APPENDIX E

ST MARYS DEVELOPMENT SITE REGIONAL TRAFFIC MODELLING, TRAFFIC AND TRANSPORT REPORT

MARYLAND DEVELOPMENT COMPANY PTY LTD

St Marys Development Site Regional Traffic Modelling

Traffic and Transport Assessment

OCTOBER 2017

CONFIDENTIAL

St Marys Development Site Regional Traffic Modelling

Traffic and Transport Assessment

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GLOSSARY

ANPR	Automatic Number Plate Recognition
BCC	Blacktown City Council
CBD	Central Business District
DP&E	Department of Planning and Environment
DoS	Degree of Saturation
DUE	Dynamic User Equilibrium
GEH	GEH Statistic
GPS	Global Positioning System
LoS	Level of Service
OD	Origin-Destination
PCC	Penrith City Council
SCATS	Sydney Coordinated Adaptive Traffic System
STFM	Sydney Transport Forecast Model
Roads and Maritime	Roads and Maritime Services
Strategic Model	Roads and Maritime Strategic Traffic Model
TfNSW	Transport for NSW

EXECUTIVE SUMMARY

The Maryland Development Company Pty Limited, a subsidiary of Lendlease, has appointed WSP to undertake a traffic modelling study to evaluate the impact of the St Marys Development Site on the existing road network. The St Marys Development Site is located approximately 5 km to the north-east of Penrith and comprises five discrete precincts identified as:

— Jordan Springs – formerly known as Western Precinct

— Jordan Springs East – formerly known as Central Precinct

— Ropes Crossing – formerly known as Eastern Precinct and Ropes Creek Precinct

— North Dunheved

— South Dunheved.

The locations of the five precincts within the St Marys Development Site are shown in Figure ES.1.

Figure ES.1 St Marys Development Site precinct locations

Jordan Springs and Ropes Crossing are currently partially developed, with Jordan Springs having 1,897 occupied dwellings and Ropes Crossing having 1,950 occupied dwellings respectively at December 2016.

This study assesses two land use scenarios; existing zoning and rezoning, with the rezoning scenario involving the replacement of the employment land within Jordan Springs East with approximately 500 dwellings.

Under SREP30 Jordan Springs East will comprise of approximately 38 hectares of employment land and 95 hectares of residential land. Lendlease is currently negotiating a rezoning of the 38 hectares of employment land to a residential land with the Department of Planning and Environment. It is anticipated that the rezoning application will be placed on public exhibition in late-2017.

The total development of St Marys Development Site is expected by year 2021, when with rezoning there will be a total of 7,712 dwellings, 599 apartments, 14,335 m^2 retail/shopping centre and 99,000 m^2 employment (industrial) together with commercial, childcare, medical centre and school facilities.

The scope of works included the development of AIMSUN mesoscopic models followed by SIDRA intersection modelling to assess the impacts of the development traffic on the road network external to the development at the anticipated full completion year in 2021, 5 years after completion in 2026, and 10 years after completion in 2031. Note that the impacts of the development traffic on the internal road network within the St Marys Development Site is subject to a separate assessment and reporting.

The assessment of the development impact to the external road network considers two network scenarios, 'without Links Road extension' and 'with Links Road extension'.

The AIMSUN model utilises Roads and Maritime supplied data from the Strategic Model based on a range of assumptions including hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). These road network enhancements should not be relied upon as they may never eventuate or occur in the timeframes assumed. Data from the Strategic Model is for modelling purposes only and is subject to change.

This has been investigated to address Penrith City Council's concerns regarding accessibility to the St Marys Development sites. Links Road is a local road located in the northern and western perimeter of the Dunheved industrial precinct. As shown in Figure ES.2, the potential extension of Links Road would extend from the access to Dunheved Golf Course and form a cross-intersection with Christie Street and Lee Holm Road. The merits of the potential Links Road extension have been assessed which indicate some (albeit minimal) impact to Forrester Road and its intersections with Ropes Crossing Boulevard and Christie Street.

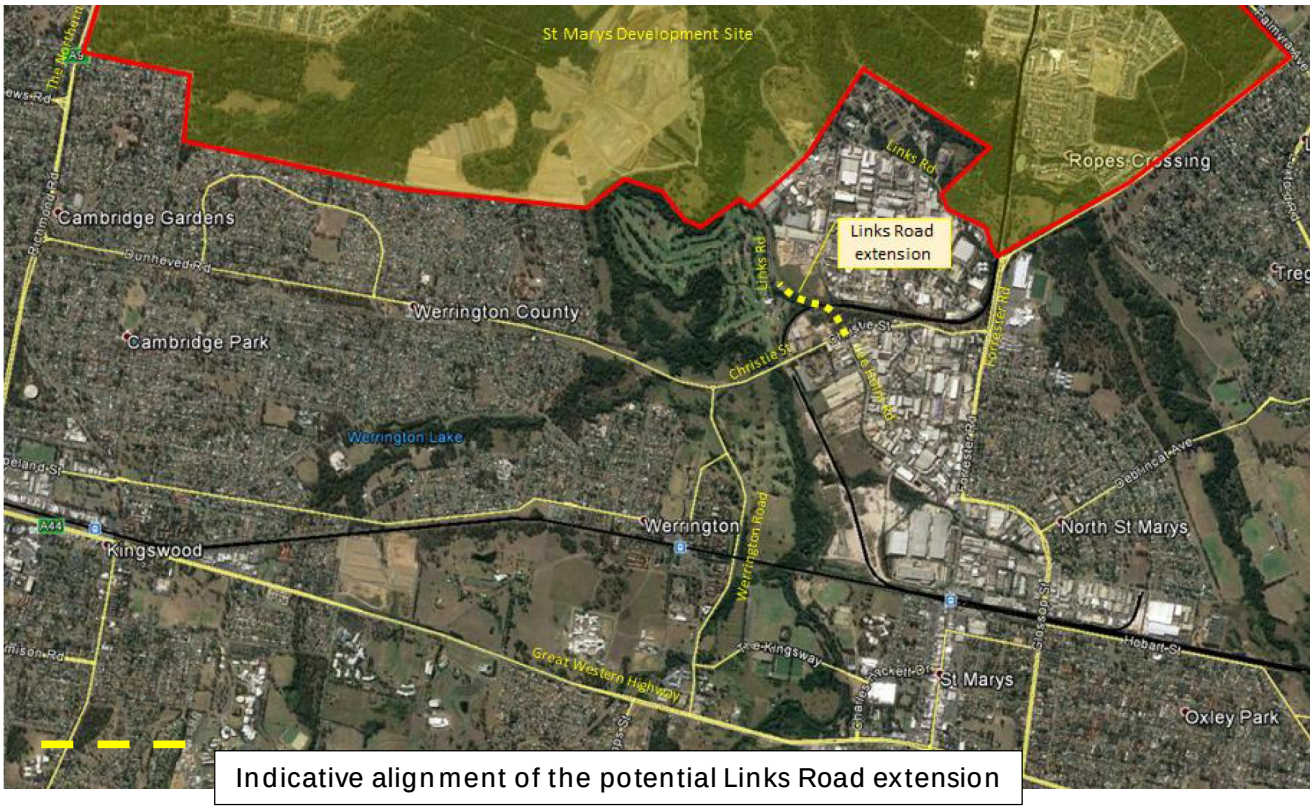


Figure ES.2 Potential Links Road extension location, St Marys NSW (Google Earth, imagery date: 5/5/2016)

The network assessment has also been undertaken reflecting forecast operation with base and hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). The SIDRA analysis at years 2021, 2026 and 2031 has identified a large number of locations where Level of Service (LoS) E or F is forecast at key intersections of the study area road network. Mitigation measures have been developed to provide additional capacity to cater for forecast demands at each assessment year.

1 INTRODUCTION

1.1 Background

The Maryland Development Company Pty Limited, a subsidiary of Lendlease, has appointed WSP to undertake a traffic modelling study to evaluate the impact of the St Marys Development Site on the existing road network. The St Marys Development Site is located to the north-east of Penrith and comprises five discrete precincts identified as:

— Jordan Springs – formerly known as Western Precinct

— Jordan Springs East – formerly known as Central Precinct

— Ropes Crossing – formerly known as Eastern Precinct and Ropes Creek Precinct

— North Dunheved

— South Dunheved.

At project commencement in 2016, both Jordan Springs and Ropes Crossing were substantially complete with a large proportion of residential dwellings built and occupied. Similarly, planning and construction work has substantially commenced at Jordan Springs East with occupation of the first dwellings expected in early 2018. The North Dunheved and South Dunheved precincts are planned for development upon the completion of Jordan Springs East.

The locations of the five precincts within the St Marys Development Site are shown in Figure 1.1.

Figure 1.1 St Marys Development Site precinct locations

The St Marys Development Site is bounded by existing residential development in the suburbs of Werrington County and Werrington Downs to the south, land zoned for Regional Open Space to the east and land zoned for Regional Park to the north and west. The precinct has a total area of 133.1 hectares.

Under the current zoning Jordan Springs East is anticipated to include approximately 1,400 dwellings to accommodate a population of between 3,900 and 4,300. It also consists of 38 ha of employment land envisaged to accommodate approximately 760 jobs in light industrial and light manufacturing sectors.

Under an alternate zoning, Jordan Springs East is anticipated to consist of approximately 1,900 dwellings, which is an additional 500 dwellings from the current zoning in lieu of the inclusion of the employment area.

1.2 Steering Committee formed

There has previously been significant traffic and transport modelling work completed in 2004 to underpin the phased development of the St Marys Development Site. However, as the project has progressed the assumptions underpinning the 2004 traffic and transport modelling have materially changed and as such, Penrith City Council (PCC) requested that a Traffic Steering Committee be formed to inform a more contemporary modelling approach that is underpinned by assumptions that more accurately reflect the nature and extent of the development, existing conditions and hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility).

The Traffic Steering Committee includes representatives of Roads and Maritime Services (Roads and Maritime), the Department of Planning & Environment (DP&E), Transport for NSW (TfNSW), Penrith City Council (PCC), Blacktown City Council (BCC), Lendlease, Elton and WSP.

WSP has been commissioned to prepare traffic modelling and reporting in accordance with the agreed expectations of the Traffic Steering Committee. The development of a contemporary traffic model has been undertaken according to the agreed scopes of a steering committee and generally in accordance with the Roads and Maritime Modelling Guidelines.

1.3 Scope of works

This report has been produced to report on all aspects of the traffic study which has been undertaken, including the model development, analysis and recommendation phases.

The scope of works included the development of AIMSUN mesoscopic models followed by SIDRA intersection modelling to assess the impacts of the development traffic on the surrounding road network at the anticipated full completion year in 2021, 5 years after completion in 2026, and 10 years after completion in 2031 relative to a base case model.

The AIMSUN model utilises Roads and Maritime supplied data from the Strategic Model based on a range of assumptions including hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). These road network enhancements should not be relied upon as they may never eventuate or occur in the timeframes assumed. Data from the Strategic Model is for modelling purposes only and is subject to change.

The base model has been used as follows:

— To investigate scenarios with and without a potential extension of Links Road to Christie Street, a north-south link road which would connect Jordan Springs East to Christie Street with connections to both Dunheved Road and Werrington Road (refer to Figure 1.2 on the following page).

— To inform the extent of intersection upgrades required with and without the St Marys Development Site on the existing road networks.

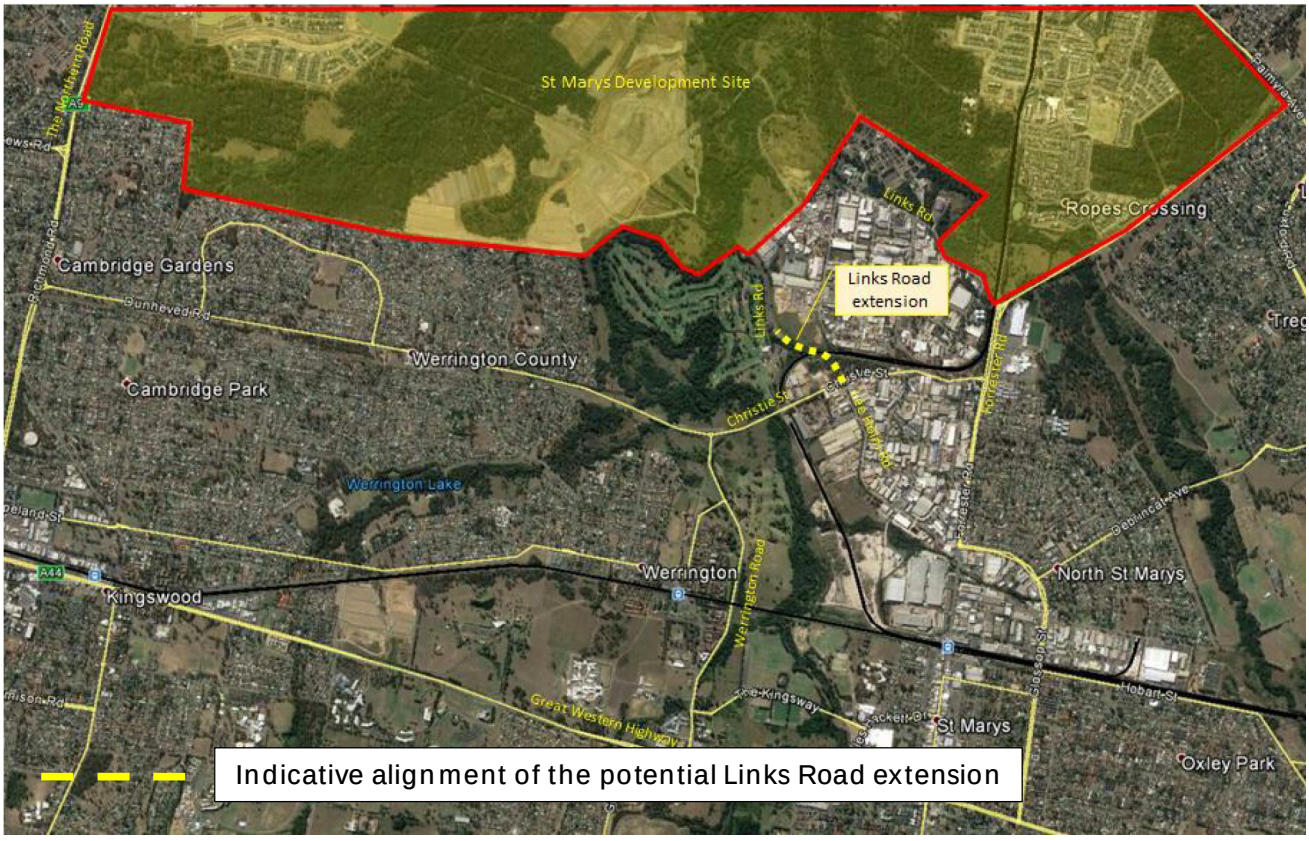


Figure 1.2 Potential Links Road extension location, St Marys NSW (Google Earth, imagery date: 5/5/2016)

1.4 Report purpose

The purpose of this report is to report on all key aspects of the study, to provide an overview of the following areas:

— description of the study area

— description of the proposed development with and without rezoning

— discussion on existing land uses and active and public transport networks

— discussion on the detailed traffic modelling process and associated methodology utilised including both AIMSUN and SIDRA modelling approved by the Steering Committee

— discussion of the traffic modelling scenarios assessed

— understand the traffic impacts of the proposed development

— understand the traffic impacts of the proposed land use changes (with and without rezoning land use changes)

— assess and understand the technical merits of the potential Links Road extension

— undertake intersection modelling to determine intersection performance

— determine necessary road and intersection upgrades required due to the proposed development traffic and background traffic growth

— provide guidance on future year reporting to address apportionment and the internal road network assessment.

