

Albion Park Rail bypass

Environmental impact statement
Technical Paper 1 – Traffic and transport

October 2015



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GLOSSARY AND ACRONYMS

ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
ATC	Daily automatic traffic counts for one week period
APRB	Albion Park Rail bypass
AM	Morning peak hour
Bypass	Albion Park Rail bypass
Base case	Represents 2014 existing condition
HCM	High Capacity Manual (2010)
HV	Heavy Vehicles
HCJV	Hyder Cardno Joint Venture
Km/h	Kilometres per hour
LGA	Local Government Area
LoS	Level of Service
LV	Light Vehicles
NB	Northbound
NSW	New South Wales
PM	Afternoon peak hour
Project	Albion Park Rail bypass
Princes Motorway	M1 Princes Motorway
Paramics	Micro-simulation software
RB	Roundabout
Roads and Maritime	NSW Roads and Maritime Services (formerly NSW Roads and Traffic Authority, RTA)
Service Road	Proposed East West Link Road
Sec	Seconds
SIDRA	Traffic Intersection Analysis software
SB	Southbound
SCC	Shellharbour City Council
SEARS	Secretary's Environmental Assessment Requirements

GLOSSARY AND ACRONYMS

Screenlines	Screenlines are often used in traffic study to characterise the north-south and east-west traffic movements at critical parts on the study area network. For the purpose of this study, nine traffic screenlines have been defined across the study area, facilitating the assessment of aggregate traffic flows and growth along the north-south and east- west movements.
TCS	Traffic Control Signals
TRACKS	Strategic Traffic Modelling Software developed by TDG Gabites (TDG)
TMP	Traffic Management Plan
TCAWS	Traffic Works at Construction Sites, Roads and Maritime Guidelines
Veh	Vehicle
Veh/h	Vehicle per Hour
VHT	Vehicle Hours Travelled
VKT	Vehicle Kilometres Travelled
WCC	Wollongong City Council
WB	Westbound
WOLSH	Wollongong and Shellharbour Strategic Transport Model
X8G	TRACKS Model, Preferred Design Option
Future Development Model	For the purpose of this study, TDG prepared the future development model for year 2041. The future development model used land use forecast for the entire Wollongong and Shellharbour areas. The future development model includes known planned new release areas including Calderwood, Tullimbar, Tallawarra, Marshall Mount and West Dapto.

EXECUTIVE SUMMARY

Overview

This report details the traffic and transport assessment of the proposed construction and operation of the motorway standard Albion Park Rail bypass (the project). In the course of preparing this traffic and transport report relevant documents associated with the project have been reviewed, and potential traffic impacts on the road network have been assessed. The assessment identifies upgrade works required for the project to maximise the performance of road network from a traffic point of view. For the purpose of traffic assessment, modelling data was sourced from Wollongong and Shellharbour Strategic Transport model (WOLSH) implemented in TRACKS software. Roads and Maritime engaged TDG Gabites (TDG) for augmenting the WOLSH model for the project study area. The WOLSH windowed model for the study area was calibrated and validated by TDG for 2014 traffic conditions. The TRACKS windowed model provided forecast traffic volumes within the project study area for existing (2014) and future development model year (2041).

This traffic and transport assessment report has been prepared to support the environmental impact statement (EIS) for the proposed motorway extension.

Strategic Context

The Princes Highway is the main north–south transport corridor linking Sydney and Wollongong to the NSW south coast and north-eastern Victoria. The highway is an important commuter, freight, bus and tourist route for the south coast. The section of the highway between Yallah and Oak Flats is also used as a local route for areas such as Albion Park, Albion Park Rail, Oak Flats, Yallah and Dapto.

Roads and Maritime Services (Roads and Maritime) is planning for a 9.8 kilometres extension of the M1 Princes Motorway between Yallah and Oak Flats to Bypass Albion Park Rail. The motorway will complete the ‘missing link’ for a high standard road between Sydney and Bomaderry. It would provide easy access to Dapto, Albion Park and Oak Flats. The motorway would reduce travel times for through and local traffic, improve the reliability of journeys through greater flood immunity and provide more consistent driving conditions. It would also divert a substantial proportion of through traffic onto the new motorway, reducing traffic volumes on the A1 Princes Highway through Albion Park Rail. This would improve local amenity and access, and reduce other traffic related impacts such as noise for nearby residents.

Existing Road Network Operation

The standard of the A1 Princes Highway between Yallah and Oak Flats is inconsistent with the M1 Princes Motorway to the north and the A1 Princes Highway to the south. Between Sydney and Nowra there are free flowing traffic conditions and limited traffic signals. The only remaining traffic signals between Heathcote and Bomaderry are located at Albion Park Rail.

The traffic volumes on the A1 Princes Highway between Yallah and Oak Flats are steadily increasing with a high proportion of through vehicles undertaking trips within the Illawarra and for longer journeys, especially for freight and tourist trips. The six sets of traffic lights and intersections along the existing highway exacerbate the stop-start traffic conditions. A substantial portion of the peak hour traffic travelling on the existing highway is through traffic, conflicting with local trips.

In 2014 the A1 Princes Highway at Macquarie Rivulet Bridge carried about 59,000 vehicles per day in a typical weekday condition. In 2014 about 4,800 heavy vehicles was counted being 9 per cent of daily traffic on the A1 Princes Highway at Macquarie Rivulet Bridge. Traffic volume has increased by an average of 600 vehicles per day per year between 2000 and 2014, which equates to an average growth rate of 1.4 per cent per annum over a 14 year period.

The existing Princes Highway experiences traffic congestion and delays during weekday peak traffic periods. Currently (in 2014) it takes 9 minutes in the northbound morning peak and 7.5 minutes in the southbound afternoon peak to travel the 7.6 kilometre section of the existing Princes Highway between Yallah and Oak

Flats. Travel speed during the weekday peak period through the township of Albion Park Rail reduces to 30-50 kilometres per hour in the northbound direction and 40-60 kilometres per hour in the southbound direction. Motorists on the A1 Princes Highway between Yallah and Oak Flats travel about 10 to 20 kilometres per hour lower than the posted speed limits.

Traffic Implications of Doing Nothing

The traffic congestion on the A1 Princes Highway is predicted to intensify as a result of continuing population growth in the Wollongong and Shellharbour Local Government Areas, with developments being planned at Calderwood, West Dapto, Tullimbar and Tallawarra. It is estimated that these would add up to 30,000 new home sites when fully developed. The future condition traffic analysis has found that if no action is taken to improve the traffic flow on the A1 Princes Highway between Yallah and Oak Flats, the following is likely to occur:

- Major congestion at a number of key intersections during peak periods in the next five to ten years, extending to a large part of the day
- Travel times on the existing route would substantially increase to 18 minutes (from 9 minutes at present) in the northbound peak and 17 minutes (from 7.5 minutes at present) in the southbound peak direction
- The A1 Princes Highway would be highly congested and there would be increased delays and queuing along the highway. Additionally, turning and cross movements at key intersections would be more than double those of today creating very high local traffic delays
- Local amenity and access at Albion Park Rail will continue to decline due to increased traffic, as will other road related impacts such as noise and localised air quality
- The efficiency of freight will decline with increased travel times.

Traffic Benefits

The Albion Park Rail bypass project will provide motorists with faster trips, saving about 12 minutes on a northbound journey from Oak Flats to Yallah in the morning peak. The travel time saving for the southbound journey from Yallah to Oak Flats will be about 10 minutes in the afternoon peak. When project is complete, the new motorway will lower travel times by 65 per cent from 18 minutes to 6 minutes in the morning peak. The new motorway will bypass six sets of traffic lights. The project also provides a substantial saving in time over the current travel time observed during travel time surveys with 3 minutes being saving on a northbound journey in the morning peak and 1.5 minute being saved on a southbound journey in the afternoon peak.

Key benefits expected to result from the project include:

- Reduced traffic volumes on the A1 Princes Highway through Albion Park Rail. The traffic reduction on the highway would improve local amenity, property access and reduce other traffic related impacts, such as noise and localised air quality, for nearby residents
- Diversion of a substantial proportion of through traffic onto the new motorway, allowing the existing section of the A1 Princes Highway at Albion Park Rail to mainly cater for local traffic. This diversion will mean that key intersections along the A1 Princes Highway between Yallah and Oak Flats for the post upgrade condition are expected to operate with a good Level of Service A and B
- Improved reliability of journey times, particularly during peak travel periods
- Increased road capacity of the M1 Princes Motorway and Princes Highway corridor, which would support population growth in West Dapto, Calderwood, Tullimbar and Tallawarra
- Provision of opportunities to improve the public domain and amenity within the Albion Park Rail town centre.

An assessment of the current and future traffic volumes travelling on the existing road network has found that the project is needed to improve the efficiency of the road network.

Operational Traffic Impacts

The project would be effective in reducing a significant proportion of north-south through and regionally generated traffic from Princes Highway and Illawarra Highway between Yallah and Oak Flats. Additionally, a significant proportion of east-west traffic would be reduced from the East-West Link Road and Tongarra Road. The project would reduce traffic on the existing Princes Highway route between Yallah and Oak Flats in the order of 56 per cent to 74 per cent depending on locations. The Illawarra Highway (Terry Street) north of Tongarra Road is forecast to experience traffic increase up to 48 per cent due to the proposed entry ramp and exit ramp with the Illawarra Highway (Terry Street).

The project will have two lanes in each direction with median separation. Allowance has been made in the concept design for upgrading to six lanes in the future. It will be signposted at a minimum of 100 kilometres per hour. The project would maintain average speeds on the new motorway at a more acceptable level from 98 kilometres per hour in 2020 (opening year) to 95 kilometres per hour in 2041 (future development year).

Construction Traffic Impacts

The analysis has determined that the construction activities associated with the project would have minimal impacts on the road network with only minor impact to traffic operation on the A1 Princes Highway, Illawarra Highway and Tongarra Road. Construction methods and staging for the project would minimise road closures, subject to other project constraints, and allow staged construction to minimise any disruption to existing traffic. . The contractor would be required to develop a traffic management plan as part of the construction environmental management plan, as required for proposed major work that would impact on existing traffic arrangements. Overall, the impact of the construction of the project is anticipated to be minor and appropriate management plans would be applied to mitigate the impact.

1 INTRODUCTION

This report is the traffic and transport assessment for the proposed construction and operation of the motorway standard Albion Park Rail bypass (the project).

Roads and Maritime Services (Roads and Maritime) is planning for a 9.8 kilometres extension of the M1 Princes Motorway between Yallah and Oak Flats to Bypass Albion Park Rail. The motorway will complete the 'missing link' for a high standard road between Sydney and Bomaderry. It would provide easy access to Dapto, Albion Park and Oak Flats, have two lanes in each direction with median separation and have capacity for additional lanes. It will be signposted 100 km/h. The motorway would reduce travel times for through and local traffic, improve the reliability of journeys through greater flood immunity and provide more consistent driving conditions. It would also divert a substantial proportion of through traffic onto the motorway, reducing traffic volumes on the A1 Princes Highway through Albion Park Rail. This would improve local amenity and access, and reduce other traffic related impacts such as noise for nearby residents.

In the course of preparing this traffic and transport report relevant documents associated with the project have been reviewed, and potential traffic impacts on the road network have been assessed. The assessment identifies upgrade works required for the project to maximise the performance of road network from a traffic point of view.

This traffic and transport assessment report has been prepared to support the environmental impact statement (EIS) submission for the proposed upgrade.

1.1 STUDY OBJECTIVES

This report has been prepared to provide an assessment of the traffic and transport related impacts (positive and negative) that can be expected to result from the construction and operation of the proposed Albion Park Rail bypass.

The report has been prepared to meet the following objectives:

- Clearly document the existing traffic and transport environment within the project study area
- Clearly document the impacts on the traffic and transport that can be expected attributable to the project
- Provide traffic input to inform the project design
- Identify construction and operational traffic impacts and mitigation measures
- Fully address traffic and transport related elements of the Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning and Environment (DP&E) on 18 March 2015.

1.2 THE PROJECT

The project is located within the Wollongong and Shellharbour local government areas (LGAs), within the Illawarra region, about 85 kilometres south of Sydney's central business district. The project follows the alignment of the preferred option announced by Roads and Maritime in October 2014, and would provide a bypass of the suburb of Albion Park Rail.

Albion Park Rail is situated on the southern bank of Lake Illawarra, about seven kilometres inland from the coast, and about eight kilometres east of the southern portion of the Illawarra

escarpment. It is about 18 kilometres south-west of Wollongong, which is the major regional centre for the Illawarra.

Albion Park Rail provides a range of services for Shellharbour and the broader Illawarra region. Illawarra Regional Airport and the Croom Regional Sporting Complex are situated within the suburb. Figure 1-1 shows the location of the project within the region.

The key features of the project are presented in Table 1-1.

Table 1-1 Key Features of the Project

Feature	Description
Lanes	There would be grade separated motorway with 2 lanes in each direction divided by a median (with capacity to upgrade to three lanes in each direction in future).
Route	The route is shown in Figure 1-2
Interchanges	Three grade-separated interchanges provided at Yallah, Albion Park and Oak Flats would connect the local road network with the motorway.
Bridges	The following bridges would be provided: Bridges to carry the motorway over Duck Creek, Macquarie Rivulet, and Frazers Creek Bridges to carry the motorway over the Princes Highway and Tongarra Road A bridge to carry the motorway over the South Coast Railway Line Bridges to carry local roads, and ramps over the motorway Bridges to provide floodwater conveyance and flood relief.
Local road changes or upgrades	An upgrade to Yallah Road, between Larkins Lane and the Princes Highway at Yallah, would be undertaken as part of this project. Other changes and upgrades to the local road network would include minor realignments and creation of cul-de-sacs.
Pedestrian and bicycle connections	Improved pedestrian and cycle connections are proposed as part of the project. Shared use path crossings are proposed in all locations where the motorway and local roads cross. In addition, a shared use path connection is proposed between The Illawarra highway, Albion Park Rail and Terry Street, Albion Park. Cyclists would be able to use the motorway shoulders in both directions, accessible via the motorway ramps. The motorway would have controlled access fencing to prevent pedestrians from accessing the road corridor.
Drainage	The following drainage elements would be provided: Network of gutters, channels, pipes and pits to collect and convey stormwater by gravity to the point of discharge into receiving waters Scuppers and carrier pipes to convey stormwater from bridged sections to the bridge supports Detention basins, vegetated swales, sediment traps, oil interceptors, etc. where required.

Feature	Description
Emergency access and management facilities	Emergency stopping bays would be provided along the mainline at a spacing of 1-2 kilometres. Maintenance access would be provided to bridge abutments, basins, utilities and cut benches. Access tracks would generally originate from emergency stopping bays.
Detention Basins	Adjustments to the Green Meadows Detention Basin would ensure an appropriate level of flood storage would be maintained. An additional detention basin is proposed adjacent to Croome Road to mitigate flooding impacts in low level flood events.
Noise barriers	Noise barriers between the motorway and sensitive receivers would be required in some locations to reduce noise impacts.
Lighting	Lighting would be provided as required for safety reasons. Typically this would be limited to busy entry and exit ramps and the local road network.
Earthworks	The motorway would be constructed on earth fill embankments across floodplains to provide flood immunity.
Landscape and urban design	Landscape and urban design treatments would integrate the project with the surrounding environment.
Croom Regional Sporting Complex	Directly impacted sporting facilities at the Croom Regional Sporting Complex would be replaced, including sporting fields and associated amenities. Changes would be made to the southern access of the sporting complex, and new and reconfigured internal roads, pedestrian/cycle paths, and parking would be provided.

