3: Development Traffic Allowance in August 2017 Traffic Study

Development Site	Development Yield	Morning Peak Period	Evening Peak Period
Walter Street R3 Zoning	174 Apartments	33 vph	26 vph
Walter Street R4 Zoning	350 Apartments	67 vph	53 vph
Channel 9 Site	510 Apartments + 1,322m² commercial + 415m² retail	171 vph	171 vph
No. 1 -1A Walter Street & Nos. 452-460 Willoughby Rd	225 Children + 35 Staff	174 vph	152 vph

The August 2017 traffic study also made allowance for growth in the background traffic as agreed with Roads and Maritime Services (Roads and Maritime). The adopted growth rates are shown in Figure 4.

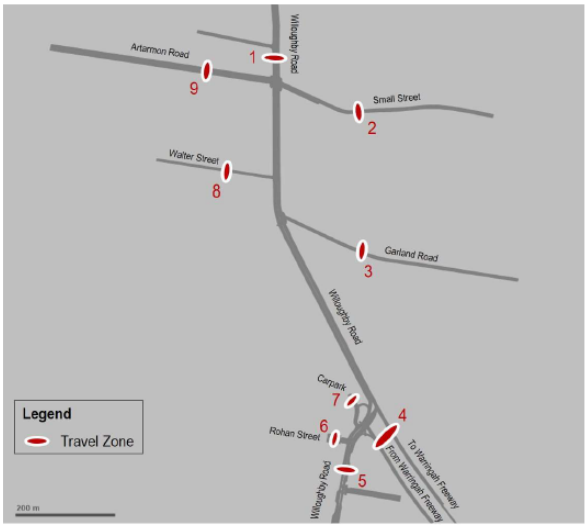
Figure 4: Background Traffic Growth

AM Peak hour STM traffic increase from 2016 to 2026

	1	2	3	4	5	6	7	8	9
1				21%					
2									
3									
4	23%				94%				26%
5									9%
6									
7									
8									
9	10%			25%	30%				

PM Peak hour STM traffic increase from 2016 to 2026

	1	2	3	4	5	6	7	8	9
1				28%					
2									
3									
4	25%				146%				
5	1%								25%
6									
7									
8									
9				47%	5%				



As part of TTPP's traffic study, a VISSIM micro-simulation traffic model of the Willoughby Road corridor within the vicinity of the site was developed to assess the traffic implications arising from the proposed Walter Street rezoning with consideration to the cumulative traffic effects arising from known developments and growth of the background traffic as discussed above.

In the August 2017 traffic study, four traffic modelling scenarios were developed to assess the traffic effects due to Walter Street development uplift and other known developments. The traffic modelling scenarios include:

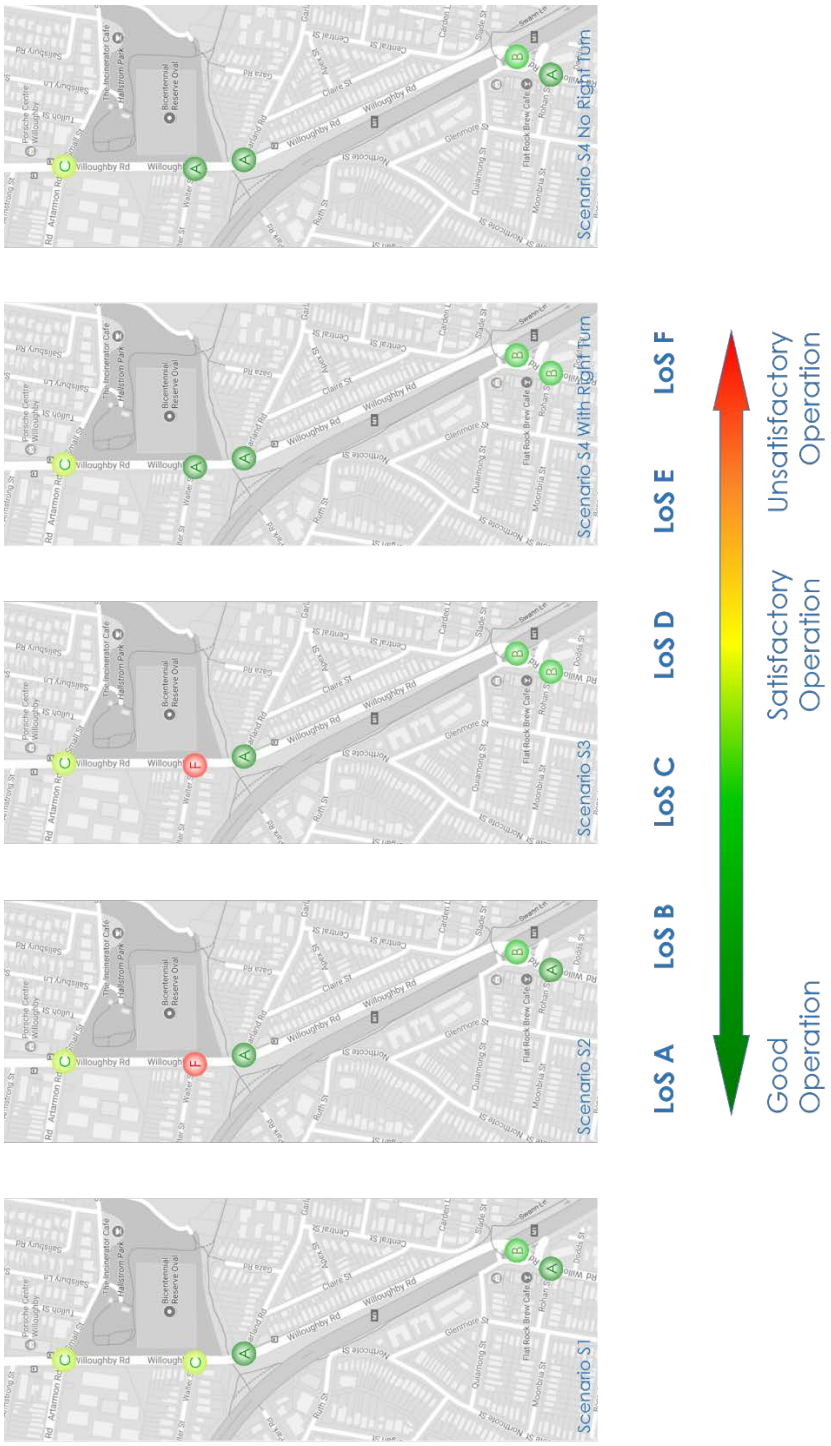
- Scenario 1 (S1) – 2017 existing base case conditions (using existing traffic surveys)
- Scenario 2 (S2) – 2027 future base case with no development plus 10-year growth of the existing background traffic with existing intersection and road geometry
- Scenario 3 (S3) – S2 above plus Walter Street additional development traffic from the current approved R3 zoning and extra development traffic from the Channel 9 site and

proposed childcare centre at Nos. 1-1A Walter Street and Nos. 452-460 Willoughby Road, Willoughby, and

- Scenario 4 (S4) – S2 above plus Walter Street development traffic arising from the proposed R4 zoning, and extra development traffic generated from the Channel 9 site and the proposed childcare centre.

Figure 5 provides a summary of the intersection level of service for all modelled intersections.

Figure 5: Intersection Performance



The August 2017 traffic study finds that growth in the background traffic alone would result in the Willoughby Road intersection with Walter Street operating with poor performance. A combination of traffic generated by the subject development zoned as R3, the Channel 9 site and proposed childcare centre would trigger the need to upgrade the Walter Street intersection.

However, a new traffic signal at the Walter Street intersection would provide sufficient capacity to accommodate development traffic from all known developments plus growth in the background traffic.

Roads and Maritime Services Approval

Roads and Maritime has reviewed the TTPP's August 2017 traffic study including the VISSIM traffic model. Following their review, the traffic model has been deemed "fit for purpose" by Roads and Maritime. Roads and Maritime also granted approval for the provision of traffic signals at the Willoughby Road intersection with Walter Street subject to a number of requirements including right turn movements from Willoughby Road into Walter Street to be prohibited during the peak periods. The approval letter from Roads and Maritime is contained in Attachment Two of this letter.

Willoughby Road Traffic Signals – Council's Traffic Engineering Comment

Willoughby City Council's Planning Officer has prepared a report to Ordinary Council Meeting dated held on 12 March 2018 recommending that Council support the public for the public exhibition of the planning proposal. In that report, it was noted that Council's Traffic and Transport Team Leader had no objections to the traffic signals at Willoughby Road-Walter Street intersection. Council's traffic engineer also agrees with TTPP's findings that "*the proposed new traffic control signals with all movements provided will operate with an acceptable level of service and Willoughby Road (including key intersections modeled) will also continue to operate with a similar level of service to the existing situation for the greatest level of development on the site for 10 years into the future (with forecast regional traffic growth and that generated by large developments planned nearby and assuming an upgrade at Willoughby Road/ Artarmon Road is completed)*".

The relevant page of the Council report has been extracted and is contained in Attachment Three of this letter.

Trip Generation Comparison

Roads and Maritime Technical Direction (TDT2013/04) and Guide to Traffic Generating Developments, 2002 provide traffic generation rates for various land uses. For high density residential apartment development, the Roads and Maritime guidelines suggest the following traffic generation rates:

- morning peak period – 0.19 trips per peak hour per apartment, and
- evening peak period – 0.15 trips per peak hour per apartment.

The above traffic generation rates are consistent with the TTPP's August 2017 traffic study.

Using the above Roads and Maritime trip rates, the proposed revised master plan (as presented in Table 1) is expected to generate 36 vph and 28 vph in the morning and evening peak period, respectively.

Table 4 provides a summary of the previous traffic generation allocations for the master plan site as estimated in the August 2017 traffic study (namely the VISSIM traffic model), compared to the traffic generation estimates arising from the revised proposed master plan.

Table 4: Comparative Traffic Generation

Master Plan	Development Yield	Morning Peak Period	Evening Peak Period
Previous Proposed Master Plan (R4 Zoning)	350 Apartments	67 vph	53 vph
Revised Proposed Master Plan (R4 Zoning)	194 Apartments	37 vph	29 vph
Net Difference in Traffic	-	- 30 vph	- 24 vph

Table 4 indicates that the revised proposed master plan is likely generate less trips than that envisaged for the site in the VISSIM traffic model – up to 30 vph less.

Furthermore, in relation to the sites at No. 462 Willoughby Road (Site E) and Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road (Site F), it is noted that these properties are subject of a separate planning proposal to rezone the respective sites also to R4 High Density Residential.

Site E is expected to generate some 5 vph during the busiest period, while Site F is expected to generate some 8 vph. As such the planning proposal for this combined site is expected to generate approximately 13 vph during the busiest period.

As noted in the traffic assessment (Ref: 18138l01 Traffic Statement 180719 dated 19 July 2018) for the planning proposal for No. 462 Willoughby Road (Site E) and Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road (Site F), the respective sites have been estimated to generate 5 vph and 174 vph during the busiest peak period. As such, Sites E and F are also expected to generate significantly less traffic than that assumed in the August 2017 traffic study, specifically some 166 vph less.

Overall with consideration to the subject revised proposed master plan (for Nos. 3-31 Walter Street) and the planning proposal (for No. 462 Willoughby Road (Site E) and Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road (Site F)), there would be a reduction of 197 vph of the traffic assumed in the August 2017 traffic study during the busiest peak period. It is further noted that the significant reduction in future development traffic is primarily due to the displacement of the approved childcare centre at Nos. 1-1A Walter Street and Nos. 450-460 Willoughby Road (Site F) by the high density residential development proposed in the planning proposal for Site F.

As such, the revised proposed master plan is not expected to result in any adverse impact on the surrounding road network (assuming that the Walter Street intersection with Willoughby Road would operate with traffic signal control in the future) and is considered consistent with the inputs into the VISSIM traffic model which was developed as part of the August 2017 traffic study. It is further noted that the VISSIM traffic model has been reviewed by Roads and Maritime and has been deemed "fit for purpose". Consequently, the conclusions from TTPP's August 2017 traffic study are still therefore be valid and robust, noting that the impacts arising from the proposed development site would be less than that initially estimated.

On a separate matter, it is noted in the approval for the childcare centre (on the site Nos. 1-1A Walter Street and Nos. 450-460 & No. 462 Willoughby Road) RMS requires the Walter Street intersection to be converted to permit only left-in and left-out traffic movements from/to Willoughby Road. This was on the basis that Walter Street would be developed with R3 residential developments (with FSR of 0.9:1) as per under the current LEP zoning.

However, as stated in TTPP's August 2017 traffic report the cumulative traffic effects (including those from the approved childcare centre) would require Walter Street intersection to be upgraded to traffic signal control.

It is further noted that with Walter Street rezoned to permit R4 high density development (with FSR of 1.5:1 as contemplated in this planning proposal) and the approved childcare centre displaced by R4 high density residential developments, it is expected that Walter Street intersection (configured to permit a left-in/left-out traffic movements) would have sufficient traffic capacity to accommodate the additional development traffic from all known developments including those arising from the R4 high density development on Walter Street as per this planning proposal.

Parking Assessment

Car Parking

The car parking requirements for the proposed development envisaged in the revised proposed master plan has been assessed against the Willoughby City Council's Development Control Plan (WDCP) 2016. A summary of the car parking requirements for the proposal is summarised in Table 5.

Table 5: WDCP 2016 Car Parking Requirements

Site	No. of Units	WDCP Car Parking Rates	WDCP Car Parking Requirements
Site A			
- 1-Bedroom Units	22 Units	1.0 Space/Unit	22.0
- 2-Bedroom Units	52 Units	1.0 Space/Unit	52.0
- 3-Bedroom Units	2 Units	1.25 Spaces/Unit	2.5
- Visitors	76 Units	1.0 Space/4 Units	19.0
- Site A Sub-Total			*95.5*
Site B			
- 1-Bedroom Units	12 Units	1.0 Space/Unit	12.0
- 2-Bedroom Units	26 Units	1.0 Space/Unit	26.0
- 3-Bedroom Units	6 Units	1.25 Spaces/Unit	7.5
- Visitors	44 Units	1.0 Space/4 Units	11.0
- Site B Sub-Total			*56.5*
Site C			
- 1-Bedroom Units	9 Units	1.0 Space/Unit	9.0
- 2-Bedroom Units	28 Units	1.0 Space/Unit	28.0
- 3-Bedroom Units	6 Units	1.25 Spaces/Unit	7.5
- Visitors	43 Units	1.0 Space/4 Units	10.75
- Site C Sub-Total			*55.25*
Site D			
- 1-Bedroom Units	7 Units	1.0 Space/Unit	7.0
- 2-Bedroom Units	23 Units	1.0 Space/Unit	23.0
- 3-Bedroom Units	1 Units	1.25 Spaces/Unit	1.25
- Visitors	31 Units	1.0 Space/4 Units	7.75
- Site D Sub-Total			*39.0*
All Sites Total	**-**	**-**	**246**

Note: Where the amount of parking required is not a whole number, the number of spaces required has been rounded down to the nearest number, as per WDCP 2016 requirements.

Table 5 indicates that a total of 246 car parking spaces is required for combined development. It is proposed to provide onsite car parking to comply with the WDCP 2016 car parking requirements.

As such, the proposed car parking provision is considered satisfactory. The car park and associated elements are proposed to be designed in accordance with the design requirements set out in the relevant Australian Standards for car parking facilities, namely AS2890.1:2004 and AS2890.6:2009.

Bicycle Parking

The WDCP 2016 requires bicycle parking to be provided at a rate of one space per 10 units for residential tenancies and one space per 12 units for residential visitors. It is also proposed to comply with this requirement, with bicycle parking facilities proposed to be designed in accordance with WDCP 2016 and AS2890.3:2015 design requirements.

Motorcycle Parking

In accordance with the WDCP 2016, motorcycle parking should be provided at a rate of one space per 25 car parking spaces. It is also proposed to comply with this requirement, with all motorcycle parking spaces proposed to be designed as 1.2m wide by 3.0m long parking spaces, as per WDCP 2016 design requirements.

Summary and Conclusion

From TTPP's review of the proposed masterplan, it is concluded that the traffic effects arising from the revised proposed master plan is considered to be acceptable. The proposed development in this revised proposed master plan is expected to generate less traffic than that assumed in TTPP's August 2017 traffic study and as such traffic impacts arising from the revised proposed master plan would not be worse than that derived in the August 2017 traffic study.

It is noted that the approved childcare centre on the site Nos. 1-1A Walter Street and Nos. 450-460 & No. 462 Willoughby Road together with all known development would require the Walter Street intersection upgrade to traffic control. However, if the approved childcare centre is also displaced also by R4 high density residential developments the Walter Street intersection configured to permit left-in/left-out traffic movements would have sufficient traffic capacity to accommodate the development traffic arising from this planning proposal and other known developments.

Compliant parking provision would be provided to serve the proposed development as per WDCP 2016 parking requirements.

As such, it is concluded that the traffic and parking aspects of the proposed development would be satisfactory.

We trust the above is to your satisfaction. Should you have any queries regarding the above or require further information, please do not hesitate to contact the undersigned on 8437 7800.

Yours sincerely,

Michael Lee
Director

Attachment One

August 2017 Master Plan Traffic Study

Walter Street, Willoughby Proposed Development Uplift

Traffic Study

Prepared for:

Walter Projects Pty Ltd ATF/Walter Developments Trust

22/08/2017

The Transport Planning Partnership Pty Ltd

E: info@ttpp.net.au

Walter Street, Willoughby
Proposed Development Uplift
Traffic Study

Client: Walter Projects Pty Ltd ATF/Walter Developments Trust

Version: Final

Date: 22/08/2017

TTPP Reference: 16186

Quality Record

Version	Date	Prepared by	Reviewed by	Approved by	Signature
Final	22/07/17	ML	ML	ML	

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APPENDICES

A. Base Model Calibration and Validation Technical Note prepared by Bitzios Consulting

B. Walter Street Intersection Upgrade Concept Plan Prepared by Calibre Consulting

C. RMS Letter to Willoughby Council Indicating Support for the Proposed Traffic Signals

1 Introduction

This traffic report relates to a proposed development uplift for a number of properties on the northern side of Walter Street, Willoughby and at No.462 Willoughby Road, Willoughby. Figure 1.1 shows the location of the properties and their environs.

Figure 1.1: Walter Street, Willoughby Location Plan

Under existing planning controls, namely Willoughby Local Environmental Plan 2012 (LEP), these properties have a residential zoning of R3 Medium Density Residential and a floor space ratio (FSR) of 0.9:1 permitting a variety of housing types within a medium density residential environment.

Walter Projects Pty Ltd has engaged The Transport Planning Partnership (TTPP) to assess the traffic effects of the R3 medium density zoning on Walter Street with consideration for additional traffic arising from other nearby known proposed developments. In addition, TTPP has assessed the traffic effects of R4 high density residential zoning on Walter Street with consideration for additional traffic associated with other nearby developments (i.e. additional development uplift above the current approved R3 medium density zoning).

Following consultation with Roads and Maritime Services (RMS), a micro-simulation traffic model of the Willoughby Road corridor was developed to assess the traffic effects of the proposed development as being zoned as R3 and R4. The micro-simulation traffic models have been developed using the traffic modelling tool VISSIM.

TTPP has engaged Bitzios Consulting (Bitzios) to assist with the development of the VISSIM micro-simulation traffic models.

The findings of the traffic assessment are documented in this report.

The remainder of the report is set out as follows:

- Chapter 2 describes development yield permitted under current R3 zoning as well as R4 zoning, and other nearby known proposed developments;
- Chapter 3 reviews historical crash data in the vicinity of the subject site;
- Chapter 4 presents the traffic analysis results;
- Chapter 5 addresses the RMS warrants for the installation of traffic signals;
- Chapter 6 outlines the consultations that have been conducted with the relevant stakeholders; and
- Chapter 7 presents the conclusions of the traffic assessment.

2 Development Status

2.1 Walter Street Proposed Development Uplift

The planning proposal relates to land at No. 3 to No. 31 Walter Street, Willoughby and No. 462 Willoughby Road, Willoughby. It comprises 20 individual lots. The land is zoned R3 under the current LEP. These properties are located predominantly on the northern side of Walter Street, while No. 462 fronts on to the western side of Willoughby Road. This assessment does not include land on the southern side of Walter Street which is zoned as SP2.

The combined land size for these properties is approximately 12,220m^2.

The existing R3 zoning permits a FSR of 0.9 to 1.0:1 which would result in a gross floor area ranging from approximately 10,998m^2 to approximately 12,220m^2. Using an average apartment size of 70m^2, the resultant development yield would be approximately 157-174 residential apartments.

The traffic effects of additional development uplift above the current R3 zoning was also assessed. This analysis assumes that the current R3 zoning would be amended to a R4 zoning. For traffic analytical purposes, a floor space ratio of 1.5 to 2:1 was examined. A FSR of 1.5 to 2.0:1 would have a resultant gross floor area ranging from approximately 18,330m^2 to approximately 24,440m^2. Based on an average apartment size of 70m^2, the resultant number of residential apartments would range from 262 to 350.

For traffic analytical purposes, the higher yields in both cases have been adopted:

- current R3 zoning – 174 apartments, and
- proposed R4 zoning – 350 apartments.

It is noted that current LEP planning control requires 4 per cent of the apartments (under R3 zoning) to be dedicated to Council as affordable housing. It is further noted that in the proposed voluntary planning agreement (VPA), the proponent proposes to dedicate 5 per cent of the apartments approved under the R4 zoning to be dedicated to Council as affordable housing.

2.2 Other Known Developments

This traffic assessment considers the cumulative traffic effects from two other known developments. These are discussed below.

2.2.1 Channel 9 Site

The Channel 9 site located on Artarmon Road in Willoughby was originally granted a concept plan approval in December 2014 for 400 residential apartments with 500m^2 of

non-residential floor area. An application has been submitted seeking approval to revise the approved concept plan. The revised development proposes 510 residential apartments with 1,322m^2 of commercial floor space and 415m^2 of retail floor space. A transport impact assessment (Ref: 16S1405100 Transport Impact Assessment Issue: B July 2016 prepared by GTA Consultants) accompanied the revised application.

The transport impact assessment estimated that the revised development would generate approximately 171 vehicles per hour (vph) (including commercial and retail development traffic) in each of the two commuter peak periods.

The traffic assessment for the Channel 9 site considered the suggested intersection upgrade for the Willoughby Road intersection with Artarmon Street as part of the redevelopment of the Willoughby Leisure Centre.

The above estimated development traffic and intersection upgrade have been included in this assessment.

2.2.2 Proposed Childcare Development 1-1A Walter Street and 452-460 Willoughby Road, Willoughby

A development application has been submitted to Willoughby City Council for a proposed childcare centre at 1-1A Walter Street and 452-460 Willoughby Road, Willoughby. The proposed childcare centre site is located at the north-western corner of Walter Street and Willoughby Road intersection, and to the immediate east of the subject site.

The development application seeks approval for 225 children with 35 staff. The proposed development includes 17 car parking spaces for staff and 24 car parking spaces for pick-up and drop-off of children.

The traffic report (Ref: 16.246r01v5 1-1A Walter Street and 452-460 Willoughby Road, Willoughby – July 2016 prepared by Traffix) that accompanied the development application indicates that the proposed childcare centre would generate approximately 174 vph and 152 vph during the morning and evening peak period respectively.

It is noted that the childcare development application has been refused by the Sydney North Planning Panel in July 2017. However, this traffic assessment has included development traffic from the proposed childcare centre.

2.3 Background Traffic Growth

Outputs from the 2016 and 2026 Sydney Strategic Travel Models (STM) were compared to establish the change in background traffic growths in the Willoughby Road corridor within the study area. The cordon matrix from the STM model for the study area was obtained from RMS. The growths in background traffic were calculated by comparison of 2016 and 2026 cordon matrices.

The 2016 to 2026 growth from the STM data are shown Figure 2.1. Accordingly, this has been applied to all future case models.

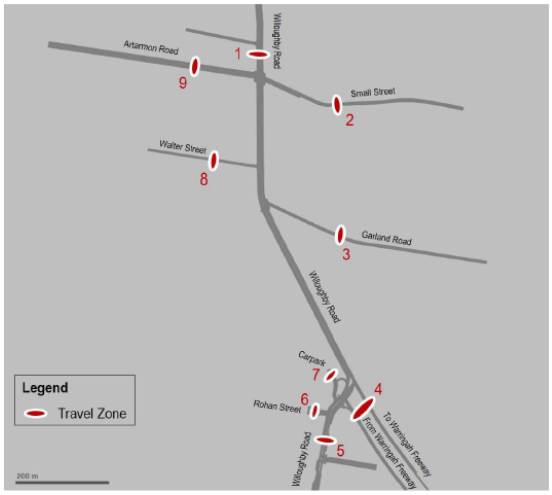
Figure 2.1: Willoughby Rd Background Traffic Growth

AM Peak hour STM traffic increase from 2016 to 2026

	1	2	3	4	5	6	7	8	9
1				21%					
2									
3									
4	23%				94%				26%
5									9%
6									
7									
8									
9	10%			25%	30%				

PM Peak hour STM traffic increase from 2016 to 2026

	1	2	3	4	5	6	7	8	9
1				28%					
2									
3									
4	25%				146%				
5	1%								25%
6									
7									
8									
9				47%	5%				



RMS confirms that 2016 and 2026 STM data can be used to determine the changes for the background through traffic on Willoughby Road, while changes in the traffic to/from the side streets (e.g. Artarmon Road) could be obtained from reviewing the relevant traffic reports for the respective development applications.