1.5 Report structure

This report has been structured as follows:

— Section 1: Introduction, scope of works and report purpose

— Section 2: Details of site location and existing transport network

— Section 3: Details of base model development

— Section 4: Development overview and details of trip generation with and without rezoning

— Section 5: Future year model development

— Section 6: Future year base modelling (i.e. without St Marys development)

— Section 7: Future year project modelling

— Section 8: Investigates the mitigation measures which are required due to the development traffic and background traffic growth

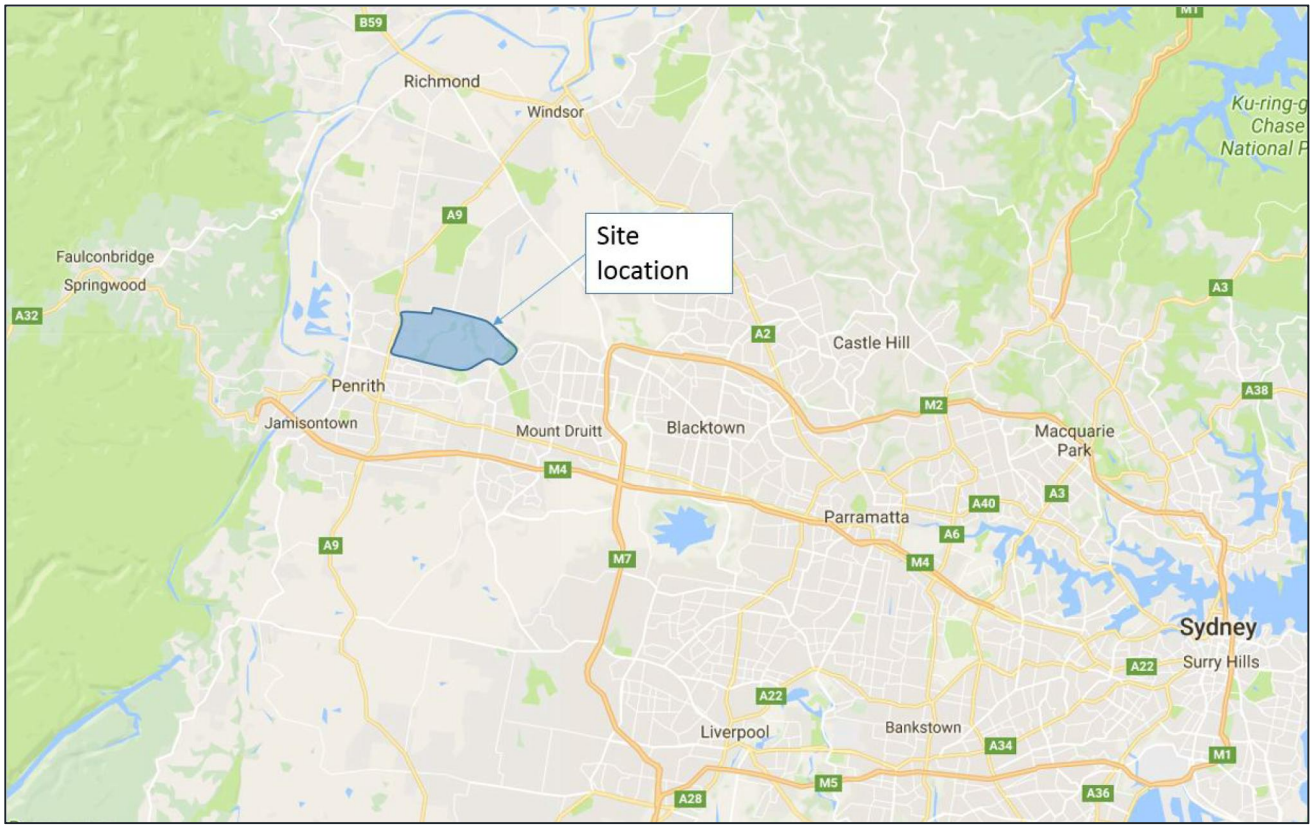
— Section 9: Provides detailed discussion on the key findings of the study

— Section 10: Conclusion of the study.

2 SITE LOCATION AND EXISTING TRANSPORT NETWORK

2.1 Site location

The St Marys Development Site is located approximately 5 km to the north-east of Penrith, and 25 km to the north-west of Parramatta and 45 km west of Sydney Central Business District (CBD). The location of the site with relation to Penrith, Parramatta and Sydney CBD is shown in Figure 2.1.



Source: Google Maps

Figure 2.1 Site location

The site is located to the north of the Western Rail Line, Great Western Highway and M4 Western Motorway. The entire site is roughly 7 km wide east to west and 2 km wide north to south. It is bounded by The Northern Road to the west, Ninth Avenue, Eighth Avenue and Palmyra Avenue to the north, Forrester Road and Christie Street to the east and the neighbouring suburbs of Werrington County, Werrington Downs and Cambridge Gardens to the south.

2.2 Study area road network

The study area includes north-south arterial roads (Parker Street/Richmond Road/The Northern Road in the west) and the Great Western Highway and M4 Motorway in the south. The Northern Road corridor provides access to Penrith CBD and the M4 Motorway in the south as well as Richmond in the north. On the eastern side, Forrester Road and Glossop Street provide access across the Western Rail Line to St Marys and via Mamre Road to the M4 Motorway. Dunheved Road and Christie Street provide a sub-arterial connection between these north-south corridors, as well as providing access to the Dunheved Industrial Area and the surrounding suburbs such as Werrington and Werrington County. Werrington Road connects Dunheved Road and Christie Street to the Great Western Highway. The study area partially includes the University of Western Sydney Penrith Campus and Nepean Hospital to the south.

The descriptions of key road corridors in proximity to the site are outlined below:

— Great Western Highway (GWH) Corridor: Running east-west and parallel to the M4, GWH services a number of Sydney's Western suburbs. Within the St Marys and Penrith region, the GWH varies between two and three lane carriage ways, with a speed limit of 80 km/h. Between Glossop Street and Parker Street, there are ten signalised intersections along the GWH, with several priority intersections accessing local roads. The Great Western Highway is a Roads and Maritime State Road.

— The Northern Road Corridor: A north-south arterial road, accessing the Great Western Highway and South Windsor, The Northern Road provides connectivity to the major collector roads within the Jordan Springs and Werrington regions. Operating between 60 and 70 km/h, this sub-arterial corridor services higher levels of traffic demand within the study area. The Northern Road Corridor is a Roads and Maritime State Road corridor.

— Ninth Avenue Corridor: Ninth Avenue is a collector road, located on the northern boundary of the study area that services schools and rural residential premises in the Llandilo and Jordan Springs suburbs. Ninth Avenue is a one lane dual carriageway with an allocated speed limit of 60 km/h. The Ninth Avenue Corridor is a Roads and Maritime Regional Road corridor.

— Forrester Road Corridor: Predominantly a two-lane dual carriageway, Forrester Road runs north–south connecting Palmyra Avenue and the Great Western Highway. Servicing vehicles within St Marys and Ropes Crossing, Forrester Road is another major sub-arterial corridor within the study area. Similar to the Northern Road, Forrester Road operates between 60 and 70 km/h, with a number of signalised and priority controlled intersections accessing local roads. The Forester Road Corridor is a Roads and Maritime Regional Road corridor.

— Dunheved Road/Christie Street Corridor: An east-west sub-arterial road, almost parallel to the Great Western Highway within the study area, with a speed limit of 60 km/h. This corridor also forms the southern boundary of the proposed development site between The Northern Road and Forrester Road. It is a one lane carriageway in each direction and provides right turning pocket lanes at several T-junctions. The Dunheved Road/Christie Street Corridor is a Roads and Maritime Regional Road corridor.

— Werrington Road: A north-south one lane sub-arterial road, providing a vital connection between the Great Western Highway and Dunheved Road and Christie Street. Werrington Road is a Roads and Maritime Regional Road.

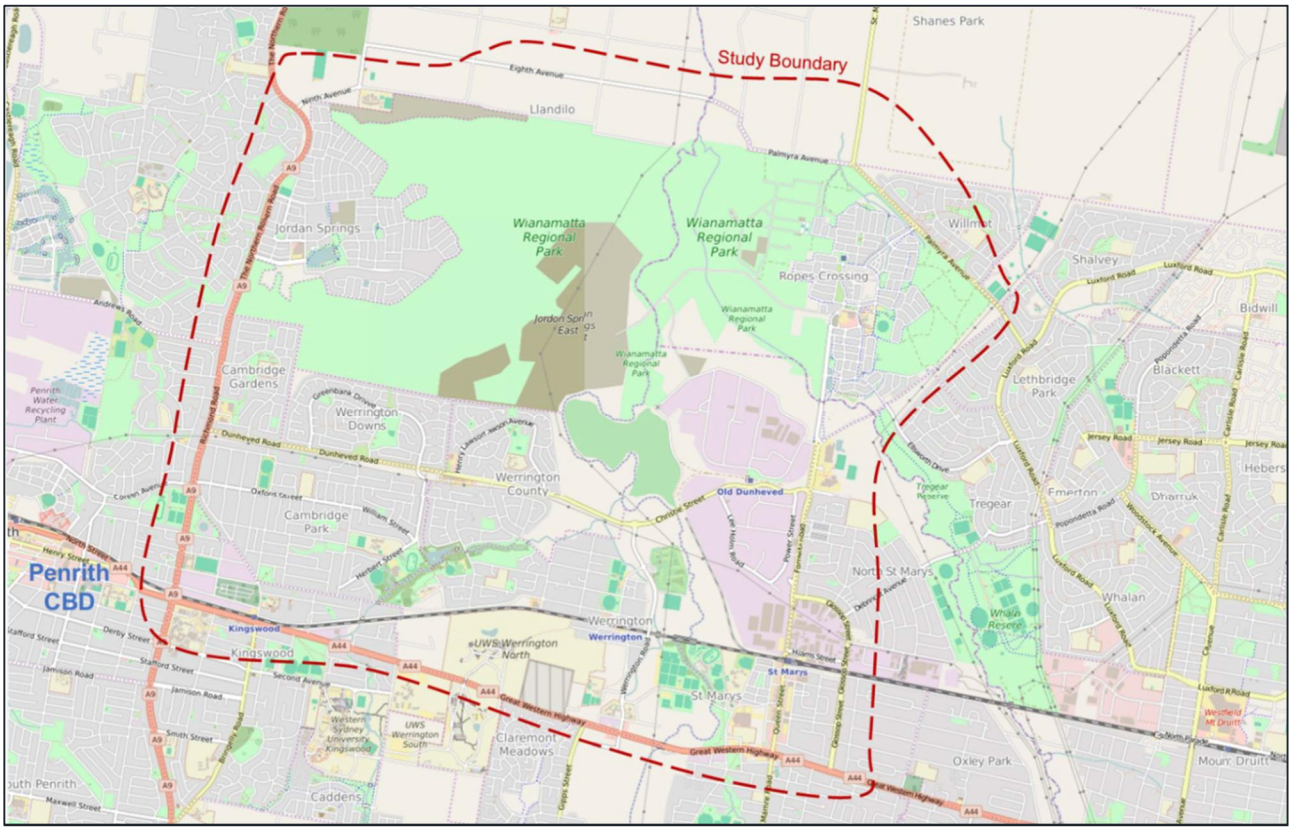
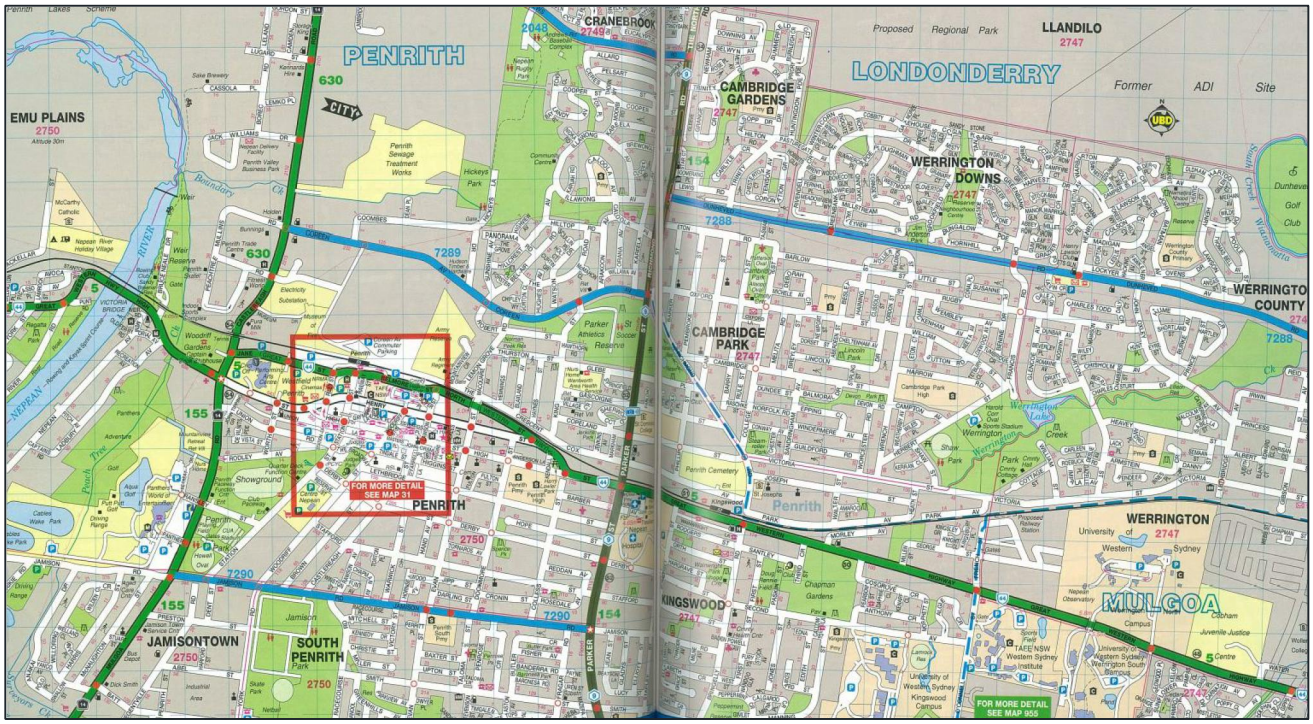


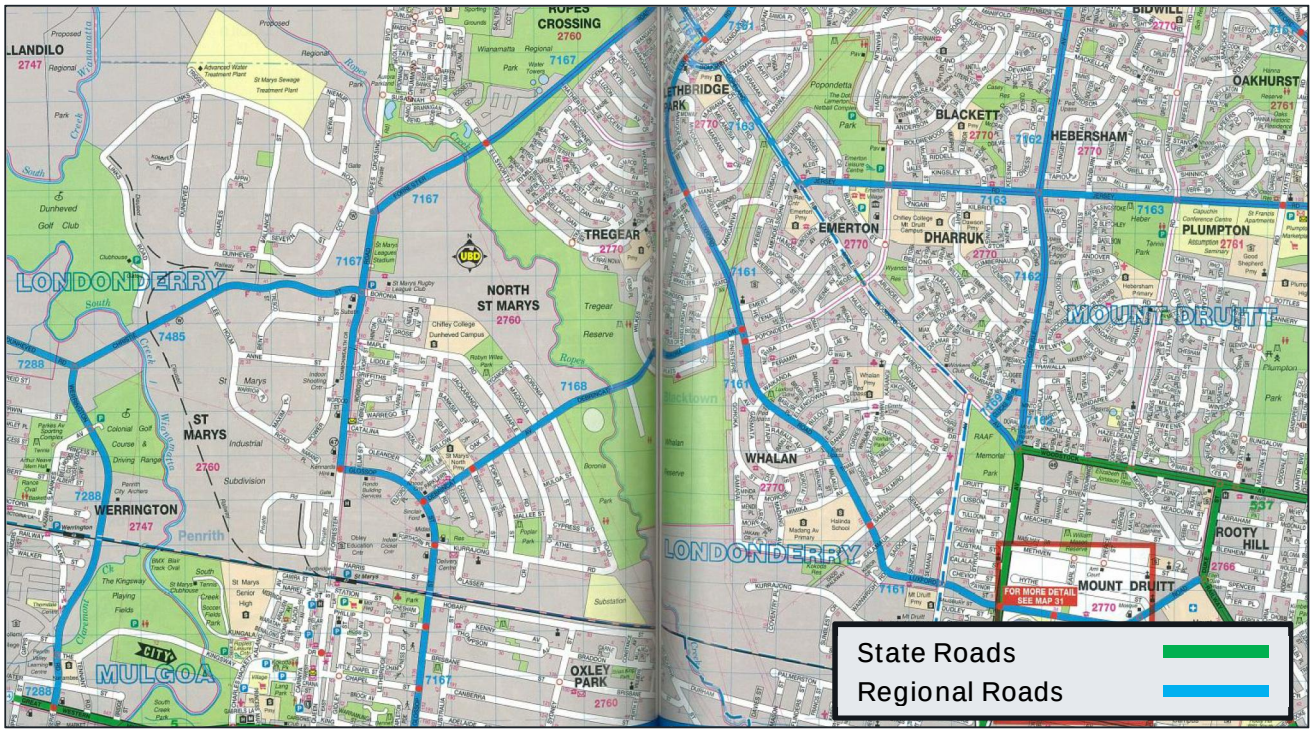
Figure 2.2 Study area

The road network hierarchy within the study area is shown in Figure 2.3, Figure 2.4, Figure 2.5 and Figure 2.6, with State Roads highlighted green, Regional Roads highlighted blue and Local Roads highlighted white. The key State Roads are The Northern Road and Great Western Highway while the key Regional Roads are Dunheved Road, Werrington Road, Christie Street, Forrester Road, Palmyra Avenue, Luxford Road, Second Avenue, Eighth Avenue and Ninth Avenue.