Feature	Description
Construction activities and temporary ancillary facilities	The key construction activities would include: - Mobilisation and site establishment - Relocation and protection of existing services - Clearing, grubbing and topsoil stripping, including clearing of all areas within the site boundary (except within the nominated environmental protection areas), temporary work areas and local work areas - Demolition of existing roads and buildings - Bulk earthwork and haulage of materials - Construction of the road pavement - Construction of drainage structures - Construction of bridges (this would likely include heavy vehicle deliveries of over-size loads) - Relocation and construction of sporting facilities - Changes to property access - Signposting - Installation of lighting and roadside furniture - Landscaping, waste disposal and rehabilitation of disturbed areas with no future use. Temporary ancillary facilities would be provided to enable the above construction activities for the project. A total of 13 temporary ancillary facility sites have been identified for the project.



Figure 1-1 Regional Context of the Project



Figure 1-2 Proposed Albion Park Rail bypass Project

1.3 STRUCTURE OF THE REPORT

This report contains the following nine sections providing traffic and transport assessment of the proposed construction and operation of the Albion Park Rail bypass (the project).

- **Section 1 Introduction** provides an overview of the project, and study objectives
- **Section 2 Assessment Requirements** provides traffic and transport requirements identified in SEARs, study approach, reference traffic data and model used in the assessment
- **Section 3 Existing Environment** provides the regional and local transport context within which assessment has taken place. This section provides an overview of road network, historical traffic growth, current transport mode share, crash data and public transport
- **Section 4 Existing Road Network Performance** describes the existing transport network performance in the study area. Results from traffic surveys are summarised in this section. An assessment of existing network capacity has been undertaken, summarising network travel speed on key roads and Level of Service at key intersections within the study area. The Level of Service definition as per Roads and Maritime Guide are provided in Section 4.4.
- **Section 5 Traffic Modelling and Forecasting Process** provides an overview of the traffic models used for this study. It describes the future land use, future traffic growth across the study area network
- **Section 6 Assessment of Operational Impacts** provides an assessment of the resulting traffic, transport and road safety impacts which are anticipated to occur as a result of operation of the project. Traffic impact with and without the project is also included in this section
- **Section 7 Assessment of Construction Impacts** provides detail traffic impact during various construction stages
- **Section 8 Management of Traffic and Transport Impacts** summarises all measures included in the project to manage traffic and transport effects
- **Section 9 Reference** includes various traffic reports, guidelines used in the assessment.

2 ASSESSMENT REQUIREMENTS

This section describes the traffic and transport requirements for the project as well as study approach and relevant assessment criteria and guidelines used.

2.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS (SEARS)

The SEARs for the environmental assessment of the proposed Albion Park Rail bypass alignment and interchanges were issued on 18 March 2015. This report forms the Traffic and Transport assessment prepared to address potential traffic impacts associated with the project.

Table 2-2 shows SEARs on Traffic and Transport and identifies where individual matters are addressed in this report. The project objectives, its justification and a full list of SEARs for the project can be found in the Environmental Impact Statement (EIS) report.

Table 2-2 SEARs Compliance Table, Traffic and Transport

Requirement	Where addressed
Traffic and Transport — including but not limited to:	
details of how: - the preferred alignment, design and staging, - the proposed interchanges and connections to the surrounding road network, and - associated road infrastructure facilities	- Section 1.2 - Section 6.4 - Section 6.5
meet the traffic and transport objectives of the proposal, taking into account the following local and regional issues: - adjacent sensitive land uses, - transport connectivity to and from existing communities and centres (such as East Dapto), - future growth areas (including but not limited to Calderwood, Tallawarra, West Dapto and Tullimbar), - approved and proposed infrastructure projects (including the proposed Albion Park (Tripoli Way) bypass and Yallah Road realignment), and - traffic (vehicular, cyclist and pedestrian) needs	- Section 2.2 - Section 2.3 - Entire Section 3 - Section 5.2 - Section 5.3 - Section 5.3
- an assessment and modelling of operational traffic and transport impacts on the local and regional road network, and the M1 Princes Motorway, including an assessment of road user safety and bus impacts; - impacts on cyclist and pedestrian access and safety, and consideration of opportunities to integrate cycleway and pedestrian elements with surrounding networks;	- Entire Section 4 - Section 5.1 - Sections 6.1 to 6.5 - Section 6.6 - Section 6.7

Requirement	Where addressed
An assessment of aviation issues associated with the Illawarra Regional Airport (during construction and operation, including proposed future operations), including impact on: - communications/navigation/surveillance infrastructure, - the Obstacle Limitation Surface (OLS), - Precision Approach Path Indicator (PAPI) Obstacle Assessment Surfaces (OAS), - the Procedures for Air Navigational Services — Aircraft Operations Surface (PANS-OPS); - road structure generated windshear and turbulence, and - lighting distractions and glare to pilots; and	The aviation issues have been addressed in a separate technical report titled <i>Aviation Impact Assessment, Albion Park Rail bypass, Prepared by REHBEIN Airport Consulting, April 2015.</i>
Construction Traffic and Transport impacts of the Proposal (including ancillary facilities) and associated management measures, in particular: - impacts to the road network (including safety and Level of Service, pedestrian and cyclist access, and disruption to public transport services and access to properties), - access and route identification and scheduling of transport movements, - the number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles), - the nature of existing traffic on construction access routes (including consideration of peak traffic times), and - the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the proposal, having reference to the cumulative construction impacts of other major projects preparing for or commencing construction	- Entire Section 7 - Entire Section 8

2.2 REFERENCE TRAFFIC DATA AND MODELLING

In 2013 Roads and Maritime prepared the Albion Park Rail Bypass Road Corridor Review Report (2013 Report). At that time a Traffic Study was undertaken by Bitzios Pty Ltd for the Albion Park Rail Bypass which provided key traffic input to the 2013 Report. This traffic study has further refined future development models based on the current 2014 traffic survey.

For the purpose of traffic assessment, modelling data was sourced from Wollongong and Shellharbour Strategic Transport model (WOLSH) implemented in TRACKS software. Roads and Maritime engaged TDG Gabites (TDG) for augmenting the WOLSH transport model for the project study area. The WOLSH transport model was calibrated and validated by TDG for 2014 traffic conditions. TDG undertook model calibration and validation for the WOLSH windowed model in April/May 2014. The TRACKS windowed model provided forecast traffic volumes within the project study area for existing (2014) and future development model (year 2041).

To assess the existing and future intersection performance, SIDRA software was used. The Highway Capacity Manual (HCM) 2010 used for weaving, merging and diverging assessment at Yallah, Albion Park and Oak Flats interchanges. The microsimulation modelling using Paramics software was only used for assessing future traffic performance at Yallah interchange A. Paramics model was developed by Bitzios Pty Ltd for the Yallah Road / Howards Bay Road interchange with the A1 Princes Highway at Yallah. The model was referenced in the design and assessment of the Yallah Road area.

Four types of transport modelling software including TRACKS, SIDRA, HCM and Paramics provided an assessment tool that identified:

- Existing and future traffic performance on the A1 Princes Highway between Yallah and Oak Flats
- Future traffic volumes on the project and associated three interchanges for the design year
- Long term options for improvements to traffic flows, including an assessment of the likely traffic performance of the project

To assess the operational performance of the project, the assessment considered the following traffic conditions:

- The performance of existing critical intersections with the A1 Princes Highway between Yallah and Oak Flats based on 2014 volumes, to represent the existing condition
- The year 2041 was selected to represent the design year of the project being 20 years after opening to traffic in 2020/2021 (refer to Section 5.4.1)
- Two future conditions based on 2041 traffic volumes to assess the network performance. The first being without the project ('do nothing'), the second being with the project.

2.3 STUDY APPROACH

For the purpose of traffic and transport assessment of the project a comprehensive study approach was developed. It involved new 2014 traffic survey, traffic data analysis, augmenting TRACKS windowed model, identification of network operational issues and assessment of the project from traffic grounds.

A consultation process involving Roads and Maritime staff constituted an important element of the traffic assessment. This included detailed traffic modelling during options assessment, a value management workshop and further modelling to design development of the preferred option.

Key steps in the traffic study included:

- 1 Traffic data, survey and analysis.** A new traffic survey was conducted in April 2014 by Roads and Maritime for the purpose of this study. Supplementary traffic survey was undertaken in July 2014 for further traffic model refinements and option assessment purposes. The April 2014 traffic survey provided key input to the base case TRACKS windowed model development, calibration and validation undertaken by TDG. Four types of data were collected in April 2014 including intersection turning movement counts, midblock traffic counts, queue length, and travel time survey.
- 2 Base case model development, calibration and validation.** The existing base case TRACKS windowed model was validated by TDG using the April 2014 counts. The calibration and validation works were undertaken in April and May 2014.
- 3 Existing network performance.** Existing Level of Service at key intersections was assessed for both morning (AM) and afternoon (PM) weekday peak traffic conditions. Both April and July 2014 traffic counts formed the basis of intersection Level of Service assessment where required.
- 4 Future base case models.** The future year base case and project case models represent future development models using TRACKS windowed model for 2041 traffic conditions for AM and PM peak periods. The future development models considered Calderwood, Tallawarra, West Dapto and Tullimbar growth areas and approved and

proposed infrastructure projects including the proposed Albion Park (Tripoli Way) bypass and Yallah Road realignment, Section 5.2 and Section 5.3 documented key assumptions included in the future development models.

5 Assess future traffic performance of the project. This included modelling of the following:

- A four lane Albion Park Rail bypass alignment
- Three new interchanges at Yallah, Albion Park and Oak Flats
- Capacity improvements at existing roads and intersections due to the project.

2.4 RELEVANT GUIDELINES

The following guidelines and standards are used in the traffic and transport assessment including:

- Roads and Maritime Traffic Modelling Guidelines, February 2013 Version 1.0
- Highway Capacity Manual (HCM 2010)
- Guide to Traffic Generating Developments, Issue 2.2, Roads and Maritime, October 2002
- AustRoads Guide to Traffic Engineering Practice
- AustRoads Guide to Traffic Management Part 3 – Traffic Studies Analysis
- AustRoads Guide to Traffic Management Part 6 – Intersections-Interchanges-Crossings
- AustRoads Roads and Maritime Supplements Guide To Road Design Part 4C – Interchanges.

3 EXISTING ENVIRONMENT

The existing traffic and transport conditions in the study area are describe within this chapter. This chapter provides the regional and local context within which the assessment has been undertaken.

3.1 ROAD NETWORK

The A1 Princes Highway is the main north–south transport corridor linking Sydney and Wollongong to the NSW south coast and north-eastern Victoria. The highway is an important freight, bus and tourist route for the south coast. The section of the highway between Yallah and Oak Flats is also used as a local route for areas such as Albion Park, Albion Park Rail, Oak Flats, Yallah and Dapto.

The traffic volumes on the A1 Princes Highway between Yallah and Oak Flats are steadily increasing with a high proportion of through vehicles undertaking trips within the Illawarra and for longer journeys, especially for freight and tourist trips. The six sets of traffic signals and intersections along the existing highway exacerbate the stop-start traffic conditions. A substantial portion of the peak hour traffic travelling on the existing highway is through traffic, conflicting with local trips.

The traffic congestion on the highway is predicted to intensify as a result of continuing population growth in the Wollongong and Shellharbour LGAs, with developments being planned at Calderwood, West Dapto, Tullimbar and Tallawarra. It is estimated that these would add up to 30,000 new home sites when fully developed.

In 2014 the A1 Princes Highway at Macquarie Rivulet Bridge carried about 59,000 vehicles per day in a typical weekday condition. Traffic volumes have increased by an average of 600 vehicles per year between 2000 and 2014, which equates to an average growth rate of 1.4 per cent per annum over a 14 year period. Traffic flows on the A1 Princes Highway are highest during major holiday periods, including the school holidays at Christmas, Easter and Labour Day in October. The nearest counting site on the M1 Princes Motorway (Station 07.594, north of Northcliffe Drive) indicates 25 per cent more vehicles during the Christmas and New Year period in comparison to the typical weekday traffic condition. In 2014 heavy vehicles constituted about 10 per cent of daily traffic on the A1 Princes Highway at Macquarie Rivulet Bridge.

Figure 3-1 shows the traffic and transport study area.



Figure 3-1 Traffic Modelling Study Area

3.2 ROAD HIERARCHY

The road hierarchy and speed environment within the study area are described as follows:

3.2.1 PRINCES MOTORWAY (M1)

The M1 Princes Motorway provides the primary link from Sydney to Wollongong and surrounding areas. The motorway has a four lane divided carriageway, with provisions for slow lanes on sections with steep grades. The majority of the motorway has a sign-posted speed of 100 km/h or above (with some exceptions around Wollongong and largely associated with steep grades). The motorway predominantly provides access via grade separated interchanges.

3.2.2 PRINCES HIGHWAY (A1)

To the north of Albion Park Rail the M1 Motorway changes to a highway standard arterial road with 4 lane carriageway configuration. It has numerous at-grade intersections (signalised and priority) and property accesses. Direct access to the highway is currently available for both residential and commercial properties. The posted speed limit along the A1 Princes Highway between Yallah and Oak Flats ranges from 60 km/h to 100 km/h. In 2014 Princes Highway through Albion Park Rail carried about 46,000 to 47,000 vehicles per day in a weekday traffic condition.

The posted speed and 2014 daily traffic volumes at three analysed sections along the A1 Princes Highway varied depending on site conditions:

- **Between Oak Flats Interchange and Tongarra Road:** The posted speed limit in the northbound carriageway is 100 km/h, but reduces to 80 km/h, north of Oak Flats interchange. A further reduction in speed to 60 km/h occurs on approach to Woollybutt Drive. The speed limit on the southbound carriageway increases from 60 km/h before the A1 Princes Highway/Tongarra Road intersection to 70 km/h, just after the signalised intersection. The speed limit increases to 100 km/h on approach to the Oak Flats Road interchange. This section of Princes Highway carries about 46,000 vehicles per day (south of Tongarra Road).
- **Between Tongarra Road and Illawarra Highway:** The speed limit on this section is 60 km/h between Tongarra Road and north of Creamery Road; and 70 km/h north of Creamery Road to Illawarra Highway. This section of Princes Highway carries about 47,000 vehicles per day (south of Illawarra Highway).
- **Between Illawarra Highway and Yallah Bay Road:** The speed limit on the northbound carriageway increases from 70 km/h to 100 km/h, at a distance 80 metres north of the Illawarra Highway roundabout. The speed limit for the southbound carriageway decreases from 100 km/h to 70 km/h at 300 metres north of the Illawarra Highway roundabout. This section of Princes Highway carries about 59,000 vehicles per day (at Macquarie Rivulet Bridge).