As such, the VISSIM micro-simulation traffic models developed include development traffic from all known developments and considers any changes to the through traffic along Willoughby Road.

3 Walter St Crash Data

Crash data for the five-year period from 1 January 2011 to 31 December 2015 within 500m of the Willoughby Road intersection with Walter Street has been obtained from RMS. Below is a summary of the crash history data:

- there has been a total of 28 crashes over the five-year period within the study area (between two and nine crashes per year);
- of the 28 crashes, there were no fatality crashes, 13 personal injury crashes and 15 non-casualty crashes;
- one crash involved a pedestrian;
- 79 per cent of crashes occurred at intersections with Willoughby Road as follows:
  - Artarmon Road – 46 per cent;
  - Walter Street – 11 per cent;
  - Garland Road – 7 per cent;
- 54 per cent of crashes were rear-end type (RUM 30 and 31), about half of which involved a truck in the crashes occurring at non-intersection locations; and
- 18 per cent of crashes involved vehicles from adjacent approaches (RUM 10 and 13) occurring at intersections.

The crash data is summarised in Table 3.1.

Table 3.1: Crash Data

Year	Crash Severity			Total
	Fatal	Injury	Property Damage	
2011	0	5	4	9
2012	0	3	5	8
2013	0	1	1	2
2014	0	1	3	4
2015	0	3	2	5
Total	**0**	**13**	**15**	**28**

4 Traffic Impact Assessment

4.1 Traffic Generation and Distribution

RMS Technical Direction (TDT2013/04) and Guide to Traffic Generating Developments, 2002 provide traffic generation rates for various land uses. For high density residential apartment development, the RMS guidelines suggest the following traffic generation rates:

- morning peak period – 0.19 trips per peak hour per apartment; and
- evening peak period – 0.15 trips per peak hour per apartment.

Therefore, applying RMS traffic generation rates the current R3 zoning with 174 apartments would generate approximately 33 vph during the morning peak period, and approximately 26 vph during the evening peak period.

Adopting RMS traffic generation rates to evaluate the proposed R4 zoning with 350 apartments would generate approximately 67 vph and 53 vph in the morning and evening peak periods, respectively.

These trips are expected to be distributed 20 per cent inbound and 80 per cent outbound during the morning peak period. During the evening peak period, the reverse would apply.

Table 4.1 presents a summary of the estimated development traffic.

Table 4.1: Estimated Development Traffic

Apartment Yield	Peak Period	Inbound	Outbound	Combined Two-way Flows
Current R3 Zoning – 174 Apartments	Morning	7	26	33
	Evening	21	5	26
Proposed Uplift (R4 Zoning) – 350 Apartments	Morning	13	54	67
	Evening	42	11	53

The estimated development traffic has been assigned to the local road network based on existing traffic patterns.

4.2 Intersection Performance Criteria

RMS uses level of service as a measure to indicate the operating efficiency (ie. level of service) of a given intersection. The level of service (LoS) ranges from A to F. Levels of service between A and D indicate the intersection is operating within capacity with LoS A providing exceptionally good performance to LoS D indicating satisfactory performance. LoS E and F indicate the intersection is operating at or near capacity

and would require intersection improvement works to maintain reasonable performance.

LoS is directly related to the average delay experienced by vehicles travelling through the intersection. At signalised intersections, the average delay is the volume weighted average of all movements. For roundabouts and priority controlled intersections (give way and stop sign), the average delay relates to the worst movement.

The level of service and average delays performance criteria are set out in Table 4.2.

Table 4.2: Level of Service Criteria

Level of Service (LoS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Sign
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	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Source: RMS' Guide to Traffic Generating Development, 2002

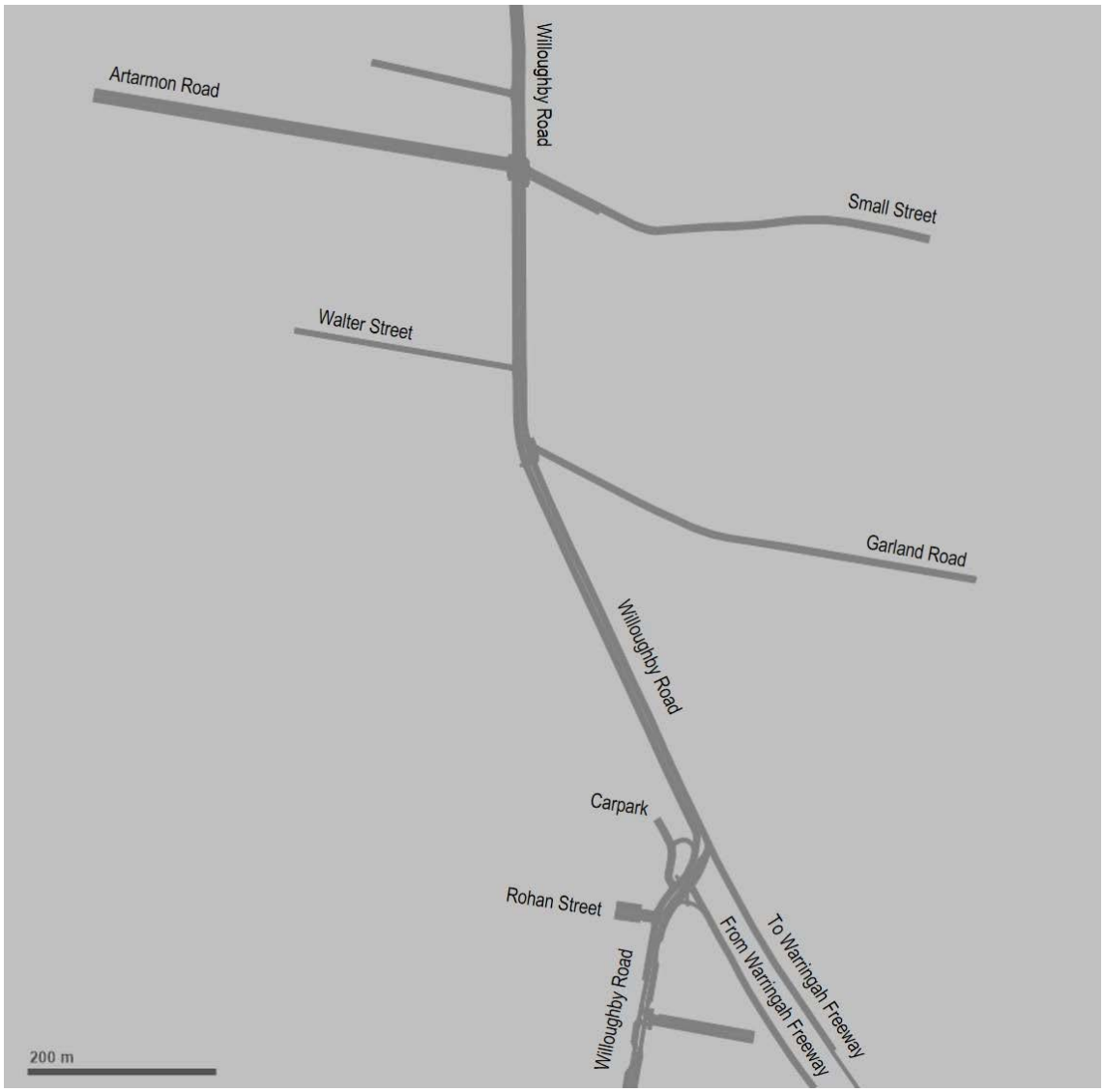
4.3 Calibration and Validation of Existing Condition Models

Bitzios has developed a VISSIM micro-simulation traffic model of the Willoughby Road corridor within the vicinity of the subject site. The VISSIM traffic model includes the following intersections along Willoughby Road as nominated by RMS:

- Artarmon Road;
- Walter Street;
- Garland Road;
- Warringah Freeway On/Off Ramps; and
- Rohan Street.

Figure 4.1 shows the modelled area of the road network including intersections in the VISSIM models.

Figure 4.1: Modelled Area



Source: Bitzios Consulting

The traffic model relates to weekday morning and evening peak periods.

The VISSIM traffic models have been built, calibrated and validated with the following traffic data:

- classified intersection turning movement counts;
- lane by lane queue length data;
- RMS traffic signal timing (SCATS Intersection Diagnostic Monitor (IDM)) data;
- travel time surveys;
- traffic patterns and behaviour observed on site; and
- aerial imaginary of the study area.

Bitzios has calibrated and validated the traffic models to *RMS Traffic Modelling Guidelines*, February 2013. Bitzios states that "*the VISSIM models are deemed suitably*

calibrated and validated in accordance with the RMS Guidelines. The models are considered fit for purpose of assessing the road network and intersection upgrades on the section of Willoughby Road within the study area".

Bitzios has prepared a technical note (*Base VISSIM Model Calibration and Validation* dated 26 June 2017) documenting the data collection, model development process, key assumptions and the calibration and validation of the base model. Appendix A contains the calibration and validation report prepared by Bitzios.

Electronic files of the existing case VISSIM models have been submitted to RMS for their review. RMS has agreed for the calibrated base case VISSIM models to be used for assessment of the proposed development provided the models are recalibrated to address the issues identified by RMS.

Bitzios Consulting has reviewed the comments from RMS and has addressed the comments accordingly.

4.4 Traffic Modelling Scenarios

Four traffic modelling scenarios have been developed to assess the traffic implications associated with the proposed development on Walter Street. The traffic modelling scenarios are as follows:

- Scenario 1 (S1) – 2017 existing base case conditions (using existing traffic surveys)
- Scenario 2 (S2) – 2027 future base case with no development plus 10-year growth of the existing background traffic with existing intersection and road geometry
- Scenario 3 (S3) – S2 above plus Walter Street additional development traffic from the current approved R3 zoning and extra development traffic from the Channel 9 site and proposed childcare centre at 1-1A Walter Street and 452-460 Willoughby Road, Willoughby, and
- Scenario 4 (S4) – S2 above plus Walter Street development traffic arising from the proposed R4 zoning, and extra development traffic generated from the Channel 9 site and the proposed childcare centre.

Scenarios S2, S3 and S4 include 10-year growth of the background traffic. The 10-year growth factor has been determined as per discussion in Section 2.3.

It is noted that in Scenarios S3 and S4, it has been assumed that the intersection of Willoughby Road and Artarmon Road would be upgraded as per the recommended layout proposed as part of the Willoughby Leisure Centre development.

4.4.1 Scenario S1 VISSIM Modelling Results

The VISSIM modelling results at the five RMS nominated intersections for the morning and evening peak periods are presented in Table 4.3.

Table 4.3: Scenario S1 (Existing Condition) VISSIM Modelling Results

Intersection	Intersection Control	Morning Peak Period		Evening Peak Period	
		Ave. Delay (Sec)	Level of Service	Ave. Delay (Sec)	Level of Service
Willoughby Rd-Artarmon Rd	Traffic Signal	29	C	28	B
Willoughby Rd-Walter St	Priority Control	22	B	30	C
Willoughby Rd-Garland Rd	Traffic Signal	9	A	8	A
Willoughby Rd-Warringah Fwy	Traffic Signal	14	A	19	B
Willoughby Rd-Rohan St	Priority Control	3	A	14	A

The model results indicate that all modelled intersections along Willoughby Road operate with good level of service with minimal delays during both peak period.

4.4.2 Scenario S2 VISSIM Modelling Results

The VISSIM modelling results for Scenario S2 future base case with 10-year growth of the background traffic are presented in Table 4.4. This assumes that the existing intersection configurations and controls would remain as they presently exist.

Table 4.4: Scenario S2 (Future Base Case) VISSIM Modelling Results

Intersection	Intersection Control	Morning Peak Period		Evening Peak Period	
		Ave. Delay (Sec)	Level of Service	Ave. Delay (Sec)	Level of Service
Willoughby Rd-Artarmon Rd	Traffic Signal	38	C	33	C
Willoughby Rd-Walter St	Priority Control	191	F	40	C
Willoughby Rd-Garland Rd	Traffic Signal	12	A	10	A
Willoughby Rd-Warringah Fwy	Traffic Signal	16	B	20	B
Willoughby Rd-Rohan St	Priority Control	3	A	14	A

From Table 4.4, it can be seen that additional traffic due to growth in the background traffic is not expected to have any material effects on the performance of the assessed intersections, with the exception of Walter Street intersection. These intersections would continue to operate with performance levels similar to those under existing conditions, albeit with some minor increases to delays.

The Walter Street intersection performance would deteriorate to LoS F operation during the morning peak period. The poor performance is attributable to the growth in the background traffic along Willoughby Road alone. The additional traffic on Willoughby Road resulted in traffic on Walter Street unable to seek an acceptable gap in the traffic stream to enter Willoughby Road.

4.4.3 Scenario S3 VISSIM Modelling Results

The VISSIM modelling results for Scenario S3 which considers traffic generated by the subject development under R3 zoning as well as extra traffic from the Channel 9 site

and proposed childcare centre at the corner of Walter Street and Willoughby Road are presented in Table 4.5. This scenario also assumes that the existing intersection configurations and controls would remain as they presently exist except for the Artarmon Road intersection which would be upgraded to provide additional capacity as noted in the Channel 9 traffic report.

Table 4.5: Scenario S3 (Future Case Walter St R3) VISSIM Modelling Results

Intersection	Intersection Control	Morning Peak Period		Evening Peak Period	
		Ave. Delay (Sec)	Level of Service	Ave. Delay (Sec)	Level of Service
Willoughby Rd-Artarmon Rd	Traffic Signal	31	C	31	C
Willoughby Rd-Walter St	Priority Control	109	F	46	D
Willoughby Rd-Garland Rd	Traffic Signal	11	A	11	A
Willoughby Rd-Warringah Fwy	Traffic Signal	19	B	22	B
Willoughby Rd-Rohan St	Priority Control	3	A	15	B

The VISSIM modelling results for Scenario S3 indicate that the traffic arising from the subject development zoned as R3 as well as the development traffic from the Channel 9 site and childcare centre and background growth would exacerbate the poor intersection performance in the morning peak period as observed in Scenario S2.

However, it is noted that the other intersections would continue to operate satisfactorily with some intersections experiencing minor additional traffic delays.

4.4.4 Scenario S4 VISSIM Modelling Results

The VISSIM modelling results for Scenario S4 with traffic arising from subject development under the proposed R4 zoning and the other known developments as well as background traffic growth are presented in Table 4.6. The Artarmon Road intersection would be upgraded as noted in the Channel 9 site traffic report. This scenario also assumes the Walter Street intersection would be upgraded to operate under traffic signal control.

It is expected that the Walter Street signalised intersection would be configured in a similar manner to that of the Garland Road signalised intersection. That is, two lanes on each of the Willoughby Road approaches with the median southbound lane marked as a shared through and right turn lane. The intersection would operate with a simple two-phase traffic signal sequence with similar phase and cycle times as Garland Street intersection.

Table 4.6: Scenario S4 (Future Case Walter St R4) VISSIM Modelling Results with Right Turn into Walter St Permitted

Intersection	Intersection Control	Morning Peak Period		Evening Peak Period	
		Ave. Delay (Sec)	Level of Service	Ave. Delay (Sec)	Level of Service
Willoughby Rd-Artarmon Rd	Traffic Signal	32	C	32	C
Willoughby Rd-Walter St	Traffic Signal	11	A	9	A
Willoughby Rd-Garland Rd	Traffic Signal	9	A	9	A
Willoughby Rd-Warringah Fwy	Traffic Signal	17	B	21	B
Willoughby Rd-Rohan St	Priority Control	3	A	16	B

The VISSIM modelling results indicate that with the Walter Street intersection operating as a signalised intersection, all of the modelled intersections would operate at a satisfactory level of service C or better. The results also indicate that the other modelled intersections other than Walter Street would operate with similar performance levels to those in Scenario S3.

The results in Table 4.6 assume that the right turn movement from Willoughby Road to Walter Street would be permitted. A separate model was developed to assess the traffic effects of prohibiting the right turn into Walter Street. The VISSIM modelling results are shown in Table 4.7.

Table 4.7: Scenario S4 (Future Case Walter St R4) VISSIM Modelling Results with Right Turn into Walter St Prohibited

Intersection	Intersection Control	Morning Peak Period		Evening Peak Period	
		Ave. Delay (Sec)	Level of Service	Ave. Delay (Sec)	Level of Service
Willoughby Rd-Artarmon Rd	Traffic Signal	31	C	32	C
Willoughby Rd-Walter St	Traffic Signal	11	A	4	A
Willoughby Rd-Garland Rd	Traffic Signal	11	A	14	A
Willoughby Rd-Warringah Fwy	Traffic Signal	20	B	23	B
Willoughby Rd-Rohan St	Priority Control	3	A	14	A

The VISSIM modelling results shown in Table 4.7 indicate that the intersection performance would be almost the same in both cases. Hence, the impact of prohibiting the right-turn from Willoughby Road to Walter Street is negligible.

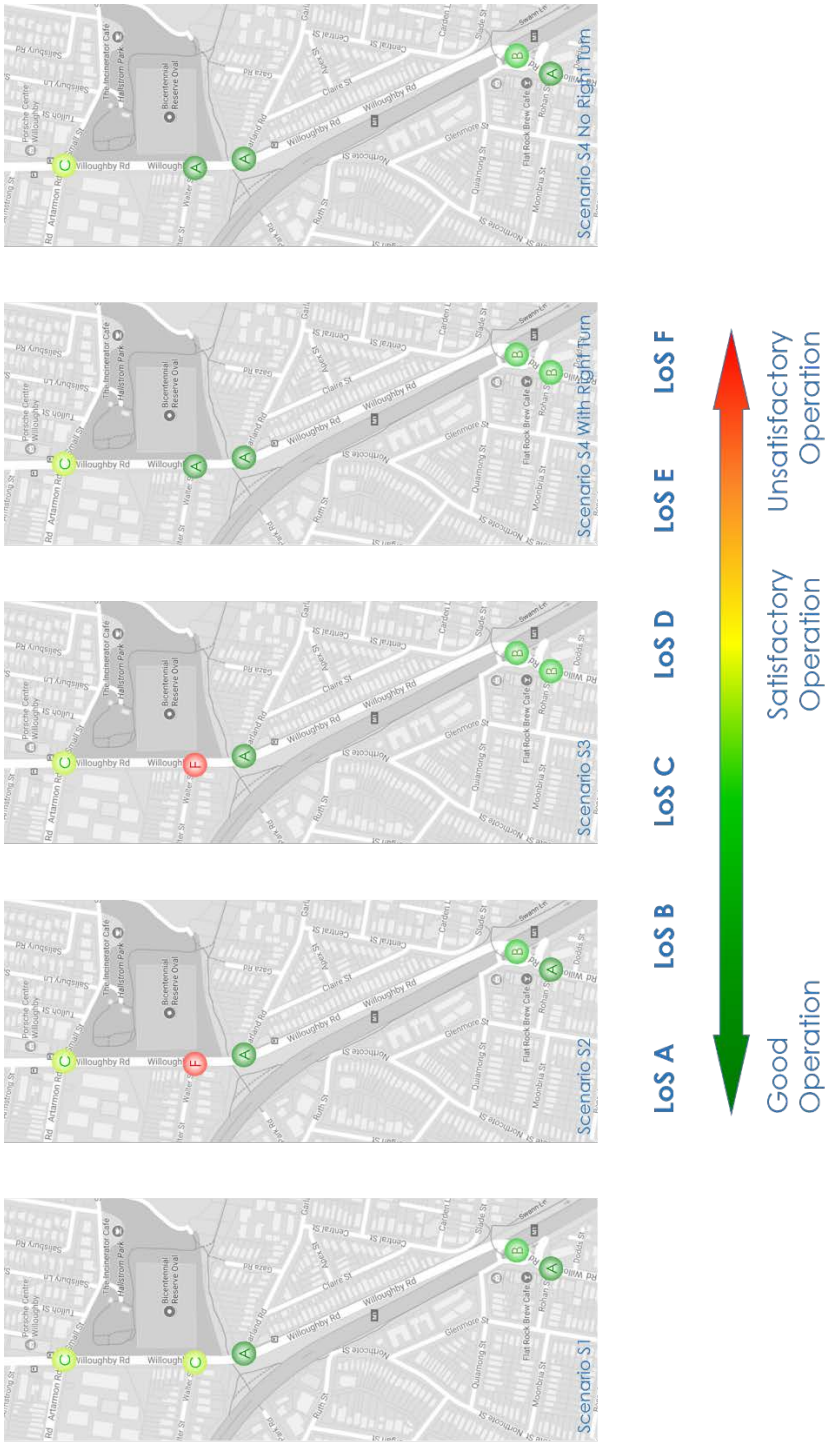
4.4.5 Summary

The VISSIM modelling results indicate that growth in the background traffic alone would result in the Walter Street intersection operating unsatisfactorily (ie. Scenario S2). The VISSIM modelling results also indicate that the development traffic generated by the current R3 zoning for Walter Street and the additional traffic on Willoughby Road (arising from background traffic growth, redevelopment of the Channel 9 site and the proposed childcare centre) (ie. Scenario S3) would continue to operate with similar performance level as the future base case (Scenario S2).

However, if Walter Street was to be upgraded from its current give way priority control to traffic signal control, it would have sufficient traffic capacity to accommodate the traffic arising from the subject development on Walter Street zoned as R4.

Figure 4.2 provides a summary of the intersection level of service for all modelled intersections.

Figure 4.2: Level of Service for All Modelled Scenarios



In addition, widening of Walter Street to accommodate kerbside parking along either side of the road as well as traffic lanes to provide independent two-way flows along Walter Street would assist with maintaining the traffic efficiency at the upgraded Walter Street intersection. This would allow eastbound traffic along Walter Street to move up to the intersection without being blocked by traffic in the opposing traffic so to minimise the wastage of intersection green time for Walter Street traffic.

A concept plan for the upgrade of the intersections prepared by Calibre Consulting is shown in Appendix B.

5 RMS Traffic Signal Warrant

The additional development traffic arising from the redevelopment of Walter Street in accordance with the current LEP R3 zoning and other nearby known proposed developments would require the Walter Street intersection with Willoughby Road to be upgraded to operate as a signalised intersection.

Installation of traffic signals at any intersection requires the approval of RMS. The approval process considers whether the RMS warrants for traffic signals has been satisfied. An extract of the RMS warrants for traffic signals is presented below:

> *As a guide, a signalised intersection may be considered if one of the following warrants is met.*
>
> *(a) Traffic demand:*
>
> *For each of four one-hour periods of an average day:*
>
> *(i) the major road flow exceeds 600 vehicles/hour in each direction; and*
>
> *(ii) the minor road flow exceeds 200 vehicles/hour in one direction.*
>
> *OR*
>
> *(b) Continuous traffic:*
>
> *For each of four one-hour periods of an average day:*
>
> *(i) the major road flow exceeds 900 vehicles/hour in each direction; and*
>
> *(ii) the minor road flow exceeds 100 vehicles/hour in one direction; and*
>
> *(iii) the speed of traffic on the major road or limited sight distance from the minor*
>
> *road causes undue delay or hazard to the minor road vehicles; and*
>
> *(iv) there is no other nearby traffic signal site easily accessible to the minor road*
>
> *vehicles.*
>
> *OR*
>
> *(c) Pedestrian safety:*
>
> *For each of four one-hour periods of an average day:*
>
> *(i) the pedestrian flow crossing the major road exceeds 150 persons/hour; and*
>
> *(ii) the major road flow exceeds 600 vehicles/hour in each direction or, where*
>
> *there is a central median of at least 1.2 m wide, 1000 vehicles/hour in each*
>
> *direction.*
>
> *OR*
>
> *(d) Pedestrian safety – high speed road:*
>
> *For each of four one-hour periods of an average day:*
>
> *(i) the pedestrian flow crossing the major road exceeds 150 persons/hour; and*

(ii) the major road flow exceeds 450 vehicles/hour in each direction or, where

there is a central median of at least 1.2 m wide, 750 vehicles/hour in each

direction; and

(iii) the 85th percentile speed on the major road exceeds 75 km/h.

OR

(e) Crashes:

(i) The intersection has been the site of an average of three or more reported

tow-away or casualty traffic accidents per year over a three year period,

where the traffic accidents could have been prevented by traffic signals; and

(ii) the traffic flows are at least 80% of the appropriate flow warrants.

From the above, the RMS warrants consist of five separate sections whereby compliance with only one of these sections is required for the consideration of traffic signals.

Under the "Traffic Demand" warrant, the major road flow is required to exceed 600 vph in each of four one-hour periods in a typical day. In addition, the minor road flow is required to exceed 200 vph in each of four one-hour periods.

In Scenario S3, the two-way morning and afternoon peak hour flows on Willoughby Road would be approximately 3,400 vph and 3,200 vph, respectively. Similarly, the two-way morning and afternoon peak hour flows on Walter Street would be 219 vph and 192 vph, respectively. In Scenario S4, Walter Street traffic would increase to 250 vph and 215 vph during the morning and evening peak periods respectively. It is noted that the hourly flows on either side of the peak hour during the morning and evening peak periods would have similar traffic flows as well.