Source: Roads and Traffic Authority *Sydney and Blue Mountains Street Directory, 2012, UBD Gregory's*

Figure 2.3 Road hierarchy – part 1

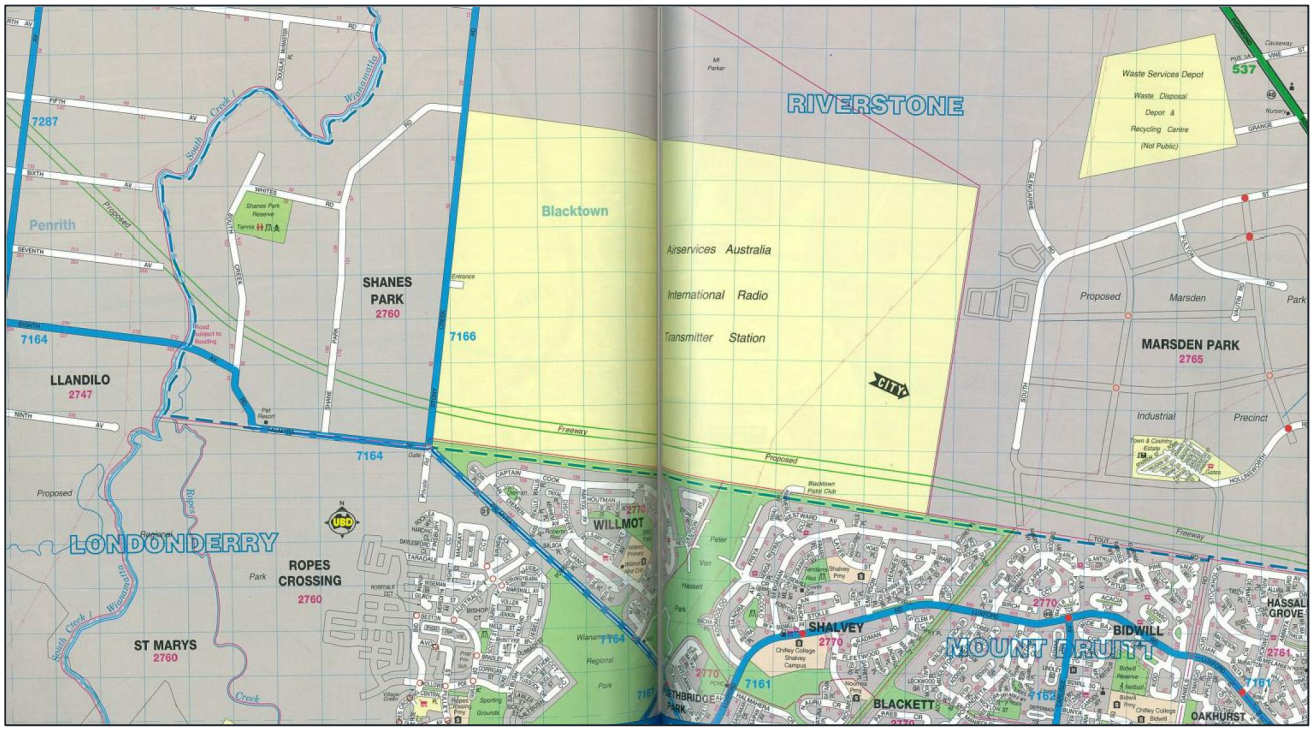


Source: Roads and Traffic Authority *Sydney and Blue Mountains Street Directory, 2012, UBD Gregory's*

Figure 2.4 Road hierarchy – part 2

Source: Roads and Traffic Authority *Sydney and Blue Mountains Street Directory, 2012, UBD Gregory's*

Figure 2.5 Road hierarchy – part 3



Source: Roads and Traffic Authority Sydney and Blue Mountains Street Directory, 2012, UBD Gregory's

Figure 2.6 Road hierarchy – part 4

The posted speed limits within the study area are shown in Figure 2.7, highlighting a range of speed limits between 50 km/h and 80 km/h.

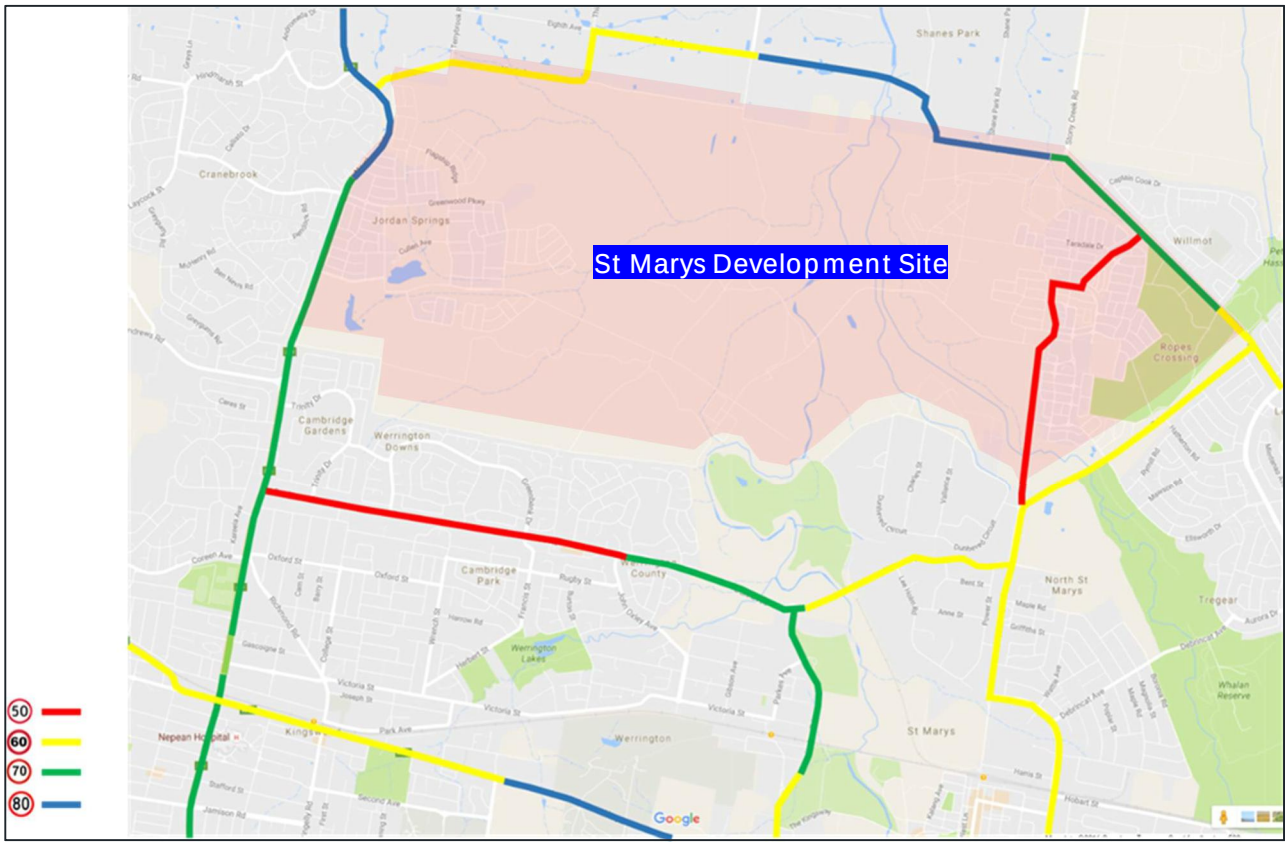


Figure 2.7 Road speed limits

2.3 Rail network

The T1 Main Western Line is in proximity to the St Marys Development Site, with the nearest stations being at Kingswood, Werrington and St Marys. Kingswood station is the nearest station for the western areas of the development, while Werrington is nearest to the central areas of the development and St Marys is nearest to the eastern areas of the development, as highlighted in Figure 2.8.

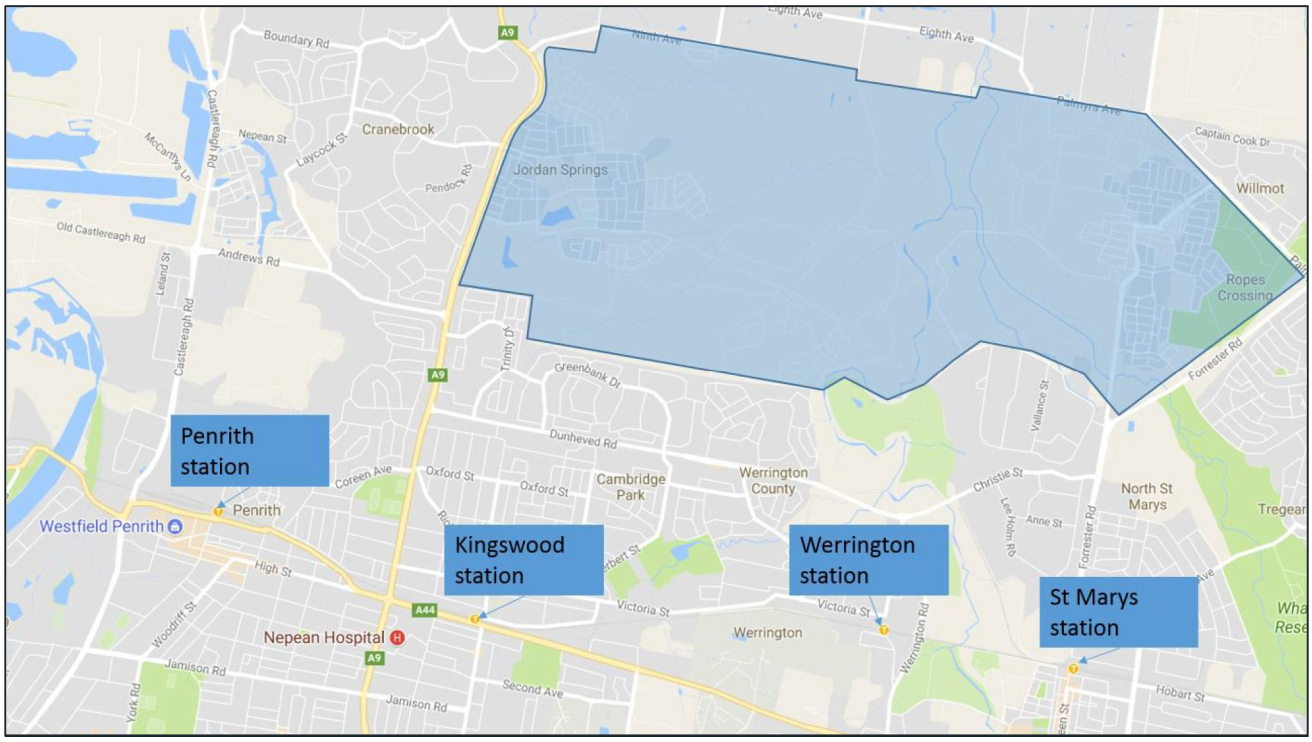


Figure 2.8 Rail stations in proximity to site

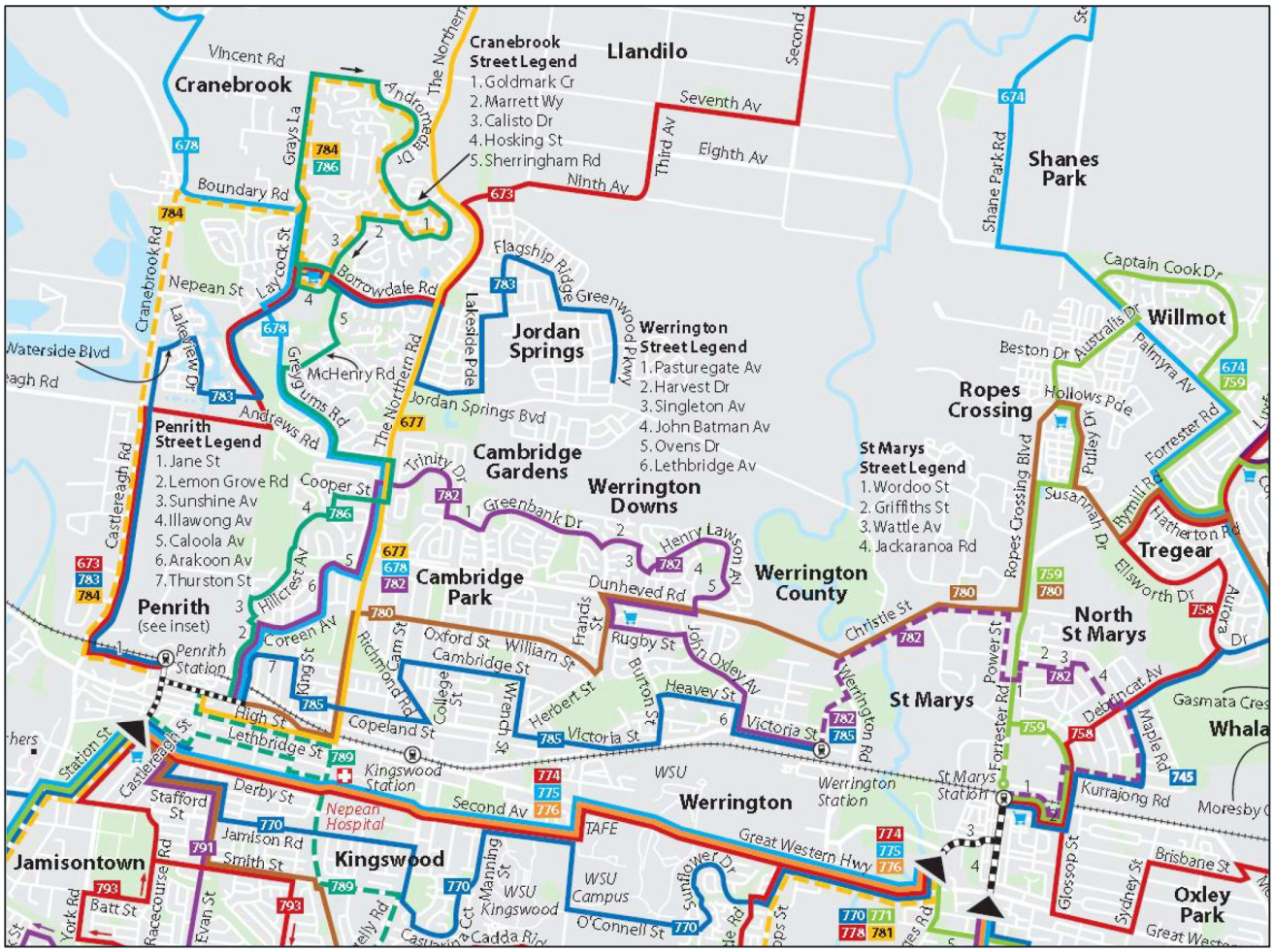
The rail services which are operating from each of the stations is show in Table 2.1, highlighting the trains per hour (TPH) operating in each direction during the AM peak, off peak and PM peak.

Table 2.1 Rail services

Station	AM peak		Off peak		PM peak	
	Eastbound (TPH)	Westbound (TPH)	Eastbound (TPH)	Westbound (TPH)	Eastbound (TPH)	Westbound (TPH)
Werrington/Kingswood	6	3	4	4	4	4
St. Marys	8	5	4	4	4	5

2.4 Bus network

There are several existing bus routes serving the St Marys Development Site and these are shown in Figure 2.9. The routes are predominantly in the west along The Northern Road and in the east along Ropes Crossing Boulevard, together with routes along the northern and southern boundaries of the development. Jordan Springs is served by Route 783 which operates between Jordan Springs and Penrith Interchange. Ropes Crossing is served by Routes 759 and 780 with connections to both Penrith and St Marys Interchanges.



Source: TfNSW

Figure 2.9 Existing bus routes

Future bus routes through Jordan Springs East are currently being finalised. Provision of the future bus routes within the Jordan Springs East internal road network have been made through design implementation ensuring higher order roads are designed with suitable widths and intersection geometry to ensure manoeuvrability and operation of public buses. A bus-only north-south link through Werrington County will also be provided as previously discussed with Transport for NSW.

The details of existing bus routes operating in the vicinity of the development site are shown in Table 2.2.

Table 2.2 Existing bus route schedules

Route	AM peak (headway)	PM peak (headway)	Off peak
673 Penrith to Kable Street	30–60 mins	30–60 mins	1 trip
674 Mount Druitt to Kable Street	40–60 mins	40–60 mins	2 trips
677 Penrith to Richmond	60 mins	60 mins	2 trips
678 Penrith to Richmond	30–60 mins	30–60 mins	1 trip
758 Mount Druitt to St Marys	15 min	30 mins	15 mins
759 Mount Druitt to St Marys	30 mins	30 mins	30/60 mins
780 Mount Druitt to Penrith	15 mins	15 mins	12/30 mins
782 Penrith to St Marys	30 mins	30 mins	60 mins
783 Jordan Springs to Penrith	30 min	30 min	60 min
785 Penrith to Werrington	30 mins	30 mins	60 mins

2.5 Cycle network

The most significant cycling facility within the vicinity of the development site is the shared path provided along the south side of the Great Western Highway. In addition, there are sections of shared path on The Northern Road together with sections of recreational paths which run through a number of the parks, including Whalan Reserve and Werrington Lakes. The current development within Jordan Springs and Ropes Crossing is comparatively friendly for cycling compared with older suburbs, with slower speed roads, tighter intersection radii and shared paths. Shared paths are provided off-road along key road connections within Jordan Springs.

2.6 Pedestrian facilities

Pedestrian footpaths of adequate width are provided on the vast majority of roads within both Jordan Springs and Ropes Crossing.

2.7 Summary

The St Marys Development Site is located approximately 5 km to the north-east of Penrith and 25 km to the north-west of Parramatta. The site is surrounded by an extensive road network, in particular north-south roads to the east and west of the site, and east-west corridors to the south. There are a number of existing bus services operating between the site and nearby rail stations on the T1 Main Western Line.

3 BASE MODEL DEVELOPMENT

3.1 Introduction

This section provides details of the key aspects of the 2016 Base model development process which has been undertaken during the project. An earlier memo (2197037A-ITP-MEM-006 Rev B dated 27 March 2017) was prepared specifically documenting the proposed modelling methodology and this is included in Appendix A for reference. The calibration and validation report (2197037A-ITP-REP-001 Rev A) has been produced and this is included in Appendix B.

3.2 Methodology overview

The base model of the road network surrounding St Marys Development Site has been developed to reflect the existing operation of the road network with consideration of the existing land uses. It provides an opportunity to confirm the validity of the assumptions and statistical traffic data collected, observed and inputted, thus ensuring a reliable benchmark to which future year modelling scenarios can be developed on and comparisons between 'with' and 'without' development can be determined.

The 2016 Base model development process associated with the development of the AIMSUN models is illustrated below in Figure 3.1. This process was designed to comply with the Roads and Maritime *Traffic Modelling Guidelines* (February 2013). Subsequent to the development of the 2016 Base AIMSUN models, 2016 Base SIDRA models were developed using the turning volumes included within the AIMSUN models.