3.2.3 TONGARRA ROAD

Tongarra Road is an arterial road providing key connectivity to Albion Park from Oak Flats and Albion Park Rail. Tongarra Road is the main east-west access through the township. To the west of Terry Street, Tongarra Road is also known as the Illawarra Highway (A48) and provides connectivity to the main Albion Park township area. Tongarra Road currently forms a signalised intersection with the A1 Princes Highway. Tongarra Road to the west of Terry Street is a four lane divided carriageway. Between Terry Street and Princes Highway, Tongarra Road has a two

lane carriageway. The road has provisional on-street parking along its length. The posted speed limit is 60 km/h between Calderwood Road and Terry Street, but increases to 80 km/h at approximately 400 metres east of Stapleton Avenue. There are two 40 km/h school zones in this area. In 2014, Tongarra Road carried about 12,000 vehicles per day (west of Illawarra Highway).

3.2.4 ILLAWARRA HIGHWAY (A48)

The Illawarra Highway has a two lane undivided carriageway with a predominately 90 km/h speed limit (some sections have 70 km/h). The road provides a key regional link between the Southern Highlands and the Illawarra providing the primary connection between the Hume Highway and Princes Highway. It is also the primary route for the Albion Park township. In 2014, Illawarra Highway carried about 15,000 vehicles per day (south of Princes Highway).

3.2.5 CORMACK AVENUE

Cormack Avenue is a local road, however performs a collector road function as it is the primary link for motorists travelling to and from the Princes Highway south of Yallah for the Koonawarra / east Dapto residential estate. The road provides connection to the Princes Highway to / from the south.

3.2.6 YALLAH BAY ROAD

Yallah Bay Road currently travels east/west and provides a link to the Yallah Bay Tallawarra power station and tourist facilities around Lake Illawarra. The road currently forms a sign controlled T-intersection with Princes Highway.

3.2.7 YALLAH ROAD

Yallah Road is a rural standard local road / collector road. The road is a two lane, undivided carriageway. Yallah Road provides access to the Mount Marshall area on its western side connecting to the Princes Motorway at the Yallah Interchange. Yallah Road would provide an important connection to future development as part of the urban release area of West Dapto.

3.2.8 EAST WEST LINK

East West Link is a sub arterial road providing a secondary link between the major townships of Albion Park and Shellharbour. The East West Link connects the southern residential areas on Albion Park to the roundabout at New Lake Entrance Road. The road has a two lane undivided carriageway with 80 km/h speed limit. The road also provides a primary link to two quarries as well as the Croome sporting field. The access to Croome Road provides an important alternative to Tongarra Road.

3.2.9 NEW LAKE ENTRANCE ROAD

New Lake Entrance Road is a sub arterial road which provides key connectivity to the Shellharbour township, in particular the Shellharbour Town Centres and Hospital. The road also provides a key link to the tourist and commercial areas surrounding Lake Illawarra and a secondary link to Port Kembla. The New Lake Entrance Road has six lanes with a divided carriageway and 80 km/h speed limit.

3.2.10 HAYWARDS BAY DRIVE

Haywards Bay Drive is a two lane undivided local road. It provides access to Haywards Bay connecting to the Princes Motorway at the Yallah Interchange. The sign posted speed limit is 50 km/h

3.2.11 WOOLLYBUTT DRIVE

Woollybutt Drive is a two lane undivided local road. It connects the East West Link roundabout at its southern end and the Princes Highway on its northern end. The sign posted speed limit is 60 km/h. The Woollybutt Drive and Princes Highway intersection is a priority give way control.

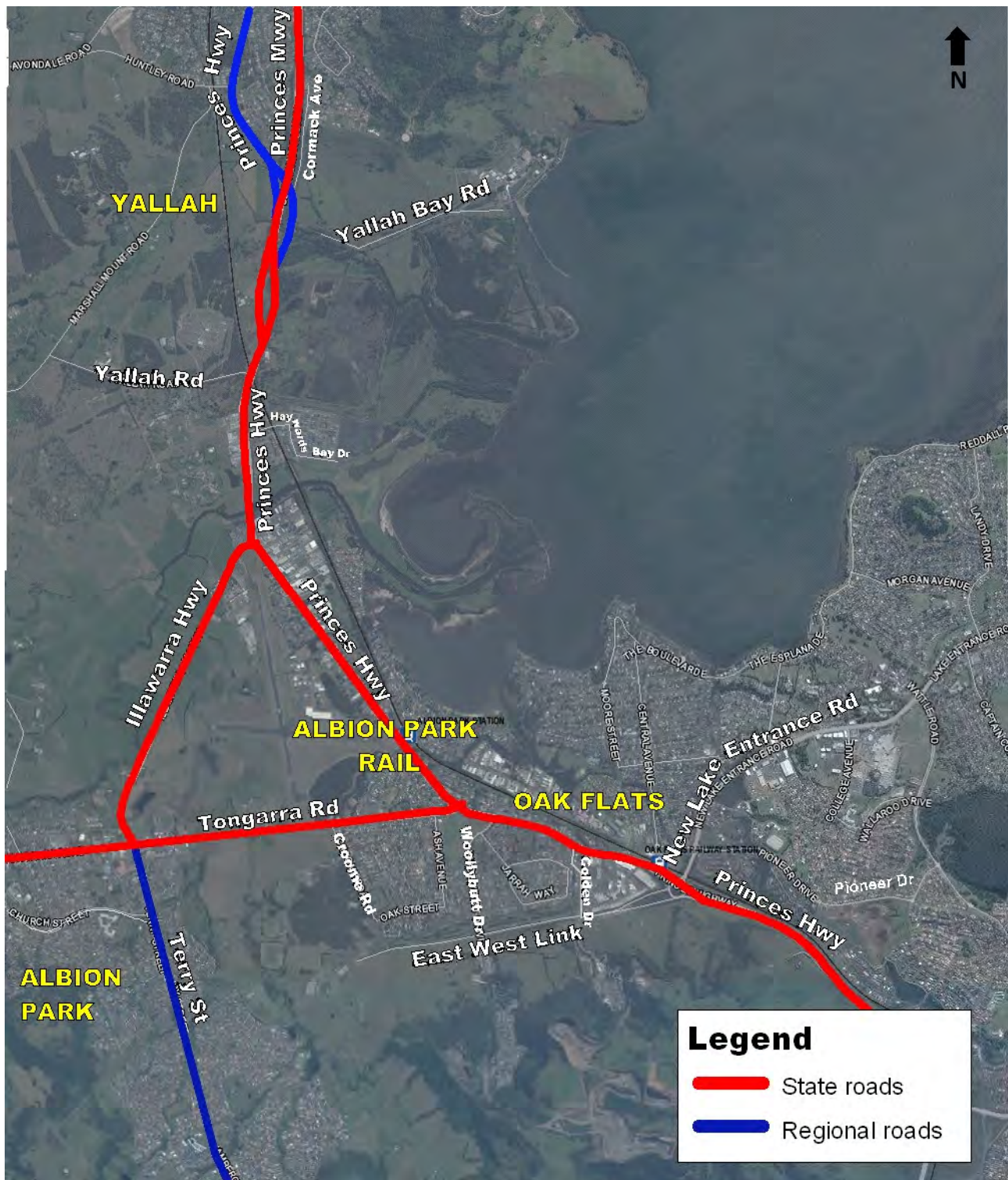
3.2.12 COLDEN DRIVE

Colden Drive is a two lane undivided local road. It connects the East West Link roundabout at its southern end and the Princes Highway on its northern end. The sign posted speed limit is 60 km/h. The Colden Drive Road and Princes Highway intersection is a signalised intersection. It provides access to the Oak Flats industrial and commercial area. Current Colden Drive alignment is under construction between Durgadin Drive and Shandan Circuit

3.2.13 CROOME ROAD

Croome Road is a two lane undivided local road. It connects the East West Link roundabout at its southern end and the Tongarra Road on its northern end. Croome Road provides access to the 'Croom Sport Centre' located adjacent to the East West Link. The sign posted speed limit is 60 km/h. The Croome Road and Tongarra Road intersection is a priority give way control.

Figure 3-1 shows existing road hierarchy for the study area.



Source: Classification road maps, Greater Sydney area, RMS 2011.

Figure 3-1 Existing Road Hierarchy

3.3 HEAVY VEHICLES

A review of the heavy/freight vehicles movements through the study area indicates the following key routes:

- M1 Princes Motorway – As the primary north / south connector, the road forms the primary freight movement through the region. The road provides access to and from the Port to and through the study area.
- A1 Princes Highway – As per above, freight movements travel through the Albion Park Rail area via the A1 Princes Highway. Freight movements, to and from the south, as well as those with local destinations, are required to travel along the A1 Princes Highway.
- A48 Illawarra Highway – carries moderate heavy vehicle volumes however the road forms the freight route to Albion Park and the west.
- East-West Link – There are two quarries located along East-West link (opposite Woollybutt Drive and Colden Drive). The section of East-West Link between the A1 Princes Highway is a freight route to accommodate the quarry movements onto the A1 Princes Highway.

Heavy vehicle routes are outlined as follows:

3.3.1 4.6 METRES HIGH VEHICLE ROUTES

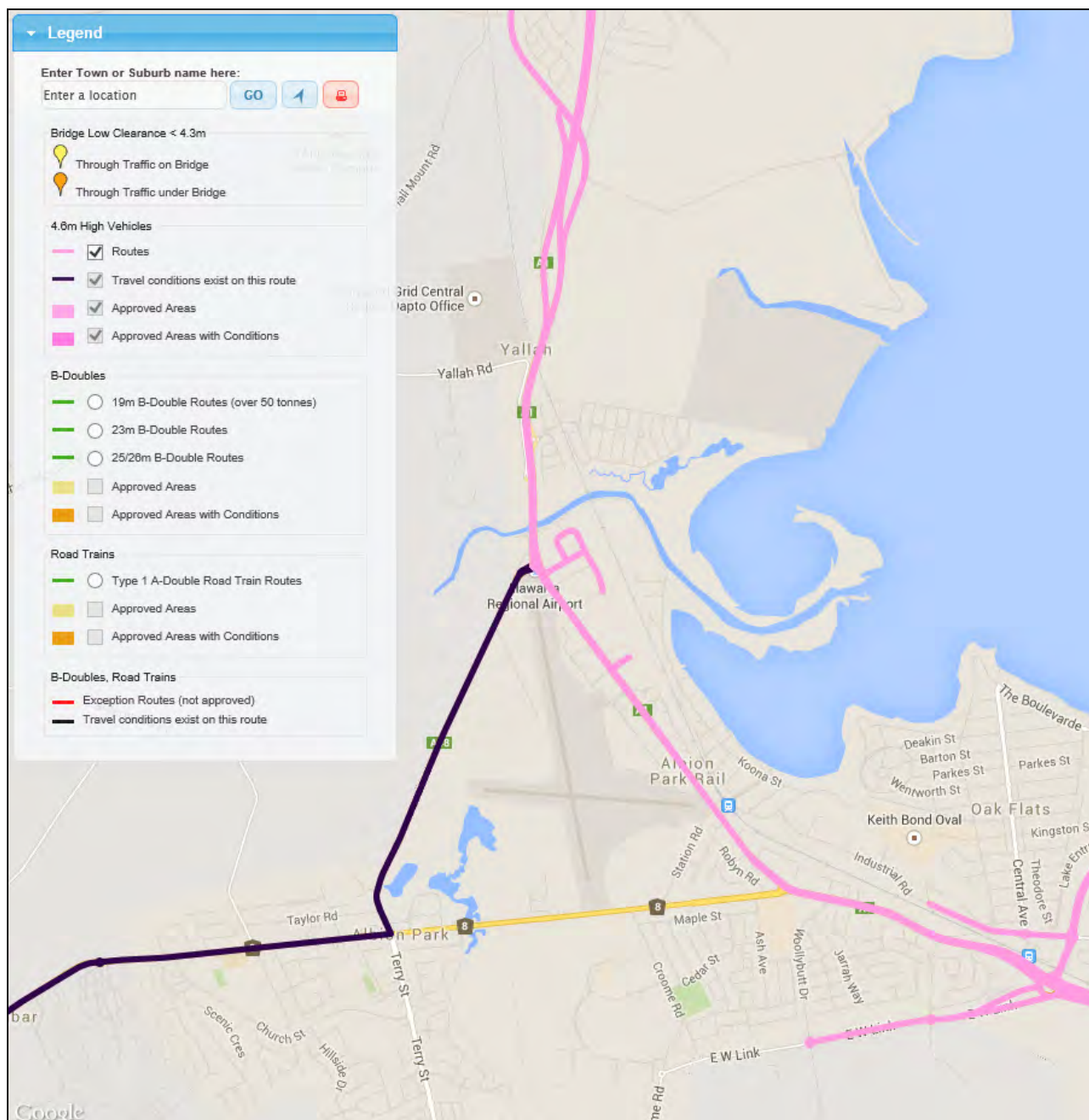
There are a number of approved routes in the study area for 4.6 metres high vehicles as showed in Figure 3-2. The predominant route is the north/south movement along the M1 Princes Motorway and Princes Highway (through the Albion Park Rail). The high vehicle route also exists through East-West Link which provides access to the quarries and industrial estate. Illawarra Highway and Tongarra Road (west of Terry Street) are identified as roads where movements of vehicles over 4.6 metres are possible.

3.3.2 B-DOUBLE ROUTES

The B-double routes for 19 metres, 23 metres and 25 metres / 26 metres vehicles are shown in Figure 3-3. The primary route is the north-south movement along the M1 Princes Motorway and Princes Highway (through Albion Park Rail). A B-double route also exists through the East-West Link which provides access to the quarries and industrial estate.