Therefore, future traffic flows at this intersection are such that it would meet the "Traffic Demand" warrant for traffic signals in which each of four hourly flows on Willoughby Road and Walter Street would exceed the volumes specified in the warrant.

6 Consultation

6.1 Roads and Maritime Services (RMS)

In conducting the traffic study, TTPP has consulted RMS in relation to the proposed signalisation of the Walter Street intersection.

Initially, traffic assessment were undertaken in SIDRA Intersection modelling software. The SIDRA modelling results were included in an earlier version of this report. That report together the SIDRA electronic model files were forwarded to RMS for their review and comment.

Following their review of the submitted information, RMS has written to Willoughby City Council indicating their in principle approval for Walter Street intersection with Willoughby Road be upgraded to traffic signals. RMS' letter to Council is contained in Appendix C.

Subsequent to RMS and Council discussions, RMS also requested for the traffic assessment to be conducted using micro-simulation traffic modelling software, VISSIM. As noted in this report, TTPP has engaged Bitzios Consulting to prepare and develop the VSSIM traffic models. The results from the VISSIM models are discussed in Section 4 of this report.

6.2 Willoughby City Council

The applicant of this planning proposal has had several meetings with Willoughby City Council. In the meetings, Council has not raised any concerns relating to the signalisation of the Walter Street intersection.

Council's Traffic Engineer also provided comments on a draft copy of this report. These comments have addressed and discussed in a meeting with Council on 18 May 2017.

6.3 Applicant for Proposed Childcare Centre

A meeting was also held on 7th February 2017 between the proponents of the subject planning proposal and the proposed childcare centre at 1 Walter Street.

In the meeting both, parties agree that traffic signals at Walter Street would provide the best outcome for all stakeholders. As such, the applicant for the childcare centre has indicated support for the proposed traffic signals. It was agreed that all stakeholders would work together in a holistic approach to achieve outcomes to the mutual benefits of all parties.

7 Conclusion

This traffic report examines the traffic effects of the redevelopment of Walter Street under R3 medium density residential zoning and R4 high density residential zoning with consideration to background traffic growth and traffic arising from the other proposed developments within the vicinity (the Channel 9 site as well as proposed childcare centre on Walter Street).

This traffic assessment finds that growth in the background traffic alone would result in the Walter Street and Willoughby Road intersection to operate poorly. A combination of traffic generated by the subject development zoned as R3, the Channel 9 site and proposed childcare centre would trigger the need to upgrade the Walter Street intersection.

Traffic signals at the Walter Street intersection would have more than adequate capacity to provide a good level of service in the future following the completion of all known developments.

If the Walter Street intersection was to be upgraded to operate under traffic signal control, it would also have sufficient traffic capacity to accommodate additional development traffic arising the proposed zoning of Walter Street as R4 high density residential zoning.

It is envisaged that if the Walter Street intersection was to be upgraded to operate under signal control, widening of Walter Street would also be necessary to provide two-way independent flows to improve the efficiency of the new traffic signal at Willoughby Road.

RMS warrants for the installation of traffic signals are also met under future traffic conditions at the Walter Street intersection for each of the four one-hour periods.

Finally, it is noted that RMS has provided in principle approval for the Walter Street intersection to be upgraded to traffic signals.

Appendix A

Base Model Calibration and Validation Technical Note prepared by Bitzios Consulting

Issue History

File Name	Prepared by	Reviewed by	Issued by	Date	Issued to
P3062.001T Walter Street Willoughby VISSIM Modelling	S. Hasan	A. Ahmed	A. Ahmed	26/04/2017	Michael Lee Michael.Lee@ttpp.net.au
P3062.002T Walter Street Willoughby VISSIM Modelling	S. Hasan	A. Ahmed	A. Ahmed	29/05/2017	Michael Lee Michael.Lee@ttpp.net.au
P3062.003T Walter Street Willoughby VISSIM Modelling	S. Hasan	A. Ahmed	A. Ahmed	26/06/2017	Michael Lee Michael.Lee@ttpp.net.au
P3062.004T Walter Street Willoughby VISSIM Modelling	S. Hasan	A. Ahmed	A. Ahmed	26/07/2017	Michael Lee Michael.Lee@ttpp.net.au

Technical Note – Base Model Calibration and Validation

1. INTRODUCTION

1.1 BACKGROUND

Bitzios Consulting has been engaged by The Transport Planning Partnership Pty Ltd (TTPP) to develop an existing condition traffic model for a section of Willoughby Road between Artarmon Road in the north and Rohan Street in the south. It is understood that TTPP is currently assisting a private property developer with a planning proposal that includes a proposal for rezoning the existing properties that are located on the northern side of Walter Street, from R3 medium density to R4 high density residential. It is also noted that currently there are other development proposals including a childcare centre at the north-west corner of Willoughby Road / Walter Street intersection and re-development of Channel 9 site on Artarmon Road. The additional traffic from these developments would use Willoughby Road. It is understood that TTPP has performed some initial analysis on the Willoughby Road / Walter Street intersection which suggests the intersection requires to be signalised. Roads and Maritime Service (Roads and Maritime) has approved the signalisation which requires additional traffic modelling and assessment to demonstrate the impact of such upgrade.

An existing condition VISSIM micro-simulation traffic model has been developed for Willoughby Road between Artarmon Road and Rohan Street including Warringah Freeway interchange, as suggested by Roads and Maritime. The model demonstrates the existing traffic conditions during a typical weekday AM and PM peak periods, and can be used to create future year models to assess traffic performance in the study area.

This technical note documents data collection/collation, model development process and key assumptions as well as the calibration and validation of the base model.

1.2 STUDY AREA

The study area comprises of Willoughby Road as shown in Figure 1.1 within its wider context, while the modelled area is shown in Figure 1.2

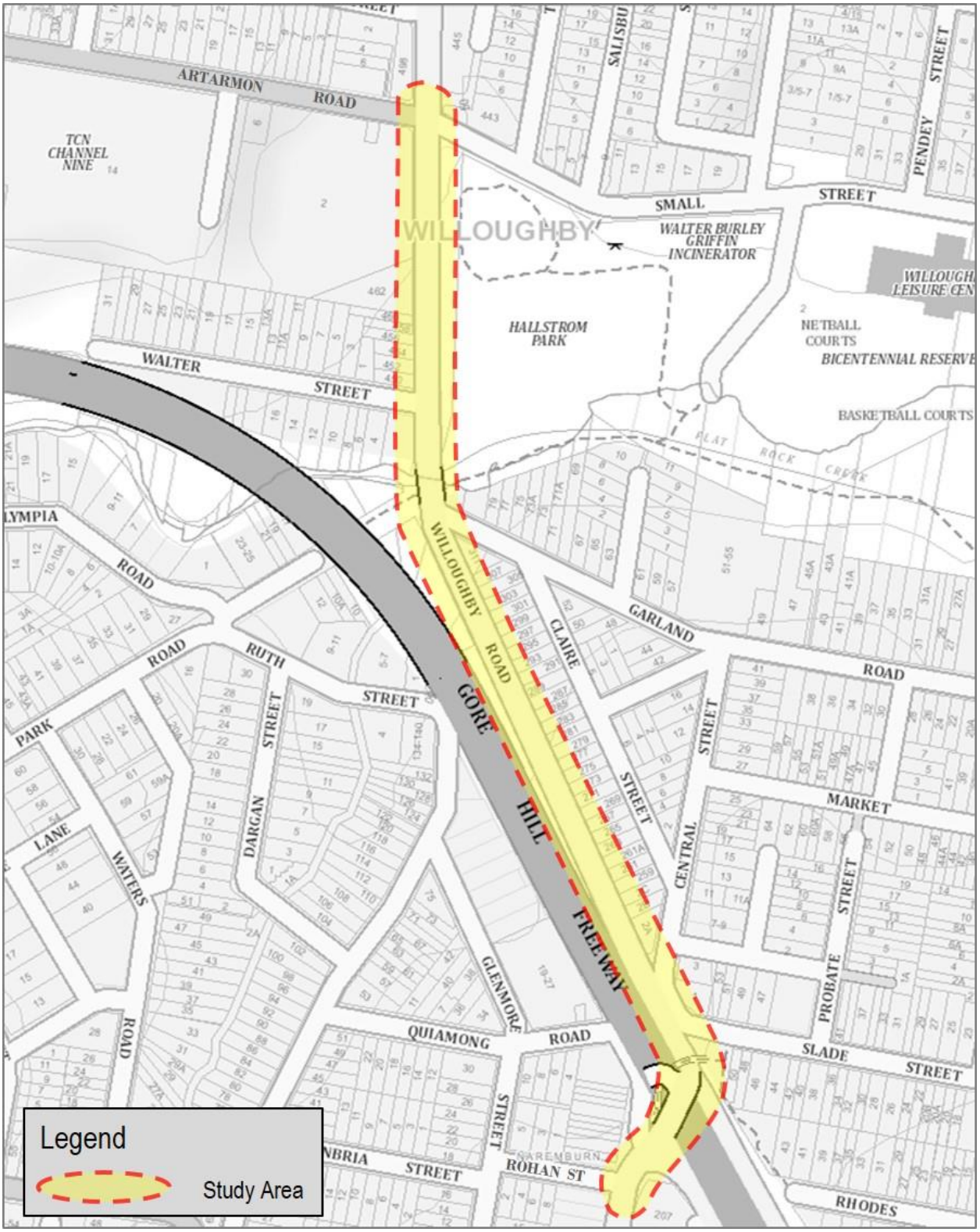


Figure 1.1: Study Area

The modelled area captures the length of Willoughby Road between Artarmon Road and Rohan Street including the Warringah Freeway entry ramp and exit ramp intersection with Willoughby Road. All key side-roads and pedestrian crossings are included in the model. The modelled roads and intersections are shown in Figure 1.2.

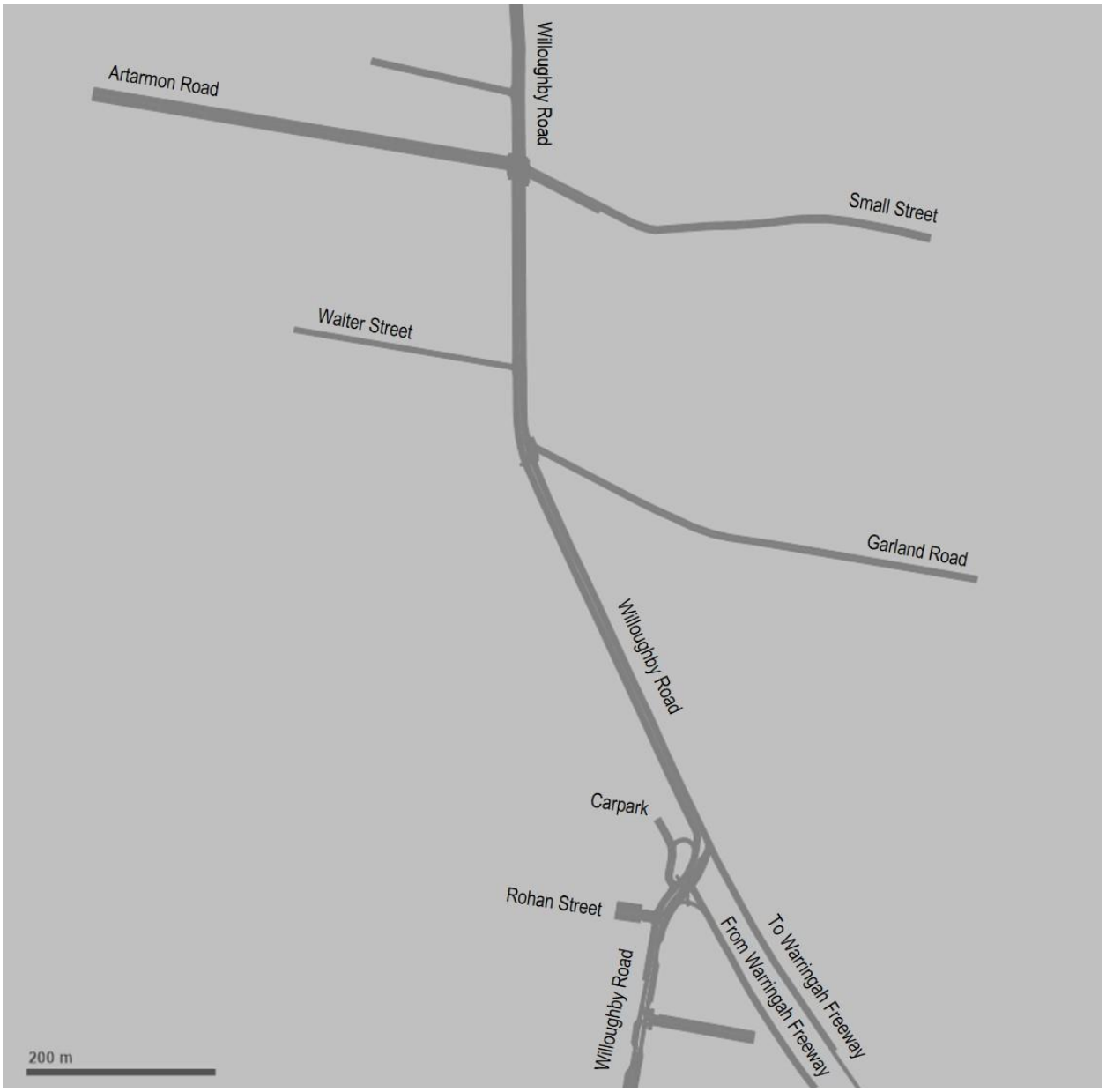


Figure 1.2 Modelled Area

1.3 SITE VISIT

Site visits were conducted on Wednesday 29 March 2017, during morning and afternoon peak hours. On-site observations were undertaken of traffic flows, pedestrian behaviour and the signal operations at the Willoughby Road / Artarmon Road, Willoughby Road / Garland Road and Willoughby Road / Warringah Freeway signalised intersections. Other features such as on-street parking, bus stop locations and a qualitative understanding of vehicle and pedestrian volumes were also gained during the site visit.

2. DATA SOURCES

2.1 KEY DATA

Traffic data used to develop the VISSIM model have been extracted from a variety of sources including:

- intersection turning volumes;
- pedestrian counts;
- queue survey;
- IDMs informing signal phasing programs; and
- travel time surveys.

2.2 INTERSECTION COUNTS

Traffic and pedestrian counts were collected for the following five intersections:

- Willoughby Road / Artarmon Road / Small Street;
- Willoughby Road / Walter Street;
- Willoughby Road / Garland Road;
- Willoughby Road / Warringah Freeway; and
- Willoughby Road / Rohan Street.

The count locations are shown in Figure 2.1.

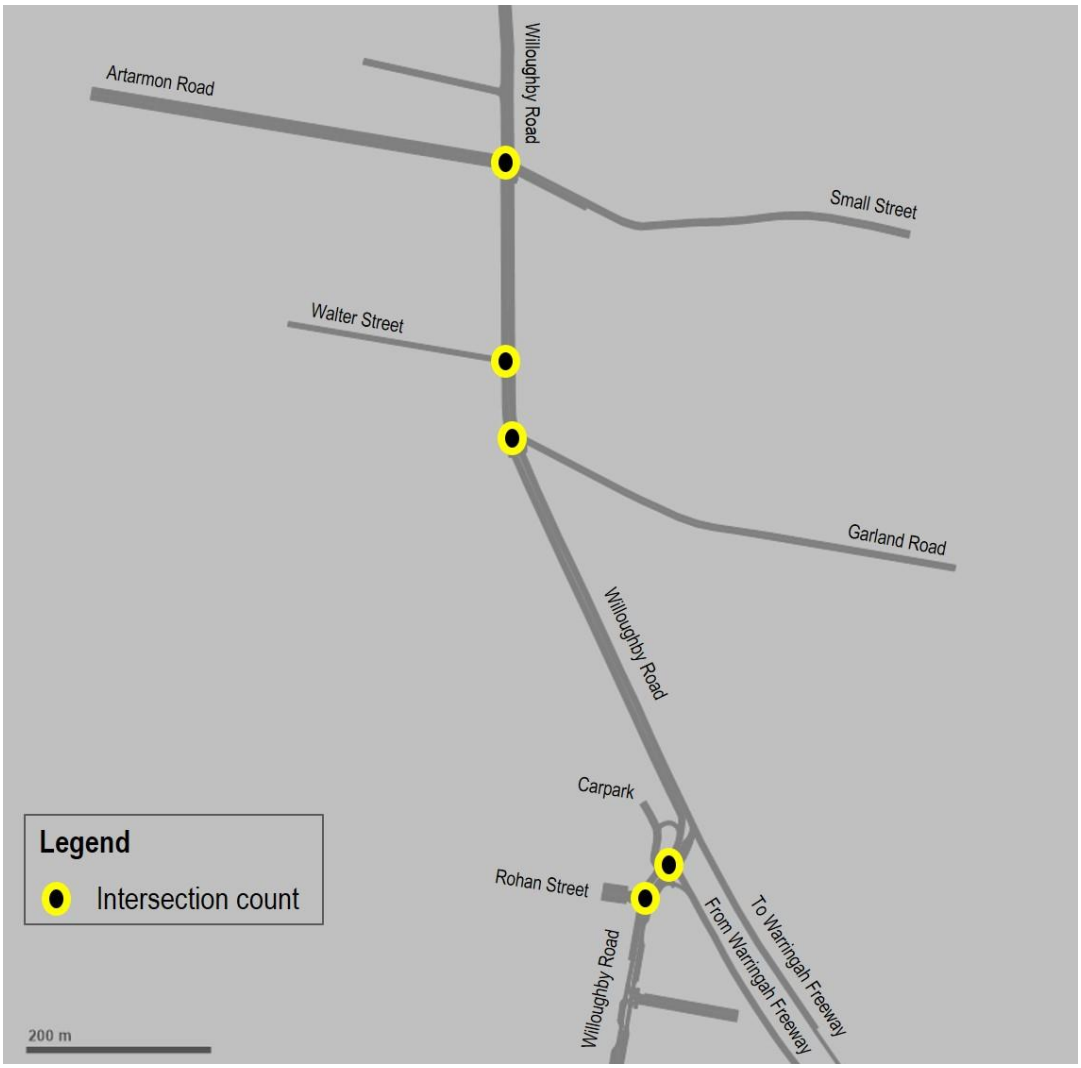


Figure 2.1: Intersection Count Locations

The morning (7am - 9am) and afternoon (4pm – 6pm) peak traffic data was collected on Thursday 18th August 2016 at the following intersections:

- Willoughby Road / Artarmon Road / Small Street;
- Willoughby Road / Walter Street; and
- Willoughby Road / Garland Road.

For the following two intersections within the study area, the morning and afternoon peak traffic data was collected on Wednesday 29th March 2017:

- Willoughby Road / Warringah Freeway; and
- Willoughby Road / Rohan Street.

Output time interval for each of these data was 15 minutes, which included following road user classes:

- Cars,
- Trucks;
- Buses; and
- Pedestrians.

2.3 BALANCED TRAFFIC COUNT

Engineering judgement was applied to manually balance the different data sets of traffic counts. The balanced traffic counts for AM and PM peaks are shown in Figure 2.2 and Figure 2.3, respectively.

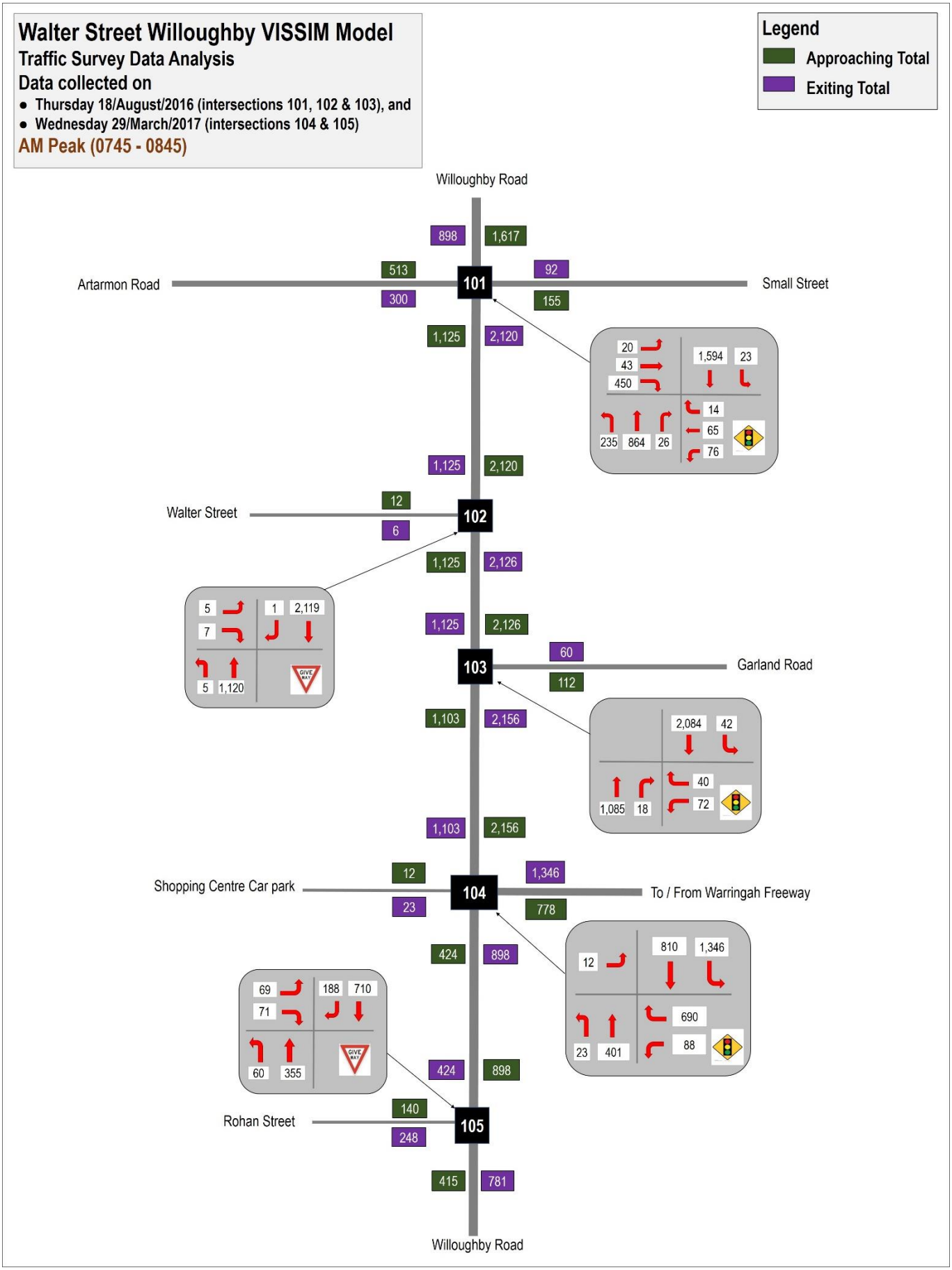


Figure 2.2: AM Flow Stick Diagram

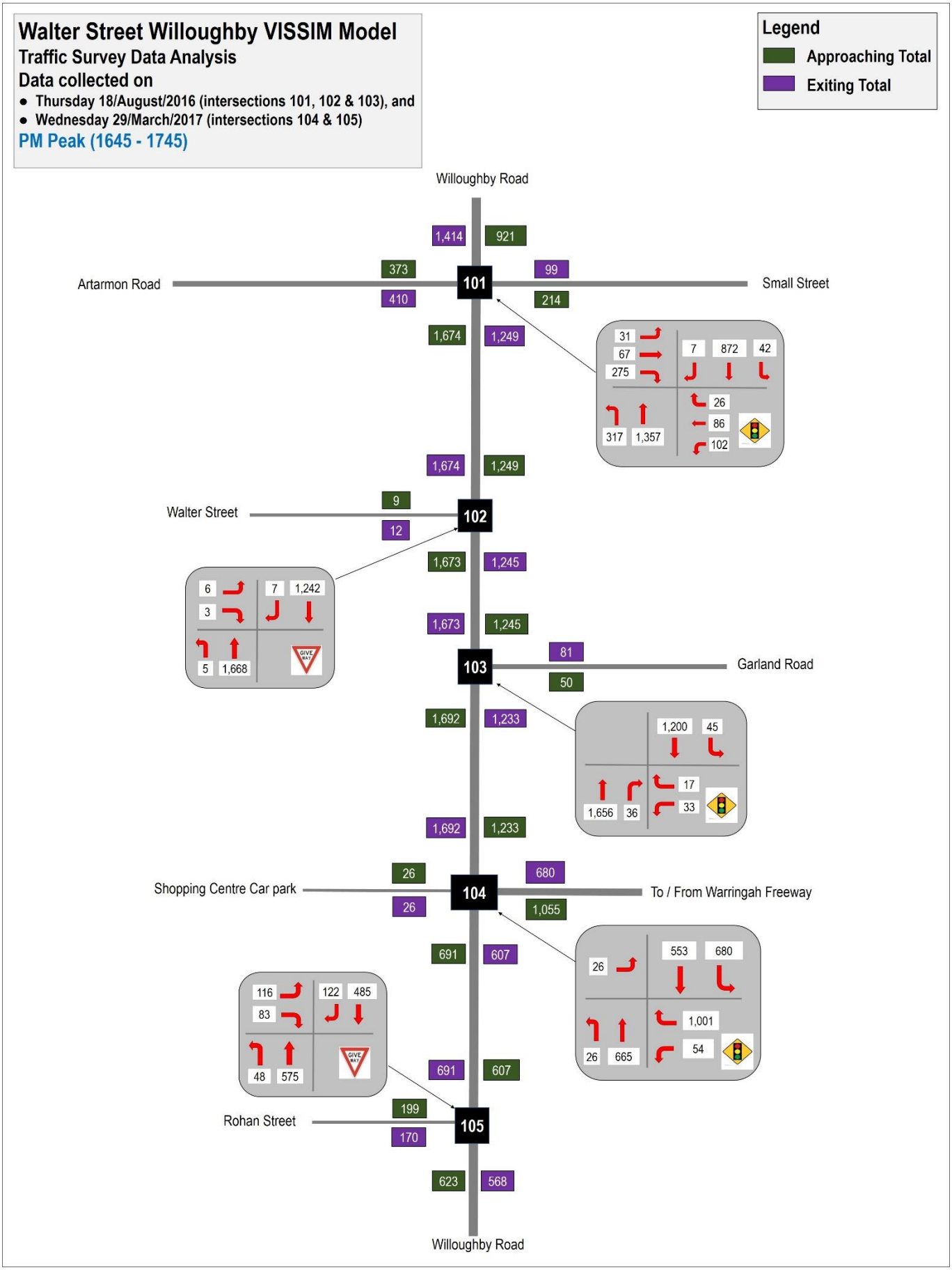


Figure 2.3: PM Flow Stick Diagram

2.4 QUEUE DATA

The morning (7am - 9am) and afternoon (4pm – 6pm) peak queues data was collected on Wednesday 29th March 2017 at the following intersections:

- Willoughby Road / Artarmon Road / Small Street;
- Willoughby Road / Walter Street;
- Willoughby Road / Garland Road;
- Willoughby Road / Warringah Freeway; and
- Willoughby Road / Rohan Street.