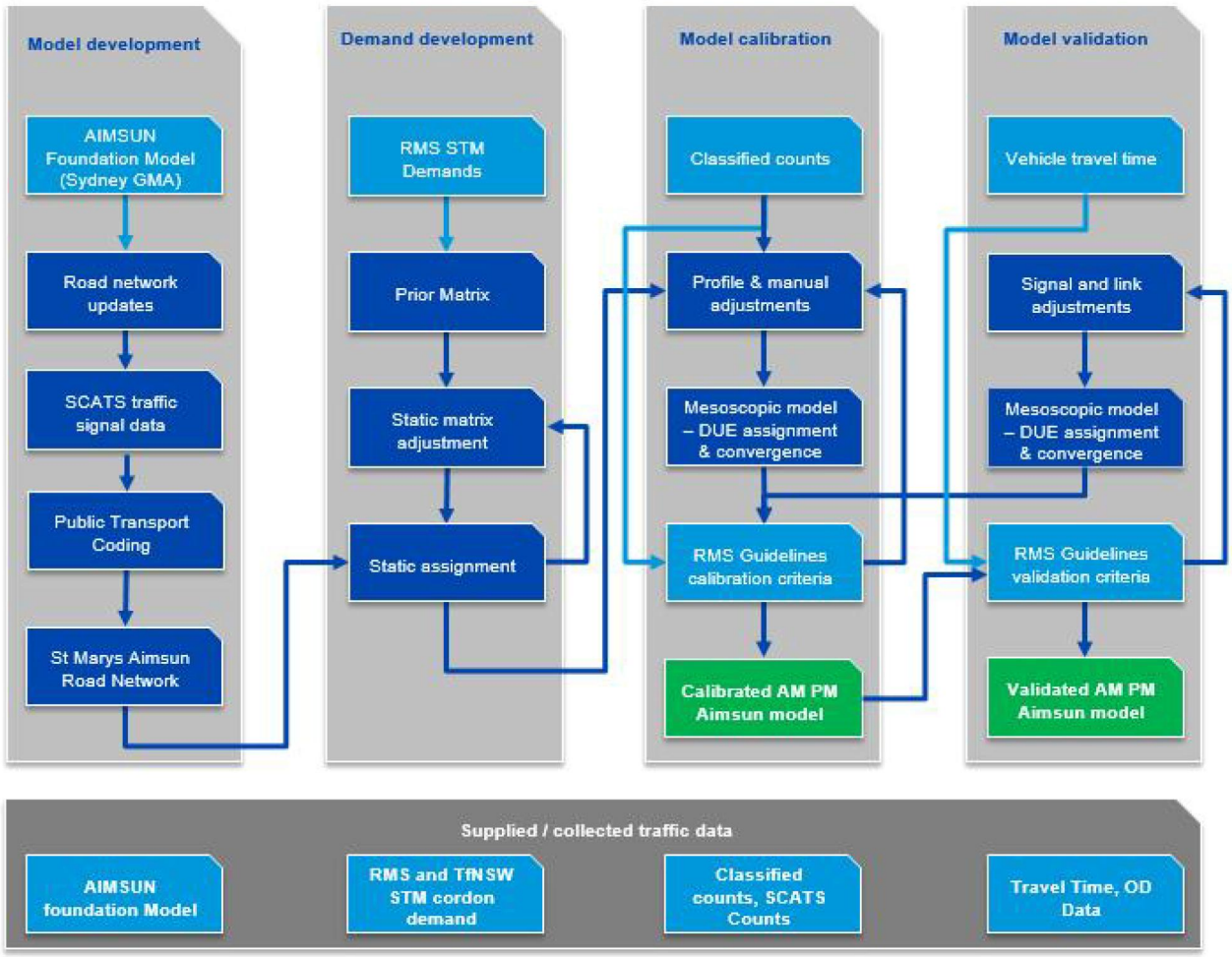


Figure 3.1 Base traffic model methodology

3.3 Key modelling parameters

The key modelling parameters adopted during the development of the model are described here.

3.3.1 Study area

The network of the 2016 base model is shown in Figure 3.2, extending to Glossop Street/Forrester Road in the east, Great Western Highway in the south, The Northern Road in the west and Ninth Avenue/Eighth Avenue/Palmyra Avenue in the north.

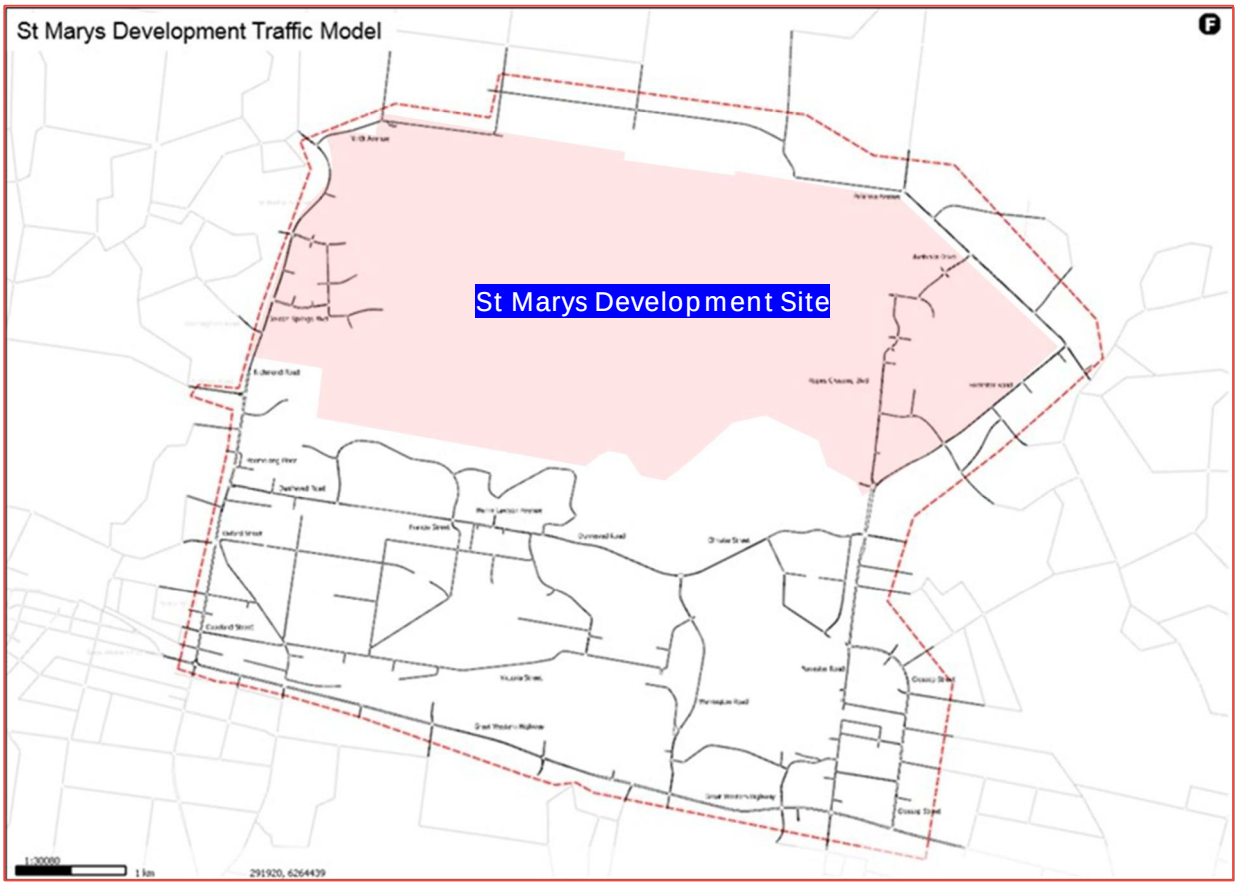


Figure 3.2 2016 AIMSUN base model

3.3.2 Time periods

The AIMSUN model incorporates both the weekday AM and PM peaks. The modelled peak hour periods are:

— AM peak: 7.00 am to 9.00 am

— PM peak: 4.00 pm to 6.00 pm.

A one hour warm-up period has been applied upfront to provide a good representation of traffic conditions within the road network prior to the two-hour peak period, with a one hour cool-down period applied to maximise the traffic release following the peak period.

3.3.3 Traffic modelling assumptions

The traffic modelling assumptions have included reference to the following key reference documents.

— Jordan Springs residential subdivision, Village Six Transport Impact Assessment (GTA, 2014)

— St Marys Development Rezoning Application (Road Delay Solutions, June 2016)

— *Traffic Modelling Guidelines* (Roads and Maritime, 2013)

— *Guide to Traffic Generating Developments* (Roads and Maritime, 2002)

— *Guide to Traffic Generating Developments, Updated Traffic Surveys TDT 2013/04* (Roads and Maritime, 2013)

— Traffic surveys completed in September 2016.

3.3.4 Site inspections

Site inspections were carried out during the AM (7.30 am to 9.00 am) and PM (4.00 pm to 6.00 pm) peak hours on Thursday, 8 September 2016. These site visits were conducted on the same day as the traffic surveys being undertaken by TTM. The objective of the site visit was to understand the traffic operations in the study area and identify the locations experiencing traffic congestion during the weekday AM and PM peak periods.

3.4 Network data

3.4.1 Road geometry

Prior to the network refinement, the study area was carefully checked using *Google Maps* aerial photography and street view images as well as site visit observations to ensure model details corresponded to the existing road network. Key features that were checked within the study area included:

— length of short/turning lanes

— lane configurations

— on-street parking restrictions

— speed limits

— priority control at intersections (giveaway or stop signs)

— school zones.

3.4.2 Signal operations

The Sydney Coordinated and Adaptive Traffic System (SCATS) traffic signal data for the signalised intersections (locations shown in Figure 3.3) within the study area were collected on 8 September 2016 (the same date of the site visit and the collection of classified intersection counts). The data provided by Roads and Maritime included:

— SCATS Intersection Diagnostic Monitor (IDM) files, which contain the phase time, frequency and cycle length data.

— Traffic Control Site (TCS) graphics plots, showing phasing plans, signal groups and detector locations.

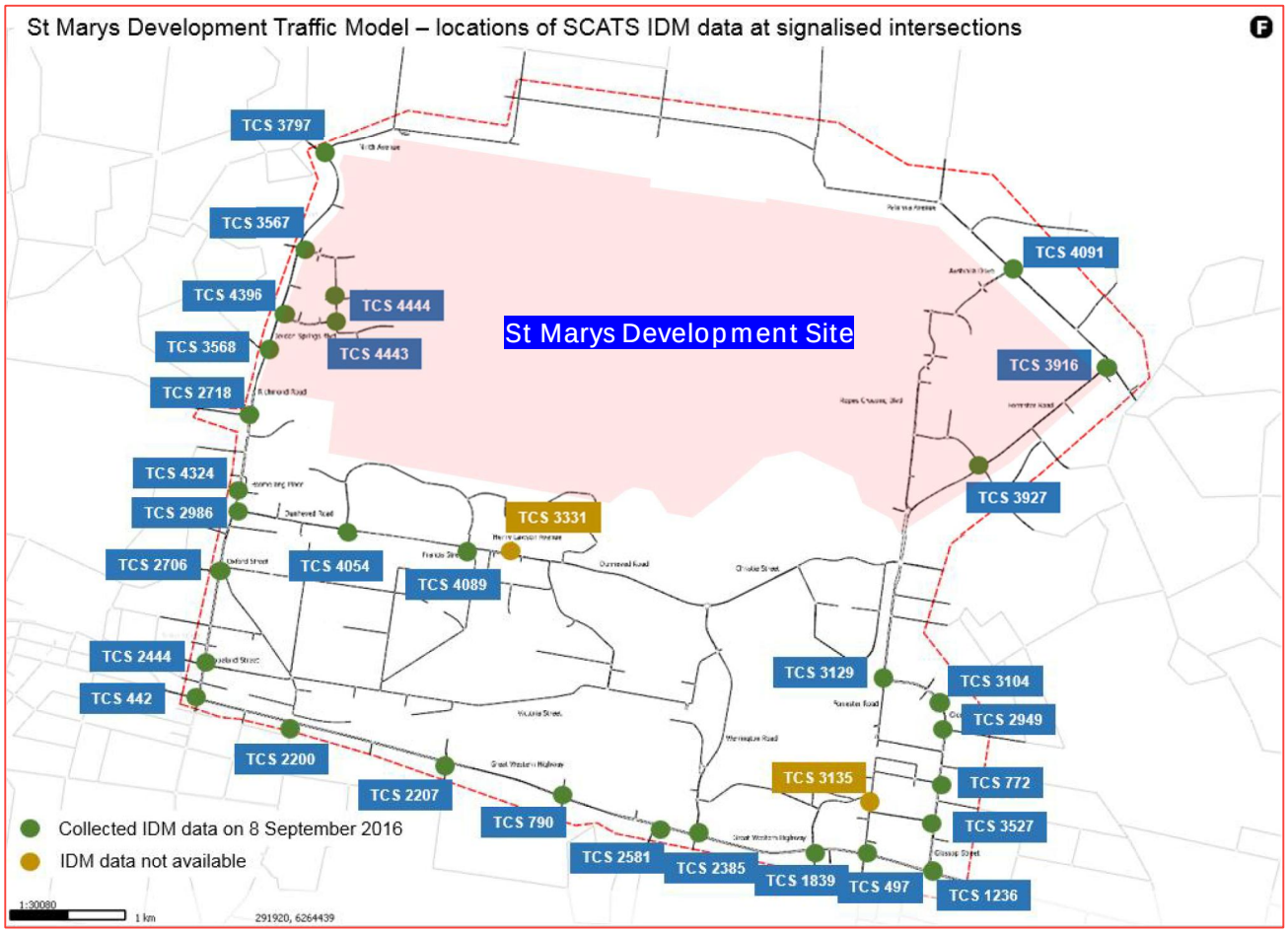


Figure 3.3 Locations of signalised intersections and supplied IDM data

3.4.3 *Bus operation data*

Bus route information was extracted from the Greater Sydney General Transit Feed Specification (GTFS) open-source data. Bus Stop IDs, dwell times and bus routes within this data package were allocated GPS coordinates, which were imported into geospatial software (QGIS). These exported locations and bus paths were cross-referenced with *Busways timetable data*. A list of the bus routes coded in the traffic model is shown in Table 3.1.

Table 3.1 Bus routes coded in the traffic model

Bus route	Locations
673	Windsor to Penrith via Bligh Park
674	Windsor to Mt Druitt via Bligh Park
677	Richmond to Penrith via Londonderry and Northern Road
678	Richmond to Penrith via Agnes Banks, Castlereagh and Cranebrook
758	Mt Druitt to St Marys via Emerton and Shalvey
759	Mt Druitt to St Marys via Emerton, Willmot and Ropes Crossing
774	Penrith to Mt Druitt via St Marys and Oxley Park
775	Penrith to Mt Druitt via St Marys and Erskine Park

Bus route	Locations
776	Penrith to Mt Druitt via St Marys and St Clair
780	Mt Druitt to Ropes Crossing
781	Penrith to St Marys via Glenmore Park, Orchard Hills and Claremont Meadows
782	Penrith to St Marys via Cambridge Gardens and Werrington Station
783	Penrith to Jordan Springs
785	Penrith to Werrington Station via Cambridge Park

3.5 Traffic surveys

Traffic surveys were carried out on Thursday 8 September 2016 and Thursday 15 September 2016 by TTM. These surveys included:

— intersection turning counts – 30 locations

— classified mid-block traffic counts – 10 locations

— origin-destination survey – 15 locations

— travel time surveys – six routes

— queue length surveys – 19 locations

— SCATS detector counts in one hour intervals (collected at 11 locations in addition to the TTM traffic counts).

The traffic data was collected for the following intervals, which captured most trips associated with commuting, schooling, business and other key activities in the study area:

— AM peak: 6.00 am–10.00 am

— PM peak: 3.00 pm–7.00 pm.

The locations of the traffic surveys are summarised in Figure 3.4.

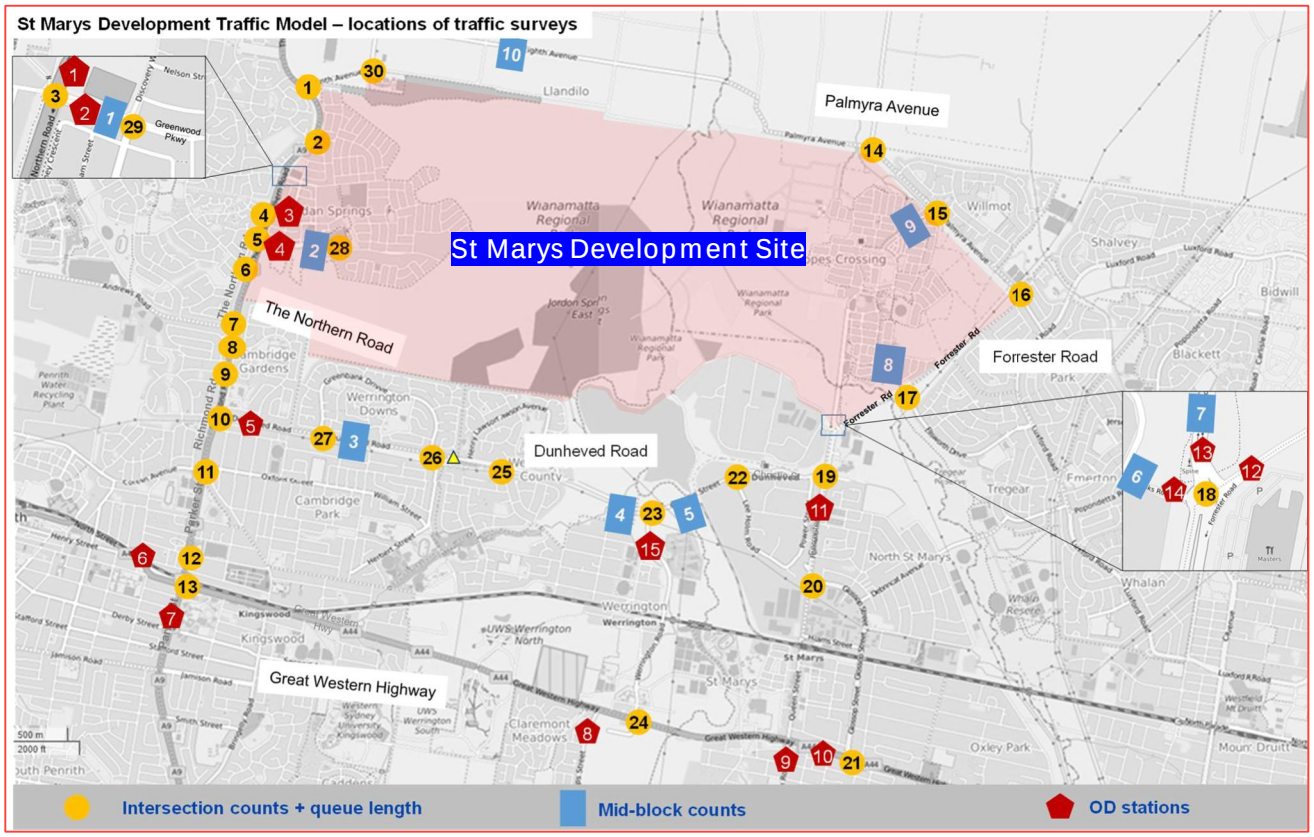


Figure 3.4 Traffic data collection locations

3.5.1 *Origin-destination survey results*

Vehicle origin-destination (OD) surveys were conducted to assess the travel patterns and distribution associated with the existing Jordan Springs and Ropes Crossing developments. The surveys were undertaken using Automatic Number Plate Recognition (ANPR) technology, on Thursday 15 September 2016, one week after the classified intersection counts were undertaken.