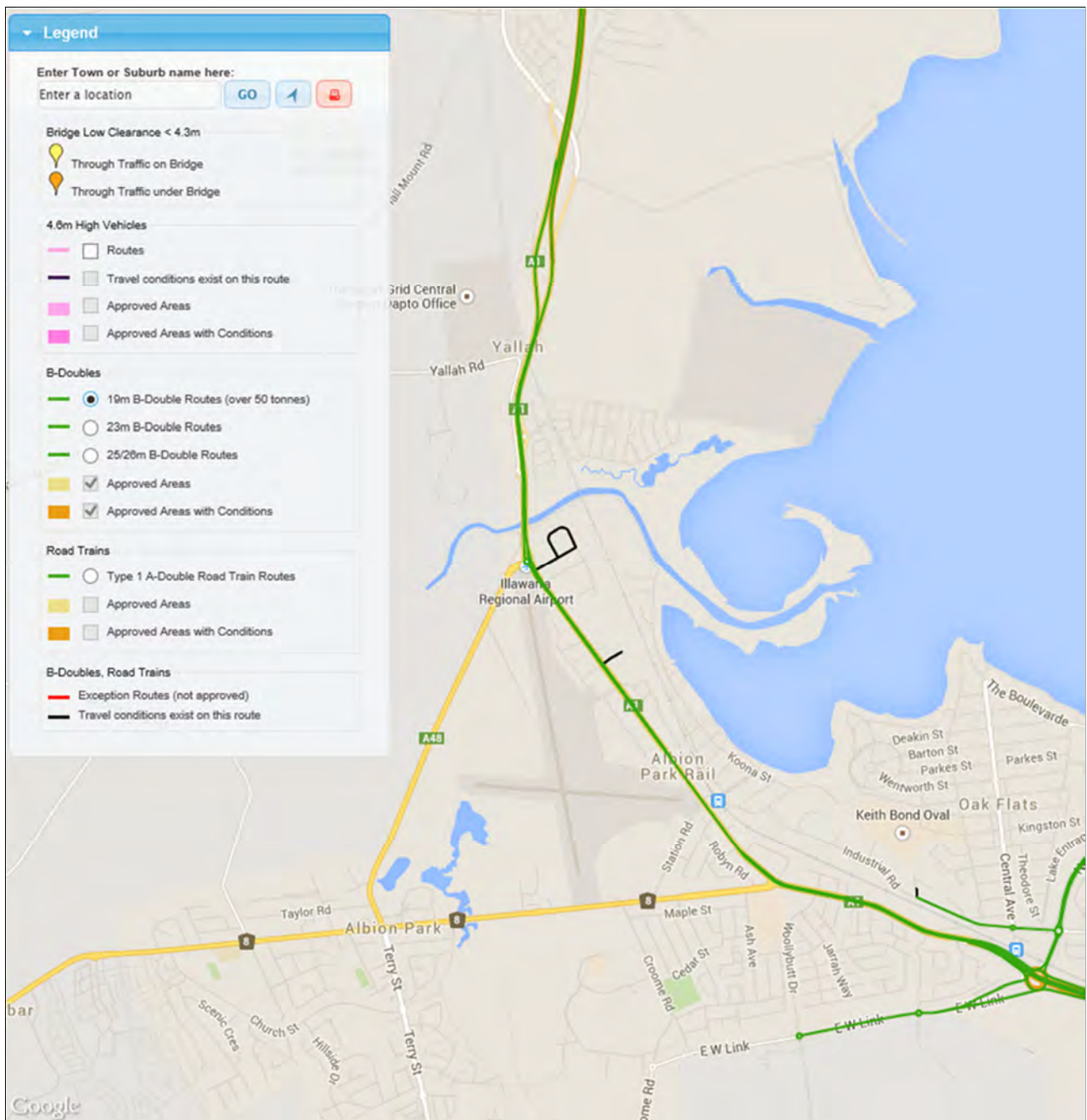
3.3.3 A-DOUBLE ROAD TRAIN ROUTES

There are no A-Double routes within the study area.



Source: Roads and Maritime Restricted Access Vehicle Map NSW

Figure 3-2 Designated 4.6m High Vehicle Routes in the Study Area



Source: Roads and Maritime Restricted Access Vehicle Map NSW

Figure 3-3 Designated B-Double Routes in the Study Area

3.4 EXISTING LAND USE

A number of existing land uses influence travel patterns within the study area. Key areas are described as follows:

3.4.1 DAPTO AND KOONAWARRA

The land use through Dapto is predominately residential with rural land use zones to the west of the township extending through the Penrose suburb. The land uses in the northern part of Dapto are for industrial and commercial purposes providing services for the immediate residential catchment area including the suburbs of Penrose and Brownsville. Wollongong City Council is preparing a strategic access plan for West Dapto expansion, bringing new residential and commercial areas. Koonawarra land use is predominately developed as low density residential area. One third of the Koonawarra area forms part of the Mount Brown natural reserve.

3.4.2 ALBION PARK RAIL

The land use through Albion Park Rail is generally residential, however there is a substantial area nominated for the Airport. Land adjacent to the west and south of the Airport is rural. There is also a section of land nominated as industrial on the northern approach to the township which is currently a mixture of warehouses, car yards and white goods stores. Albion Park Rail town centre is located on both the main north-south road link as well as the main north-south rail link. It is located to the immediate south-east of the A1 Princes Highway and Creamery Road intersection. A rail station exists within the town centre, this being Albion Park Station. The Albion Park Rail station is also likely to remain a lower order rail station providing for local resident's needs, with the larger station at Oak Flats providing a greater interchange role with buses and park and ride facilities.

3.4.3 ALBION PARK

The land use through Albion Park is predominately residential with rural land use zones to the north and south of the township located near the intersection of Terry Street and Tongarra Road. Albion Park Town Centre currently provides essential services for the immediate residential catchment area. The Albion Park community has grown rapidly over the past 10 years. The intersection of Terry Street and Tongarra Road experiences high traffic delays during the AM and PM weekday peak periods. Extended traffic delays also occur during long weekends and holiday season when substantial traffic heads towards the Jamberoo or the Southern Highlands along the Illawarra Highway (via Macquarie Pass).

3.4.4 SHELLHARBOUR TOWN CENTRE

The Shellharbour town centre is currently undergoing major growth. Stockland Shellharbour recently completed its re-development / expansion of its shopping centre and now contains 75,000 square metres Gross Leasable Floor Area to make it the second largest shopping centre in the Illawarra, South Coast and Southern Highland Regions.

Figure 3-4 show existing land use in the study area.

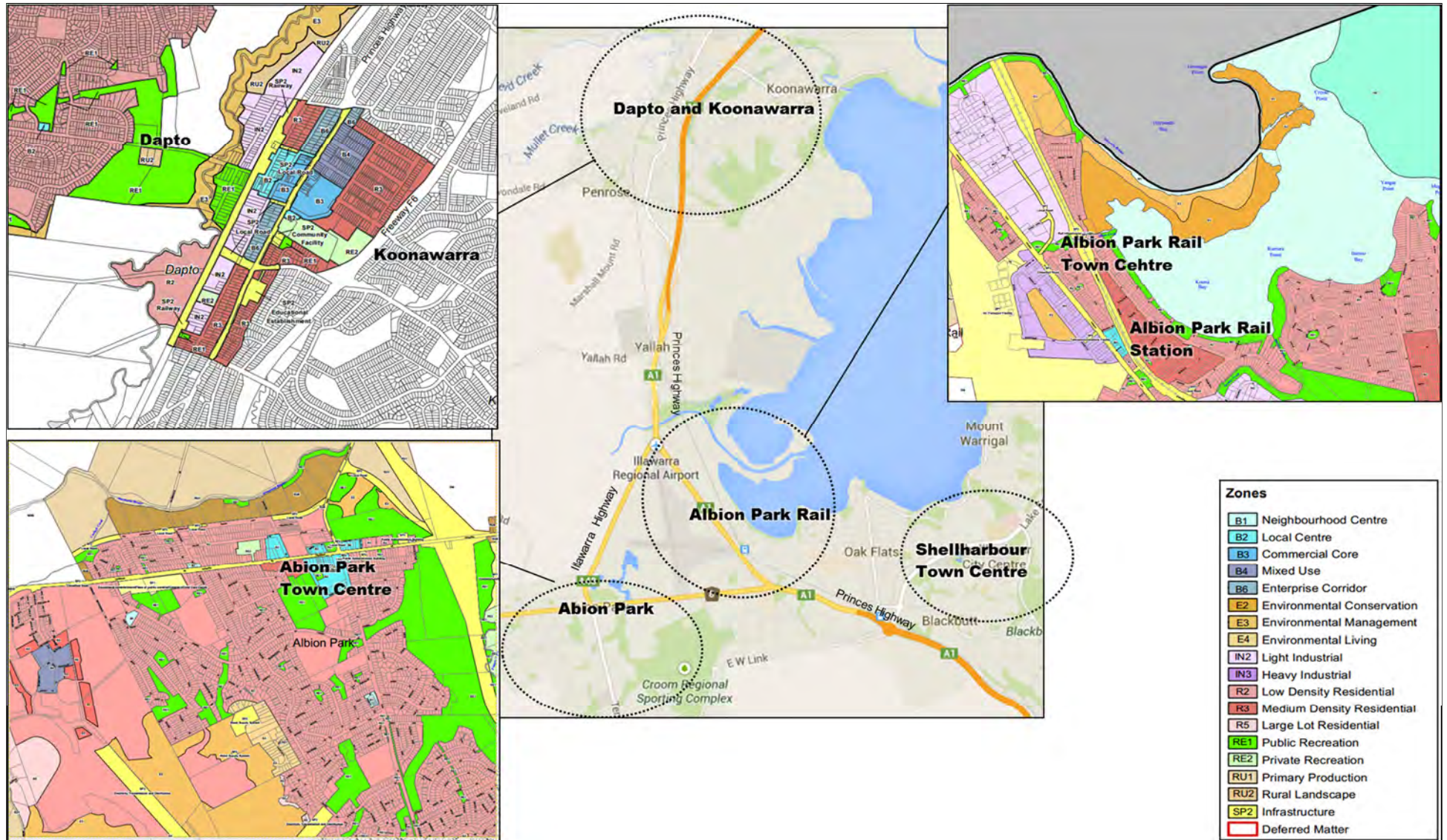


Figure 3-4 Existing Land Use in the Study Area

3.5 HISTORICAL TRAFFIC GROWTH

Historical traffic data between 2000 and 2014 on the A1 Princes Highway, Illawarra Highway and Tongarra Road were obtained from Roads and Maritime. The historical traffic data represents annual average daily traffic (AADT) on these roads. Table 3-3 shows ADT and AADT data for the last 14 years on Princes Motorway, Princes Highway, Illawarra Highway and Tongarra Road. The AADT data for 2014 was estimated from average daily traffic (ADT) sourced from traffic surveys undertaken between 30 March and 5 April 2014. In general traffic volumes expressed in AADT and ADT varies for key roads analysed for the study area due to seasonal factors. The ADT for analysed roads in the month of April was about per cent higher than the AADT. Nevertheless, the historical ADT and AADT data provides an understanding of background traffic volumes across the network for about 14 years period. Key points to note from Table 3-1:

- In the last 14 years (between 2000 and 2014), traffic volumes on the Prices Highway north of Illawarra Highway (07.035) has increased from 45,000 vehicles per day in 2000 to 57,600 vehicles per day in 2014
- Similar traffic increases were observed on the southern sections of the Prices Highway. Traffic volumes on the A1 Princes Highway east of Illawarra Highway (07.037) have increased from between 38,000 vehicles per day (2000) to 46,200 vehicles per day (2014). Traffic volumes on Princes Highway east of Tongarra Road, Oak Flats have increased from 40,700 vehicles per day (2000) to 45,000 vehicles per day (2014)
- Traffic volumes on the Illawarra Highway west of Princes Highway (07.038) have increased slightly from 13,400 vehicles per day (2000) to 14,700 vehicles per day (2014)
- Traffic volumes on Tongarra Road were found to be consistent between 12,000 and 13,000 vehicles per day.

The historical traffic analysis suggests that north-south traffic movements on the A1 Princes Highway have grown consistently. In the future traffic on the A1 Princes Highway will continue to grow due to new land release areas being planned within the study area.

Figure 3-5 shows historical traffic growth observed on the M1 Princes Motorway, Princes Highway, Illawarra Highway and Tongarra Road. The growth rate is estimated based on the AADT data between 2000 and 2014.

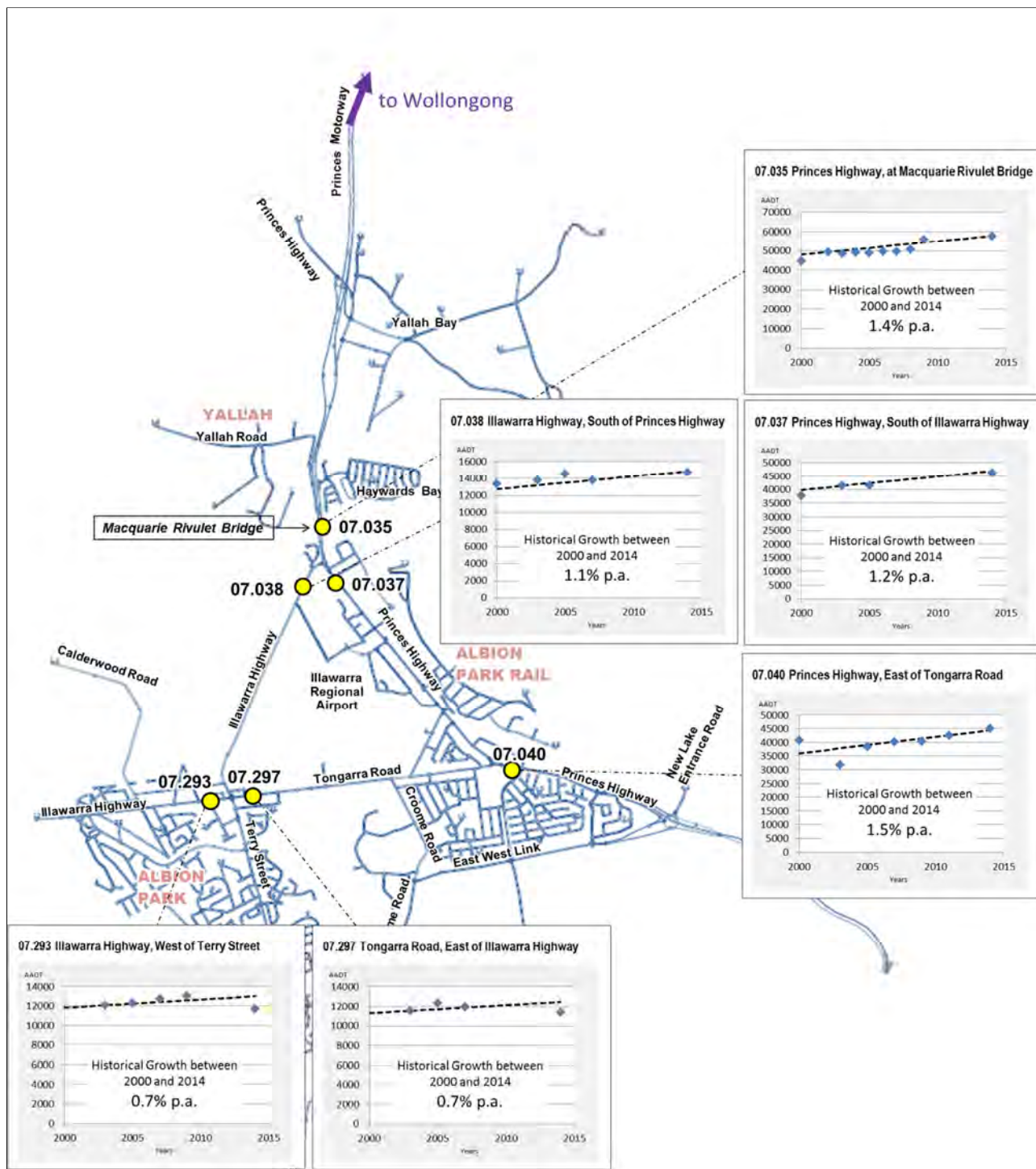
The historical data in the last 14 years (between 2000 and 2014) indicates the following traffic growth trends:

- Traffic on the A1 Princes Highway between Yallah and Oak Flats has grown between 1.2 and 1.5 per cent per annum depending on locations assessed
- Traffic on the Illawarra Highway has grown in the order of 1.1 per cent per annum
- Traffic on Tongarra Road has grown in the order of 0.7 per cent per annum.