These locations are shown in Figure 2.4.

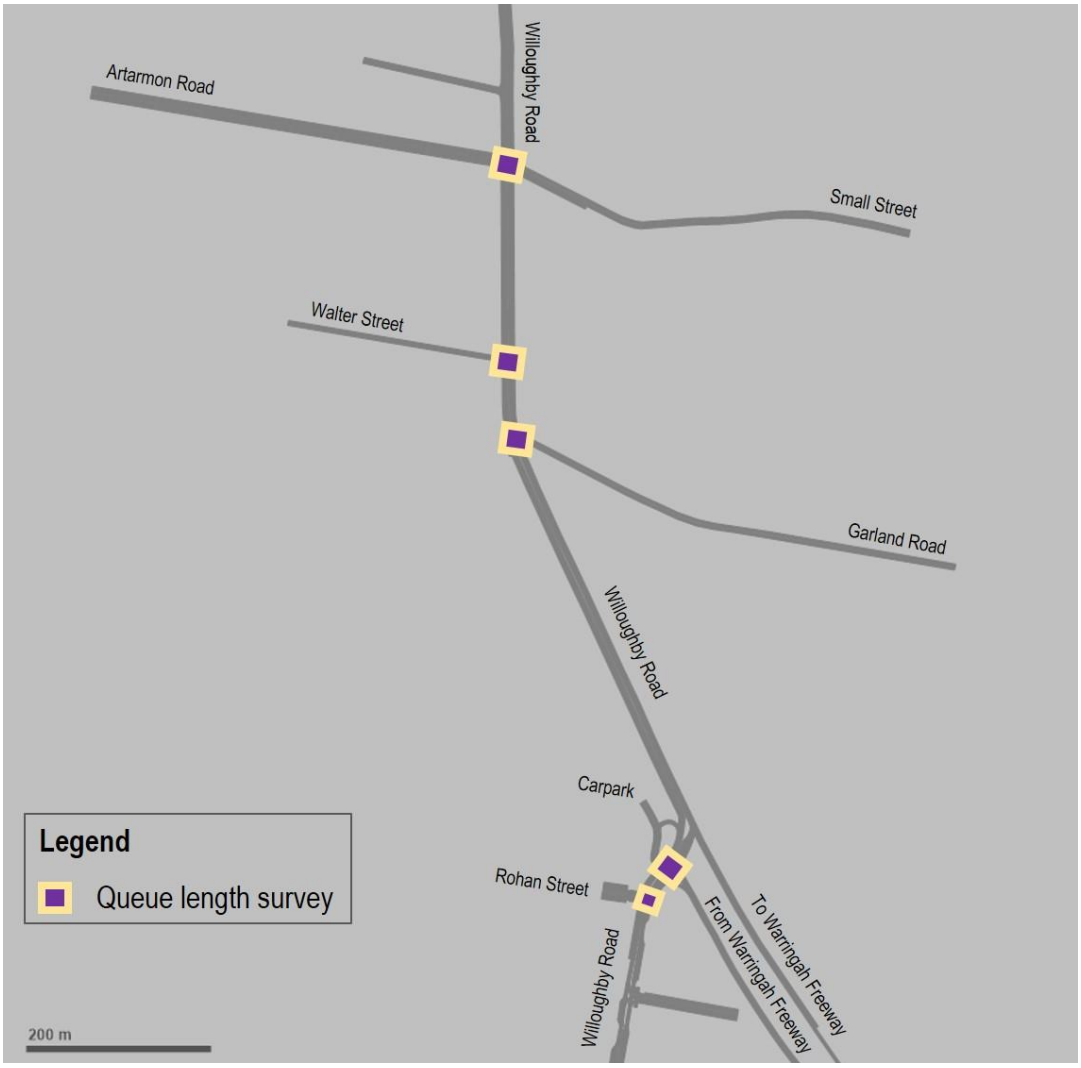


Figure 2.4 Queue Length Survey locations

Data was collected for every 5-minutes interval for each lane on all approaches.

2.5 SCATS IDM DATA

SCATS IDM data was recorded by Roads and Maritime for the following three signalised intersections:

- Willoughby Road / Artarmon Road / Small Street;
- Willoughby Road / Garland Road; and
- Willoughby Road / Warringah Freeway.

These locations are shown in Figure 2.5.

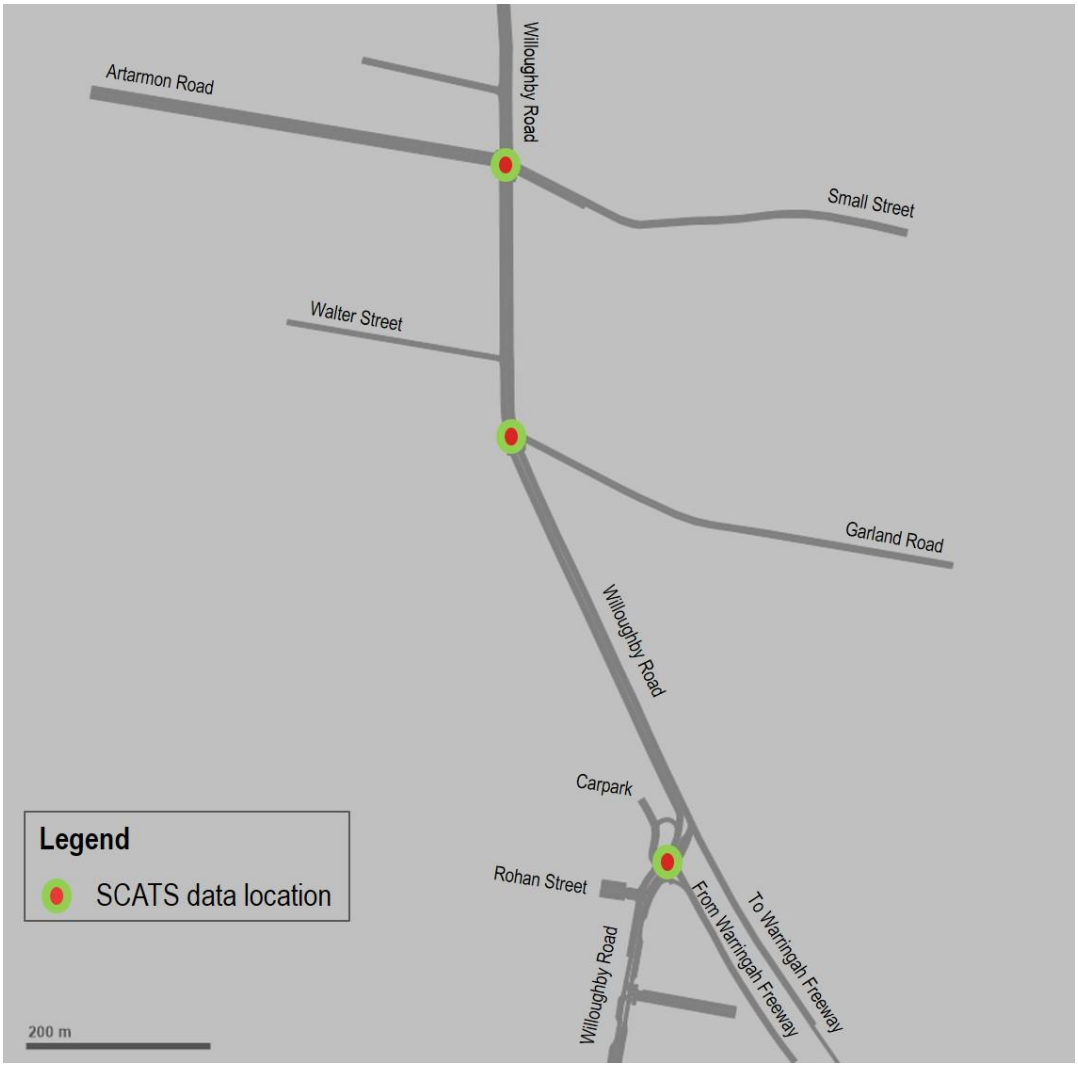


Figure 2.5 SCATS Data Locations

Data was provided for 15 minute intervals for Wednesday, 29 March 2017.

2.6 TRAVEL TIME SURVEYS

A travel time surveys was conducted on Wednesday 29th March 2017 for the following two routes in the northbound and southbound directions:

- between the Willoughby Road / Armstrong Street Intersection and the Willoughby Road / Rohan Street intersection; and
- between the Artarmon Road Scott Street intersection and the Warringah Freeway entry/exit ramp.

The northbound and southbound routes are shown in Figure 2.6.

Figure 2.6: Travel Time Sections

2.6.1 Travel Time Survey Method

The travel time survey was conducted using Bluetooth technology. Bluetooth sensor was placed at the start and the end points of each route. The sensor recognises unique Bluetooth frequency from a vehicle mounted device (e.g. mobile phones, ear phone and in vehicle hands free audio system) as it passes a particular entry point at a particular time. The subsequent detection of the same vehicle at the exit point determines the travel time.

This survey method was able to provide a large number of sample. The number of samples collected during the peak period is summarised in Table 2.1.

Table 2.1 Travel Time Survey - Sample Size

Peak	Routes			
	Armstrong Street and Rohan Street		Scott Street and Freeway	
	Northbound	Southbound	Northbound	Southbound
AM (07:45 -08:45)	148	124	76	80
PM (16:45 -17:45)	168	144	118	117

2.7 SPEED LIMIT

The section of Willoughby Road north of the Warringah Freeway ramps is subject to 60 km/h speed limit. The posted speed limit on the Willoughby Road section south of the Warringah Freeway ramps is 50 km/h. All the side roads including Artarmon Road, Walter Street, Garland Road and Rohan Street are subject to 50 km/h. The section of Willoughby Road under investigation does not have a school zone.

The existing speed zones are summarised in Figure 2.7.

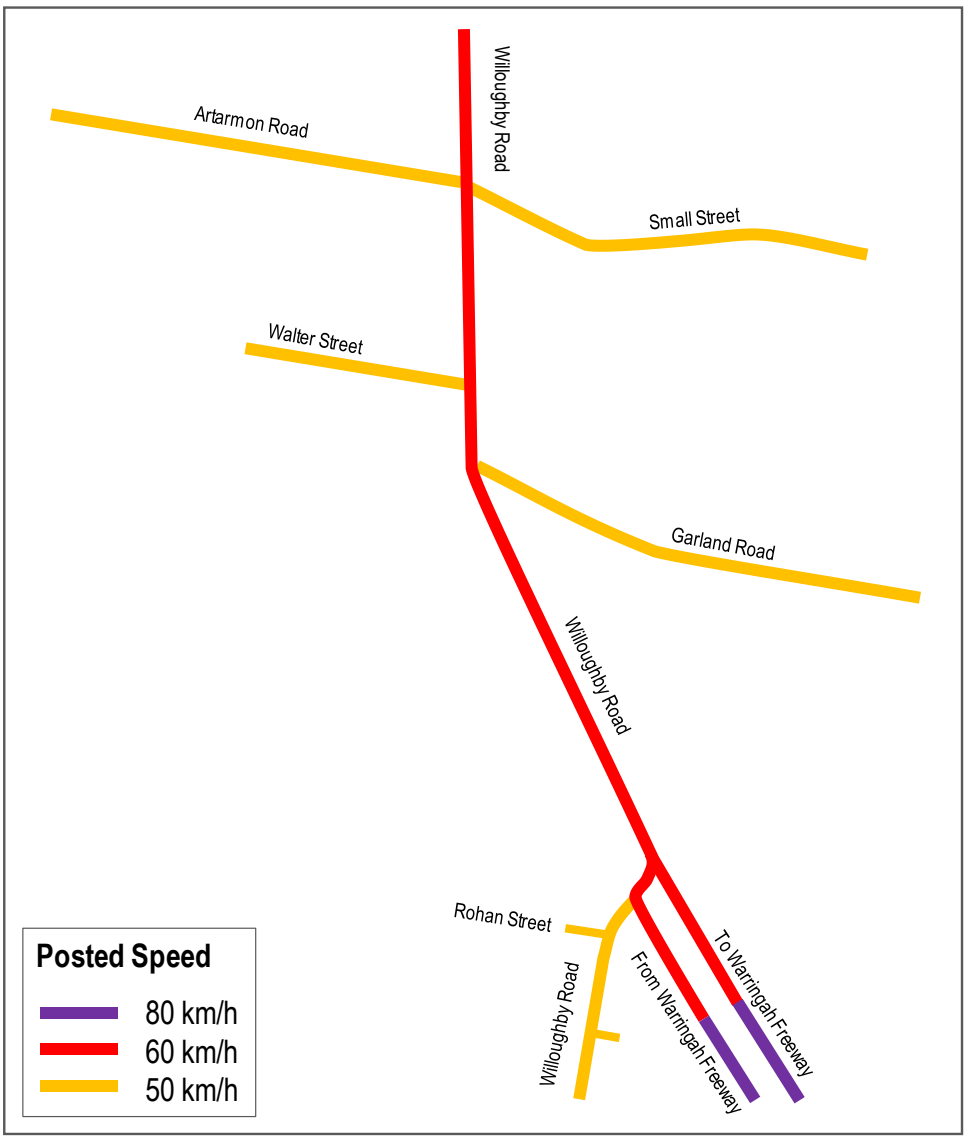


Figure 2.7: Speed Zones

3. VISSIM MODEL DEVELOPMENT

3.1 OVERVIEW

The VISSIM model was coded in accordance with RMS Modelling Guidelines. Model parameters were left at the VISSIM defaults. Some of the key features of the model coding that should be noted are:

- movements within intersections and approaching pedestrian crossings are controlled by "Priority Rules" to demonstrate appropriate give-way behaviours;
- vehicle inputs release vehicles into the models as per the existing posted speed limit;
- reduced speed areas were included in some locations to more accurately reflect vehicle behaviour in particular parts of the corridor, or while completing certain manoeuvres; and
- kerbside parking spaces were included in the model to simulate the friction caused by the on-street parallel parking present.

The following aspects of the model development are more thoroughly explained below:

- public transport services;
- zone system and matrix formulation;
- demand profiling; and
- VisVAP signalling.

The following turn restrictions are currently in place at the Willoughby Road intersection with Artarmon Road:

- The right turn movement from the northern approach of Willoughby Road (AM peak); and
- The right turn movement from the southern approach of Willoughby Road (PM peak).

3.2 PUBLIC TRANSPORT SERVICES

An updated information of bus service within the study area was collated from www.transportnsw.info and Google Maps, and presented in **Table 3.1** with reference to **Figure 3.1** below.

Table 3.1 Bus Service Summary

Route	Route Description	Reference to Figure 3.1	Remarks
257	Balmoral to Chatswood via Crows Nest	ac	
	Chatswood to Balmoral via Crows Nest	xy	
272	City Wynyard to North Willoughby	bc	Weekdays Afternoon Peak only
	North Willoughby to City Wynyard	xz	Weekdays Morning Peak only
343	Kingsford to Chatswood	ac	
	Chatswood to Kingsford	xy	
M40	Bondi Junction to Chatswood	bc	
	Chatswood to Bondi Junction	xz	

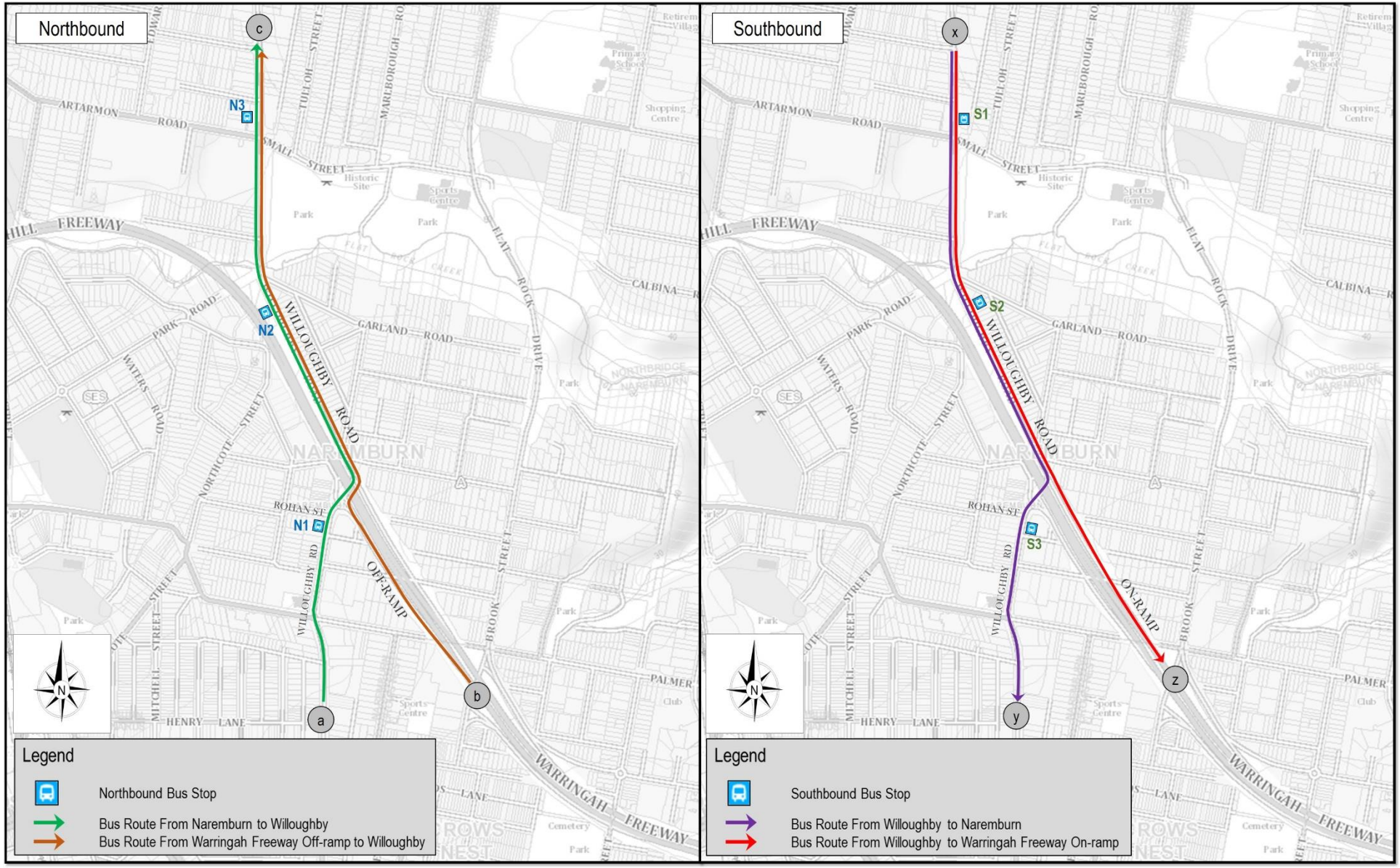


Figure 3.1 Bus Routes Overview Map

The bus stops within the study area are summarised in Table 3.2 and Table 3.3.

Table 3.2 List of Northbound Bus Stops

TSN	Description of Transit Stop	Reference to Figure 3.1	Bus Routes
206550	Willoughby Road Near Rohan Street	N1	257, 343
206551	Willoughby Road Near Garland Road	N2	257, 272, 343, M40
206881	Willoughby Road Near Armstrong Street	N3	257, 272, 343, M40

Table 3.3 List of Southbound Bus Stops

TSN	Description of Transit Stop	Reference to Figure 3.1	Bus Routes
206879	Willoughby Road Near Small Street	S1	257, 272, 343, M40
206534	Willoughby Road Near Garland Road	S2	257, 272, 343, M40
206535	Willoughby Road Near Dodds Street	S3	257, 343

The timetabled stopping times were gathered from www.transportnsw.info for each TSN based on January 2017. This data is presented in Attachment A.

3.3 TRAVEL ZONE SYSTEM AND MATRIX FORMULATION

Engineering judgement was applied to combine the balanced traffic data with site observations, to estimate a "best guess" prior matrix. Each period's matrix was then run through the model with manual adjustments made to satisfactorily represent the base traffic patterns while achieving the model calibration criteria. The study area includes the following nine travel zones:

- Zone 1: Willoughby Road (North);
- Zone 2: Small Street;
- Zone 3: Garland Road;
- Zone 4: Warringah Freeway;
- Zone 5: Willoughby Road (South);
- Zone 6: Rohan Street;
- Zone 7: Shopping Centre Car park;
- Zone 8: Walter Street; and
- Zone 9: Artarmon Road;

The travel zones are shown in Figure 3.2.

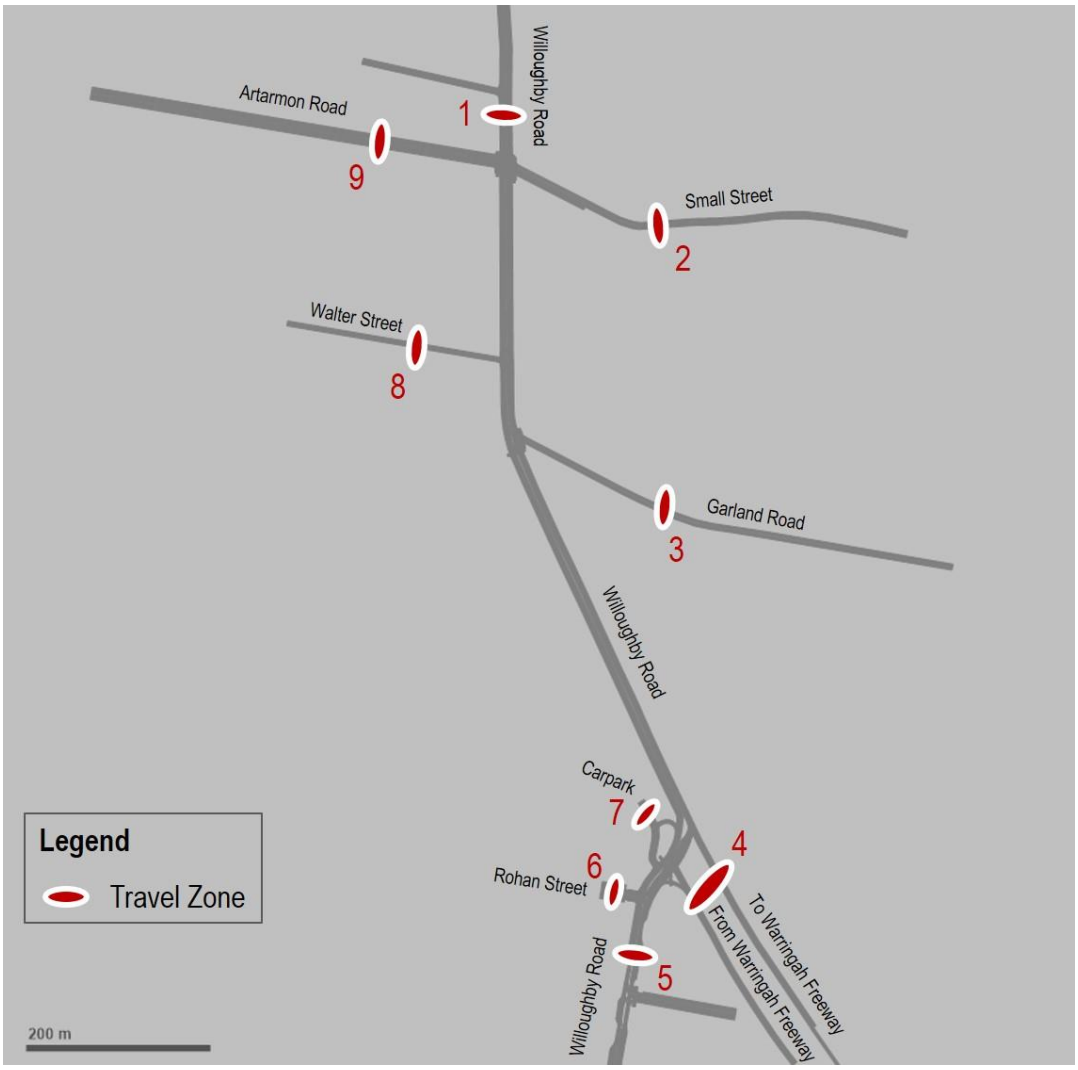


Figure 3.2: Zones for Travel Matrix

3.4 TIME PERIODS AND PROFILES

3.4.1 Modelled Periods

The AM and PM peak periods were identified based on traffic survey data at the key intersection of Willoughby Road and Warringah Freeway. This is considered to be the key intersection within the study area. The model has been set up to include a 45-minutes warm-up period, a 1-hour evaluation period and a 15-minutes cool-down period, for both the peak periods. These are:

Peak Periods	Warm Up	Peak Period	Cool Down
AM	07:00 – 07:45	07:45- 08:45	08:45 – 09:00
PM	16:00 – 16:45	16:45- 17:45	17:45 – 18:00

Results have been set up to be recorded in 15-minute intervals, while the majority of model inputs are also entered in 15-minute increments.