3.5.2 *Travel time survey results*

Floating car travel time surveys were undertaken by TTM on six routes and presented in Figure 3.5. Travel time data were collected in each peak hour during the AM and PM peak periods on Thursday, 8 September 2016.

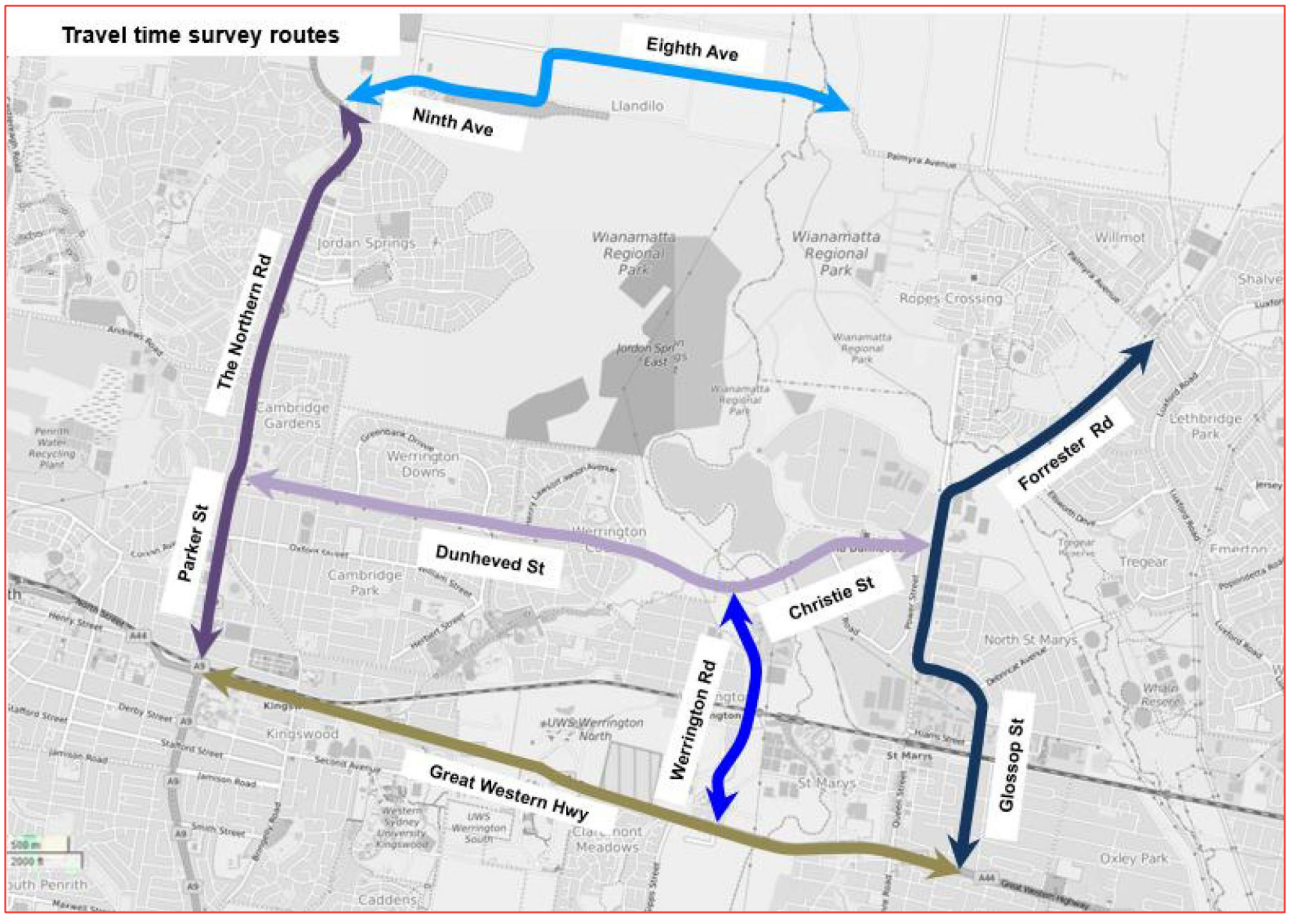


Figure 3.5 Travel time survey routes

3.5.3 Queue length survey results

Queue length survey results were reviewed and issued in the memorandum: *Jordan Springs East, St Marys Development Site – SIDRA Base Year Model* (April 2017). Although the queue length survey results were used to gain an appreciation of the network congestion, they were only used to validate SIDRA base models.

3.6 Traffic demand development

The traffic demand development process has involved the following key stages:

— Prior matrix development: 2 hour prior matrices were obtained from the Roads and Maritime Strategic Traffic Model (Strategic Model), which were then converted to peak hour matrices, followed by disaggregation to two vehicle classes and expansion of zones to an AIMSUN zone system.

— Zone system refinement: a review of the Strategic Model link and zone structure was undertaken and a refined level of disaggregation of both external and internal zones was carried out for the model boundary area.

— Matrix estimation: prior matrix finessing using the AIMSUN process tool followed by manual adjustment to reflect surveyed traffic counts.

3.7 Calibration and validation

Table 3.2 provides a summary of the key calibration and validation results for the St Marys Development mesoscopic traffic model and how it performs against the agreed target criteria.

Table 3.2 St Marys Development traffic model calibration and validation summary

Criteria	AM peak	PM peak	Summary
Model calibration			
Prior and post matrix check (Trip-end and trip length)	✓	✓	Trip length distributions correspond to the Roads and Maritime Strategic Model. Whilst some trips have transferred from mid-length to short-length, these are within acceptable limits (less than average 3 to 4%).
Assignment convergence	✓	✓	The models meet the calibration criteria for convergence.
Assignment calibration (turning counts at intersections)	✓	✓	The results show a good degree of calibration, with over 85% of the modelled volumes at a total of 30 intersections (and 19 critical intersections) having a very good correlation (GEH < 5) with the survey counts, in each peak hour.
Screenline calibration	✓	✓	The screenline calibration shows that the individual modelled screenline volumes are well correlated (GEH <5) with the observed screenline volumes in all cases. Only three screenline locations show the GEH values between 4 and 5.
St Marys development site OD distribution check	✓	✓	The OD distribution of trips from/to Jordan Spring development site has a good match between the survey and model results.
Route choice check			The route choices on the major corridors were checked and the results were deemed reasonable.
Model validation			
Cars – key corridor travel time	✓	✓	Corridor travel time validation statistics show an excellent level of validation against observed data, with 46 out of 48 routes (or 96%) meeting the criteria.
Model stability			
Vehicle distance travelled Number of vehicles inside the network'	✓	✓	The results produced by five seed values were plotted and compared with each other and the average. The comparison results show acceptable variability in both the AM and PM peak models.

3.8 SIDRA assessment

3.8.1 Introduction

SIDRA has been used for the purpose of providing detailed analysis of key intersections within the study area, thereby providing accurate assessment of existing and future peak operation with the alternative assessment scenarios. The SIDRA analysis process has involved demand volumes being exported from AIMSUN to SIDRA.

3.8.2 Assessment criteria

3.8.2.1 Level of service

Level of Service (LoS) is a basic performance parameter used to describe the operation of an intersection. Levels of service range from A (indicating good intersection operation) to F (indicating over-saturated conditions with long delays and queues). At signalised intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At priority controlled (give-way and stop controlled) and roundabout intersections, the LoS is based on the modelled delay (seconds per vehicle) for the most delayed movement.

The Roads and Maritime LoS criteria for intersections which has been followed is shown in Table 3.3.

Table 3.3 Level of service criteria for intersections

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

Source: Roads and Maritime *Guide to Traffic Generating Developments, 2002*

3.8.2.2 Degree of Saturation

The Degree of Saturation (DoS) is the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For a satisfactory situation, DoS should be less than the nominated practical degree of saturation, usually 0.9. The intersection DoS is based on the movement with the highest value.

3.8.2.3 Average Vehicle Delay

This is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. At signalised intersections, the average intersection delay is usually reported. At roundabouts and priority controlled intersections, the average delay for the most delayed movement is usually reported.

3.8.2.4 Queue length

Queue length is measured in metres reflecting the number of vehicles waiting at the stop line and is usually quoted as the 95th percentile back of queue, which is the value below which 95% of all observed queue lengths fall. It reflects the number of vehicles per traffic lane at the start of the green period, when traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

3.8.2.5 Intersection Performance Criteria

Typically acceptable intersection performance is defined as follows:

— LoS D or better (the worst case scenario of vehicle delay was less than or equal to 56 seconds)

— DoS less than or equal to 0.8 at priority controlled intersection, and 0.90 at a signalised controlled intersection

— 95th percentile worst back of queue length not interfering with adjacent intersections.

3.8.3 2016 Base

The 2016 Base SIDRA results are shown in Table 3.4. This analysis is undertaken using the turning volumes which have been produced by the AIMSUN 2016 Base model, including traffic associated with the existing development within the site.

Table 3.4 2016 Base intersection performance

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.83	21	B	149	The Northern Road – north-west approach
		PM	0.81	19	B	150	The Northern Road – north-west approach
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.77	34	C	144	The Northern Road – south approach
		PM	0.86	31	C	144	The Northern Road – north approach

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.51	15	B	122	The Northern Road – north approach
		PM	0.57	20	B	134	The Northern Road – north approach
I-07	The Northern Road and Andrews Road	AM	0.73	17	B	108	Richmond Road – south approach
		PM	1.03	19	B	134	Richmond Road – south approach
I-08	Richmond Road and Trinity Drive	AM	0.78	160	F	24	Trinity Drive – east approach
		PM	0.37	72	D	12	Richmond Road – south approach
I-10	Richmond Road and Dunheved Road	AM	0.92	26	B	220	Richmond Road – north approach
		PM	0.74	25	B	206	Richmond Road – north approach
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.76	36	C	199	Richmond Road – north approach
		PM	0.86	32	C	206	Parker Street – south approach
I-13	Great Western Highway and Parker Street	AM	1.03	49	D	232	Parker Street – north approach
		PM	1.17	100	F	475	Parker Street – south approach
I-15	Palmyra Avenue and Australis Drive	AM	0.74	10	A	31	Palmyra Avenue – north-west approach
		PM	0.77	12	A	41	Palmyra Avenue – south-east approach
I-16	Palmyra Avenue and Forrester Road	AM	0.63	15	B	59	Palmyra Avenue – south-east approach
		PM	0.88	20	B	103	Palmyra Avenue – south-east approach
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	0.59	17	B	39	Ropes Crossing Boulevard – north approach
		PM	0.50	22	B	30	Ropes Crossing Boulevard – north approach
I-19	Forrester Road, Christie Street and Boronia Road	AM	0.55	17	B	42	Christie Street – west approach
		PM	0.95	74	F	203	Forrester Road – south approach

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-21	Great Western Highway and Glossop Street	AM	0.77	32	C	130	Great Western Highway – east approach
		PM	0.71	29	C	171	Glossop Street – north approach
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.44	13	A	36	Dunheved Road – west approach
		PM	0.64	20	B	59	Werrington Road – south approach
I-24	Werrington Road and Great Western Highway	AM	0.90	33	C	173	Werrington Road – north approach
		PM	1.05	55	D	355	Werrington Road – north approach
I-25	Dunheved Road and John Oxley Avenue	AM	0.1	17	A	2	John Oxley Avenue – south approach
		PM	0.08	23	B	6	Dunheved Road – west Approach
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.94	24	B	110	Dunheved Rd – East Approach
		PM	1.06	27	B	159	Dunheved Rd – East Approach
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.97	13	A	119	Dunheved Rd – West approach
		PM	0.79	7	A	68	Dunheved Road – west approach

The SIDRA analysis results for year 2016 Base are shown summarised in Figure 3.6, highlighting the LoS during both the AM and PM peaks. It can be seen that intersections I-8 (Richmond Road/ Trinity Drive), I-13 (Great Western Highway/Parker Street) and I-19 (Forrester Road/Christie Street/ Boronia Road) experience LoS F during the peak periods.

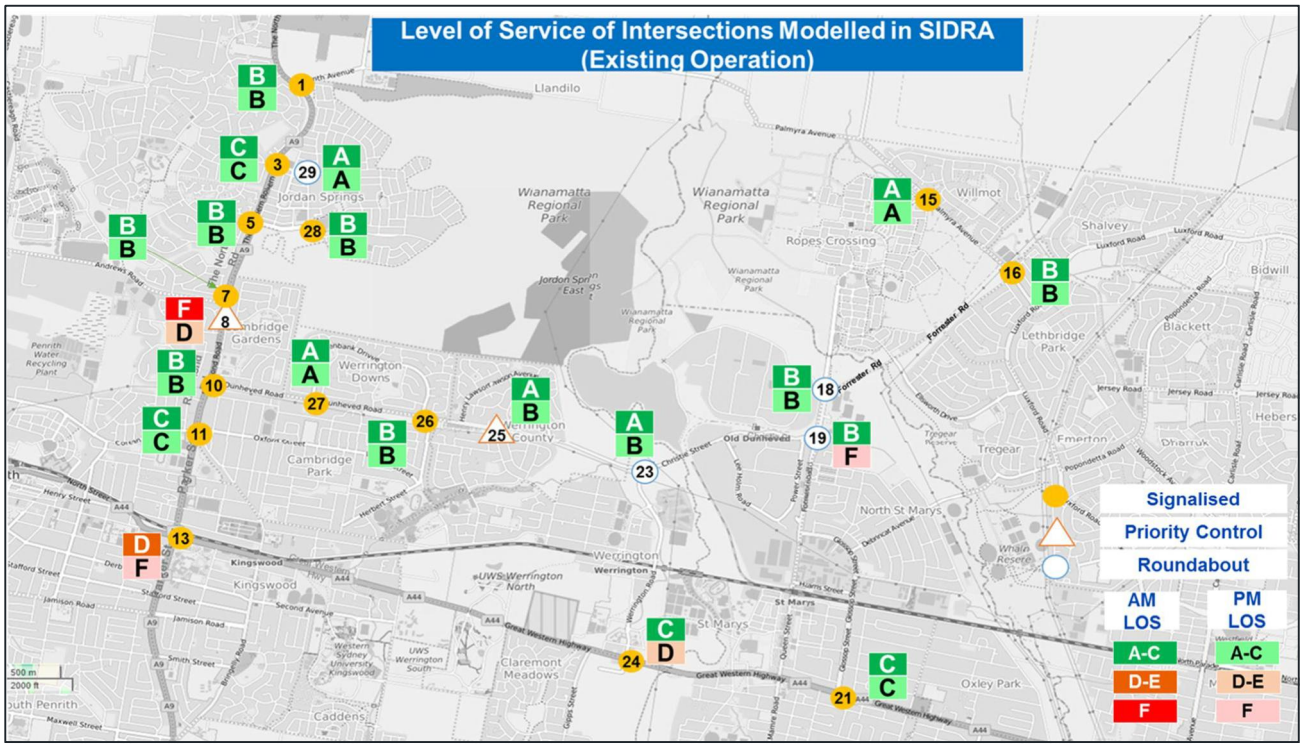


Figure 3.6 2016 Base intersection performance

3.8.4 2016 Pure Base (Without existing development)

The 2016 Pure Base (without existing development) SIDRA results are shown in Table 3.5. The input volumes for this SIDRA analysis been obtained from the 2016 Base AIMSUN, but with the current traffic generation associated with the existing development on the St Marys Development Site being used to remove the development traffic and provide the 'pure base'. This 'pure base' is only produced at 2016, for the purpose of assessing the network with no development traffic.