Table 3-3 Historical Traffic Volumes on Key Roads between 2000 and 2014

Stations	Roads	ADT/AADT ⁽¹⁾										
		2000	2002	2003	2004	2005	2006	2007	2008	2009	2011	2014 ⁽²⁾
07.035	Princes Highway, at Macquarie Rivulet Bridge	44,635	49,452	48,648	49,025	48,842	49,708	49,507	50,627	55,976		57,600
07.037	Princes Highway, South Of Illawarra Highway	37,869		41,413		41,595						46,200
07.038	Illawarra Highway, West of Princes Highway	13,355		13,773		14,553		13,805				14,700
07.040	Princes Highway, East of Tongarra Road	40,689		31,749		38,290		40,210		40,404	42,564	45,100
07.293	Tongarra Road, West of Terry Street			12,061		12,262		12,731		13,065		11,700
07.297	Tongarra Road, East of Illawarra Highway			11,562		12,322		11,969				11,400

Source: (1) Roads and Maritime, (2) 2014 AADT was estimated from 2014 traffic survey (ADT). For analysed roads 2008, 2009 and 2011 data represents ADT. The site 07.035 is the only permanent site and counts are available for each year. The remaining sites are coverage counts and counts were undertaken for short term at two years intervals.



Source: Roads and Maritime AADT, 2014 AADT was estimated from 2014 traffic survey (ADT).

Figure 3-5 Historical Traffic Growth between 2000 and 2014

3.6 CRASH DATA

The crash data analysis has been undertaken using crash data provided by Roads and Maritime for a five-year period from 2009 to 2014. Crash data was provided for A1 Princes Highway, Illawarra Road, and Tongara Road. Figure 3-6 shows crash locations on key roads within the study area.

Between 1 April 2009 and 31 March 2014, a total of 351 crashes have been reported on A1 Princes Highway, Illawarra Highway and Tongarra Road between Yallah and Oak Flats.

- 2 fatal crashes
- 149 injury-related crashes
- 200 non-casualty (tow-away) crashes

The four most common types of crashes account for 75 per cent of all reported accidents within the study area on State Roads. These were:

- Rear-end (191 crashes represent about 54 per cent)
- Right-through (26 crashes represent about 7 per cent)
- Off left on straight, hit object (24 crashes represent about 7 per cent)
- Adjacent – cross traffic (23 crashes represent about 7 per cent)

Table 3-4 shows the crash statistics recorded between 2009 and 2014.

Table 3-4 Summary of Crashes in Study Area by Type (2009 – 2014)

Crash Description	Crashes	%
Rear-End	191	54%
Right Through	26	7%
Off Left on Straight Hit Object	24	7%
Adjacent - Cross Traffic	23	7%
Lane Change	16	5%
Vehicle Accessing Road	11	3%
Adjacent - Right Near	9	3%
Adjacent - Other	8	2%
Off Right on Straight Hit Object	6	2%
Hit Stationary Vehicle	5	1%
Head-On	3	1%
Off Left on L/H Bend Hit Object	3	1%
Off Left on R/H Bend Hit Object	3	1%
Off Right on Straight	3	1%
Other	3	1%
Parallel Lanes; Turning	3	1%

Crash Description	Crashes	%
Hit Pedestrian	2	1%
Object on Road	2	1%
Off Right on L/H Bend Hit Object	2	1%
Off Right on R/H Bend Hit Object	2	1%
Out of Control on Bend	2	1%
Off Left on L/H Bend	1	0.3%
Off Left on R/H Bend	1	0.3%
Off Left on Straight	1	0.3%
Out of Control on Straight	1	0.3%
Total	351	100%

3.6.1 PRINCES HIGHWAY CRASHES

The majority of crashes were reported on the A1 Princes Highway, being 290 crashes or 83 per cent. Similarly, the four most common types of crashes account for over 80 per cent of the reported crashes on the A1 Princes Highway:

- Rear-end (164 crashes represent about 57 per cent)
- Intersection, adjacent approaches (29 crashes represent about 10 per cent)
- Off road on straight, hit object (23 crashes represent about 8 per cent)
- Opposing vehicles; turning (18 crashes represent about 6 per cent)

Table 3-5 shows the crash statistics on the A1 Princes Highway between 2009 and 2014.

Table 3-5 Summary of Crashes on Princes Highway by Type (2009 – 2014)

Crash Description	Crashes	%
Rear-end	164	57%
Intersection, adjacent approaches	29	10%
Off road on straight, hit object	23	8%
Opposing vehicles; turning	18	6%
Other crash type	15	5%
Lane change	14	5%
Off road on curve, hit object	7	2%
Vehicle leaving driveway	6	2%
Off road, on straight	4	1%
Hit pedestrian	3	1%
Head-on (not overtaking)	2	1%
Parallel lanes; turning	2	1%

Crash Description	Crashes	%
Off road, on curve	2	1%
Out of control on straight	1	0%
Total	290	100%

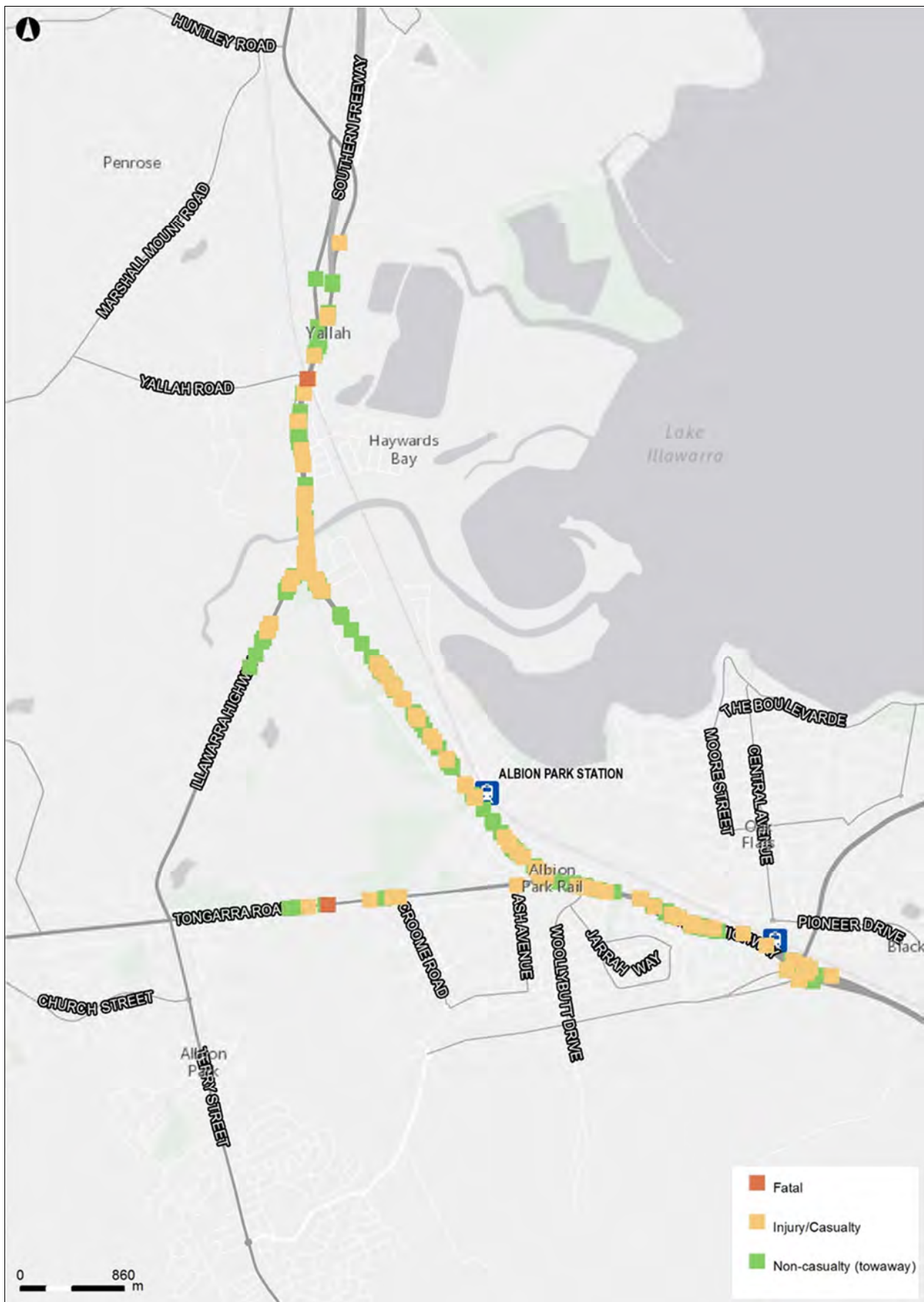
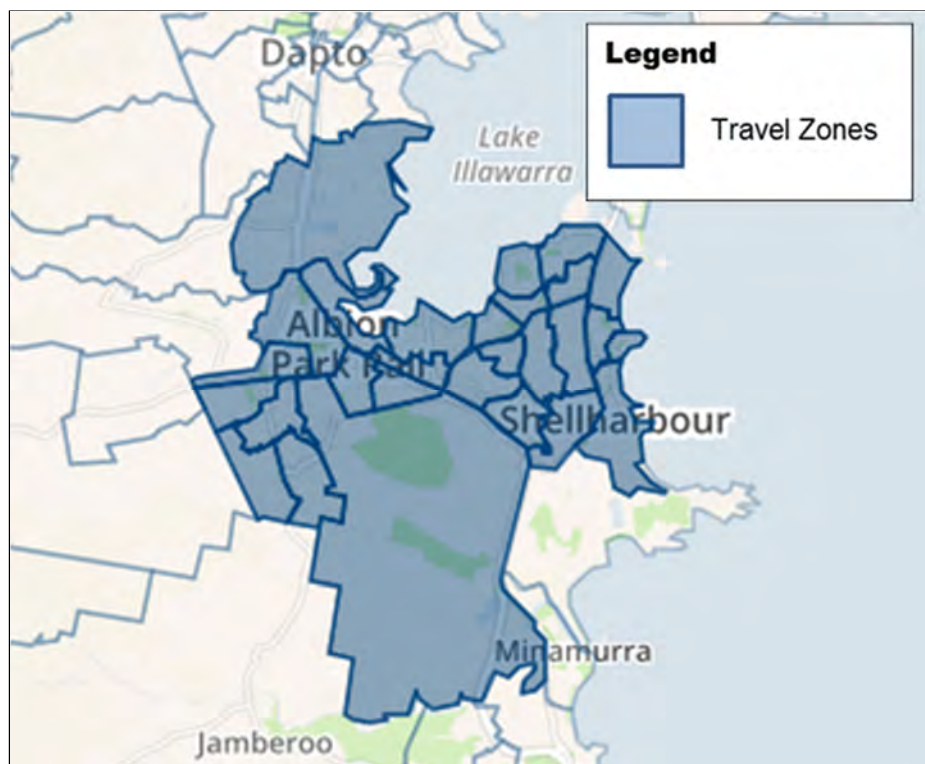


Figure 3-6 Distribution of Crashes on Key Roads between 2009 and 2014 (5 Years)

3.7 TRANSPORT MODE SHARE

The Bureau of Transport Statistics (BTS) provided journey to work (JTW) data for Albion Park, Albion Park Rail and Oak Flats. This data provides a comprehensive sample of commuter travel, which was collected during the 2011 Census. Work trip origin and destinations are coded to the 2011 travel zones. Figure 3-7 shows travel zones within the study catchment area. Table 3-6 shows existing mode share within the study catchment area.

In 2011 as per JTW data, about 25,000 employees travelled from the study catchment area to work. For outbound trip statistics, about 16 per cent of people did not travel to work or worked from home on the census day. The 2011 data showed around 79 per cent of work trips from the study catchment area were made by private car. Only 3 per cent travelled by public transport and 2 per cent walked. Similarly, in 2011 about 14,000 employees travelled to the study catchment area to work. For inbound trip statistics, it can be seen that private cars are still the dominant mode of travel to work, about 77 per cent. Only 1 per cent of employees travelled by public transport and 3 per cent walked.



Source: Bureau of Transport Statistics (JTW explorer)

Figure 3-7 Travel Zones for the Catchment Area

Table 3-6 Daily Work Trips and Mode Share for the Catchment Area

Travel Mode	Study Area as Home (Outbound trips)	Study Area as Home (Outbound trips) %	Study Area as Workplace (Inbound trips)	Study Area as Workplace (Inbound trips)%
Car Driver	18,584	73%	10,150	70%
Car Passenger	1,490	6%	988	7%
Public Transport	676	3%	226	1%
Walking	404	2%	378	3%
Worked at home/ Did not travel/ Not stated/Other Mode	4,162	16%	2,730	19%
Total	25,316	100%	14,472	100%

Note: Selected travel zones: 5806, 5807, 5801, 5803, 5804, 5835, 5831, 5830, 5833, 5832, 5850, 5851, 5847, 5848, 5845, 5846, 5849, 5852, 5840, 5842, 5813, 5812, 5841, 5839, 5838, 5810 represent the study area. Source: BTS

3.7.1 WORK TRIP DISTRIBUTION

The JTW data was further analysed to understand the distribution of work trips from the catchment area. For better interpretation, travel zones beyond the study area were grouped into six sectors in accordance with the external road network. Outbound work trip distribution made by private car (both as driver and as passenger) from the catchment area are summarised in Table 3-7 and Figure 3-8.

Inbound work trip distribution made by private car (both as driver and as passenger) to the catchment area are summarised in Table 3-8 and Figure 3-9.