3.4.2 Demand Profiling

In order to ensure that the correct number of vehicles are released into the network as per defined time slices, a demand profile was constructed. Temporal traffic profiles were developed for 15 minute periods based on the surveyed traffic data at the key intersection of Willoughby Road and Warringah Freeway.

The AM and PM peak demand profiles are presented in Table 3.4 and Table 3.5 below.

Table 3.4: AM Traffic Demand Profile

Measure	AM Peak			
	07:45 - 08:00	08:00 - 08:15	08:15 - 08:30	08:30 - 08:45
Demand Profile	26%	24%	26%	24%

Table 3.5: PM Traffic Demand Profile

Measure	PM Peak			
	16:45 - 17:00	17:00 - 17:15	17:15 - 17:30	17:30 - 17:45
Demand Profile	25%	25%	26%	24%

3.4.3 Traffic Composition

Traffic composition used in the model was based on the analysis of traffic mix at the Willoughby Road / Warringah Freeway signalised intersection. The traffic composition used in the model is summarised in Table 3.6.

Table 3.6: AM and PM Traffic Composition

Measure	AM Peak		PM Peak	
	Light	Heavy	Light	Heavy
Traffic Composition	96%	4%	98%	2%

3.4.4 Bus Dwell Time

A normal distribution of bus dwell times has been assumed in VISSIM using the program setting. The average dwell time and standard deviation at bus stops are 20-40 seconds and 2 seconds respectively.

3.5 VISVAP SIGNALLING

The signal groups within the model are partially actuated and controlled by a VisVAP program, incorporating the signal behaviours reflected in the IDMs. The signal behaviour varies in half-hour blocks, depending on the average, observed phase timings from the IDMs.

The VisVAP signal is designed to be fully demand responsive such that phase times vary with traffic demand. In the event a phase runs shorter than the maximum phase time or the phase is skipped due to lack to demand, the cycle time is maintained by transferring any unused green time to the stretched phase.

4. CALIBRATION

4.1 CRITERIA

The model was calibrated to the balanced vehicle movement data originating from both the link counts and the turning counts. This was undertaken in accordance with the *RMS Traffic Modelling Guidelines 2013*, stipulating the requirements for model calibration. Essentially:

- for all turn and link volumes, the range of GEH values must be satisfactory;
- for volumes within a "core area", modelled volumes must also be satisfactory against specified "tolerance limits"; and
- R^2 Value to be 0.9 throughout the network, and 0.95 within "core area".

These criteria are elaborated on below. Due to the modelled area directly relating to the area under investigation, the whole model has been considered "core area".

4.2 GEH STATISTIC

The Geoffrey E. Havers (GEH) Statistic is an industry standard measure of variance between the observed count and modelled count, expressed by the following:

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

Where M is the Modelled Volume and C is Observed Volume.

This expression effectively relates the severity of variance to the size of the observed volume and allows the variance from both large and small volumes to be assessed by the same measure.

The *RMS Traffic Modelling Guidelines 2013* (Table 11.1) uses the GEH Statistic as the main measurement of variance in microsimulation modelling and sets out the following requirements for calibration to turning movement and link volumes:

- 100% of turns and links with a GEH < 10; and
- 85% of turns and links with a GEH < 5.

The GEH results for the AM and PM base model in relation to these criteria are summarised in Table 4.1, while the detailed calculations for each movement are shown in Attachment B.

Table 4.1: AM and PM Base Model Turning Movement GEH Results

Measure	AM	PM
% of GEH < 10	100%	100%
% of GEH < 5	100%	100%
Average GEH	0.4	0.3

As indicated by the results in Table 4.1, the model satisfies the GEH calibration requirements in both peaks.

4.3 CORE AREA TOLERANCE LIMITS AND R^2 VALUE

Table 11.2 of *RMS Traffic Modelling Guidelines 2013* recommends the following tolerance limits for all modelled volumes within "core areas", in this case consisting of the entire modelled area:

- for Flows < 99 vehicles – to be within 10 vehicles of the observed value;
- for 100 < Flows < 999 – to be within 10% of the observed value;
- for 1000 < Flows < 1999 – to be within 100 vehicles of the observed value;
- for Flows > 2000 – to be within 5% of the observed value; and
- R^2 of modelled vs. observed plots to be > 0.95.

The plot of the modelled vs. observe flows with the above tolerance margins are shown in Figure 4.1 and Figure 4.2 for the AM and PM peaks, respectively. The R^2 and equation of the linear trend line are also provided as per RMS requirements.

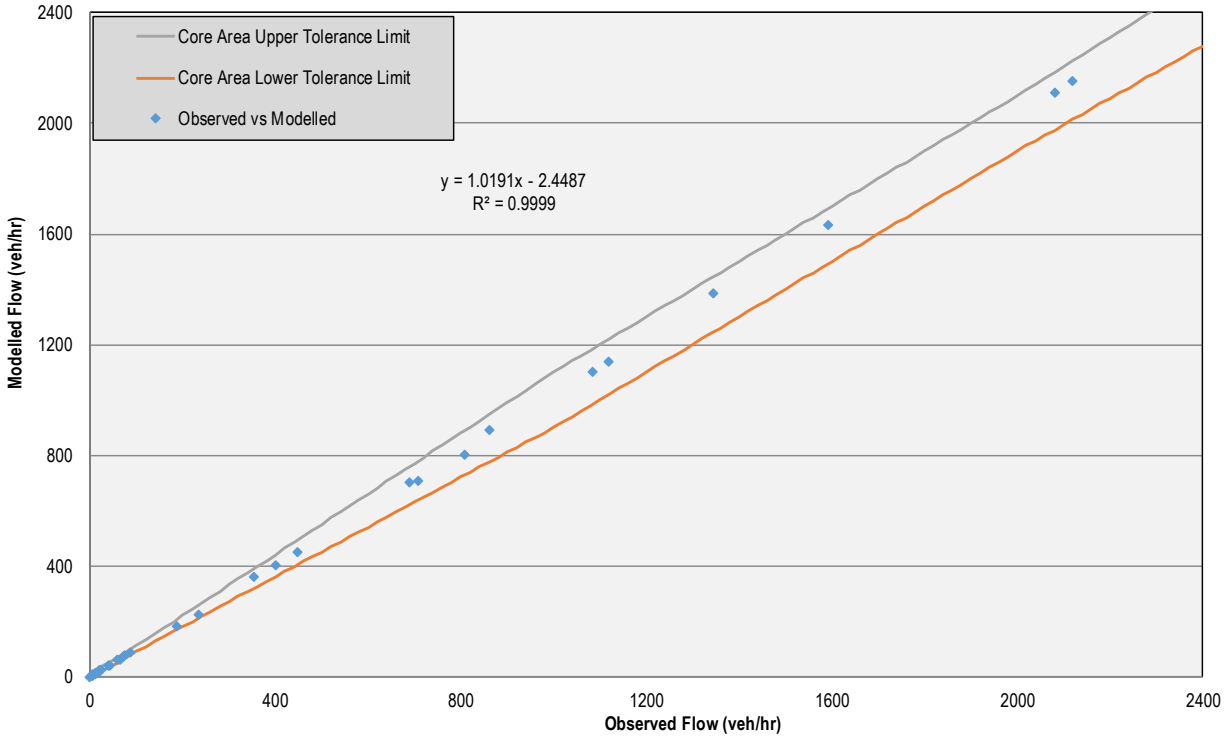


Figure 4.1: AM Traffic Volume Comparison

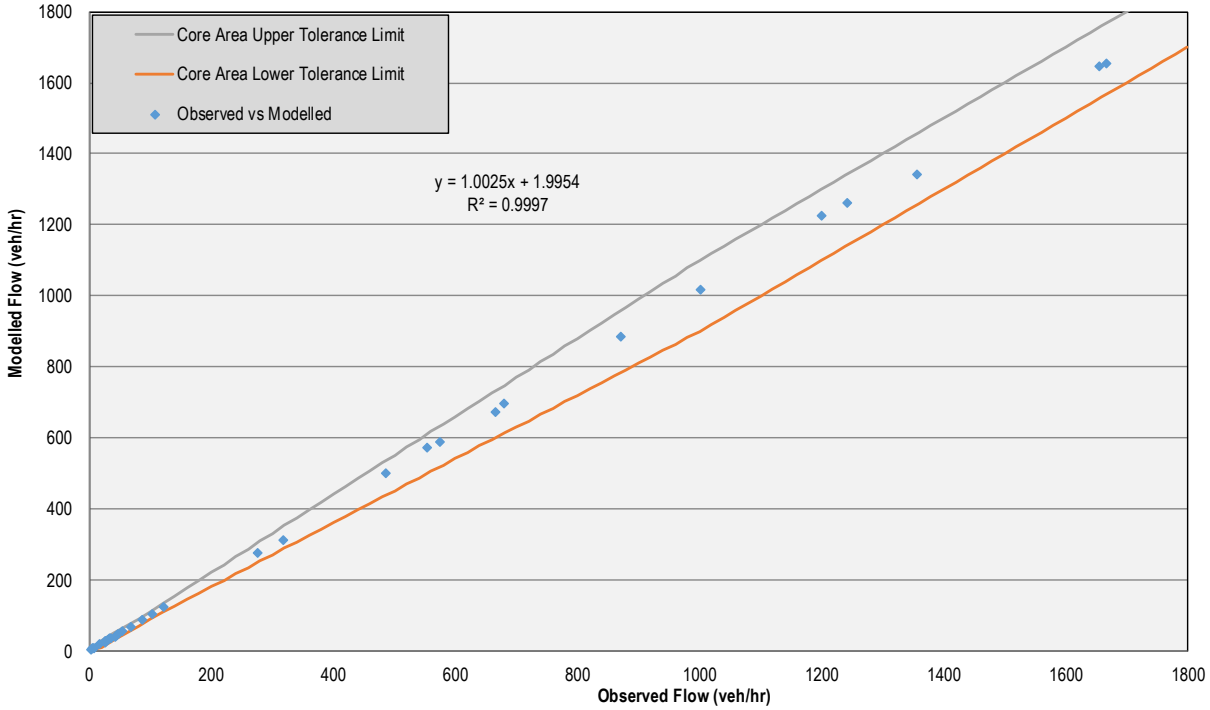


Figure 4.2: PM Traffic Volume Comparison

As evidenced by the above plots, generally, key movements are within the applicable tolerances and the R^2 values are greater than 0.95 for all peaks.

4.4 MODEL STABILITY

4.4.1 Stability Testing

Model stability between runs/seed values is particularly important in microsimulation models and is demonstrable using a variety of network performance measures. The following network performance measures have been adopted to demonstrate model stability:

- number of vehicles in the model; and
- cumulative travel time for all vehicles (vehicle hours travelled).

Model outputs for each of the two measures are presented at 15-minutes interval in Figure 4.3 through to Figure 4.6 across the following five seeds modelled:

- Run 1: Seed 10;
- Run 2: Seed 15;
- Run 3: Seed 20;
- Run 4: Seed 25; and
- Run 5: Seed 30.

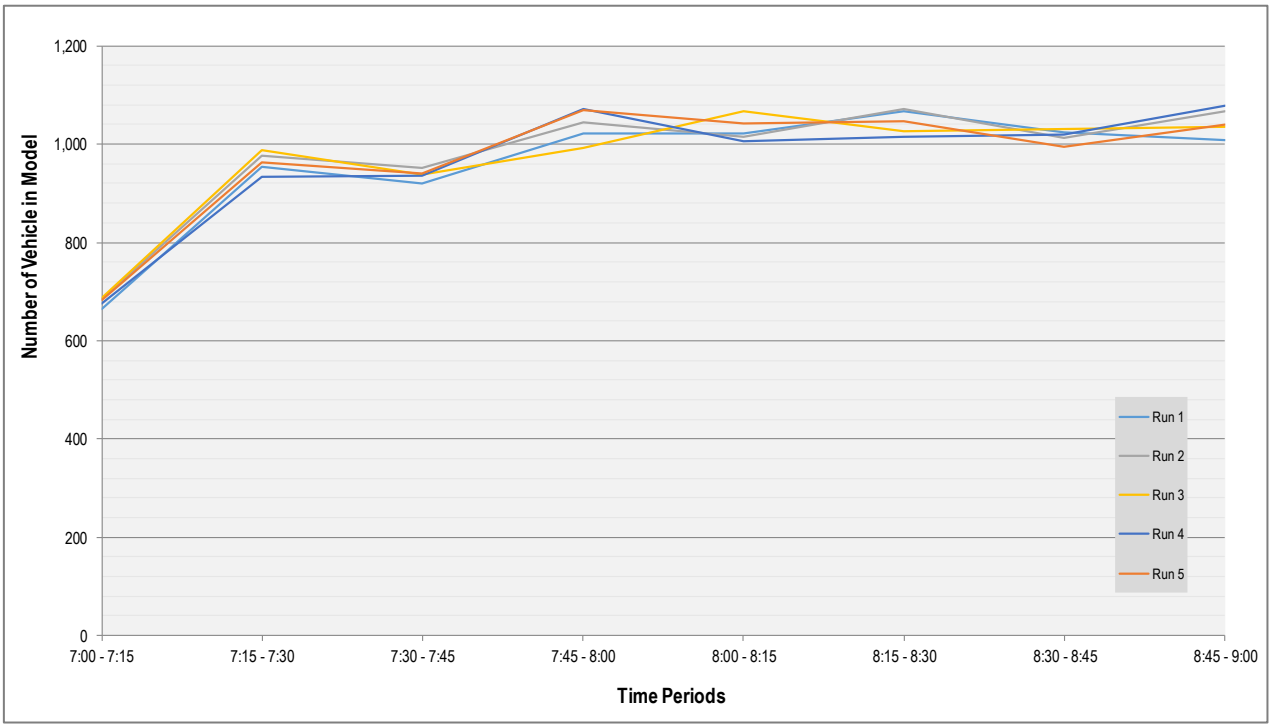


Figure 4.3: AM Peak Number of Vehicles in Model

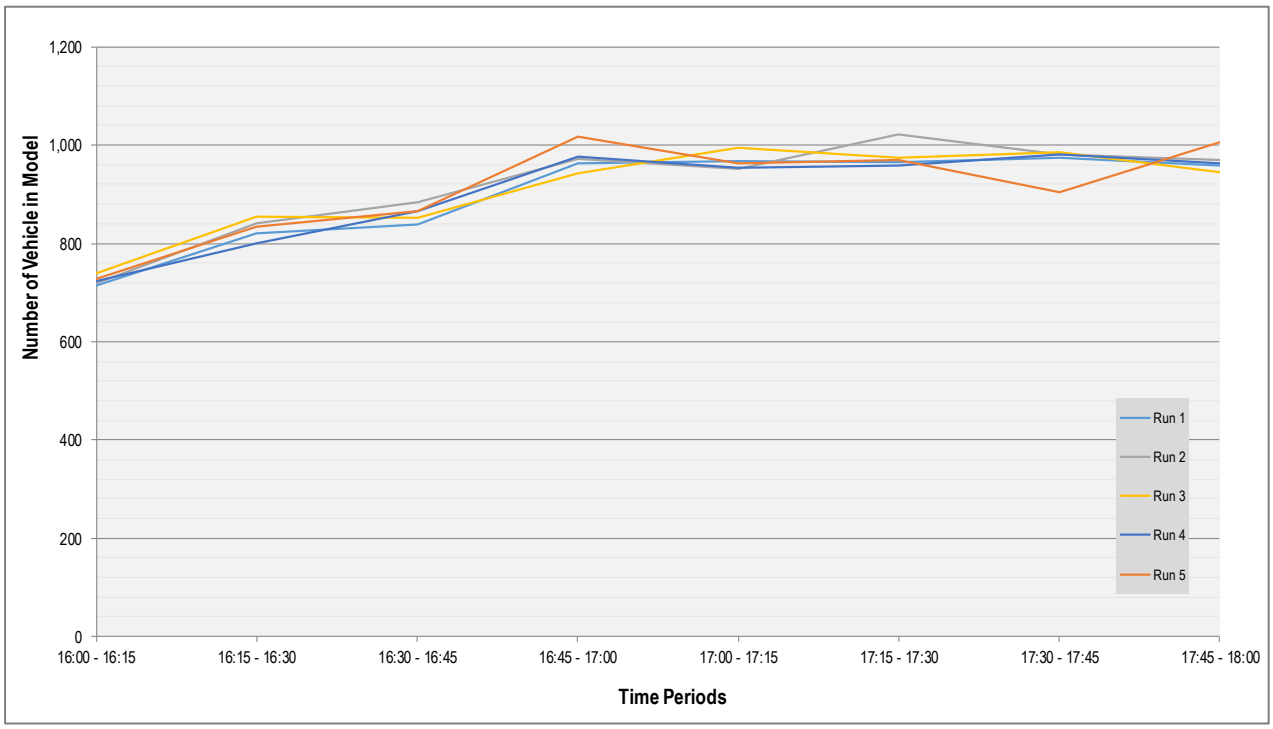


Figure 4.4: PM Peak Number of Vehicles in Model

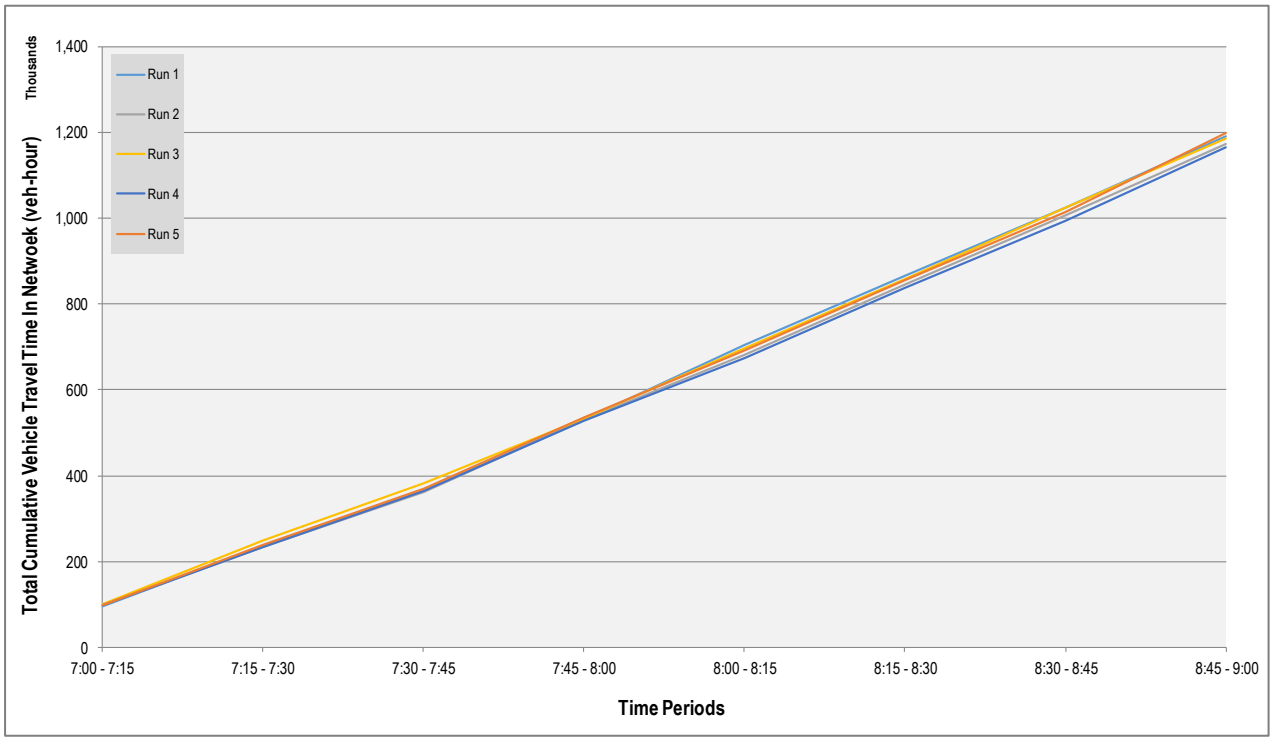


Figure 4.5: AM Peak Vehicle Hours Travelled

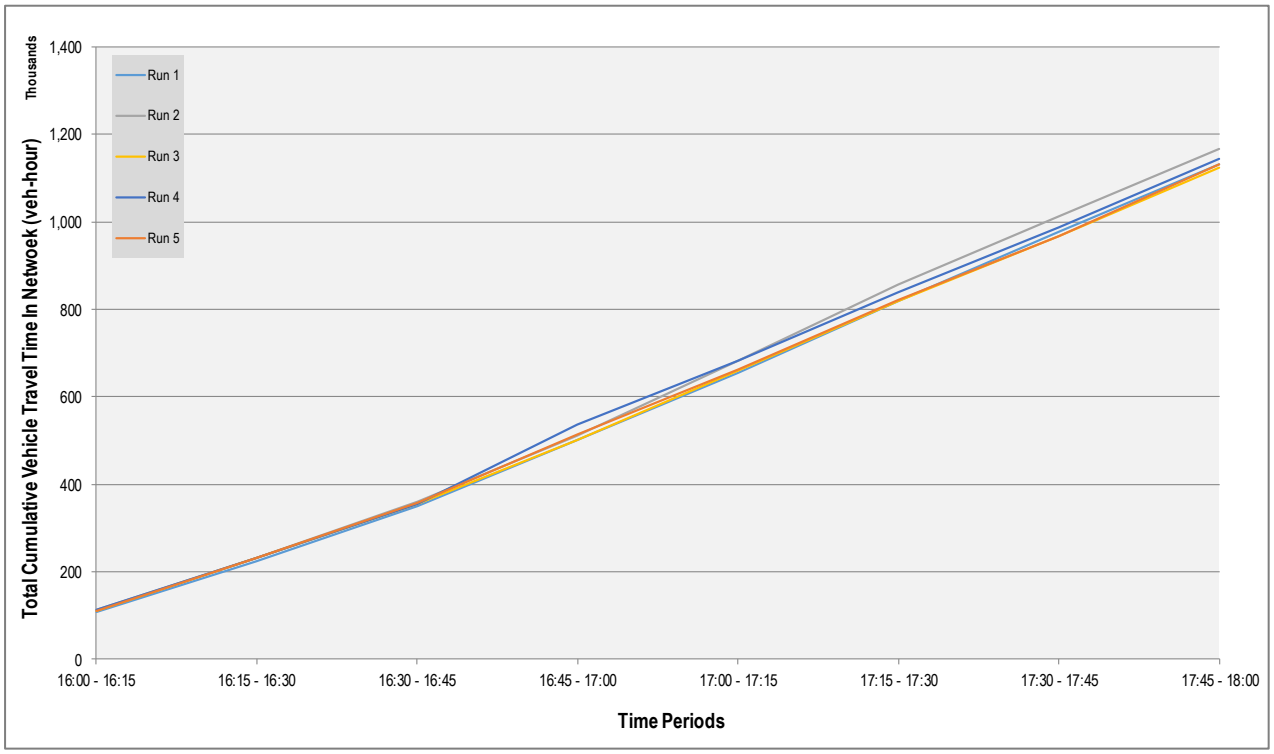


Figure 4.6: PM Peak Vehicle Hours Travelled

As evidenced by the above figures, the model behaviour across these two measures is quite consistent between seed runs. The models are therefore considered to be stable.

4.4.2 Median Seed

The median seed for each peak period has been identified by assessing the vehicle hours travelled (VHT) for each of the simulated runs. The AM and PM peak median seeds are:

- AM: Seed 30; and
- PM: Seed 30.