Table 3.5 2016 Pure Base intersection performance

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-01	The Northern Road and Ninth Avenue	AM	0.72	18	B	149	The Northern Road (NW)
		PM	0.81	19	B	150	The Northern Road (NW)
I-03	The Northern Road, Borrowdale Way and Greenwood Parkway	AM	0.68	31	C	144	The Northern Road (S)
		PM	0.55	26	B	123	The Northern Road (S)
I-05	The Northern Road and Jordan Springs Boulevard	AM	0.40	7	A	87	The Northern Road (N)
		PM	0.50	13	A	112	The Northern Road (N)
I-07	The Northern Road and Andrews Road	AM	0.73	17	B	109	Richmond Road (S)
		PM	0.81	15	B	134	Richmond Road (S)
I-08	Richmond Road and Trinity Drive	AM	0.39	37	C	5	Trinity Drive (E)
		PM	0.37	32	C	7	Richmond Road (S)

ID	Intersection	Peak period	DoS	Average Delay (s)	LoS	Queue (m)	Approach with worst queue
I-10	Richmond Road and Dunheved Road	AM	0.90	25	B	161	Dunheved Road (E)
		PM	0.73	24	B	133	Richmond Road (N)
I-11	Richmond Road, Parker Street, Coreen Avenue and Oxford Street	AM	0.67	35	C	159	Richmond Road (N)
		PM	0.69	30	C	191	Parker Street (S)
I-13	Great Western Highway and Parker Street	AM	1.03	47	D	163	Parker Street (N)
		PM	1.04	64	E	271	Parker Street (S)
I-15	Palmyra Avenue and Australis Drive	AM	0.35	7	A	31	Palmyra Avenue (NW)
		PM	0.44	8	A	41	Palmyra Avenue (SE)
I-16	Palmyra Avenue and Forrester Road	AM	0.44	17	B	81	Palmyra Avenue (SE)
		PM	0.88	20	B	87	Palmyra Avenue (SE)
I-18	Forrester Road, Ropes Crossing Boulevard and Links Road	AM	0.44	14	A	25	Forrester Road (S)
		PM	0.49	14	A	27	Forrester Road (S)
I-19	Forrester Road, Christie Street and Boronia Road	AM	0.53	12	A	29	Christie Street (W)
		PM	0.52	15	B	30	Forrester Road (N)
I-21	Great Western Highway and Glossop Street	AM	0.62	29	C	123	Great Western Highway (W)
		PM	0.67	28	B	169	Glossop Street (N)
I-23	Christie Street, Dunheved Road and Werrington Road	AM	0.49	13	A	34	Dunheved Road (W)
		PM	0.61	17	B	53	Werrington Road (S)
I-24	Werrington Road and Great Western Highway	AM	0.90	28	B	144	Werrington Road (N)
		PM	1.05	41	C	350	Great Western Highway (E)
I-25	Dunheved Road and John Oxley Avenue	AM	0.50	17	B	2	John Oxley Avenue (S)
		PM	0.57	23	B	5	Dunheved Road (W)
I-26	Dunheved Road, Greenbank Drive and Francis Street	AM	0.94	24	B	104	Dunheved Road (E)
		PM	1.06	27	B	148	Dunheved Road (E)
I-27	Dunheved Road and Greenbank Drive (west)	AM	0.97	12	A	104	Dunheved Road (W)
		PM	0.74	6	A	58	Dunheved Road (W)

The SIDRA analysis results for year 2016 Pure Base are shown summarised in Figure 3.7, highlighting the LoS during both the AM and PM peaks. Only intersection I-13 (Great Western Highway/Parker Street) experiences LoS E during the peak periods, with the other intersections having LoS D or better.

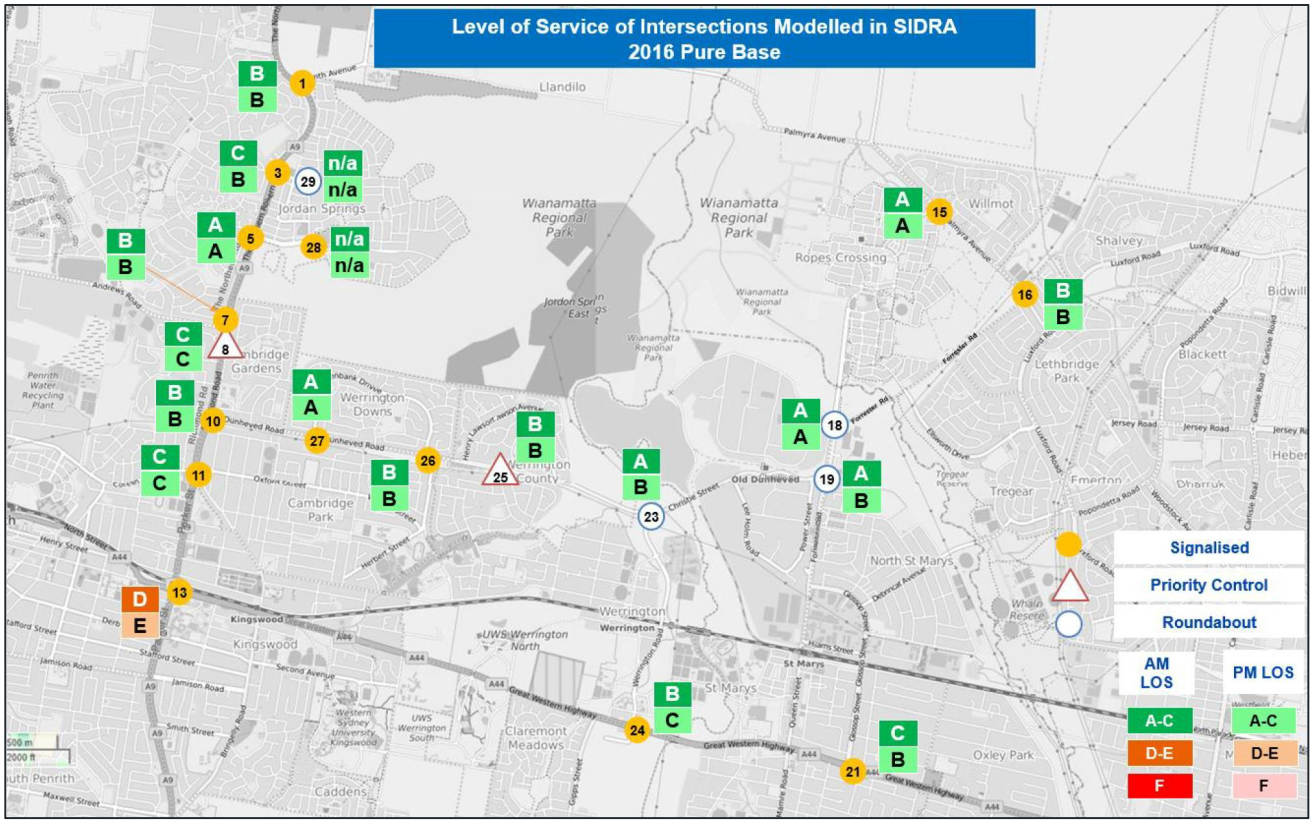


Figure 3.7 2016 Pure Base intersection performance

3.9 Summary

The base model of the road network surrounding St Marys Development Site has been developed to reflect the existing operation of the road network with consideration of the existing land uses within the St Marys development site. It provides an opportunity to confirm the validity of the assumptions and statistical traffic data collected, observed and inputted, thus ensuring a reliable benchmark to which future year modelling scenarios can be developed on and comparisons between 'with' and 'without' development can be determined.

The 2016 Base model development process has included model development, demand development, model calibration and model validation stages associated with the AM and PM peak AIMSUN models. The 2016 Base AIMSUN models have been developed based on the existing development which is currently in place, together with the existing road network.

Intersection traffic volumes from surveys undertaken at key intersections have been exported to SIDRA for further detailed analysis and development of calibrated and validated intersection models for the AM and PM peaks. Intersections I-8 (Richmond Road/Trinity Drive), I-13 (Great Western Highway/Parker Street) and I-19 (Forrester Road/Christie Street/Boronia Road) experience LoS F during the peak periods.

In addition to the 2016 Base SIDRA models, we have also developed 2016 Pure Base SIDRA models, which have been obtained by a process whereby the existing generated traffic associated with St Marys Development Site has been removed. With the 2016 Pure Base, only I-13 (Great Western Highway/Parker Street) experiences LoS E during the peak periods, with the other intersections having LoS D or better.

4 DEVELOPMENT PROPOSAL

4.1 Overview

This section provides an overview of land uses associated with the St Marys Development Site, including details of the land uses under the current zoning across all precincts within the development site and the anticipated land uses associated with the Jordan Springs East rezoning.

This section also includes details of the trip generation rates applied for the various land uses within the development site, resulting total trip generation, consideration of trip containment and directional split of trips particularly generated from Jordan Springs East to the external road network.

4.2 Precincts

The St Marys Development Site comprises five distinct precincts as described in section 1.1.

4.3 Development yields

The assessment of development yields has been undertaken based on two distinct scenarios, as follows:

— without rezoning

— with rezoning.

The 'with rezoning' scenario relates to the provision of 500 additional residential dwellings in place of the employment land within Jordan Springs East, when compared to the 'without rezoning' scenario. Figure 4.1 below shows the location of where the employment area is proposed under the 'without rezoning' scenario. Under the rezoning scenario, this same location would provide residential dwellings.

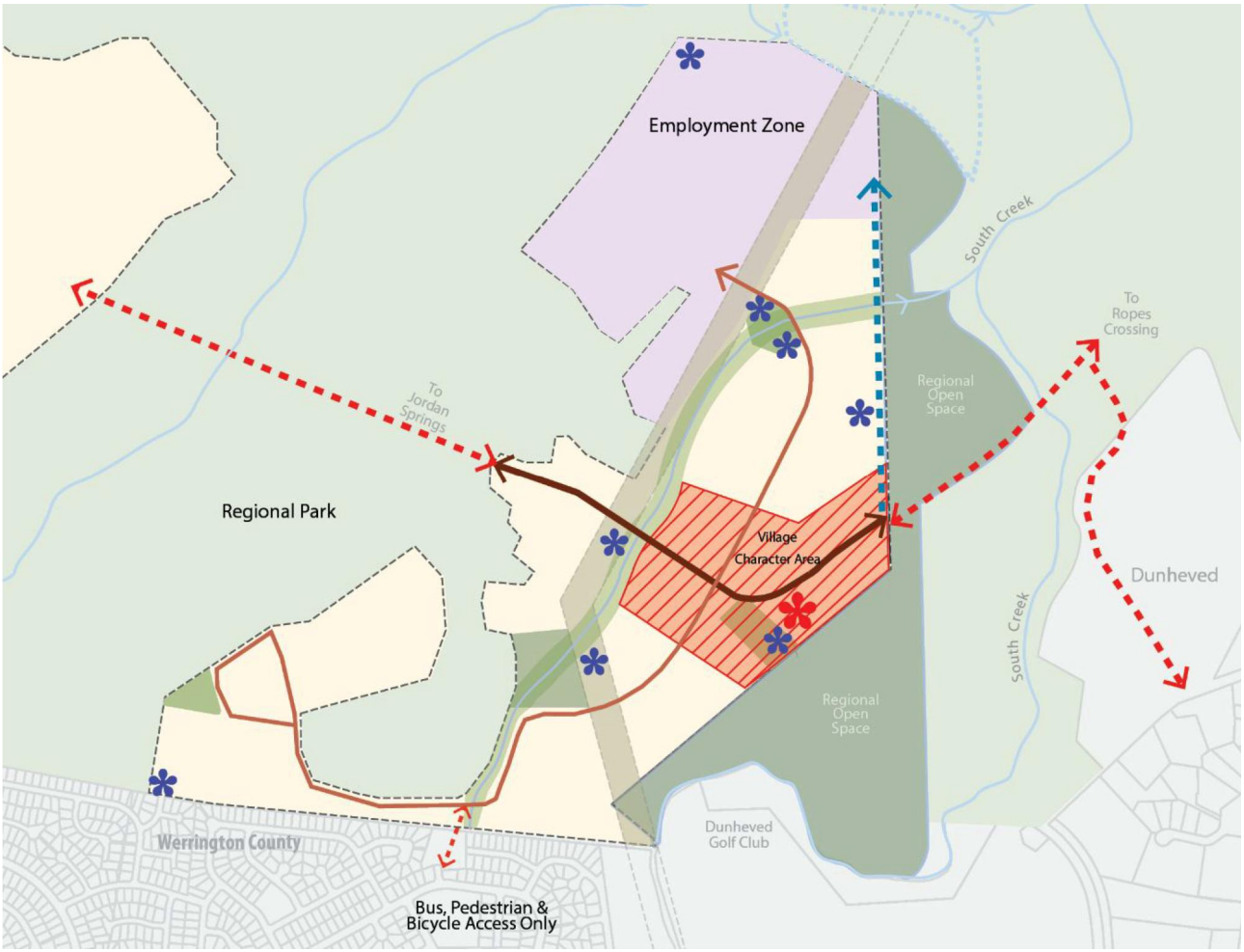


Figure 4.1 Jordan Springs East Employment Lands location under the 'without rezoning' scenario

4.3.1 Without rezoning

The land use without rezoning of Jordan Springs East is shown in Table 4.1, highlighting the planned development at each year up till the year 2021 completion. Please note that at December 2016, 1,897 dwelling houses were occupied at Jordan Springs and 1,950 dwelling houses were occupied at Ropes Crossing.

Table 4.1 Land use without rezoning

Precinct	Land use	Total no/ Size/Unit	Cumulative total no/Size/Unit					
		Ultimate	2016	2017	2018	2019	2020	2021
Jordan Springs	Residential – dwelling houses	3,437	1,897	2,800	3,437	3,437	3,437	3,437
	Residential – apartments	599	0	300	599	599	599	599
	Shopping Centre	0	0	0	0	0	0	0
	Retail (m^2)	8,200	4,920	6,560	8,200	8,200	8,200	8,200
	Commercial	0	0	0	0	0	0	0
	Childcare	200 children	60	90	120	150	200	200

Precinct	Land use	Total no/ Size/Unit	Cumulative total no/Size/Unit					
		Ultimate	2016	2017	2018	2019	2020	2021
	Medical Centre	3 doctors	3	3	3	3	3	3
	School	460 children	0	0	0	250	300	460
	Other	-	-	-	-	-	-	-
Jordan Springs East	Residential – dwelling houses	1,430	0	400	800	1,430	1,430	1,430
	Shopping Centre	800 m^2	0	0	800	800	800	800
	Retail	2,000 m^2	0	0	2,000	2,000	2,000	2,000
	Commercial	0	0	0	0	0	0	0
	Childcare	180 children	0	40	80	160	180	180
	Medical Centre	5 doctors	0	0	5	5	5	5
	Sporting Field	380	0	0	0	0	0	380
	Employment Area (m^2)	38 ha	0	0	0	48,150	96,300	96,300
Ropes Crossing	Residential – dwelling houses	2,345	1,950	2,345	2,345	2,345	2,345	2,345
	Shopping Centre	0	0	0	0	0	0	0
	Retail	3,335 m^2	3,335	3,335	3,335	3,335	3,335	3,335
	Commercial	1,000 m^2	1,000	1,000	1,000	1,000	1,000	1,000
	Childcare	120 children	120	120	120	120	120	120
	Medical Centre	3 doctors	3	3	3	3	3	3
	School	320 children	250	265	280	295	320	320
	Other	-	-	-	-	-	-	-
North Dunheved	Residential – dwelling houses	NA	NA	NA	NA	NA	NA	NA
	Shopping Centre	NA	NA	NA	NA	NA	NA	NA
	Retail	NA	NA	NA	NA	NA	NA	NA
	Commercial	NA	NA	NA	NA	NA	NA	NA
	Childcare	NA	NA	NA	NA	NA	NA	NA
	Medical Centre	NA	NA	NA	NA	NA	NA	NA
	School	NA	NA	NA	NA	NA	NA	NA
	Industrial (m^2)	14 ha	0	0	0	0	0	63,000
South Dunheved	Residential – dwelling houses	NA	NA	NA	NA	NA	NA	NA
	Shopping Centre	NA	NA	NA	NA	NA	NA	NA
	Retail	NA	NA	NA	NA	NA	NA	NA

Precinct	Land use	Total no/ Size/Unit	Cumulative total no/Size/Unit					
		Ultimate	2016	2017	2018	2019	2020	2021
	Commercial	NA	NA	NA	NA	NA	NA	NA
	Childcare	NA	NA	NA	NA	NA	NA	NA
	Medical Centre	NA	NA	NA	NA	NA	NA	NA
	School	NA	NA	NA	NA	NA	NA	NA
	Industrial (m^2)	8 ha	0	0	0	0	36,000	36,000

4.3.2 With rezoning

The land use with rezoning of Jordan Springs East is shown in Table 4.2. This includes the assessment of 500 dwelling houses in addition to the proposed 1,430 dwelling houses, which totals 1,930 dwelling houses.