The results indicate the following trip patterns:

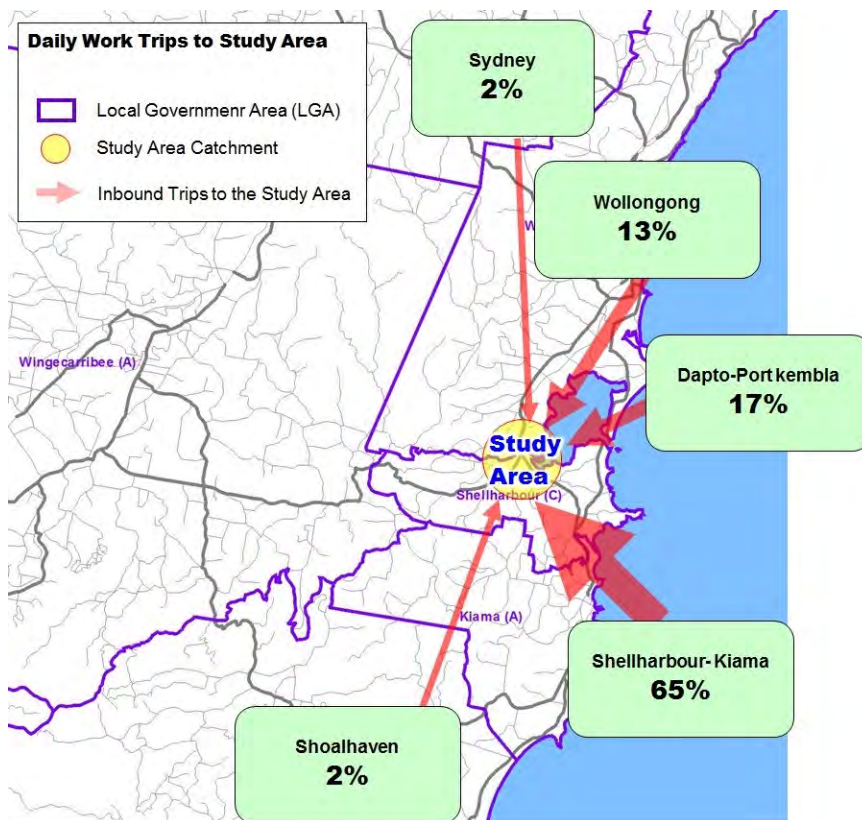
- Outbound work trip distribution indicates strong east-west and north-south movements between Albion Park and Shellharbour / Kiama / Port Kembla. About 33per cent of outbound work trips travelled to Shellharbour / Kiama. About 28 per cent travelled to Dapto / Port Kembla and about 23per cent travelled to Wollongong. About 9 per cent of outbound trips travelled toward north to Sydney.
- Inbound work trip distribution indicates strong east-west movements between the Albion Park and Shellharbour. About 65 per cent of inbound work trips travelled from Shellharbour / Kiama to the study area. About 17 per cent travelled from Dapto / Port Kembla and about 13 per cent travelled from Wollongong.

Table 3-7 Daily Car Work Trips from the Study Area (Outbound Direction)

Destination by Geographic Area	Number of car trips from APRB Catchment Area (Outbound)	%
Shellharbour / Kiama	6,673	33%
Dapto / Port Kembla	5,702	28%
Wollongong	4,581	23%
Hunter, Maitland, Newcastle and Lake Macquarie, Sydney	1,662	9%
Shoalhaven	228	1%
Others	1,228	6%
Total from Study Area	20,074	100%

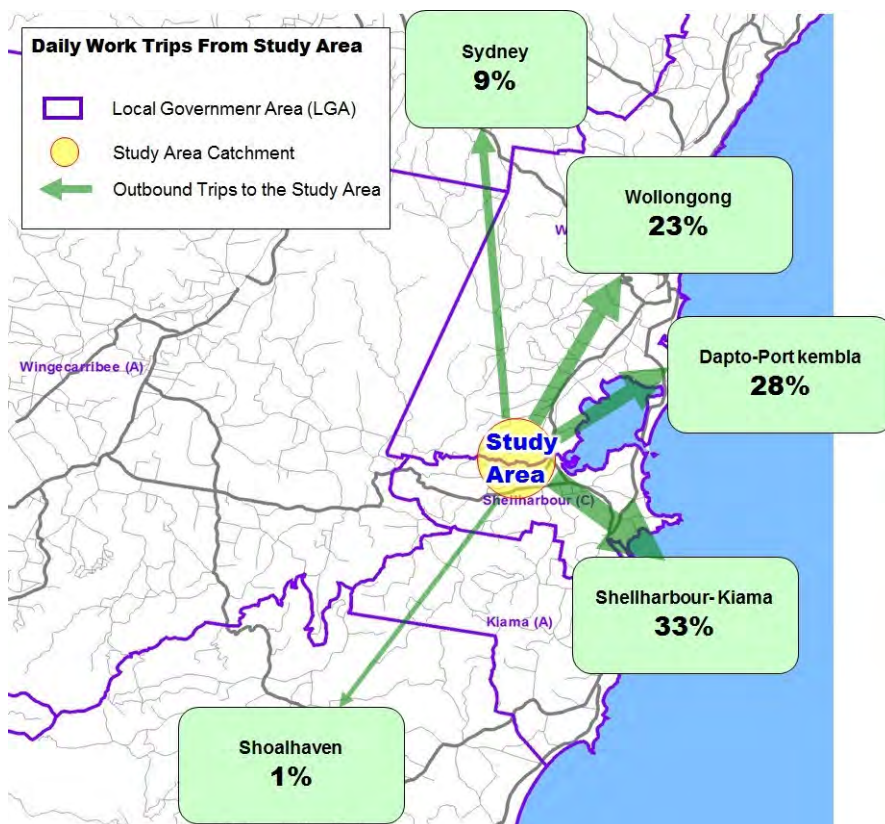
Table 3-8 Daily Car Work Trips to the Study Area (Inbound Direction)

Destination by Geographic Area	Number of car trips from APRB Catchment Area (Inbound)	%
Shellharbour / Kiama	7,297	65%
Dapto / Port Kembla	1,866	17%
Wollongong	1,394	13%
Shoalhaven	248	2%
Sydney, Central Coast, Newcastle	232	2%
Others	101	1%
Total to Study Area	11,138	100%



Note: Outbound trip to other destinations (about 6%) is not shown in the diagram.
Source BTS JTW 2011 Census

Figure 3-8 Daily Car Work Trips to the Study Area (Inbound Direction)



Note: Inbound trip to other destinations (about 1%) is not shown in the diagram.

Figure 3-9 Daily Car Work Trips from the Study Area (Outbound Direction)

3.8 PUBLIC TRANSPORT

3.8.1 RAIL SERVICES

The following rail services operate from the Albion Park Rail Railway Station and are shown in the inter-cities services map in Figure 3-10.

- Southern highlands line (i.e. green line)
- Southern Coast line (i.e. blue line).



Figure 3-10 Inter-cities Rail Services

3.8.2 SOUTHERN HIGHLANDS LINE

The Southern highlands line through Albion Park is a coach service provided by Sydney Trains through Barrawang and Robertson to Bowral through to Moss Vale/Bundanoon. Passengers can then transfer to connections to Goulburn to the south west or Campbelltown to the north. The service from Albion Park Rail is a pick-up service only heading towards Moss Vale/Bundanoon and drop off in the opposite direction towards Wollongong.

Table 3-9 summarises Southern Highlands line timetable. The travel time from Albion Park to Moss Vale is between 45 to 60 minutes in both directions. The single service per day to Bundanoon has an additional 20 minute travel time. The times vary throughout the day depending on the number of township stops.

Table 3-9 Southern Highlands Line Timetable

From	To	Departs		
		AM Peak	Midday	PM Peak
Albion Park	Bundanoon	-	-	5.50pm
	Moss Vale	7.15am	12 noon	5.50pm
Bundanoon	Albion Park	6.35am	-	-
Moss Vale		5.10am	2.30pm	6.20pm

Source: <http://www.transportnsw.info/>

3.8.3 SOUTH COAST LINE

The south coast line travels south from Sydney, through Wollongong and through Albion Park Station to Bomaderry. The train service to and from Albion Park travels to Kiama with transfer required to travel to Bomaderry.

Table 3-10 summarises South Coast line time table. The travel time from Albion Park to Central station in Sydney is approximately 2 hours and approximately 20 minutes to Wollongong. In the opposite direction, the travel time to Kiama is approximately 20 minutes with an additional 28 minutes to Bomaderry. However, the transfer time at Kiama can vary between 3 minutes and 2 hours due to the limited services between Kiama and Bomaderry.

Table 3-10 South Coast Line Timetable

From	To	Frequency		
		AM Peak	Midday	PM Peak
Albion Park	Wollongong and Sydney	50 – 70 minutes	50 – 70 minutes	50 – 70 minutes
Wollongong and Sydney	Albion Park	50 – 70 minutes	50 – 70 minutes	50 – 70 minutes

Source: <http://www.transportnsw.info/>

3.8.4 BUS SERVICES

The A1 Princes Highway is a strategic bus corridor, used by high-frequency bus services that connect major regional centres. A number of bus stops are located on both sides of the highway.

The following bus services operate in the local area:

- Route 76/77 – Shellharbour to Albion Park (20 to 40 minute frequency)
- Route 37/57 – Wollongong Loop (60 minute frequency)
- Route 43 – Port Kembla to Dapto (60 minute frequency)
- Route 31/33 – Wollongong to Horsley / Dapto (30 minute frequency).

Figure 3-11 and Figure 3-12 show extend of about bus services.

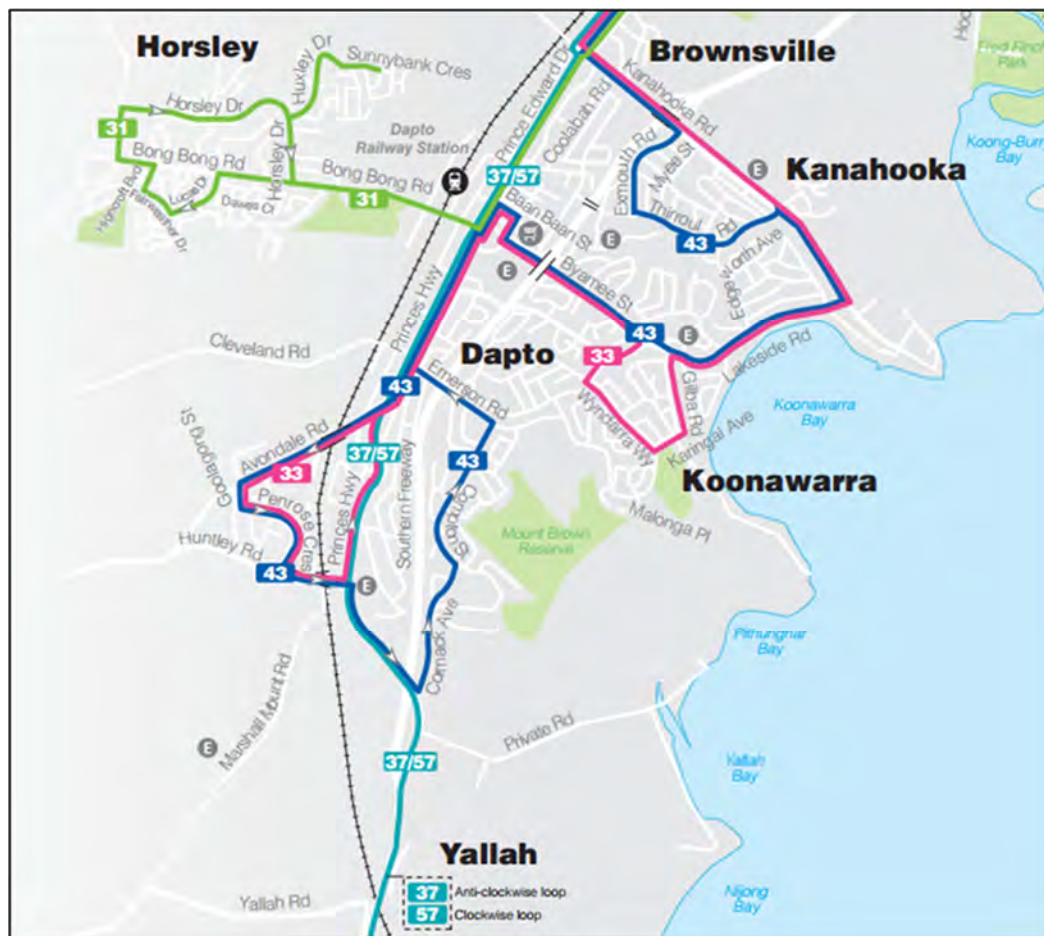


Figure 3-11 Bus Services – Dapto, Koonawarra, Yallah



Figure 3-12 Bus Services – Albion Park, Albion Park Rail, Oak Flats, Shellharbour

3.9 CYCLING AND PEDESTRIAN NETWORK

3.9.1 PEDESTRIAN

Existing and council planned key pedestrian network facilities on the study road network area are shown in Figure 3-13. For clarity, only key network paths are shown in this figure due to the large number of small road side paths within urban areas.

Pedestrian network and shared paths are provided within the residential subdivisions surrounding the Albion Park Rail. However between townships and residential subdivisions, the pedestrian network is limited.

3.9.2 CYCLING

Existing and council planned cyclist facilities on the study road network area are also shown in Figure 3-13.

The shared path and on-road cycle network is made up of a combination of on road and off road facilities. While there are some connections between town centres and residential subdivisions, there are still sections which require cyclists to travel on the road network, sharing the road with vehicles.

The Albion Park Rail bypass covers an area within the Wollongong City Council and Shellharbour City Council.

3.9.2.1 WOLLONGONG CITY COUNCIL CYCLE NETWORK

The City of Wollongong has developed a bike path for 2014 to 2018 to provide an integrated approach to improve cycling infrastructure. The key objectives of the bike plan include the following:

- Increase participation in all forms of cycling
- Develop a safe, connected network of bicycle routes
- Facilitate growth in bicycle tourism
- Undertake promotion and education campaigns that will improve cycling awareness, safety and proficiency.

3.9.2.2 SHELLHARBOUR CITY COUNCIL CYCLE NETWORK

Shellharbour Council has developed a cycle and shared path strategy (2010) to outline the future cycle and shared path networks in the local area. The aim of the strategy is to:

- Enhance cyclists' access to community facilities
- Improve connectivity within the city
- Complete the "missing links" in the current Shared Use Path Strategy.

Along the A1 Princes Highway, there are a number of sections of off-road shared paths, however there are currently gaps in the network for cyclists travelling between Albion Park Rail and Yallah. The strategy has nominated north / south links along the A1 Princes Highway through Albion Park Rail, connecting Oak Flats, through Albion Park Rail, through to Yallah.

An 2001 Shellharbour City Council Pedestrian Access and Mobility Plan was also reviewed however due to inconsistencies with the 2010 plan, this is considered superseded.