All calibration and validation outputs reported are drawn from the median seed run.

5. VALIDATION

Following the calibration of the model to vehicle flows, the model was validated to average vehicle travel time, queue lengths and signal behaviour.

5.1 TRAVEL TIME VALIDATION

The *RMS Traffic Modelling Guidelines* require the modelled travel times are measured in shorter sub-sections within a route with each section to be within 15% of the observed value, either above or below. Each travel time route is divided into four subsections. It is therefore possible demonstrate the level of delays at various key points along each route.

The model travel time was validated for each travel time routes as presented for both travel directions in Figure 5.1 and Figure 5.2. The northbound and southbound routes are validated well against the observed travel times in the AM and PM peak periods. Generally, the modelled average travel times are within the -15% and +15% of the observed mean. The following observation can be made:

- in the AM peak all four travel time routes are within the -15% and +15% of the observed mean;
- in the PM peak the northbound travel time between Freeway and Scott Street, modelled travel time is slightly smaller than the -15% boundary

The travel time validation summary is provided in Attachment C.

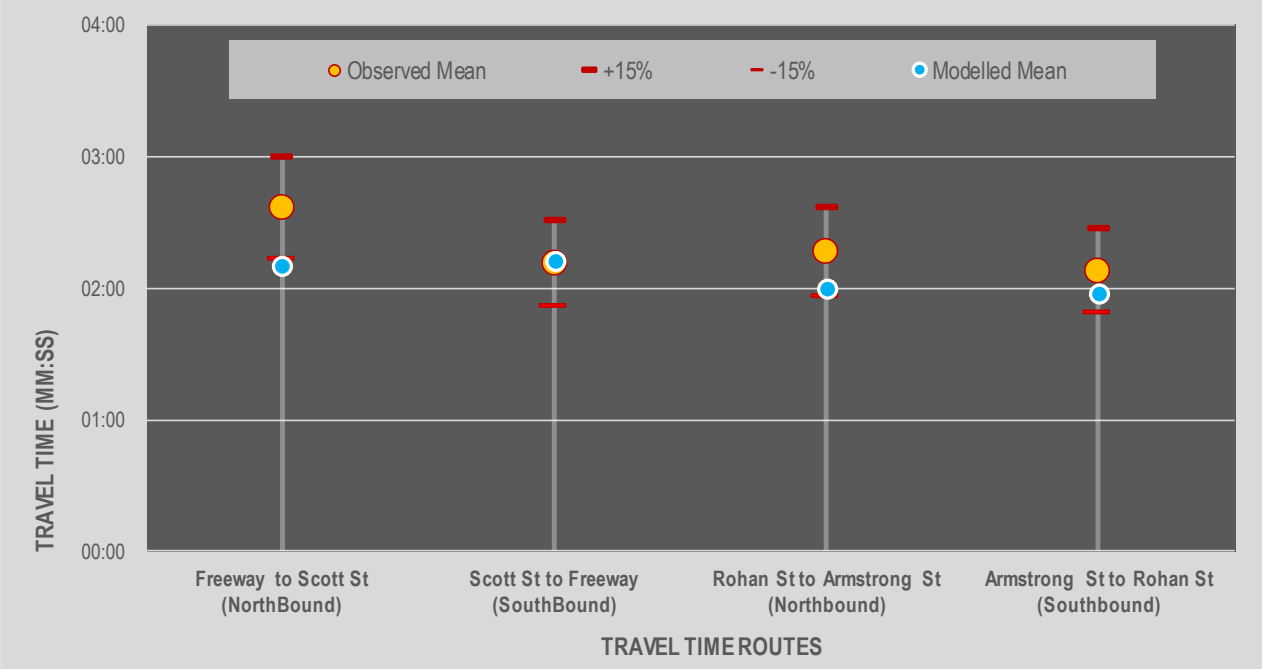


Figure 5.1: AM peak Travel Time- Observed vs Modelled

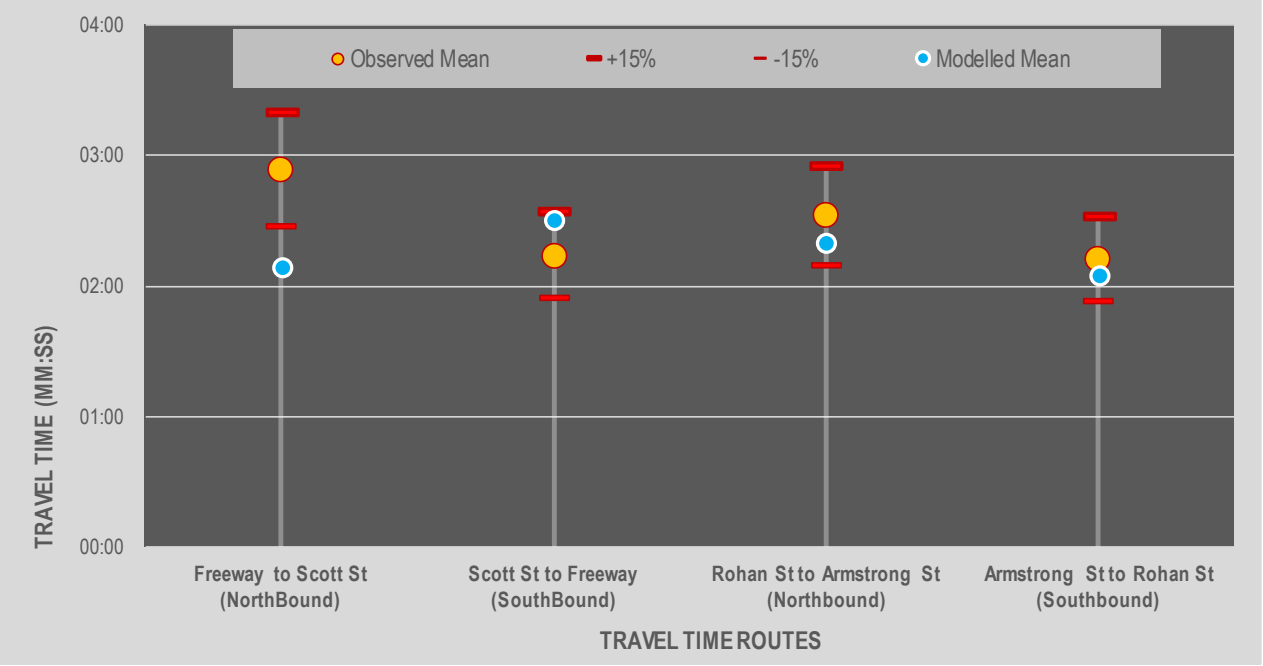


Figure 5.2: PM peak Travel Time- Observed vs Modelled

5.2 QUEUE LENGTH VALIDATION

5.2.1 Locations

During the site visits, queues were observed at several intersections on Willoughby Road. Additionally, Roads and Maritime Network Operations staff familiar with Willoughby Road traffic day-to-day operations also provided typical queue lengths at all the signalised intersections.

Queue outputs were obtained from the VISSIM model within the AM and PM peak periods. Table 5.1 shows a comparison of the observed queue (as suggested by Roads and Maritime) and modelled queues (longest queue) at the following signalised intersections:

- Willoughby Road / Artarmon Road / Small Street;
- Willoughby Road / Garland Road; and
- Willoughby Road / Warringah Freeway.

Table 5.1: Queues on the Intersection Approaches (in meters)

Intersection	Approach	AM Peak (0745 - 0845)		PM Peak (1645 - 1745)	
		Observed	Model	Observed	Model
Willoughby Road / Artarmon Road / Small Street	Willoughby Road (N)	190	169	130	104
	Small Street (E)	45	31	24	21
	Willoughby Road (S)	130	127	210	167
	Artarmon Road (W)	100	92	60	55
Willoughby Road / Garland Road	Willoughby Road (N)	140	134	78	67
	Garland Road (E)	45	49	36	24
	Willoughby Road (S)	110	83	185	149
Willoughby Road / Warringah Freeway	Willoughby Road (N)	175	171	125	144
	Warringah Freeway (E)	58	58	225	191
	Willoughby Road (S)	42	48	125	144

5.2.2 Willoughby Road / Artarmon Road / Small Street

VISSIM model shows the longest queue length of 169 metres in the AM peak on the Willoughby Road northern approach and, 167 metres in the PM peak on the Willoughby Road southern approach.

5.2.3 Willoughby Road / Garland Road

VISSIM model shows the longest queue length of 134 meters at this intersection on the Willoughby Road northern approach in the AM peak and 149 meters on the southern approach in the PM peak.

5.2.4 Willoughby Road / Warringah Freeway

VISSIM model shows the longest queue length of 171 meters on the Willoughby Road northern approach in the AM peak and 191 metres on the Warringah Freeway exit ramp approach in the PM peak.

VISSIM queues outputs are generally consistent with the observed queues. A graphical comparison of the observed AM and PM peak modelled and observed queues has been presented in Figure 5.3 through to Figure 5.8.

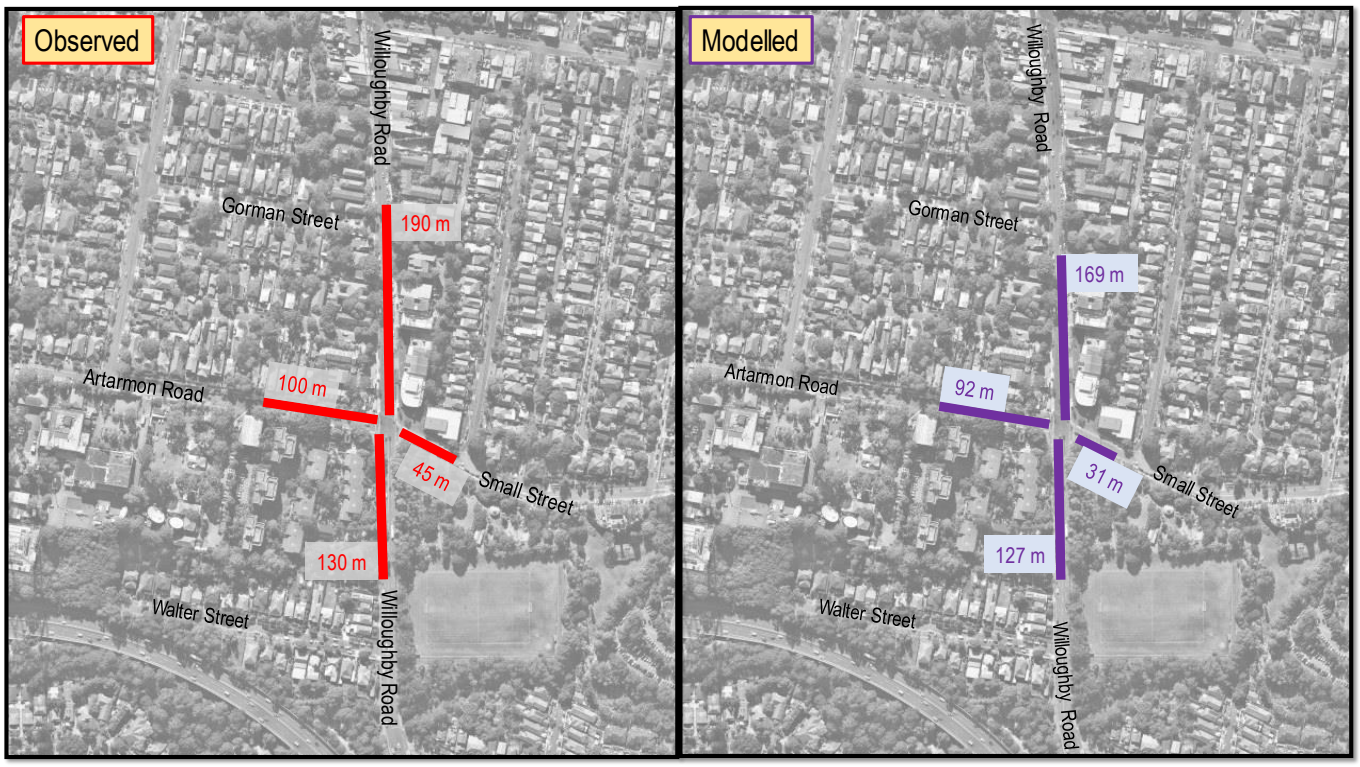


Figure 5.3: Longest Queue Length at Willoughby Road / Artarmon Road (AM Peak)

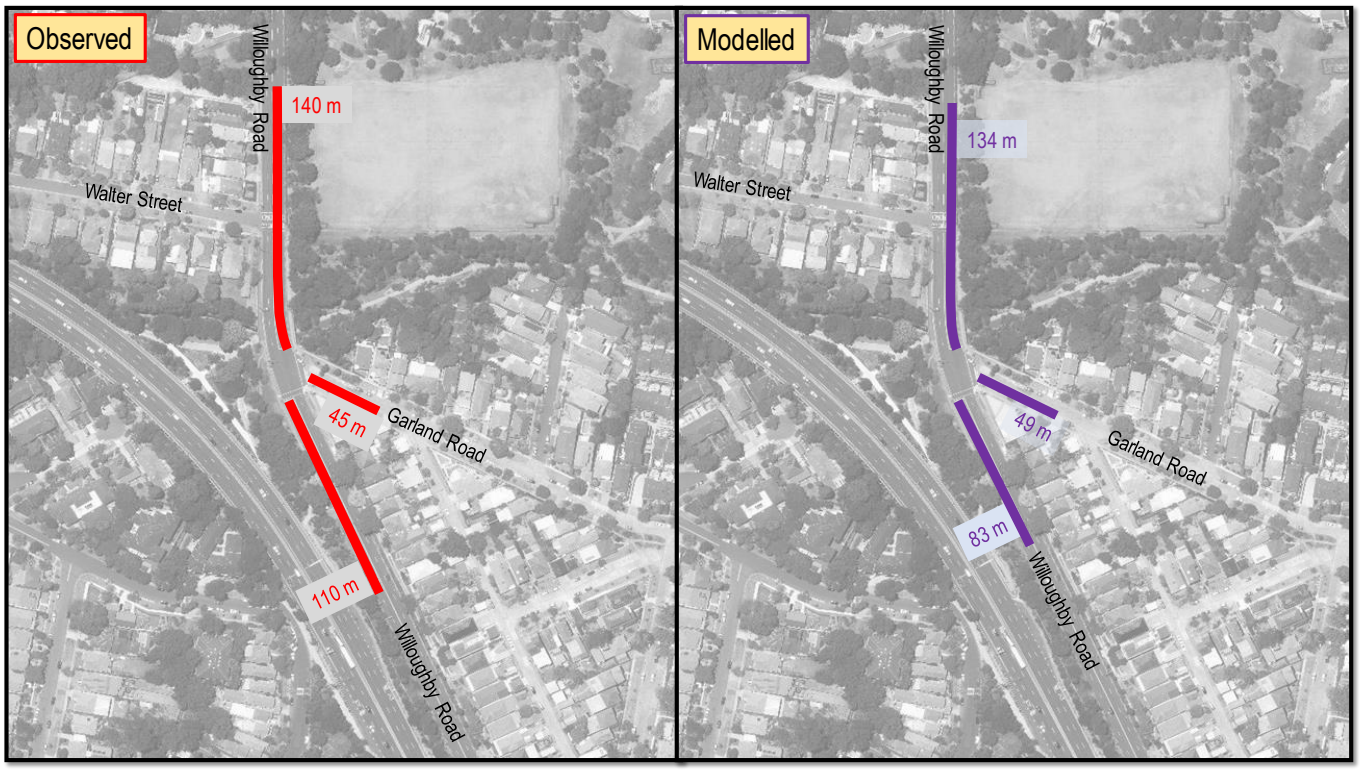


Figure 5.4: Longest Queue Length at Willoughby Road / Garland Road (AM Peak)

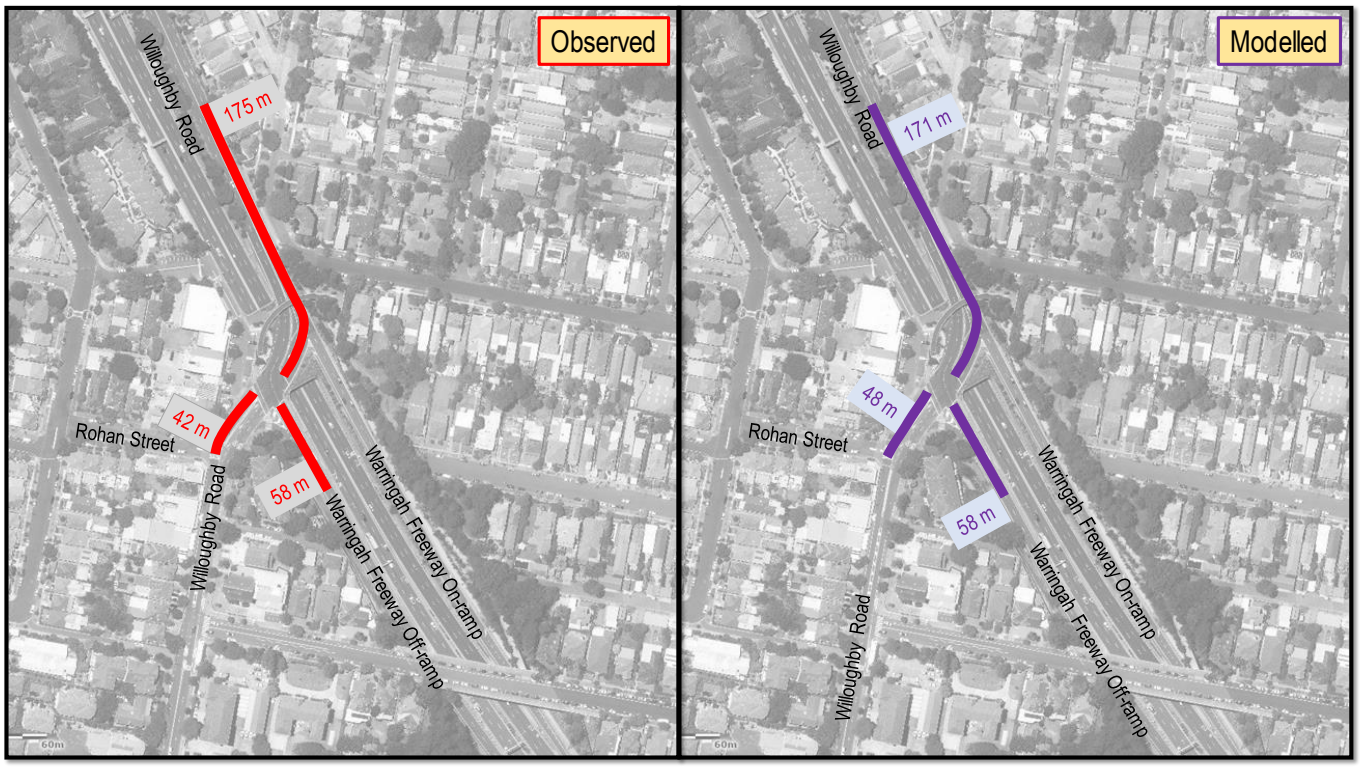


Figure 5.5: Longest Queue Length at Willoughby Road / Warringah Freeway (AM Peak)

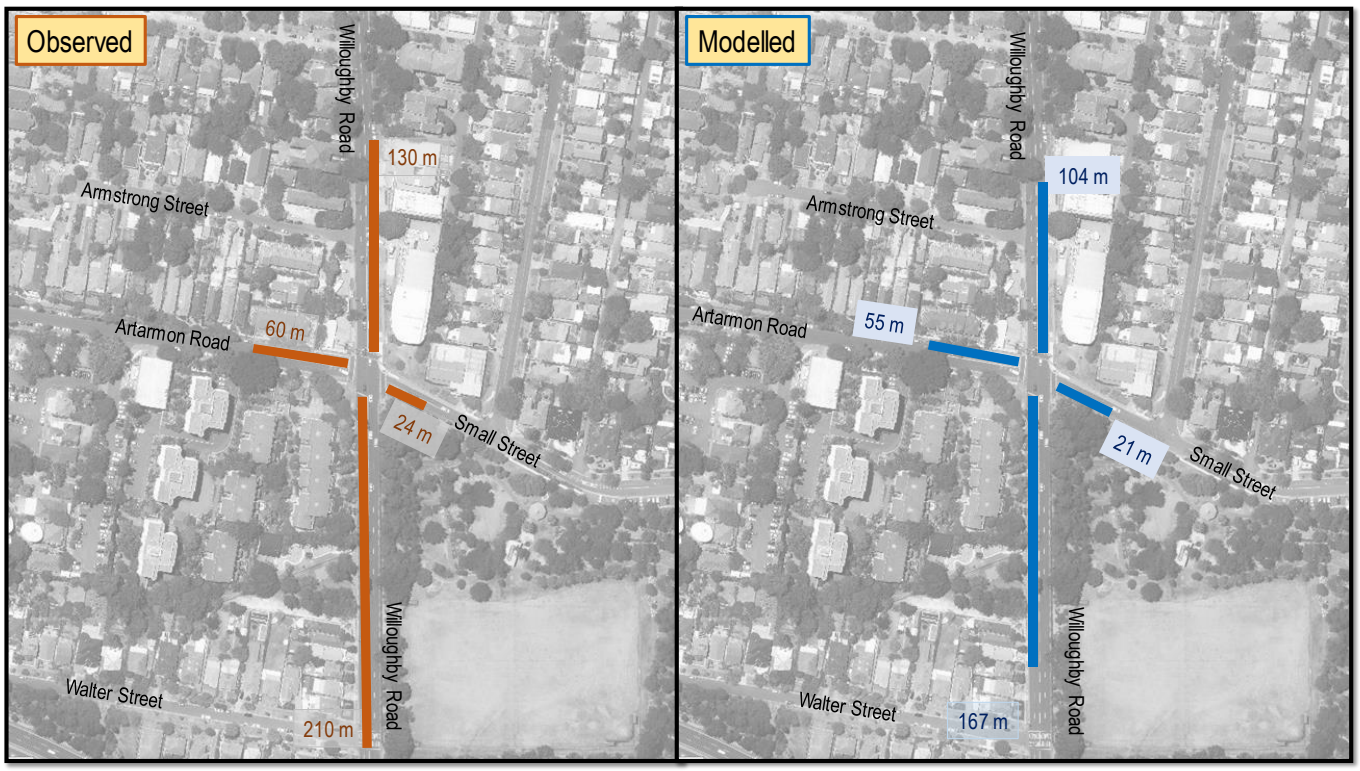


Figure 5.6: Longest Queue Length at Willoughby Road / Artarmon Road (PM Peak)

Figure 5.7: Longest Queue Length at Willoughby Road / Garland Road (PM Peak)