Table 4.2 Land use with rezoning

Precinct	Land use	Total no/ Size/Unit	Cumulative total no/Size/Unit					
		Ultimate	2016	2017	2018	2019	2020	2021
Jordan Springs	Residential – dwelling houses	3,437	1,897	2,800	3,437	3,437	3,437	3,437
	Residential – apartments	599	0	300	599	599	599	599
	Shopping Centre	0	0	0	0	0	0	0
	Retail (m^2)	8,200	4,920	6,560	8,200	8,200	8,200	8,200
	Commercial	0	0	0	0	0	0	0
	Childcare	200 children	60	90	120	150	200	200
	Medical Centre	3 doctors	3	3	3	3	3	3
	School	460 children	0	0	0	250	300	460
	Other	-	-	-	-	-	-	-
Jordan Springs East	Residential – dwelling houses	1,930	0	400	800	1,500	1,930	1,930
	Shopping Centre	800 m^2	0	0	800	800	800	800
	Retail	2,000 m^2	0	0	2,000	2,000	2,000	2,000
	Commercial	0	0	0	0	0	0	0
	Childcare	180 children	0	40	80	160	180	180
	Medical Centre	5 doctors	0	0	5	5	5	5
	Sporting Field	380	0	0	0	0	0	380
	Employment Area (m^2)	0 ha	0	0	0	0	0	0

Precinct	Land use	Total no/ Size/Unit	Cumulative total no/Size/Unit					
		Ultimate	2016	2017	2018	2019	2020	2021
Ropes Crossing	Residential – dwelling houses	2,345	1,950	2,345	2,345	2,345	2,345	2,345
	Shopping Centre	0	0	0	0	0	0	0
	Retail	3,335 m^2	3,335	3,335	3,335	3,335	3,335	3,335
	Commercial	1,000 m^2	1,000	1,000	1,000	1,000	1,000	1,000
	Childcare	120 children	120	120	120	120	120	120
	Medical Centre	3 doctors	3	3	3	3	3	3
	School	320 children	250	265	280	295	320	320
	Other	-	-	-	-	-	-	-
North Dunheved	Residential – dwelling houses	NA	NA	NA	NA	NA	NA	NA
	Shopping Centre	NA	NA	NA	NA	NA	NA	NA
	Retail	NA	NA	NA	NA	NA	NA	NA
	Commercial	NA	NA	NA	NA	NA	NA	NA
	Childcare	NA	NA	NA	NA	NA	NA	NA
	Medical Centre	NA	NA	NA	NA	NA	NA	NA
	School	NA	NA	NA	NA	NA	NA	NA
	Industrial (m^2)	14 ha	0	0	0	0	0	63,000
South Dunheved	Residential – dwelling houses	NA	NA	NA	NA	NA	NA	NA
	Shopping Centre	NA	NA	NA	NA	NA	NA	NA
	Retail	NA	NA	NA	NA	NA	NA	NA
	Commercial	NA	NA	NA	NA	NA	NA	NA
	Childcare	NA	NA	NA	NA	NA	NA	NA
	Medical Centre	NA	NA	NA	NA	NA	NA	NA
	School	NA	NA	NA	NA	NA	NA	NA
	Industrial (m^2)	8 ha	0	0	0	0	36,000	36,000

4.4 Development traffic generation

4.4.1 Trip generation rates and directional split

The trip generation rates and directional splits which have been adopted for forecasting of the development generated traffic are shown in Table 4.3, for the weekday AM and PM peak hours. The rates are consistent with Roads and Maritime Guide to Traffic Generating Developments and also specific traffic surveys which have been undertaken, as documented in Table 4.3. Trip generation rates and directional splits have been endorsed by the Steering Committee and are further detailed in Appendix A, *Proposed Traffic Modelling Methodology for St Mary Development Site Memo*.

Table 4.3 Trip generation rates and directional split

Land use	Weekday AM/PM peak trip rate	AM in/Out	PM in/Out
Residential – dwelling houses	0.76 trips per dwelling house in AM, 0.97 trips per dwelling house in PM (Source: *2016 traffic and residence occupancy surveys – 1,897 occupied dwelling houses, 1,376 trips in and out of Jordan Springs at The Northern Road intersections in the AM peak and 1,752 trips in the PM peak*)	20%/80%	80%/20%
Residential – apartments	0.5 trips per apartment in AM and PM (Source: *Section 3.3.2 – Medium Density RFB* Roads and Maritime *Guide to Traffic Generating Development* issue 2.2, 2002)	20%/80%	80%/20%
Shopping Centre/Retail	<10,000 m^2, 12.3–12.5 trips per 100 m^2 GLFA in PM <20,000 m^2, 6.2–6.7 trips per 100 m^2 GLFA in PM <30,000 m^2, 5.6–5.9 trips per 100 m^2 GLFA in PM (Source: *Shopping Centres* Roads and Maritime *Guide to Traffic Generating Development* updated traffic surveys TDT2013/04a) 30% of PM peak trips included in the AM peak	60%/40%	50%/50%
Commercial	1.6 trips per 100 m^2 in AM, 1.2 trips per 100 m^2 in PM (Source: *Office Blocks* Roads and Maritime *Guide to Traffic Generating Development* updated traffic surveys TDT2013/04a)	80%/20%	20%/80%
Industrial Estate	0.5 trips per 100 m^2 in AM and PM (Source: *Industrial Estate* Roads and Maritime *Guide to Traffic Generating Development* updated traffic surveys TDT2013/04a)	80%/20%	20%/80%
Childcare	1.4 trips per child in AM, 0.8 trips per child in PM (Source: *Section 3.11.3 – Child Care Centres* of Roads and Maritime *Guide to Traffic Generating Development* issue 2.2, 2002)	50%/50%	50%/50%

Land use	Weekday AM/PM peak trip rate	AM in/Out	PM in/Out
Medical Centre	5.8 movements/practitioner in AM and PM (First principle assumption made based on a worst-case scenario for trips attracted and generated from the car parking spaces required to be provided for a medical consulting room. Penrith CC requires that 3 car parking spaces be provided for a medical professional to practice.)	50%/50%	50%/50%
School	0.8 trips per child in AM (An assumption based of 80% of school children are driven by their parents to school. 20% of school children use school bus and active travel mode (walking/cycling).)	50%/50%	N/A – occurs before PM peak
School staff	1 trip per 30 children in AM and PM (An assumption of maximum class size is used per teaching staff. All school staff are assumed to utilise 100% car trip.)	100%/0%	0%/100%
Six sports fields floodlit	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes two teams of 20 persons per field. Assumes 20% local walking trips and the remaining single vehicle trips worst case single occupant. 192 vehicle trips in PM peak.	N/A – negligible in AM peak	100%/0%
One oval floodlit	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes two teams of 20 persons on oval. Assumes 20% local walking trips and the remaining single vehicle trips worst case single occupant. 32 vehicle trips in PM peak.	N/A – negligible in AM peak	100%/0%
Multi-purpose four tennis courts, one multi use court, one netball	Tennis Courts are four trips per court in the PM peak. 100% local trips. 16 vehicle trips in PM peak. Assumes two teams of 20 persons on court. Assumes 20% local walking trips and the remaining single vehicle trips worst case single occupant. 64 vehicle trips in PM peak.	N/A – negligible in AM peak	100%/0%
Cricket nets three lanes	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes cricket training for 1 team of say 20 persons. Assumes 20% local walking trips and the remaining single vehicle trips worst case single occupant. 16 vehicle trips in PM peak.	N/A – negligible in AM peak	100%/0%
Synthetic cricket wickets in fields (max three)	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes cricket training for 3 teams of say 20 persons. Assumes 20% local walking trips and the remaining single vehicle trips worst case single occupant. 48 vehicle trips in PM peak.	N/A – negligible in AM peak	100%/0%

Land use	Weekday AM/PM peak trip rate	AM in/Out	PM in/Out
Car parking to accommodate sportsground at maximum capacity 300 spaces.	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* The combination of all land uses tabled within exceeds 300 spaces based on trip assumptions applied. Desirable to utilised 300 vehicle trips with maximum 376 vehicle trips in PM peak proposed.	N/A – negligible in AM peak	100%/0%
Amenities block/pavilion	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes trip generation included in above land uses.	N/A – negligible in AM peak	100%/0%
Adventure playground	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes 20 persons in playground with 50% adult. Assumes 20% local walking trips and the remaining single vehicle trips with dual occupants. 8 vehicle trips in PM peak.	N/A – negligible in AM peak	100%/0%
Community activity space up to 450 m^2	No rates given for playing fields in Roads and Maritime *Guide to Traffic Generating Development issue 2.2, 2002* Assumes trip generation included in above land uses.	N/A – negligible in AM peak	100%/0%

4.4.2 Internal, external and linked trips

Further to the adoption of the trip rates and directional split, there was a requirement to consider the effects of internal, external and linked trips, as follows:

— internal trips: trips which occur within the development only e.g. home to school and back home

— linked external trips: trips which have two destinations e.g. home to school drop off and then onto work, modelled as one trip

— new external trips: trips which start or end outside of the development e.g. trips from a surrounding residential area to work within the development.

Table 4.4 Internal, linked and external trips

Land use	% Internal trips	% Linked external trips	% New external trips
Residential	0%	Included in the trip rate	n/a
Retail (RC & JS)	10%	54%	36%
Retail (JSE)	90%	10%	0%
Commercial	20%	n/a	80%
School	10%	90%	0%
School Staff	5%	n/a	95%
Medical Centre	50%	50%	0%
Sporting Facilities	30%	14%	56%

Land use	% Internal trips	% Linked external trips	% New external trips
Childcare	10%	90%	0%

The residential trip rates were calculated based on surveys undertaken at intersections external to the development, therefore it is assumed that the rates are inclusive of any linked trips i.e. home to school drop-off, then to work.

4.4.3 Generated traffic

The generated traffic was calculated based on the adopted trip rates as well as the percentage of linked, internal and external trips assumed. The generated traffic was calculated for 2 hour AM and PM peak periods, expanding the 1-hour trips rates using the demand profile within the Strategic Model, for input into the Strategic Model for the following developments:

— Jordan Springs

— Jordan Springs East (Central Precinct)

— Ropes Crossing

— North and South Dunheved.

The generated traffic, during the 2 hour AM and PM peaks, for both without rezoning and with rezoning scenarios, is shown in Table 4.5.

Table 4.5 Generated traffic

Precinct	AM peak (2-hour)				PM peak (2-hour)			
	Without rezoning		With rezoning		Without rezoning		With rezoning	
	In	Out	In	Out	In	Out	In	Out
Jordan Springs	635	2239	635	2239	2844	858	2844	858
Jordan Springs East	1071	1736	528	2114	2366	1377	2896	872
Ropes Crossing	114	438	114	438	559	144	559	144
North and South Dunheved	1471	368	1471	368	368	1471	368	1471
Total by direction	3291	4781	2748	5159	6137	3849	6666	3345
Total	8072		7907		9987		10011	

The traffic generated for the various land uses for 1 hour peak period with and without rezoning is shown in Table 4.6 and 4.7 on the following page.

Table 4.6 Generated traffic without rezoning

PRECINCT	LAND USE	UNIT	EXISTING DEVELOPMENT	ULTIMATE DEVELOPMENT	DIFFERENCE	TRIP GENERATION RATES			TRIP PROPORTIONS BY TYPE			TOTAL TRIPS (2017 to 2021) AM PEAK HR			TOTAL TRIPS (2017 to 2021) PM PEAK HR			DIRECTIONAL SPLIT AM		DIRECTIONAL SPLIT PM		AM PEAK HR TOTAL MODELLED TRIPS		PM PEAK HR TOTAL MODELLED TRIPS	
			2016	2021	2021 -2016	AM	PM	unit	EXTERNAL	LINKED	INTERNAL	EXTERNAL	LINKED	INTERNAL	EXTERNAL	LINKED	INTERNAL	IN	OUT	IN	OUT	IN	OUT	IN	OUT
JORDAN SPRINGS	Residential dwellings	dwellings	1897	3437	1540	0.76	0.97	per dwelling	100%	0%	0%	1170	0	0	1494	0	0	20%	80%	80%	20%	234	936	1195	299
	Apartments	dwellings	0	599	599	0.50	0.50	per dwelling	100%	0%	0%	300	0	0	300	0	0	20%	80%	80%	20%	60	240	240	60
	Retail (m2)	m^2	4920	8200	3280	0.06	0.12	m2	40%	54%	6%	81	109	12	161	218	24	60%	40%	50%	50%	48	32	81	81
	Commercial	m^2	0	0	0	0.02	0.01	per m2	100%	0%	0%	0	0	0	0	0	0	80%	20%	20%	80%	0	0	0	0
	Childcare	children	60	200	140	1.40	0.80	per child	0%	90%	10%	0	176	20	0	101	11	50%	50%	50%	50%	0	0	0	0
	Medical Centre	doctors	3	3	0	5.80	5.80	per doctor	0%	50%	50%	0	0	0	0	0	0	50%	50%	50%	50%	0	0	0	0
	School	children	0	460	460	0.80	0.00	per child	0%	80%	20%	0	294	74	0	0	0	50%	50%	0%	0%	0	0	0	0
	Total Jordan Springs											**1551**	**580**	**105**	**1955**	**319**	**35**					**342**	**1208**	**1515**	**439**
JORDAN SPRINGS EAST	Residential dwellings	dwellings	0	1430	1430	0.76	0.97	per dwelling	100%	0%	0%	1087	0	0	1387	0	0	20%	80%	80%	20%	217	869	1110	277
	Shopping Centre	dwellings	0	800	800	0.06	0.12	m2	0%	60%	40%	0	30	20	0	59	39	60%	40%	50%	50%	0	0	0	0
	Retail	m^2	0	2000	2000	0.06	0.12	m2	0%	60%	40%	0	74	49	0	148	98	60%	40%	50%	50%	0	0	0	0
	Childcare	children	0	180	180	1.40	0.80	per child	0%	90%	10%	0	227	25	0	130	14	50%	50%	50%	50%	0	0	0	0
	Medical Centre	doctors	0	5	5	5.80	5.80	per doctor	0%	50%	50%	0	15	15	0	15	15	50%	50%	50%	50%	0	0	0	0
	Employment area	m^2	0	96300	96300	0.005	0.005	per m2	100%	0%	0%	482	0	0	482	0	0	80%	20%	20%	80%	385	96	96	385
	Sporting Field	trips	0	380	380	1.00	1.00	trips	80%	14%	6%	0	0	0	304	53	23	0%	0%	50%	50%	0	0	152	152
	Total Jordan Springs East											**1568**	**345**	**109**	**2173**	**404**	**189**					**603**	**966**	**1358**	**815**
ROPES CROSSING	Residential dwellings	dwellings	1960	2345	385	0.76	0.97	per dwelling	100%	0%	0%	300	0	0	383	0	0	20%	80%	80%	20%	60	240	307	77
	Retail	m^2	3335	3335	0	0.03	0.06	m2	40%	54%	6%	0	0	0	0	0	0	60%	40%	50%	50%	0	0	0	0
	Commercial	m^2	1000	1000	0	0.02	0.01	per m2	100%	0%	0%	0	0	0	0	0	0	80%	20%	20%	80%	0	0	0	0
	Childcare	children	120	120	0	1.40	0.80	per child	0%	90%	10%	0	0	0	0	0	0	50%	50%	50%	50%	0	0	0	0
	Medical Centre	doctors	3	3	0	5.80	5.80	per doctor	0%	50%	50%	0	0	0	0	0	0	50%	50%	50%	50%	0	0	0	0
	School	children	250	320	70	0.80	0.00	per child	0%	80%	20%	0	45	11	0	0	0	50%	50%	0%	0%	0	0	0	0
	School staff	staff per child	250	320	70	0.03	0.03	per child	100%	0%	0%	2	0	0	2	0	0	100%	0%	0%	100%	2	0	0	2
	Total Ropes Crossing											**303**	**45**	**11**	**385**	**0**	**0**					**62**	**240**	**307**	**79**
DUNHEVED (SOUTH & NORTH)	Industrial (based FSR of 0.45)	m^2	0	99000	99000	0.01	0.01	per m2	100%	0%	0%	990	0	0	990	0	0	80%	20%	20%	80%	792	198	198	792
	Total Dunheved											**990**	**0**	**0**	**990**	**0**	**0**					**792**	**198**	**198**	**792**