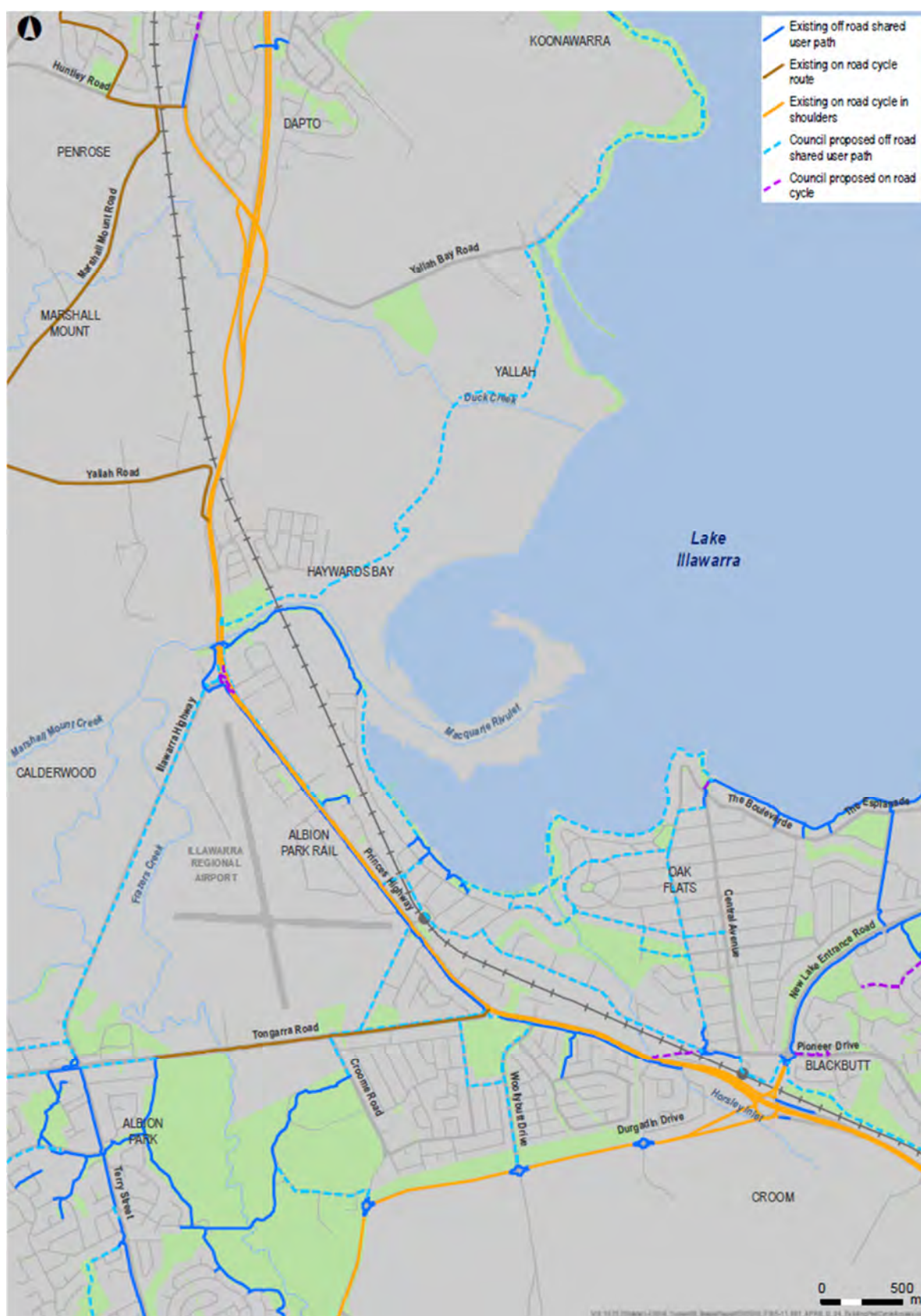


Figure 3-13 Existing Pedestrian and Cycling Network – Wollongong / Shellharbour
(Source: Bicycle info NSW, Wollongong City Council and Shellharbour City Council)

4 EXISTING ROAD NETWORK PERFORMANCE

This chapter establishes the existing transport network performance in the study area. Results from traffic surveys are summarised in this chapter. An assessment of existing network capacity has been undertaken indicating network deficiencies within the study area.

4.1 TRAFFIC SURVEY

A new traffic survey was undertaken by Roads and Maritime in April 2014 for the purpose of TRACKS windowed traffic model calibration and validation. At that time four types of data were collected including:

- Daily automatic traffic (mid-block) counts for a one week period
- Intersection movement counts during peak periods
- Intersection queue length surveys during peak periods
- Travel time surveys.

The April 2014 survey was undertaken by Roads and Maritime between 30 March and 5 April 2014. A supplementary traffic survey was undertaken by HCJV in July 2014. The July 2014 survey was undertaken on 17 July 2014.

Both surveys were undertaken by Austraffic.

Figure 4-4 shows traffic survey locations for the study area. The results of these surveys are included in the network performance analysis in subsequent sections.

4.1.1 MID-BLOCK COUNTS

Daily automatic traffic counts (ATC) were conducted for continuous seven-day period between 30 March and 5 March 2014 at following eight mid-block locations:

- Illawarra Highway, West of Terry Street
- Terry Street, South Tongarra Road
- Tongarra Road, East of Terry Street
- Illawarra Highway, South of Princes Highway
- Princes Highway, North of Illawarra Highway
- Princes Highway, South of Illawarra Highway
- Princes Highway, South of Tongarra Road
- New Lake Entrance Road, East of Pioneer Drive.

The ATC survey data was collected as per thirteen Austroads standard vehicle classes. Figure 4-1 shows mid-block survey locations.

4.1.1.1 Intersection Turning Movement Counts

Intersections turning movement counts were undertaken for 3 hours in the morning (7 am to 10 am) and 3 hours in the afternoon (4 pm to 7 pm). Two set of intersection counts were undertaken on 2 April and 17 July 2014 at the following locations: (refer to Figure 4-2 for intersections turning movements counts locations).

2 April 2014 Survey	17 July 2014 Survey
▪ Illawarra Highway and Princes Highway ▪ Tongarra Road, Illawarra Highway and Terry Street ▪ Tongarra Road and Princes Highway ▪ Princes Highway, East West Link and Lake Entrance Road ▪ East West Link and Woollybutt Drive ▪ East West Link and Croome Road ▪ Illawarra Highway and Calderwood Road ▪ Yallah Road and Princes Highway NB Onload ▪ Princes Highway and F6 NB Offload to Dapto ▪ Princes Highway and Cormack Avenue ▪ Terry Street and Russell Street.	▪ Yallah Road Overpass and On & Off Ramps ▪ Princes Highway and Mall Way ▪ Princes Highway and Airport Road ▪ Princes Highway and Creamery Road ▪ Princes Highway and Station Road ▪ Princes Highway and Woollybutt Drive ▪ Princes Highway and Colden Drive ▪ East West Link and Durgadin Drive ▪ Terry Street and Ashburton Drive ▪ Tongarra Road and Croome Road ▪ Tongarra Road and Station Road

4.1.2 INTERSECTION QUEUE LENGTH SURVEYS

The intersection queue length surveys were undertaken on 17 July 2014 for 3 hours in the morning (7 am to 10 am) and 3 hours in the afternoon (4 pm to 7 pm) at the following four (4) locations:

- A1 Princes Highway and Illawarra Highway
- A1 Princes Highway and Tongarra Road
- A1 Princes Highway and East West Link
- Illawarra Highway, Tongarra Road, and Terry Street.

Figure 4-3 shows intersection queue length survey locations.

4.1.3 TRAVEL SPEED AND TIME SURVEYS

Two sets of travel speed and time data was collected on 1 and 2 April and 17 July 2014 during morning and afternoon peak for the following four routes (each directional):

1 and 2 April:

- Route 1 –Illawarra Highway between Princes Highway and Terry Street and Church Street. Approximately 17 runs in each direction were undertaken for each period.
- Route 2 –Illawarra Highway between Princes Highway and Calderwood Road. Approximately 25 runs in each direction were undertaken for each period.

17 July 2014:

- Route 3 – Tongarra Road between Terry Street and Princes Highway. Approximately 16 runs in each direction were undertaken for each period.
- Route 4 – Princes Highway between Yallah Bay Road and New Lake Entrance Road. Approximately 12 runs in each direction were undertaken for each period.

Figure 4-4 shows travel time survey routes. The 2014 travel time data for all four routes were used in the TRACKS model validation.

The results of these surveys are included in the network performance analysis in subsequent sections.