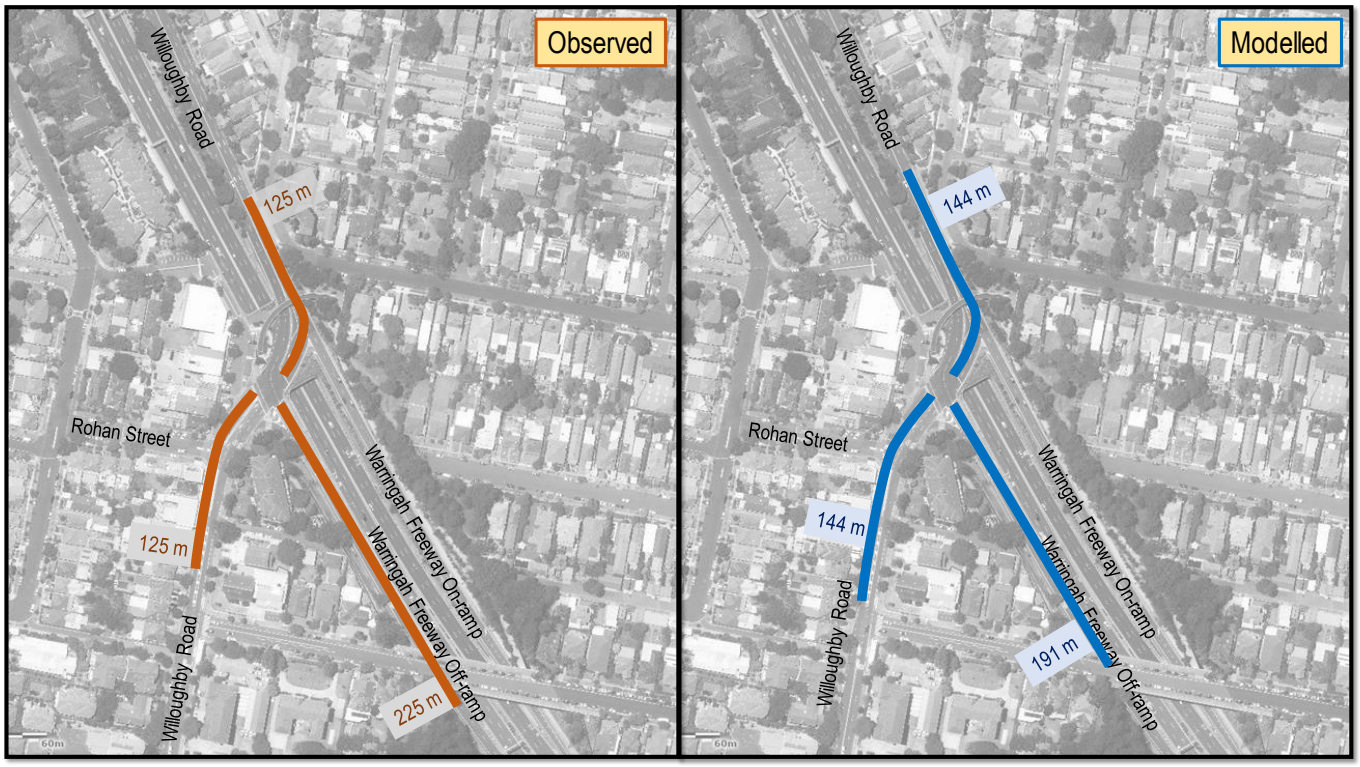
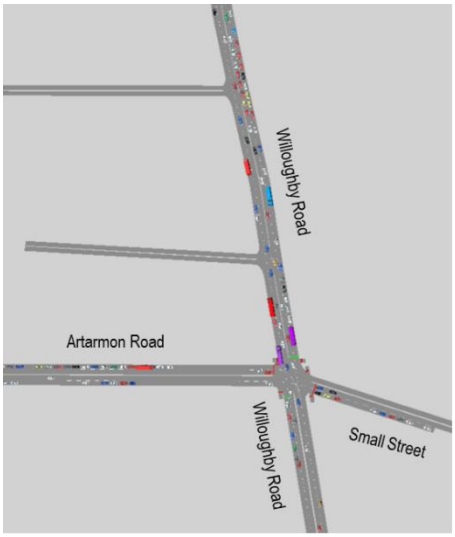
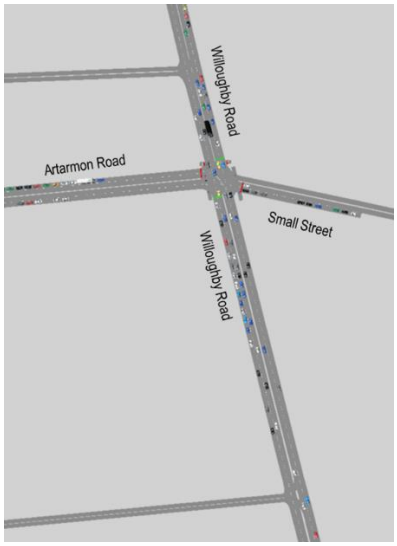
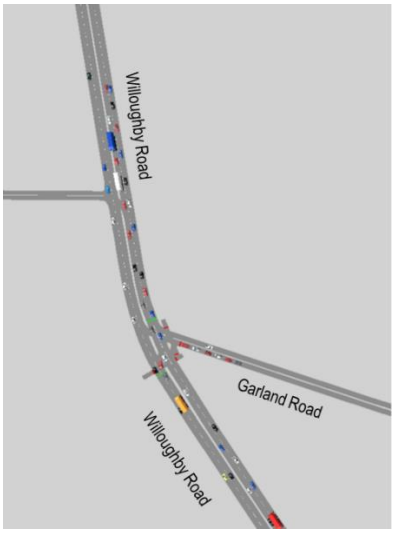
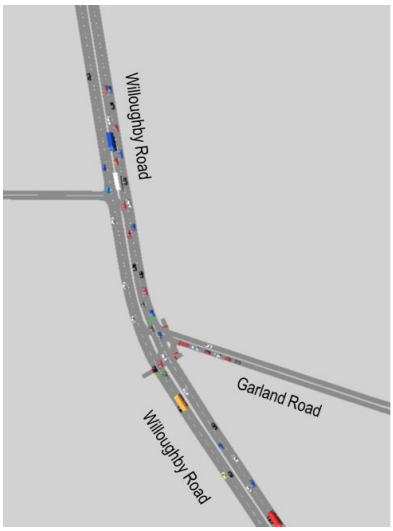
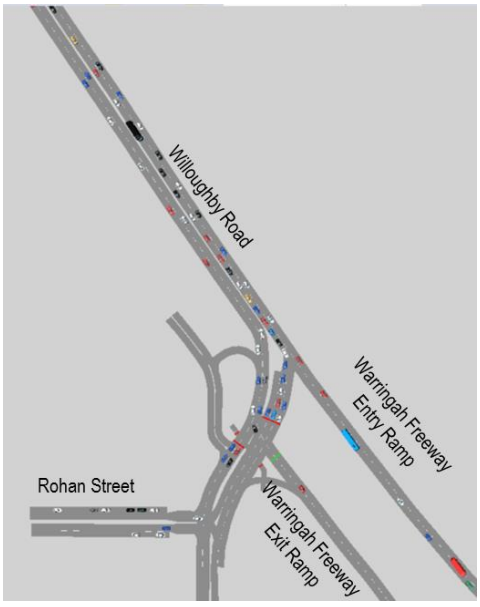
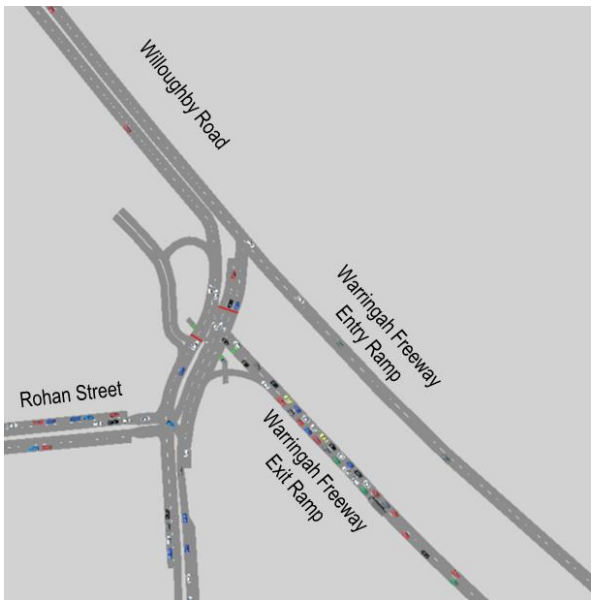


Figure 5.8: Longest Queue Length at Willoughby Road / Warringah Freeway (PM Peak)

5.3 VISSIM SCREEN CAPTURES

Screen captures from the model at the key intersections are shown below for the AM and PM peak periods.

	AM	PM
Willoughby Road / Artarmon Road		
Willoughby Road / Garland Road		
Willoughby Road / Warringah Freeway		

5.4 SIGNAL TIMING VALIDATION

5.4.1 Data Comparisons

SCATS data obtained from Roads and Maritime have been compared with model signal times. As per the RMS Modelling Guidelines the following signal attributes were used in the comparison:

- ***Cycle Time:*** average modelled cycle time in one-hour period to be within 10 percent of observed average;
- ***Green Time:*** total of green time over each one-hour period to be within 10 percent of observed equivalent for each phase; and
- ***Call Frequency:*** call frequency if demand-dependent phases (including pedestrian phase calls) to be compared with observed data to ensure phase activation occurs to a similar level over each hour period.

Willoughby Road intersections with Artarmon Road, Garland Road and Warringah Freeway are the three signalised intersections located within the study area. SCATS average cycle and green times are compared against VISSIM average times. These are summarised in Table 5.2 and Table 5.3.

5.4.2 Cycle Time

All VISSIM cycle times are within 10% of SCATS average cycle time.

5.4.3 Phase Times

The average observed phase times adopted in VISSIM are compared in Table 5.2 and Table 5.3. Most of the average phase times in VISSIM are within 10% of SCATS average observed phase times.

5.4.4 Call Frequency

A review of SCATS data suggests that:

- at the Willoughby Road / Artarmon Road / Small Street intersection, all three phases are generally called in every cycle;
- at the Willoughby Road / Garland Road intersection both phases are generally called in every cycle; and
- at the Willoughby Road / Warringah Freeway intersection both phases are generally every cycle.

The VisVAP signal logic in VISSIM was set in such a way that the reference phase was called in every cycle while the other phases were called if traffic demands exist.

Pedestrian phases were also coded as demand depended i.e. a pedestrian phase was only called if the phase was demanded by pedestrians.

Table 5.2: Signal Time Validation for AM Peak

Intersection (TCS)	Cycle / Phase	AM (07:45 - 08:45)				
		IDM			VISSIM	Within 10%?
		Avg.	10%	-10%		
Willoughby Road / Artarmon Road / Small Street (806)	CT*	119	131	107	120	√
	A	79	87	71	70	X
	B	13	14	12	20	X
	C	27	30	24	30	√
Willoughby Road / Warringah Freeway Off-Ramp (1336)	CT*	77	85	69	80	√
	A	36	40	32	35	√
	B	41	45	37	45	√
Willoughby Road / Garland Road (1712)	CT*	119	131	107	120	√
	A	100	110	90	96	√
	B	19	21	17	24	X

**CT Cycle Time*

Table 5.3: Signal Time Validation for PM Peak

Intersection (TCS)	Cycle / Phase	PM (16:45 - 17:45)				
		IDM			VISSIM	Within 10%?
		Avg.	10%	-10%		
Willoughby Road / Artarmon Road / Small Street (806)	CT*	117	129	105	120	√
	A	76	84	68	82	√
	B	16	18	14	18	√
	C	25	28	23	20	X
Willoughby Road / Warringah Freeway Off-Ramp (1336)	CT*	119	131	107	120	√
	A	55	61	50	54	√
	B	64	70	58	66	√
Willoughby Road / Garland Road (1712)	CT*	119	131	107	120	√
	A	103	113	93	96	√
	B	16	18	14	24	X

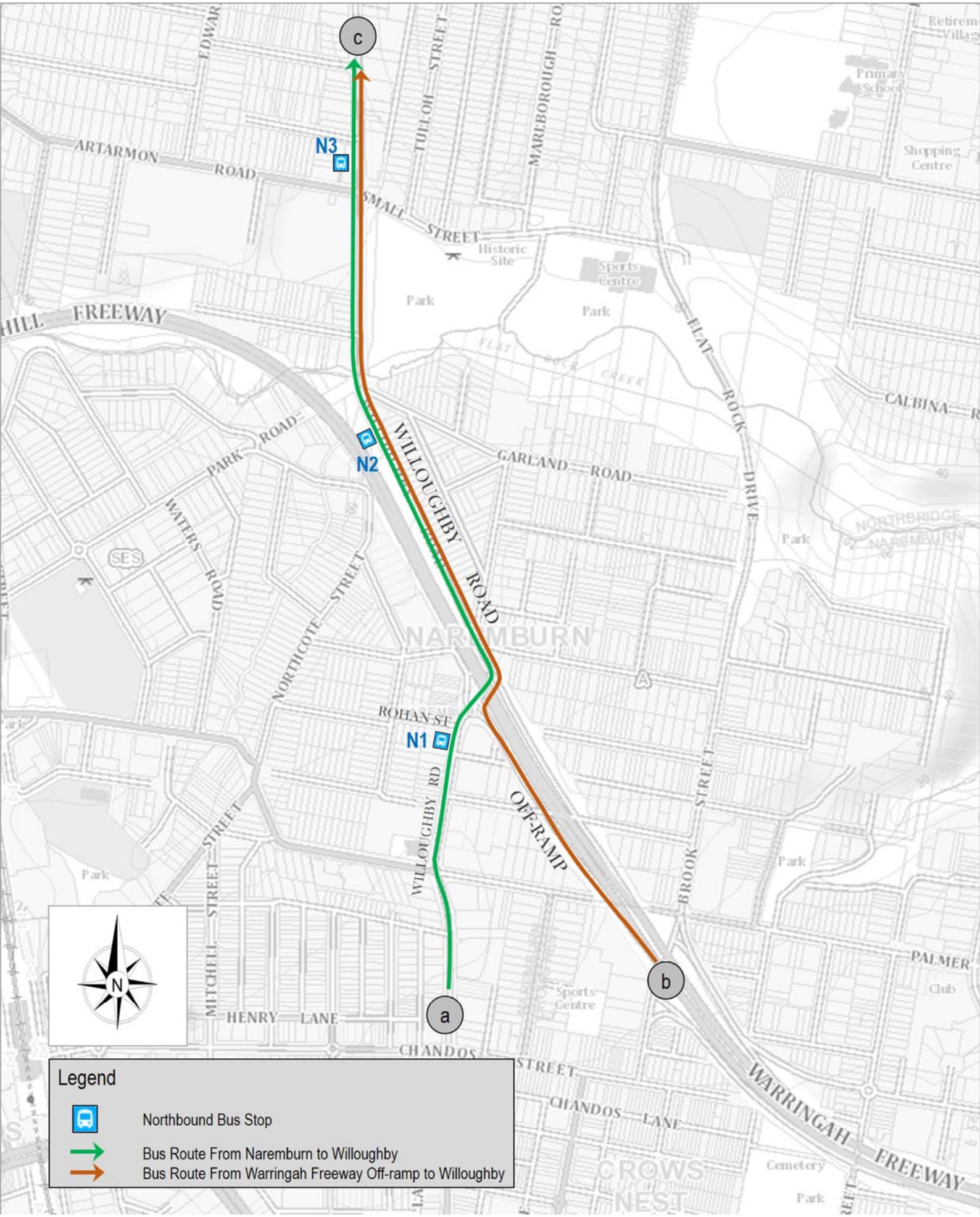
**CT Cycle Time*

6. CONCLUDING STATEMENT

In summary, the VISSIM models are deemed suitably calibrated and validated in accordance with the RMS Guidelines. The models are considered fit for purpose of assessing the road network and intersection upgrades on the section of Willoughby Road within the study area.

ATTACHMENT A

BUS SERVICE SUMMARY

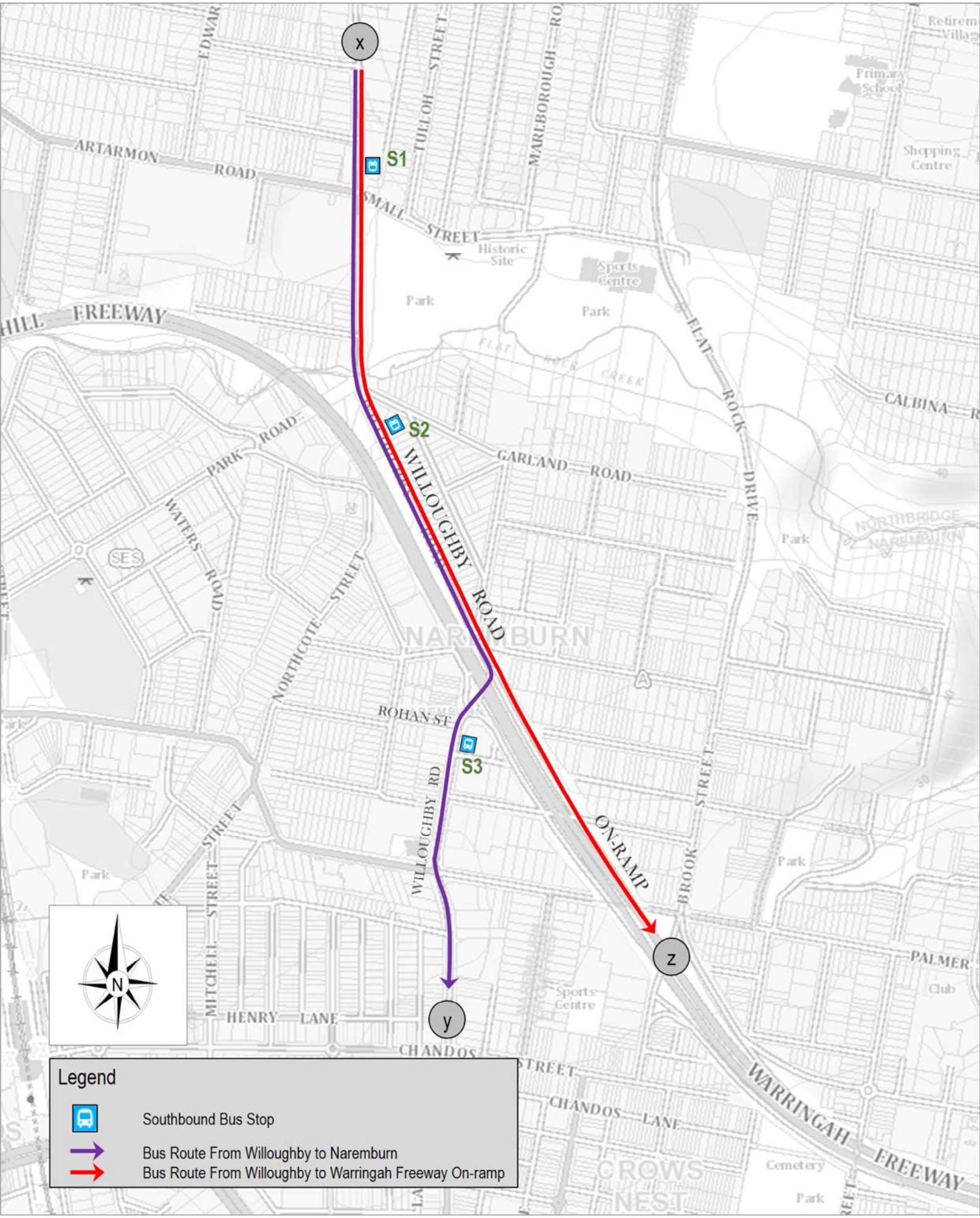

c
N3
N2
N1
a
b
ARTARMON ROAD
SMALL STREET
TULLOH STREET
MAREBOROUGH RO
Primary School
Shopping Centre
Historic Site
Sports Centre
Park
FREEWAY
FLAT ROCK CREEK
CALBINA
PARK ROAD
WILLOUGHBY ROAD
GARLAND ROAD
FLAT ROCK DRIVE
NORTHBRIDGE
NAREMBURN
WATERS ROAD
SES
NORTHCOTE STREET
ROHAN ST
WILLOUGHBY RD
OFF-RAMP
BROOK STREET
MITCHELL STREET
HENRY LANE
CHANDOS STREET
CHANDOS LANE
PALMER
Club
WARRINGAH FREEWAY
CROWS NEST
Cemetery
N
Legend
Northbound Bus Stop
Bus Route From Naremburn to Willoughby
Bus Route From Warringah Freeway Off-ramp to Willoughby

Summary of Northbound Bus Services within the Study Area

Route No	Route direction	Route Reference on Map	Specific Criterion / Restriction	Transit Stops	WEEKDAY AM Peak (0700-0900)		WEEKDAY PM Peak (1600-1800)		Total number of Occurance	
					Entry	Frequency*	Entry	Frequency*	WDAM	WDPM
257	Balmoral to Chatswood via Crows Nest	ac	Operates everyday	N1, N2, N3	0710	600, 2580, 3480, 4860, 5640, 6420	1614	840, 2640, 5100	6	3
272	City Wynyard to North Willoughby	bc	Weekdays Afternoon peak only	N2, N3	-	-	1613	780, 2580, 3840, 4500, 4980, 5460, 5940, 6420, 6900	0	9
343	Kingsford to Chatswood	ac	Operates everyday	N1, N2, N3	0704	240, 900, 1620, 2520, 3180, 3900, 4620, 5400, 6000, 6720	1609	540, 1140, 1800, 2340, 2820, 3240, 3720, 4200, 4740, 5160, 5700, 6180, 6720, 7140	10	14
M40	Bondi Junction to Chatswood	bc	Operates everyday	N2, N3	0712	720, 1380, 2040, 2760, 3480, 4140, 4860, 5520, 6180, 6780	1600	0, 600, 1200, 1800, 2460, 3060, 3720, 4320, 5040, 5760, 6420, 6840	10	12
* Frequency indicates time (seconds) of bus entering into the study area, within peak periods. For example, 0 means the start of the peak period, 780 means 780 seconds or 13 minutes from the start of the peak period, and so on.									26	38

List of Northbound bus stops

TSN	Description of transit stop	Map reference	Bus Routes	Street Name
206550	Willoughby Rd Near Rohan St	N1	257, 343	Willoughby Rd
206551	Willoughby Rd Near Garland Rd	N2	257, 272, 343, M40	Willoughby Rd
206881	Willoughby Rd Near Armstrong St	N3	257, 272, 343, M40	Willoughby Rd


x
S1
S2
S3
y
z
ARTARMON ROAD
SMALL STREET
TULLOH STREET
MAREBOROUGH
Primary School
Shopping Centre
Historic Site
Sports Centre
Park
HILL FREEWAY
FLAT ROCK CREEK
CALBINA
PARK ROAD
GARLAND ROAD
FLAT ROCK DRIVE
NORTHBRIDGE
NAREMBURN
WATERS ROAD
SES
NORTHCOTE STREET
WILLOUGHBY ROAD
ROHAN ST
WILLOUGHBY RD
ON-RAMP
BROOK STREET
MITCHELL STREET
HENRY LANE
CHANDOS STREET
CHANDOS LANE
PALMER
Club
WARRINGAH FREEWAY
Cemetery
CROWS NEST
N
Legend
Southbound Bus Stop
Bus Route From Willoughby to Naremburn
Bus Route From Willoughby to Warringah Freeway On-ramp

Summary of Southbound Bus Services within the Study Area

Route No	Route direction	Route Reference on Map	Specific Criterion / Restriction	Transit Stops	WEEKDAY AM Peak (0700-0900)		WEEKDAY PM Peak (1600-1800)		Total number of Occurance	
					Entry	Frequency*	Entry	Frequency*	WDAM	WDPM
257	Chatswood to Balmoral via Crows Nest	xy	Operates everyday	S1, S2, S3	0706	360, 1860, 4920, 6000, 7200	1627	1620, 2520, 3360, 4560, 5160, 6360	5	6
272	North Willoughby to City Wynyard	xz	Weekdays Morning peak only	S1, S2	0700	0, 600, 1140, 1680, 2340, 2880, 3300, 3540, 3840, 4140, 4440, 4740, 4980, 5220, 5460, 5700, 6000, 6300, 6600, 6900, 7200	-	-	21	0
343	Chatswood to Kingsford	xy	Operates everyday	S1, S2, S3	0713	780, 1380, 2100, 2880, 3480, 3900, 4380, 4800, 5280, 5700, 6120, 6600, 7080	1602	120, 720, 1320, 1920, 2460, 3060, 3660, 4260, 4860, 5460, 6060, 6660	13	12
M40	Chatswood to Bondi Junction	xz	Operates everyday	S1, S2	0706	360, 900, 1440, 1980, 2580, 3120, 3660, 4260, 4860, 5460, 6060, 6720	1607	420, 1140, 1860, 2460, 3060, 3660, 4260, 4920, 5640, 6360, 7020	12	11
* Frequency indicates time (seconds) of bus entering into the study area, within peak periods. For example, 0 means the start of the peak period, 60 means 60 seconds or 1 minute from the start of the peak period, and so on.									51	29

List of Southbound bus stops

TSN	Description of transit stop	Map reference	Bus Routes	Street Name
206879	Willoughby Rd Near Small St	S1	257, 272, 343, M40	Willoughby Rd
206534	Willoughby Rd Near Garland Rd	S2	257, 272, 343, M40	Willoughby Rd
206535	Willoughby Rd Near Dodds St	S3	257, 343	Willoughby Rd