Table 4.7 Generated traffic with rezoning

PRECINCT	LAND USE	UNIT	EXISTING DEVELOPMENT	ULTIMATE DEVELOPMENT	DIFFERENCE	TRIP GENERATION RATES			TRIP PROPORTIONS BY TYPE			TOTAL TRIPS (2017 to 2021) AM PEAK HR			TOTAL TRIPS (2017 to 2021) PM PEAK HR			DIRECTIONAL SPLIT AM		DIRECTIONAL SPLIT PM		AM PEAK HR TOTAL MODELLED TRIPS		PM PEAK HR TOTAL MODELLED TRIPS	
			2016	2021	2021 -2016	AM	PM	unit	EXTERNAL	LINKED	INTERNAL	EXTERNAL	LINKED	INTERNAL	EXTERNAL	LINKED	INTERNAL	IN	OUT	IN	OUT	IN	OUT	IN	OUT
JORDAN SPRINGS	Residential dwellings	dwellings	1897	3437	1540	0.76	0.97	per dwelling	100%	0%	0%	1170	0	0	1494	0	0	20%	80%	80%	20%	234	936	1195	299
	Apartments	dwellings	0	599	599	0.50	0.50	per dwelling	100%	0%	0%	300	0	0	300	0	0	20%	80%	80%	20%	60	240	240	60
	Retail (m2)	m^2	4920	8200	3280	0.06	0.12	m2	40%	54%	6%	81	109	12	161	218	24	60%	40%	50%	50%	48	32	81	81
	Commercial	m^2	0	0	0	0.02	0.01	per m2	100%	0%	0%	0	0	0	0	0	0	80%	20%	20%	80%	0	0	0	0
	Childcare	children	60	200	140	1.40	0.80	per child	0%	90%	10%	0	176	20	0	101	11	50%	50%	50%	50%	0	0	0	0
	Medical Centre	doctors	3	3	0	5.80	5.80	per doctor	0%	50%	50%	0	0	0	0	0	0	50%	50%	50%	50%	0	0	0	0
	School	children	0	460	460	0.80	0.00	per child	0%	80%	20%	0	294	74	0	0	0	50%	50%	0%	0%	0	0	0	0
	Total Jordan Springs											**1551**	**580**	**105**	**1955**	**319**	**35**					**342**	**1208**	**1515**	**439**
JORDAN SPRINGS EAST	Residential dwellings	dwellings	0	1930	1930	0.76	0.97	per dwelling	100%	0%	0%	1467	0	0	1872	0	0	20%	80%	80%	20%	293	1173	1498	374
	Shopping Centre	dwellings	0	800	800	0.06	0.12	m2	0%	60%	40%	0	30	20	0	59	39	60%	40%	50%	50%	0	0	0	0
	Retail	m^2	0	2000	2000	0.06	0.12	m2	0%	60%	40%	0	74	49	0	148	98	60%	40%	50%	50%	0	0	0	0
	Childcare	children	0	180	180	1.40	0.80	per child	0%	90%	10%	0	227	25	0	130	14	50%	50%	50%	50%	0	0	0	0
	Medical Centre	doctors	0	5	5	5.80	5.80	per doctor	0%	50%	50%	0	15	15	0	15	15	50%	50%	50%	50%	0	0	0	0
	Employment area	m^2	0	0	0	0.005	0.005	per m2	100%	0%	0%	0	0	0	0	0	0	80%	20%	20%	80%	0	0	0	0
	Sporting Field	trips	0	380	380	1.00	1.00	trips	80%	14%	6%	304	53	23	304	53	23	0%	0%	50%	50%	0	0	152	152
	Total Jordan Springs East											**1771**	**398**	**131**	**2176**	**404**	**189**					**293**	**1173**	**1650**	**526**
ROPES CROSSING	Residential dwellings	dwellings	1960	2345	385	0.76	0.97	per dwelling	100%	0%	0%	300	0	0	383	0	0	20%	80%	80%	20%	60	240	307	77
	Retail	m^2	3335	3335	0	0.03	0.06	m2	40%	54%	6%	0	0	0	0	0	0	60%	40%	50%	50%	0	0	0	0
	Commercial	m^2	1000	1000	0	0.02	0.01	per m2	100%	0%	0%	0	0	0	0	0	0	80%	20%	20%	80%	0	0	0	0
	Childcare	children	120	120	0	1.40	0.80	per child	0%	90%	10%	0	0	0	0	0	0	50%	50%	50%	50%	0	0	0	0
	Medical Centre	doctors	3	3	0	5.80	5.80	per doctor	0%	50%	50%	0	0	0	0	0	0	50%	50%	50%	50%	0	0	0	0
	School	children	250	320	70	0.80	0.00	per child	0%	80%	20%	0	45	11	0	0	0	50%	50%	0%	0%	0	0	0	0
	School staff	staff per child	250	320	70	0.03	0.03	per child	100%	0%	0%	2	0	0	2	0	0	100%	0%	0%	100%	2	0	0	2
	Total Ropes Crossing											**305**	**45**	**11**	**385**	**0**	**0**					**62**	**240**	**307**	**79**
DUNHEVED (SOUTH & NORTH)	Industrial (based FSR of 0.45)	m^2	0	99000	99000	0.01	0.01	per m2	100%	0%	0%	990	0	0	990	0	0	80%	20%	20%	80%	792	198	198	792
	Total Dunheved											**990**	**0**	**0**	**990**	**0**	**0**					**792**	**198**	**198**	**792**

4.5 Potential Links Road extension

The assessment has been undertaken at each assessment scenario for 'without Links Road extension' and potential 'with Links Road extension' scenarios. This refers to the extension of Links Road from the Dunheved Golf Club access to Christie Street, a north-south road which would connect Jordan Springs East to Dunheved Road. The location of the potential Links Road extension is shown in Figure 1.2.

Whilst the potential Link Road extension does not form part of the St Marys Development Site, Lendlease and Council have been exploring opportunities to deliver this road under a Voluntary Planning Agreement.

4.6 With and without rezoning

The land uses 'without rezoning' as documented in Table 4.1 and 'with rezoning' as documented in Table 4.2, show the difference between the two scenarios is the land use change between employment land and residential dwellings with all other land uses remaining constant. There is minimal difference in the traffic generated between the 38 ha of employment land and 500 residential dwellings and therefore the traffic impacts on the external road network between the 'with rezoning' and 'without rezoning' scenarios are negligible.

4.7 Summary

The St Marys Development Site comprises five distinct precincts; Jordan Springs, Jordan Springs East, Ropes Crossing, North Dunheved and South Dunheved. Jordan Springs and Ropes Crossing are currently partially developed, with Jordan Springs having 1,897 occupied dwelling houses and Ropes Crossing having 1,950 occupied dwelling houses respectively at December 2016.

The study has been undertaken based on two land use scenarios; existing zoning and rezoning, with the rezoning scenario involving the replacement of 38 hectares of employment land within Jordan Springs East with 500 dwelling houses.

The total development of St Marys Development Site is by year 2021, when with rezoning there will be a total of 7,712 dwelling houses, 599 apartments, 14,335 m^2 retail/shopping centre and 99,000 m^2 industrial together with commercial, childcare, medical centre and school facilities.

The generated traffic which is forecast for the St Marys Development Site has been forecast based on trip rates and directional split which have been adopted for each specific component of land use. The traffic generation forecasting process has included consideration of internal trips, linked external trips and new external trips for each land use component within each of the five precincts.

The assessment of the development has been undertaken based on two key network scenarios, 'without Links Road extension' and 'with Links Road extension'.

5 FUTURE YEAR MODEL DEVELOPMENT

5.1 Overview

This section describes the methodology for the future year model development in AIMSUN and SIDRA. A total of three future years (2021, 2026 and 2031) were modelled to assess the network impact associated with future development traffic.

The development of the future year models was undertaken in consultation with the Steering Committee. A detailed model development methodology (included in Appendix A) was submitted to the stakeholders for endorsement during the model development process. The AIMSUN model utilises Roads and Maritime supplied data from the Strategic Model based on a range of assumptions including hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility). These road network enhancements should not be relied upon as they may never eventuate or occur in the timeframes assumed. Data from the Strategic Model is for modelling purposes only and is subject to change. In summary, the following steps were undertaken to carry out model development process:

— Establishment of Base models in AIMSUN to reflect existing conditions.

— Development of future year Base models in AIMSUN with future year Base network and traffic demands from the Strategic Model. Minor modifications in phase timings were applied at existing intersections, mainly to remove unreleased trips in AIMSUN and to accommodate traffic growth and change of traffic flow pattern in future years. For the hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility), indicative intersection layouts were generated by SIDRA and coded into AIMSUN models.

— Determination of traffic generation and distribution from the development site and then updating of Strategic Model demands with development traffic.

— Development of future year Project scenarios in AIMSUN with development access roads and traffic demands from the Strategic Model. Similar to the future year Base models, minor modifications in phase timings were made at intersections to remove unreleased trips.

— Development of SIDRA models at key intersections in all future year models. Intersection traffic counts for future years were applied into SIDRA models from AIMSUN model outputs. SIDRA models were used to optimise intersection operation and to carry out mitigation measures.

Traffic demands in models inclusive of the development also considered resultant changes in background traffic patterns. The other sections of this chapter describe the details of model scenarios, future year network assumptions and demand development process.

5.2 Model scenarios

The AIMSUN model development has been undertaken for the scenarios:

— Future year base models (2021, 2026 and 2031)

— Future year project models (2021, 2026 and 2031) – with full development

— without rezoning at Jordan Springs East

— with rezoning at Jordan Springs East

— without Links Road extension

— with potential Links Road extension.

Descriptions of future year model scenarios are summarised below:

Future year base:

— Future year Base demands were obtained from the Strategic Model, reflecting existing year 2016 development within the site.

— External hypothetical road network enhancements (which are uncommitted/unfunded/pre-feasibility) were coded within the AIMSUN model consistent with the Strategic Model. Those upgrades were considered as the 'future year Base' network. No changes to the road network were made within the St Marys development site.

Future year project:

— Full development yields of Jordan Springs, Ropes Crossing and North-South Dunheved Road were considered in future year project scenarios. The assessment of development yields was undertaken based on two distinct development scenarios:

  i) without rezoning and

  ii) with rezoning.

  The 'with rezoning' scenario relates to the provision of 500 additional dwellings in place of the employment land within Jordan Springs East, when compared to the 'without rezoning' scenario.

— All external road network upgrades were considered as per the future year Base network. An internal east-west link road connection was included in this scenario. Two network assessment scenarios were carried out by assuming without and with the Links Road extension to Christie Street.

The modelling scenarios undertaken within AIMSUN are shown in Table 5.1. The future SIDRA analysis included additional scenarios, with analysis also being undertaken for base and Project under the base road network.

Table 5.1 AIMSUN traffic modelling scenarios

Modelling scenarios	Existing year	Future interim year	Future interim year	Future ultimate year	Traffic demands				Road network	
	2016	2021	2026	2031	Jordan Springs	Jordan Springs East	Ropes Crossing	North & South Dunheved	Internal connection	External road
2016	AM & PM				Existing	None	Existing	Existing	Existing	Existing
Future Base		AM & PM	AM & PM	AM & PM	Existing	None	Existing	Existing	Existing	As per RMS model
Future Project (without rezoning)		AM & PM	AM & PM	AM & PM	Full	Without Rezoning	Full	Full	Completed	As per RMS strategic model + Without and with Links Road extension
Future Project (with rezoning)		AM & PM	AM & PM	AM & PM	Full	With Rezoning	Full	Full	Completed	As per RMS strategic model + Without and with Links Road extension
	Total number of AIMSUN models: 32 (2 for 2016, 10 models for each future year 2021, 2026 and 2031)									

5.3 Future network assumptions

With the future year AIMSUN models, the road network within the study area from the Roads and Maritime Strategic Model was coded in. The primary source of information in identifying these upgrades was the Roads and Maritime Strategic Model.

5.3.1 Internal collector road access

Figure 5.1 shows the two internal collector roads which were coded into the future year AIMSUN models in the development scenarios, as follows:

— Internal east-west link road which Jordan Springs with Ropes Crossing and North and South Dunheved precincts

— Potential Links Road extension which connects Dunheved Industrial Estate with Christie Street and Lee Holm Drive as a signalised intersection.

All intersections on the internal east-west link road were coded as priority controlled intersections. A new traffic signal was coded in AIMSUN at potential Links Road extension and Christie Street intersection.

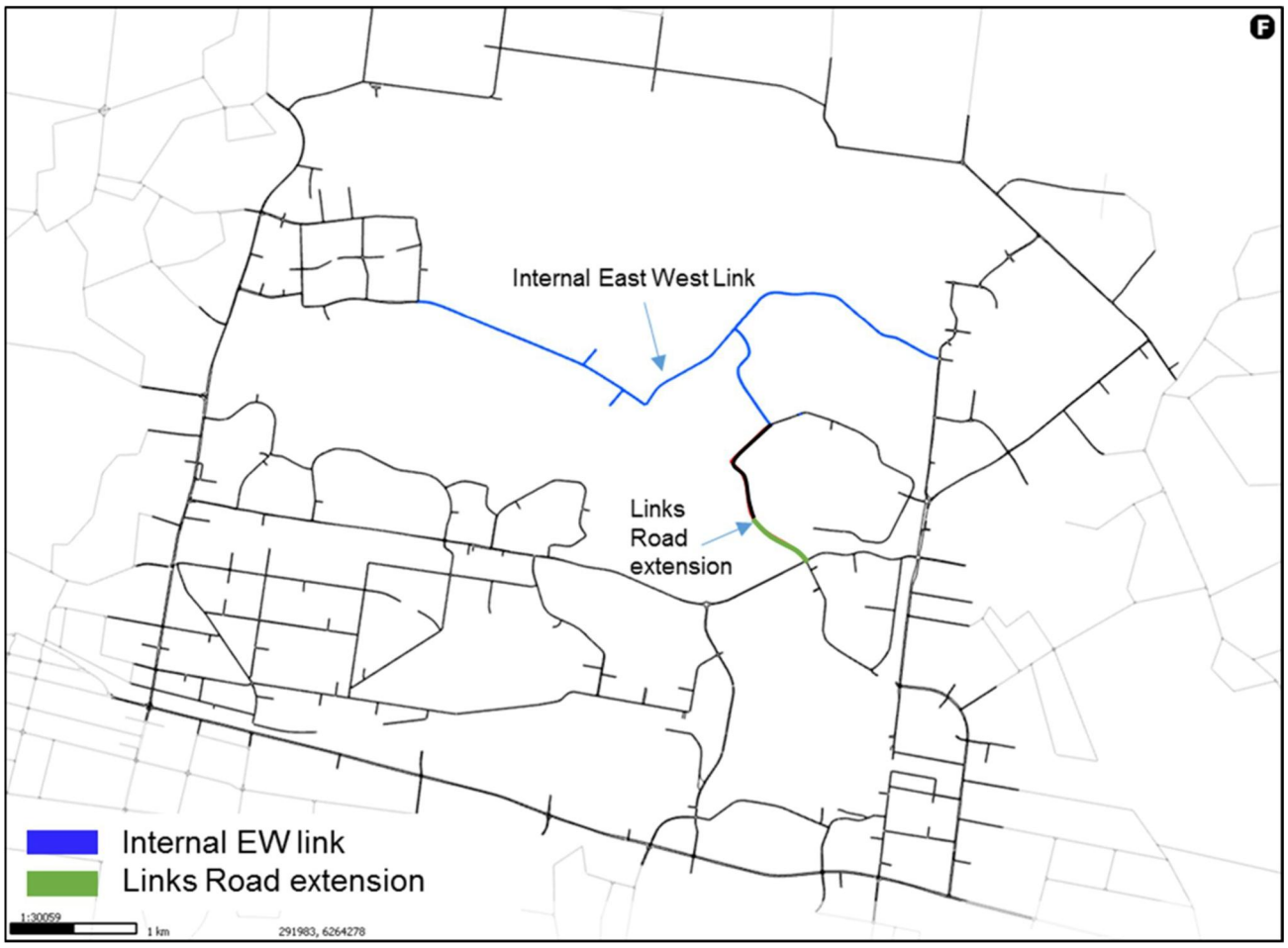


Figure 5.1 Internal collector access

5.4 Traffic demand development

The traffic demand development process has involved the development of future year matrices for input to the AIMSUN models, using the Strategic Model provided by Roads and Maritime.

5.4.1 Future growth and distribution

The generated traffic associated with the planned development was included within the future year Strategic Model (EMME) to assess the future year assignment reflecting the additional development trips. The growth in matrices for input to AIMSUN was calculated by taking the absolute value differences observed within the Strategic Model and applying these to the calibrated Base year matrices in AIMSUN. Where this resulted in negative values due to absolute numbers from Strategic Model being applied to the AIMSUN calibrated Base year matrices, percentage growth was used instead.

Future growth was based on the 2015, 2021, 2026 and 2031 Strategic Model output, which comprised 2-hour total vehicle matrices. These matrices were factored to represent peak hours using the relative proportions calculated from the calibrated and validated Base year AIMSUN model. As the Strategic Model matrices were total vehicles these were further factored to represent light and heavy vehicles for each peak period again based on the calibrated and validated Base year AIMSUN model matrices.

The distribution and trips for Ropes Crossing and Jordan Springs in the Base year matrices were retained from the calibrated/validated model and were not replaced by the Strategic Model distribution. This was specifically for the existing development at Ropes Crossing and Jordan Springs only.

Jordan Springs East distribution was calculated by picking two similar zones (based on land use) from both Jordan Springs and Ropes Crossing from the AIMSUN model, and then averaging (i.e. assuming it's an equal mix of the two as it's located between the two existing sites).

The non-development zones retained the Strategic Model distribution in future years. Strategic Model zones were disaggregated to more accurately represent the detailed land use within the study area, based on both the current and future planned land use plans for Jordan Springs and Ropes Crossing.

It should be noted that internal trips (i.e. contained trips within the proposed developments of Jordan Springs, Jordan Springs East and Ropes Crossing such as return trips by residents to the shopping centre) have not been included in the AIMSUN model, as these trips do not impact on the external road network that the AIMSUN model assesses. Performance of the internal road network are subject to a separate assessment.

Additionally, a number of trips are assumed to be linked trips, for example residential with school drop-offs on the way to work. In this situation, this was modelled as one trip from the residential zone to final destination zone, in this case work. The school drop-off was considered an internal trip and so has not been explicitly modelled as it would not affect the external network.

5.4.2 Demand development – Public transport

For school trips it was assumed 20% walked and/or caught the bus while 80% would be dropped off by car. This 80% would be linked to the residential trips which would then continue to their final destination.

For residential trips it was assumed that a further 3% of car users would travel by bus in the future (due to new services once the full development is in place). This 3% adjustment was made manually to the estimated trip generation calculations.

It is assumed that the remainder of the trip rates used are private vehicle trip rates based on surveys for similar areas and so would already account for public transport use. No further adjustments were made.

The trips for the remaining non-development zones within the model were not adjusted for public transport as they are an output from the overall Sydney Strategic Travel Model which considers modal split between private and public transport. The private vehicle output is then passed onto the Roads and Maritime Strategic Model which was the model used for this assessment.

The assumptions made with regards to the proportion of public transport assigned for the development trips have been endorsed by the Steering Committee accordingly.

5.5 Summary

The future year model development process has involved the use of the Strategic Model to develop matrices for input to AIMSUN at each of the three future assessment years (2021, 2026 and 2031), for the Base, Project without rezoning and Project with rezoning scenarios.

The AIMSUN Base and Project networks have been developed reflecting the Roads and Maritime Strategic Model which includes hypothetical assumptions for potential upgrades for the road network at each assessment year. The AIMSUN Project network also includes the east-west link road within the development site and then there are scenarios without and with Links Road extension, connecting with Christie Street in the south. The SIDRA Base and Project networks are consistent with the AIMSUN, with the exception that the SIDRA has an additional set of assessments which are 'without Roads and Maritime upgrades'.