ATTACHMENT B

TURNING COUNT CALIBRATION

P3062 Walter Street Willoughby VISSIM Model

VISSIM Data Analysis - Node

AM Peak 0745-0845

5

GEH Turn Summary 0745-0845		
>10	0	0.00%
>5, <=10	0	0.00%
<=5	36	100.00%

Time	ID	Intersection	Aimsun Code	Movement Code	From	To	Turn	Observed	Modelled	Abs. Diff (Mod - Obs)	% Diff (Mod - Obs)	GEH	Accept	Delay (s)	LoS	Queue (m)
2700	3	Willoughby Road		101-2	Willoughby Road (N)	Willoughby Road (S)	T	1,594	1,633	39	2.4%	1.0	Y	21.5	B	71.2
		Artarmon Road		101-3		Small Street (E)	L	23	23	0	0.0%	0.0	Y	21.1	B	71.3
		Small Street		101-4	Small Street (E)	Willoughby Road (N)	R	14	15	1	7.1%	0.3	Y	56.3	D	8.8
				101-5		Artarmon Road (W)	T	65	64	-1	-1.5%	0.1	Y	54.9	D	8.8
				101-6		Willoughby Road (S)	L	76	77	1	1.3%	0.1	Y	49.2	D	8.8
				101-7	Willoughby Road (S)	Small Street (E)	R	26	23	-3	-11.5%	0.6	Y	79.1	F	37.9
				101-8		Willoughby Road (N)	T	864	891	27	3.1%	0.9	Y	30.8	C	37.9
				101-9		Artarmon Road (W)	L	235	226	-9	-3.8%	0.6	Y	21.2	B	37.9
				101-10	Artarmon Road (W)	Willoughby Road (S)	R	450	451	1	0.2%	0.0	Y	45.8	D	24.4
				101-11		Small Street (E)	T	43	42	-1	-2.3%	0.2	Y	53.9	D	24.4
				101-12		Willoughby Road (N)	L	20	19	-1	-5.0%	0.2	Y	49.5	D	24.4
					All			3,410	3,464					29.3	C	42.7
	2	Willoughby Road		102-1	Willoughby Road (N)	Walter Street (W)	R	1	0	-1	-100.0%	1.4	Y	0.0	A	2.4
		Walter Street		102-2		Willoughby Road (S)	T	2,119	2,153	34	1.6%	0.7	Y	3.1	A	1.7
				102-8	Willoughby Road (S)	Willoughby Road (N)	T	1,120	1,139	19	1.7%	0.6	Y	0.3	A	0.0
				102-9		Walter Street (W)	L	5	4	-1	-20.0%	0.5	Y	0.4	A	0.0
				102-10	Walter Street (W)	Willoughby Road (S)	R	7	7	0	0.0%	0.0	Y	21.8	B	0.1
				102-12		Willoughby Road (N)	L	5	5	0	0.0%	0.0	Y	2.5	A	0.0
					All			3,257	3,308					2.2	A	0.8
	15	Willoughby Road		103-2	Willoughby Road (N)	Willoughby Road (S)	T	2,084	2,112	28	1.3%	0.6	Y	6.6	A	15.8
		Garland Road		103-3		Garland Road (E)	L	42	39	-3	-7.1%	0.5	Y	7.7	A	15.8
				103-4	Garland Road (E)	Willoughby Road (N)	R	40	39	-1	-2.5%	0.2	Y	66.1	E	11.4
				103-6		Willoughby Road (S)	L	72	70	-2	-2.8%	0.2	Y	60.2	E	11.4
				103-7	Willoughby Road (S)	Garland Road (E)	R	18	16	-2	-11.1%	0.5	Y	33.9	C	8.0
				103-8		Willoughby Road (N)	T	1,085	1,105	20	1.8%	0.6	Y	7.4	A	8.0
					All			3341	3,381					8.8	A	11.7
	18	Willoughby Road		104-2	Willoughby Road (N)	Willoughby Road (S)	T	810	804	-6	-0.7%	0.2	Y	20.1	B	16.2
		To / From Warringah Freeway		104-3		To Warringah Freeway (E)	L	1,346	1,388	42	3.1%	1.1	Y	4.9	A	16.2
		Shopping Centre		104-4	From Warringah Freeway (E)	Willoughby Road (N)	R	690	705	15	2.2%	0.6	Y	24.2	B	5.1
				104-6		Willoughby Road (S)	L	88	87	-1	-1.1%	0.1	Y	18.0	B	5.1
				104-8	Willoughby Road (S)	Willoughby Road (N)	T	401	405	4	1.0%	0.2	Y	10.6	A	0.8
				104-9		Shopping Centre (W)	L	23	24	1	4.3%	0.2	Y	3.8	A	0.8
				104-12	Shopping Centre (W)	Willoughby Road (N)	L	12	10	-2	-16.7%	0.6	Y	13.0	A	0.1
					All			3370	3,423					13.5	A	5.5
	19	Willoughby Road		105-1	Willoughby Road (N)	Rohan Street (W)	R	188	183	-5	-2.7%	0.4	Y	2.0	A	1.7
		Rohan Street		105-2		Willoughby Road (S)	T	710	708	-2	-0.3%	0.1	Y	2.4	A	3.6
				105-8	Willoughby Road (S)	Willoughby Road (N)	T	355	362	7	2.0%	0.4	Y	1.0	A	0.9
				105-9		Rohan Street (W)	L	60	60	0	0.0%	0.0	Y	1.1	A	0.9
				105-10	Rohan Street (W)	Willoughby Road (S)	R	71	70	-1	-1.4%	0.1	Y	12.4	A	1.3
				105-12		Willoughby Road (N)	L	69	68	-1	-1.4%	0.1	Y	6.0	A	1.1
					All			1,453	1,451					2.6	A	1.7

P3062 Walter Street Willoughby VISSIM Model

VISSIM Data Analysis - Node

PM Peak (1645 - 1745)

5

GEH Turn Summary 1645-1745		
>10	0	0.00%
>5, <=10	0	0.00%
<=5	36	100.00%

Time	ID	Intersection	Aimsun Code	Movement Code	From	To	Turn	Observed	Modelled	Abs. Diff (Mod - Obs)	% Diff (Mod - Obs)	GEH	Accept	Delay (s)	LoS	Queue (m)
2700	3	Willoughby Road		101-1	Willoughby Road (N)	Artarmon Road (W)	R	7	8	1	14.3%	0.4	Y	53.6	D	17.2
		Artarmon Road		101-2		Willoughby Road (S)	T	872	886	14	1.6%	0.5	Y	14.7	A	17.2
		Small Street		101-3		Small Street (E)	L	42	39	-3	-7.1%	0.5	Y	22.3	B	17.4
				101-4	Small Street (E)	Willoughby Road (N)	R	26	27	1	3.8%	0.2	Y	51.2	D	13.9
				101-5		Artarmon Road (W)	T	86	88	2	2.3%	0.2	Y	61.0	E	13.9
				101-6		Willoughby Road (S)	L	102	102	0	0.0%	0.0	Y	54.4	D	13.9
				101-8	Willoughby Road (S)	Willoughby Road (N)	T	1,357	1,340	-17	-1.3%	0.5	Y	16.5	B	36.3
				101-9		Artarmon Road (W)	L	317	313	-4	-1.3%	0.2	Y	25.3	B	36.3
				101-10	Artarmon Road (W)	Willoughby Road (S)	R	275	274	-1	-0.4%	0.1	Y	77.8	F	32.3
				101-11		Small Street (E)	T	67	65	-2	-3.0%	0.2	Y	102.4	F	32.3
				101-12		Willoughby Road (N)	L	31	30	-1	-3.2%	0.2	Y	87.4	F	32.3
					All			3,182	3,172					27.5	B	23.4
	2	Willoughby Road		102-1	Willoughby Road (N)	Walter Street (W)	R	7	7	0	0.0%	0.0	Y	9.2	A	0.1
		Walter Street		102-2		Willoughby Road (S)	T	1,242	1,262	20	1.6%	0.6	Y	0.3	A	0.0
				102-8	Willoughby Road (S)	Willoughby Road (N)	T	1,668	1,656	-12	-0.7%	0.3	Y	0.6	A	0.1
				102-9		Walter Street (W)	L	5	7	2	40.0%	0.8	Y	0.5	A	0.1
				102-10	Walter Street (W)	Willoughby Road (S)	R	3	3	0	0.0%	0.0	Y	29.9	C	0.1
				102-12		Willoughby Road (N)	L	6	7	1	16.7%	0.4	Y	13.7	A	0.1
					All			2,931	2,942					0.5	A	0.1
	15	Willoughby Road		103-2	Willoughby Road (N)	Willoughby Road (S)	T	1,200	1,226	26	2.2%	0.7	Y	4.2	A	3.8
		Garland Road		103-3		Garland Road (E)	L	45	42	-3	-6.7%	0.5	Y	5.7	A	3.8
				103-4	Garland Road (E)	Willoughby Road (N)	R	17	20	3	17.6%	0.7	Y	53.3	D	3.6
				103-6		Willoughby Road (S)	L	33	35	2	6.1%	0.3	Y	42.7	C	3.6
				103-7	Willoughby Road (S)	Garland Road (E)	R	36	33	-3	-8.3%	0.5	Y	21.8	B	13.7
				103-8		Willoughby Road (N)	T	1,656	1,645	-11	-0.7%	0.3	Y	8.4	A	13.7
					All			2987	3,001					7.5	A	7.0
	18	Willoughby Road		104-2	Willoughby Road (N)	Willoughby Road (S)	T	553	571	18	3.3%	0.8	Y	28.4	B	5.3
		To / From Warringah Freeway		104-3		To Warringah Freeway (E)	L	680	698	18	2.6%	0.7	Y	0.6	A	5.3
		Shopping Centre		104-4	From Warringah Freeway (E)	Willoughby Road (N)	R	1,001	1,015	14	1.4%	0.4	Y	21.6	B	18.7
				104-6		Willoughby Road (S)	L	54	55	1	1.9%	0.1	Y	20.8	B	18.7
				104-8	Willoughby Road (S)	Willoughby Road (N)	T	665	673	8	1.2%	0.3	Y	25.2	B	13.9
				104-9		Shopping Centre (W)	L	26	27	1	3.8%	0.2	Y	8.1	A	13.9
				104-12	Shopping Centre (W)	Willoughby Road (N)	L	26	22	-4	-15.4%	0.8	Y	75.2	F	2.8
					All			3005	3,061					19.1	B	10.2
	19	Willoughby Road		105-1	Willoughby Road (N)	Rohan Street (W)	R	122	124	2	1.6%	0.2	Y	9.5	A	4.0
		Rohan Street		105-2		Willoughby Road (S)	T	485	500	15	3.1%	0.7	Y	2.4	A	3.3
				105-8	Willoughby Road (S)	Willoughby Road (N)	T	575	588	13	2.3%	0.5	Y	10.6	A	4.2
				105-9		Rohan Street (W)	L	48	48	0	0.0%	0.0	Y	2.9	A	4.2
				105-10	Rohan Street (W)	Willoughby Road (S)	R	83	84	1	1.2%	0.1	Y	64.7	E	19.4
				105-12		Willoughby Road (N)	L	116	113	-3	-2.6%	0.3	Y	55.9	D	19.3
					All			1,429	1,457					14.1	A	10.1

ATTACHMENT C

TRAVEL TIME VALIDATION SUMMARY

P3062 Walter Street Willoughby VISSIM Modelling

Tarvel Time Data Analysis

Comparison of Survey Data and VISSIM Output

AM peak (0745-0845)

Direction	Number of Runs	Observed Mean	+15%	-15%	Modelled Mean	Within ±15%?
Freeway to Scott St (NorthBound)	76	02:37	03:00	02:13	02:11	x
Scott St to Freeway (SouthBound)	80	02:12	02:31	01:52	02:13	√
Rohan St to Armstrong St (Northbound)	148	02:17	02:37	01:56	02:00	√
Armstrong St to Rohan St (Southbound)	124	02:08	02:28	01:49	01:58	√

P3062 Walter Street Willoughby VISSIM Modelling

Tarvel Time Data Analysis

Comparison of Survey Data and VISSIM Output

PM peak (1645-1745)

Direction	Number of Runs	Observed Mean	+15%	-15%	Modelled Mean	Within ±15%?
Freeway to Scott St (NorthBound)	118	02:54	03:20	02:28	02:09	x
Scott St to Freeway (SouthBound)	117	02:14	02:34	01:54	02:31	√
Rohan St to Armstrong St (Northbound)	168	02:32	02:55	02:10	02:20	√
Armstrong St to Rohan St (Southbound)	144	02:12	02:32	01:53	02:05	√

Appendix B

Walter Street Intersection Upgrade Concept Plan
Prepared by Calibre Consulting

DO NOT SCALE DRAWINGS, USE FIGURED DIMENSIONS

1:200 A1 1:400 A3

0 2 4 6 8 10 12 14 16m

Rev	Revision Description	By	Date	App
I	FOR COORDINATION	MI	16/02/17	CB
H	FOR COORDINATION	CB	15/02/17	MI
G	PRELIMINARY ISSUE FOR REVIEW	MI	15/02/17	CB
F	PRELIMINARY ISSUE FOR REVIEW	MI	15/02/17	CB
E	PRELIMINARY ISSUE FOR REVIEW	MI	15/02/17	CB
D	PRELIMINARY ISSUE FOR REVIEW	MI	14/02/17	CB
C	PRELIMINARY ISSUE FOR REVIEW	MI	13/02/17	CB
B	PRELIMINARY ISSUE FOR REVIEW	DG	07/02/17	CB
A	PRELIMINARY ISSUE FOR REVIEW	MI	09/12/16	CB

Engineering Consultant

Calibre CONSULTING

BRISBANE CANBERRA NEW ZEALAND MELBOURNE PERTH
ROCKHAMPTON SINGAPORE SUNSHINE COAST SYDNEY

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www.calibreconsulting.co

Client
WALTER PROJECTS PTY LTD

APPROVED By:

Project
WALTER STREET AND WILLOUGHBY ROAD INTERSECTION

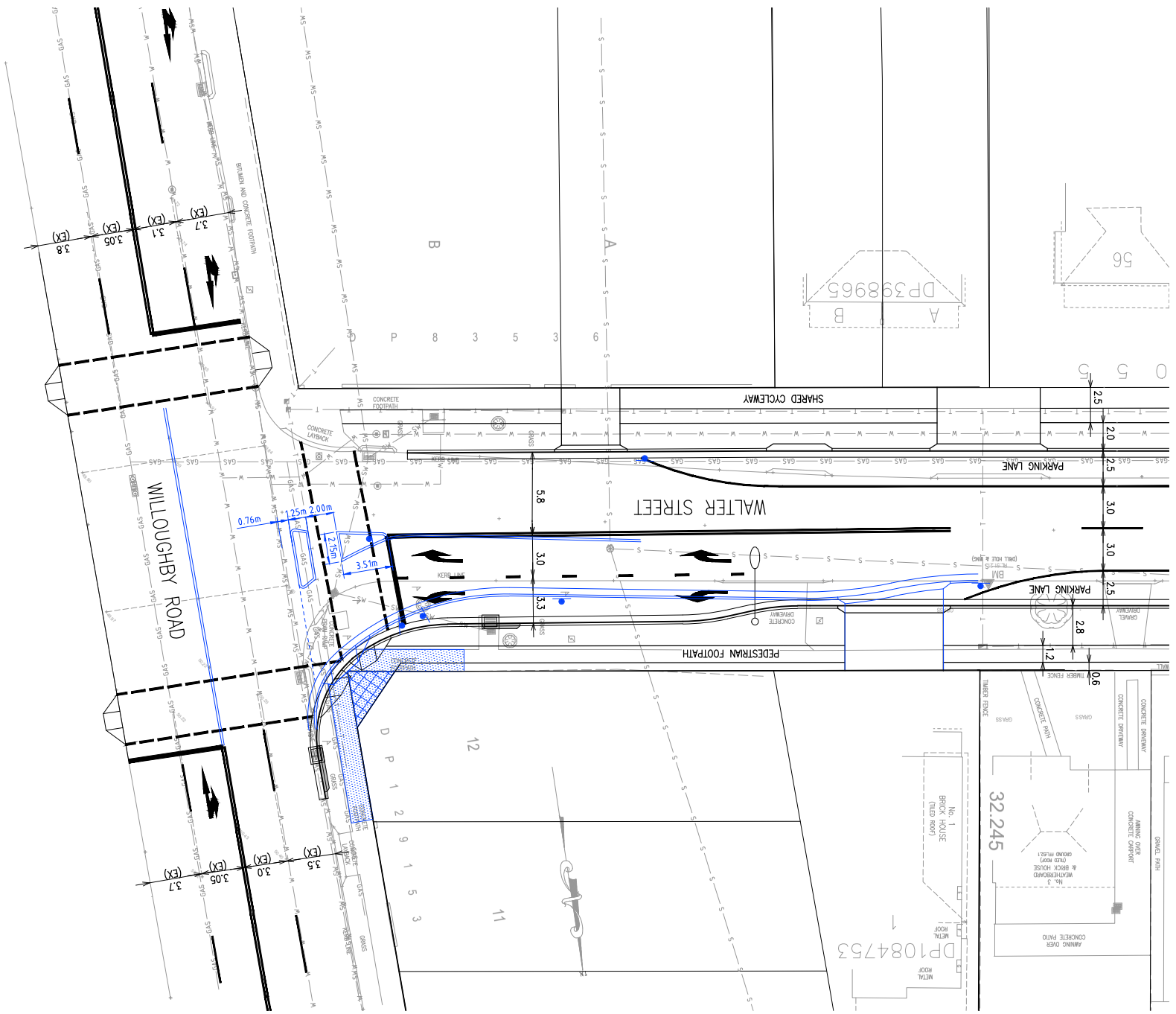
Title
CONCEPT ROAD LAYOUT SHEET 2 OF 2

FOR COORDINATION

Date	Designed
9/12/16	CB
Scale @ A1	Drawn
1:200	MI
Job Number	Drawing Number
16-003562	SKC2-02

Approved
CB

Revision
I



CAD FILE: P:\S16\16-003562 Walter St and Willoughby Rd Intersection\4-Drawing\Civil\Issued\2017-02-16 SKC2-02.dwg

DATE PLOTTED: 16/02/2017 11:09:24 AM BY: MANFUSA, ISLAM

A1

Appendix C

RMS Letter to Willoughby Council Indicating Support for the Proposed Traffic Signals

Transport
Roads & Maritime
Services

6 February 2017

Roads and Maritime Reference: SYD16/01432

Planning & Infrastructure Director
Willoughby City Council
PO Box 57
Chatswood NSW 2057

Attention: Mr Arnott

PRE-LODGEMEMNT PROPOSAL TO AMEND ZONING FOR 18 RESIDENTIAL LOTS – NO. 3 TO 31 WALTER STREET, WILLOUGHBY FROM R3 (150 UNITS) TO R4 (302 APARTMENTS)

Dear Mr Conway,

I wish to advise Willoughby City Council that 'The Transport Planning Partnership' Pty Ltd on behalf of Wellbe Properties Pty Ltd submitted a pre-lodgement traffic study in support of the abovementioned potential planning proposal to Roads and Maritime Services for review and comment. In particular, comment was sought on whether traffic signals would be supported at the existing T intersection of Walter Street and Willoughby Road in support of the potential planning proposal.

Roads and Maritime upon review of the pre-lodgement traffic study and noting the cumulative traffic impacts arising from the proposed R4 zoning (3-31 Walter Street) and proposed child care centre at 1 Walter Street, traffic signals are supported "in principle" at the intersection of Walter Street and Willoughby Road, subject to the following requirements:

1. Demonstrate to Roads and Maritime satisfaction that the provision of traffic signals at this intersection will not have a detrimental impact on traffic flows and travel times for motorists and buses on Willoughby Road. This will require the submission of traffic modelling undertaken in accordance with Roads and Maritime modelling guidelines.
2. Two approaches lanes and a single departure lane being able to be accommodated within the existing Walter Street road reserve, designed and constructed in accordance with AUSTROADS. It is recommended that as part of the lodgement of the R4 planning proposal that a geometric concept road design plan of the proposed traffic signals and associated road works be overlayed on a scaled aerial photograph and/or survey plan.
3. Independent road safety audit to assess the driver see-through effects of the closely spaced signalised intersections of Walter Street and Garland Road.
4. All costs associated with the identified civil and signal hardware (including utility recollection) shall be at no cost to Roads and Maritime.

Should the abovementioned planning proposal be supported by Council and the traffic signals approved by Roads and Maritime, the identified signal and civil works at the intersection of Walter Street and Willoughby Road shall be incorporated into a funding agreement (between Council and the proponent/landowners), prior to gazettal.

Any funding agreement should ensure that the traffic signals are installed, prior to the Occupation Certificate being released for a R4 High Density Residential development.

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

Yours sincerely

Greg Flynn
Program Manager, Land Use

The Transport Planning Partnership
Suite 402 Level 4, 22 Atchison Street
St Leonards NSW 2065

P.O. Box 237
St Leonards NSW 1590

02 8437 7800

info@ttpp.net.au

www.ttpp.net.au

Attachment Two

Roads and Maritime Services Approval of the August 2017 Traffic Study and Proposed Walter St Traffic Signals

Transport
Roads & Maritime
Services

7 November 2017

Roads and Maritime Reference: SYD16/01432

Planning Manager
Willoughby City Council
PO Box 57
Chatswood NSW 2057

Attention: Jane Hosie

PROPOSED PLANNING PROPOSAL - LOCAL ENVIRONMENTAL PLAN AMENDMENT FOR NO. 3 THROUGH TO NO. 31 WALTER STREET, WILLOUGHBY FROM RESIDENTIAL MEDIUM DENSITY (R3) TO HIGH DENSITY (R4)

Dear Mr Arnott,

I refer to Willoughby City Council's letter of 24 May 2017 seeking comment from Roads and Maritime Services on the abovementioned planning proposal, in particular the proposal for the provision of traffic control signals on Willoughby Road at the Walter Street intersection. Roads and Maritime appreciates the opportunity to provide comment on the planning proposal.

As Council would be aware, Roads and Maritime provided 'in principle' support to the provision of traffic control signals (TCS) at the subject intersection in a letter of 6 February 2017 (**TAB A**), subject to a number of requirements including traffic modelling demonstrating (to Roads and Maritime satisfaction) that this traffic management measure will not have a detrimental impact on traffic flows and travel times for motorists and buses on Willoughby Road.

Roads and Maritime were of the view that the optimum tool to identify any detrimental impact from the proposed TCS on traffic flows and travel times on Willoughby Road was micro-simulation modelling (VISSIM software).

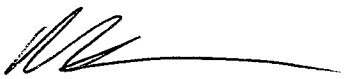
Micro-simulation modelling was submitted and deemed 'fit for purpose' by Roads and Maritime (following calibration adjustments requested by Roads and Maritime) to determine whether the provision of the proposed TCS will result in detrimental impacts on traffic flows and travel times for motorists and buses on Willoughby Road.

Roads and Maritime upon review of the traffic modelling provides approval to the provision of the traffic signals at the signalised intersection of Willoughby Road and Walter Street as part of the planning proposal, subject to the following requirements:

- Right turn movements from Willoughby Road into Walter Street shall be prohibited in the AM (6-10AM and PM (3 – 7PM) peak periods through the provision of regulatory signage that legally prohibits this movement.
- Two approach lanes for a minimum distance of 20 metres (vehicle storage) from the stop line on the Walter Street approach to the proposed TCS and one departure lane on Walter Street shall be designed and constructed in accordance with AUSTROADS and RMS Supplements.
- An updated geometric road design plan illustrating full road design dimensions (i.e. land widths, footpath widths etc) shall be submitted to Council and referred to Roads and Maritime for 'in principle' endorsement of the full geometric footprint of the signalised intersection, prior to the gazettal of the planning proposal.
- It is noted that a small parcel of land at the south-east corner of No. 450 Willoughby Road is required to facilitate the construction of the signalised intersection. As Council would be aware, any land components required from No. 450 Willoughby Road for the provision of the TCS and associated civil works will require land owners consent and ideally provided, prior to the gazettal of the planning proposal.
- All costs associated with the civil and signal hardware (including utility relocation) shall be at no cost to Roads and Maritime.
- The proposed traffic signals and associated civil works should be included in a Planning Agreement and executed, prior to the gazettal of the subject planning proposal.
- The above Planning Agreement should include a trigger point for the construction of the signalised intersection and linked to a specific residential unit yield. The nominated residential yield should be agreed between the land owners and Council (with advisory input from Roads and Maritime).

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

Yours sincerely



Mary Whalan
Director Network North Precinct

Attachment Three

Willoughby Road Traffic Signals – Council's Traffic Engineering Comment

Traffic Generation

Traffic studies prepared by The Transport Planning Partnership (TTPP) on behalf of the Proponent recommended the provision of traffic lights at the Walter St intersection. TTPP concluded that growth in the background traffic alone would result in the Walter St intersection with Willoughby Rd operating poorly. Additional traffic arising from the redevelopment of Walter St in accordance with the current R3 zoning for Walter St as well as traffic from the Channel 9 site and the proposed Walter St childcare centre would trigger the need to upgrade the Walter St intersection.

According to the Traffic report, traffic signals at the Walter St intersection would provide more than adequate capacity to provide a good level of service in the future following the completion of all known developments. The traffic report states that if the Walter St intersection was to be upgraded to operate under signal control, widening of Walter St would also be necessary to provide two-way independent flows to improve the efficiency of the new traffic signal at Willoughby Rd.

Council's Traffic and Transport Team Leader had no objections to the report and advised:

The report indicates that the proposed new traffic control signals with all movements provided will operate with an acceptable level of service and Willoughby Road (including key intersections modeled) will also continue to operate with a similar level of service to the existing situation for the greatest level of development on the site for 10 years into the future (with forecast regional traffic growth and that generated by large developments planned nearby and assuming an upgrade at Willoughby Road/ Artarmon Road is completed).

- Roads and Maritime Service Advice

RMS advice (Attachment 7) supports the installation of traffic lights with restrictions on right turn movements from Willoughby Rd in peak hours and other requirements including updated road design to provide two lanes exiting from Walter St and one lane entering Walter St. The RMS requires the proposed traffic lights and associated civil works to be at the cost of the Proponent and to be included in a Planning Agreement executed prior to the gazettal of the Planning Proposal.

The RMS advice is noted and supported however the mechanism for providing the traffic lights should be a requirement in a condition of consent for the first Development Application for R4 High Density Residential in Walter St rather than as a Planning Agreement. The provision of traffic lights is not a public benefit but a consequence of the density increase facilitated by the Planning Proposal.

Car parking

The Proponent's Planning Proposal indicates provision of car parking at the rate required for developments not located on a major public transport corridor (MPTC). The Willoughby Development Control Plan (WDCP) identifies Willoughby Rd as a MPTC. It stipulates where any part of the street block adjoins a MPTC, the whole block is considered to be included as a MPTC. Therefore a lower rate of car parking is applicable to the Planning Proposal. Future Development Applications in the precinct would need to comply with the lower car parking requirement.

Bicycle Improvement opportunities

The Proponent has offered to fund a new pedestrian and cycle connection from the centre of Walter St to under the freeway connecting to the existing cycle way. Walter St connects to