Figure 4-1 Midblock Count Locations

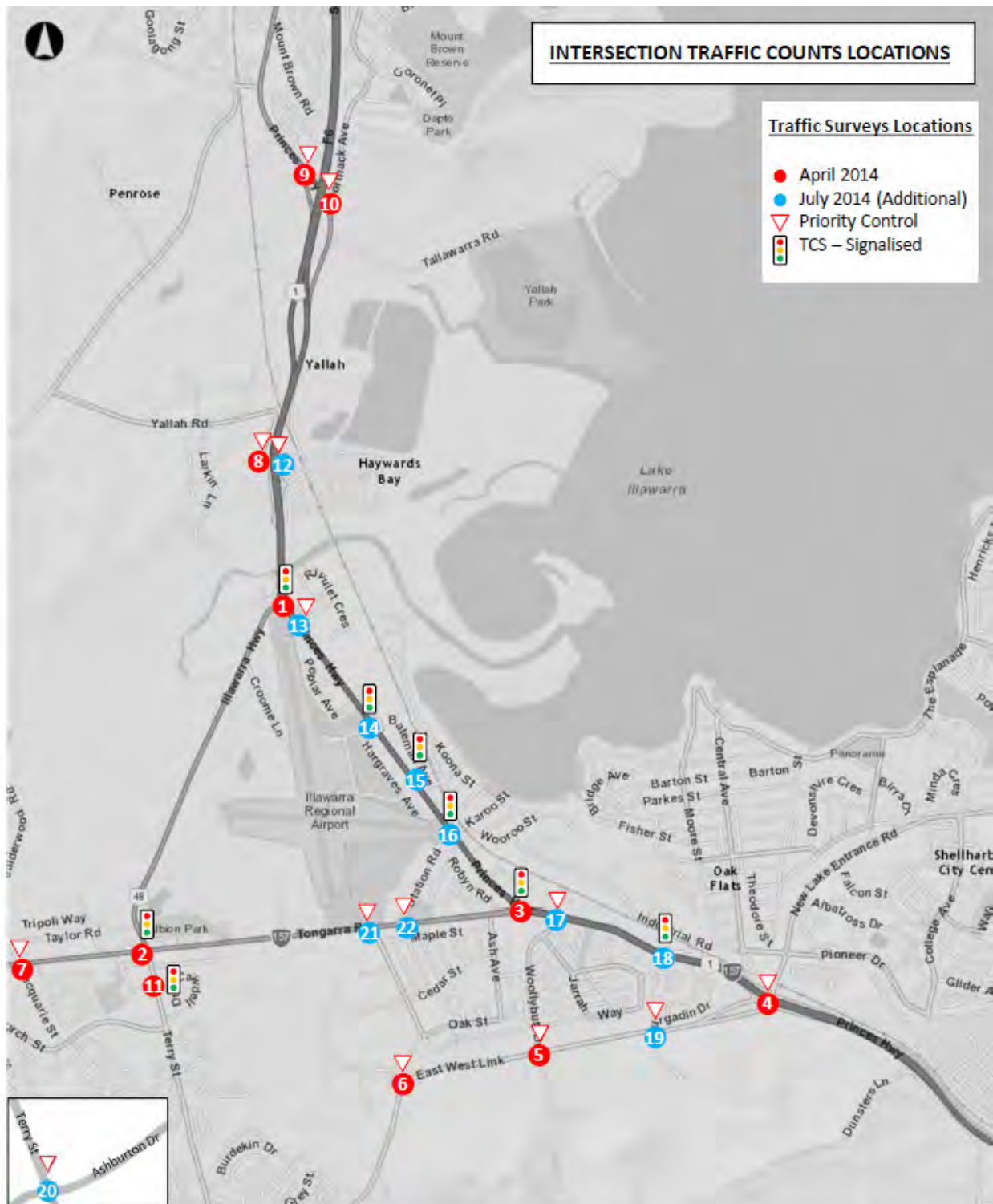


Figure 4-2 Intersection Movement Counts Locations

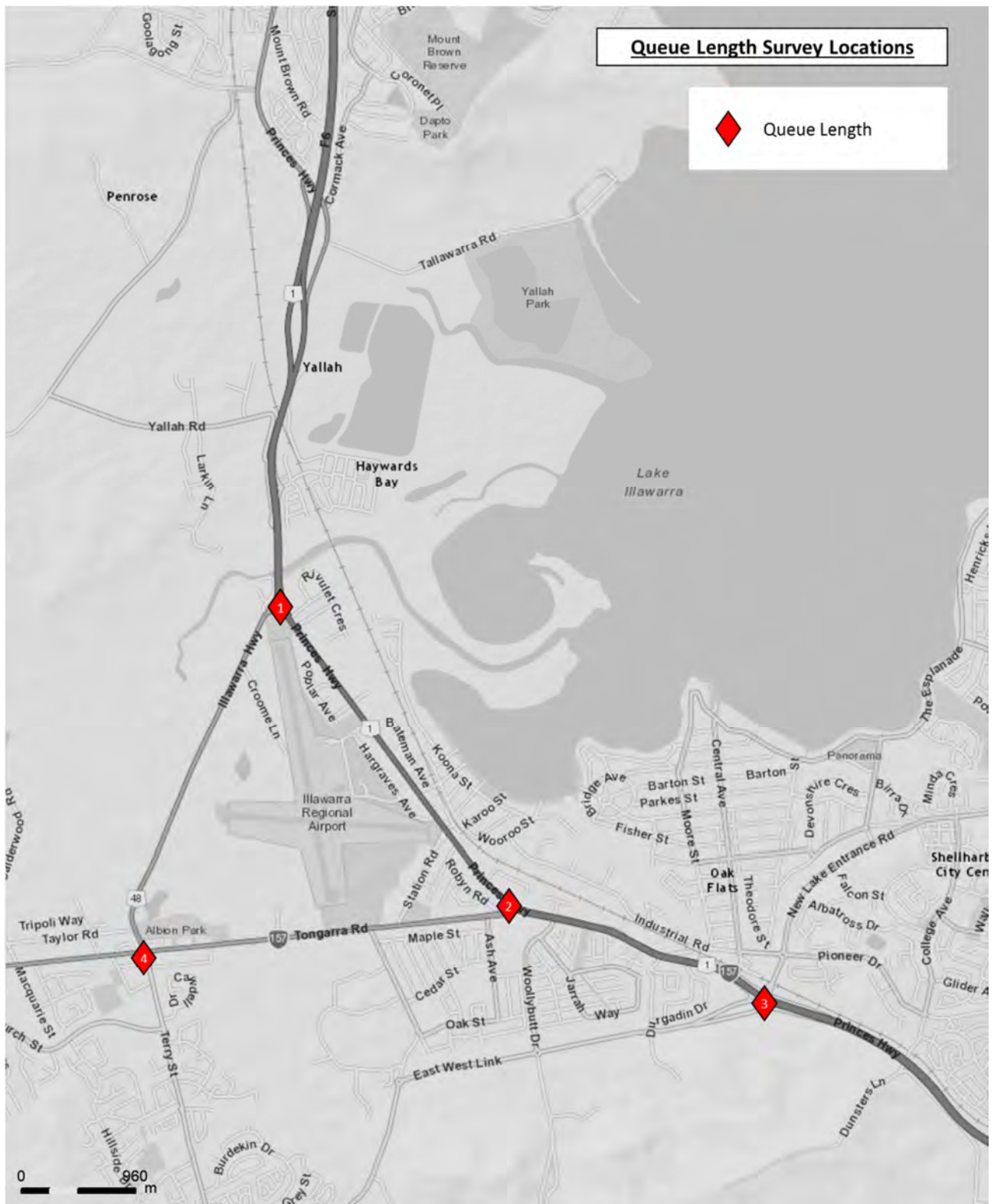


Figure 4-3 Intersection Queue Length Survey Locations

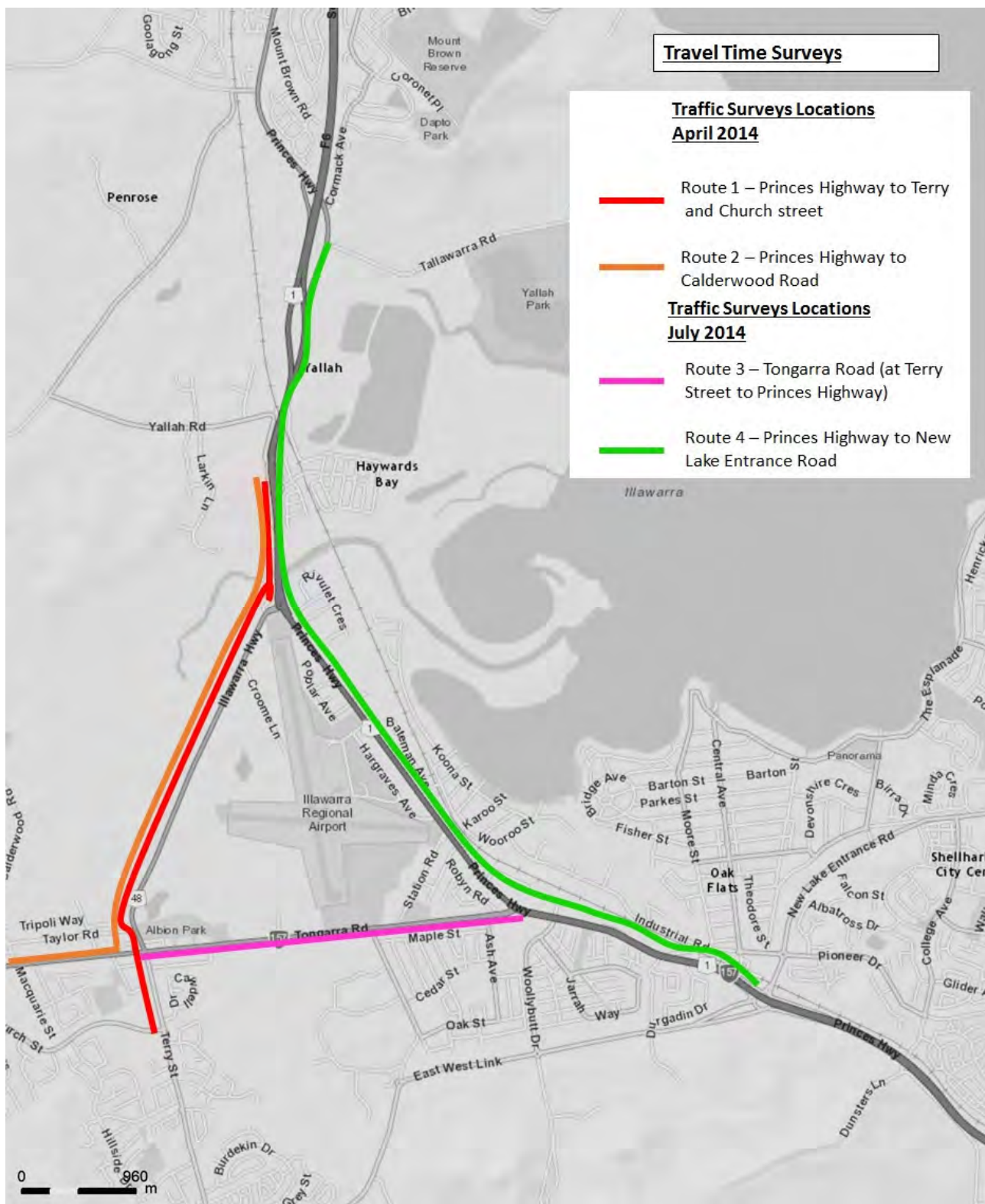


Figure 4-4 Travel Time Survey Routes

4.2 DAILY AND PEAK TRAFFIC VOLUMES

This section reports daily and peak hour traffic flows on key roads and intersections within the study area based on surveys undertaken in April and July 2014. The traffic results provides a context within which to consider likely traffic changes that would result from future traffic growth and proposed road upgrades attributable to the project. The results are based on survey data on key roads and intersections for the year 2014.

4.2.1 DAILY TRAFFIC VOLUMES

Daily traffic flow results are based seven-day traffic survey undertaken between 30 March and 5 April 2014. Table 4-11 summarises daily traffic flows on key roads within the study area for average daily (7 days) traffic (ADT). Table 4-1 also shows existing heavy vehicles and its proportion on surveyed roads. Figure 4-5 shows average daily traffic volumes (ADT) at key locations within the study area. The following points noted from existing 2014 traffic data in Table 4-1:

- Princes Highway at Macquarie Rivulet Bridge carried about 59,000 vehicles per day in a typical weekday condition. About 4,800 heavy vehicles were counted, being 9 per cent of daily traffic on the A1 Princes Highway
- Between Illawarra Highway and New Lake Entrance Road, the A1 Princes Highway carried in the order 46,000 to 47,000 vehicles per day.
- The Illawarra Highway south of Princes Highway carried about 15,000 vehicles per day on average day. Heavy vehicle proportion was found to be about 4 per cent of total daily traffic
- Tongarra Road and Illawarra Highway east of Terry Street carried about 12,000 vehicles per day on average day. Heavy vehicle proportion was found to be about 5 per cent of total daily traffic
- New Lake Entrance Road east of Pioneer Drive carried about 26,000 vehicles per day on average day. Heavy vehicle proportion was found to be about 3 per cent of total daily traffic.

Table 4-11 Daily Traffic Volumes (vehicles)

ID	Road	Location	Average Daily Traffic (ADT)	Heavy Vehicles	% Heavy Vehicles
1	Illawarra Highway	West of Terry Street	11,890	610	5%
2	Terry Street	South of Tongarra Road	12,590	450	4%
3	Tongarra Road	East of Terry Street	11,630	520	5%
4	Illawarra Highway	South of Princes Highway	15,000	570	4%
5	Princes Highway	At Macquarie Rivulet Bridge	58,730	4,800	9%
6	Princes Highway	South of Illawarra Highway	47,150	3,700	8%
7	Princes Highway	South of Tongarra Road	46,010	3,600	8%
8	New Lake Entrance Road	East Princes Highway	37,500	860	3%

Note: ADT- average daily (7 days) traffic
Source: Traffic survey April 2014.



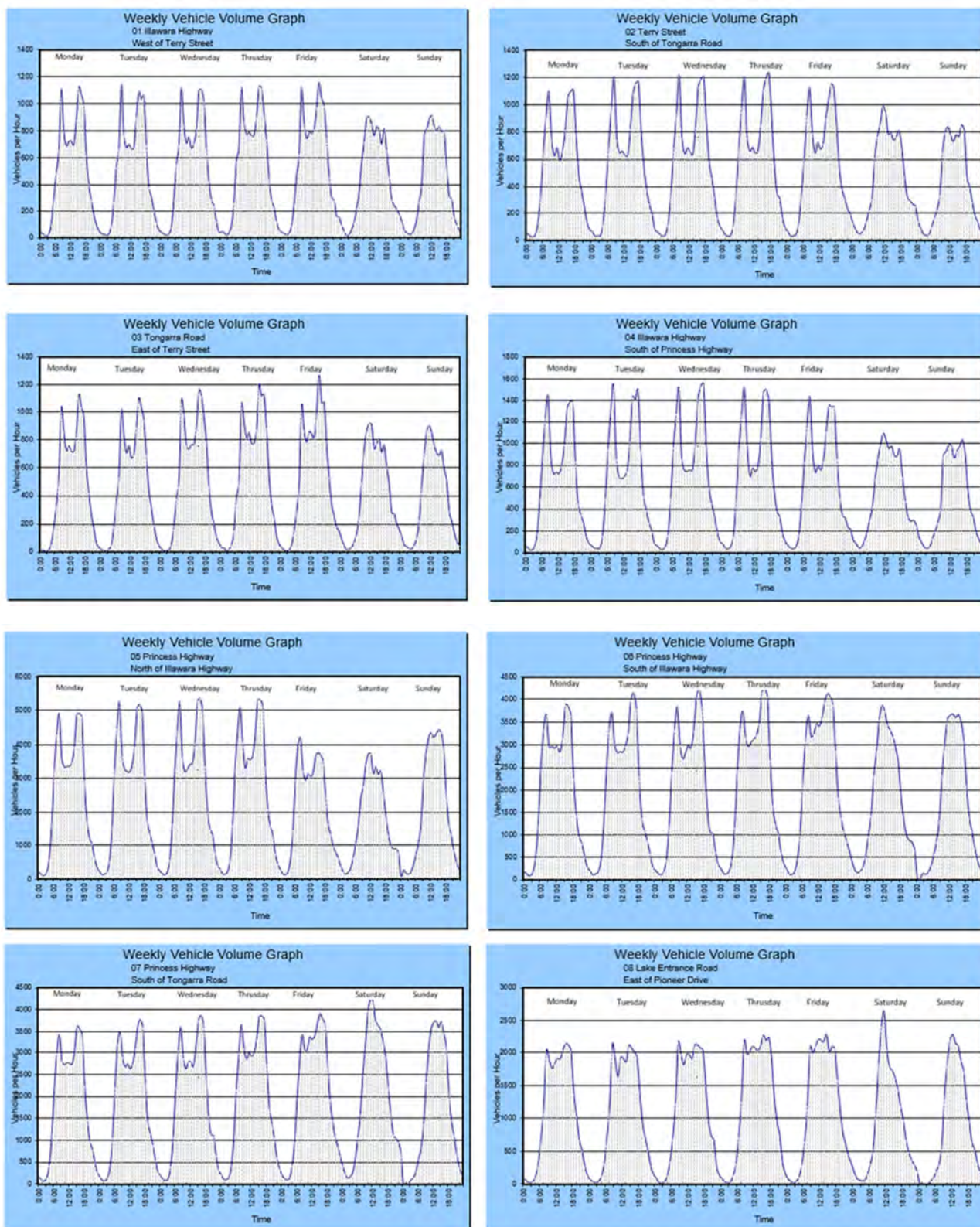
Note: ADT- average daily (7 days) traffic
Source: Traffic survey April 2014.

Figure 4-5 Average Daily Traffic (ADT) at Key Locations Traffic Variations

Figure 4-6 shows the variation of the traffic profiles over the one week survey period on Princes Highway, Illawarra Highway, Tongarra Road and New Lake Entrance Road. Traffic volumes at eight mid-block locations are presented on the charts. The results in Figure 4-6 show the general profile of traffic on Princes Highway, Illawarra Highway, Tongarra Road and New Lake Entrance Road:

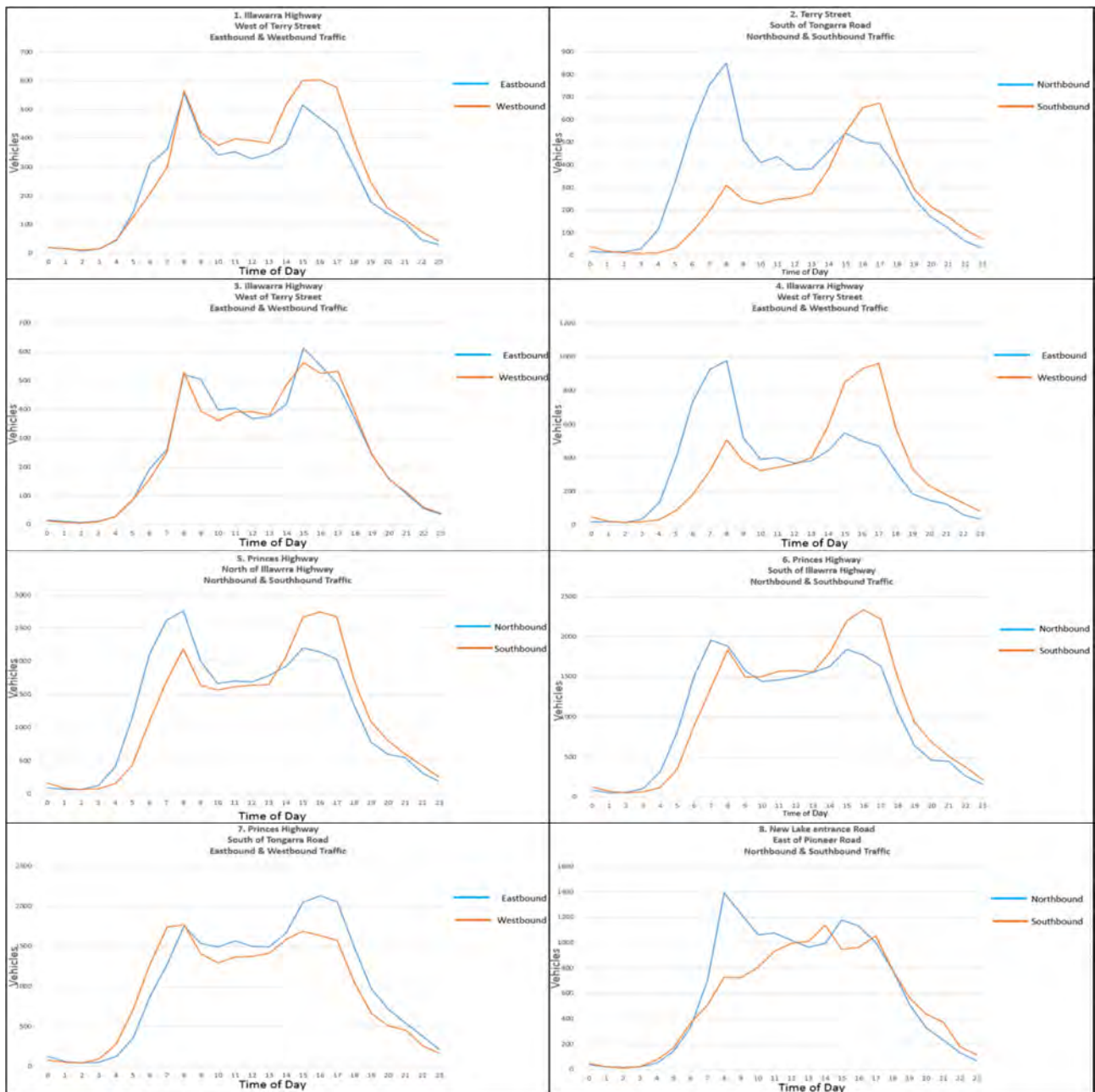
- Traffic is relatively constant across the weekdays from Monday to Friday
- Weekend traffic volumes are lower than weekday traffic volumes
- Traffic volumes during morning and afternoon peak periods across five weekdays show similar profiles.

Further data analysis was undertaken to identify 24 hours traffic variations across the entire day. The hourly traffic variations across the entire day are presented in Figure 4-7 for Princes Highway, Illawarra Highway, Tongarra Road and New Lake Entrance Road. On the A1 Princes Highway, morning peak period occurred between 8am and 9am. The afternoon peak period occurred between 4 pm and 5 pm.



Source: Traffic survey April 2014

Figure 4-6 Daily Traffic Profiles on Key Surveyed Roads



Source: Traffic survey April 2014

Figure 4-7 Hourly Traffic Profiles on Key Surveyed Roads

4.2.2 PEAK HOUR TRAFFIC

This section quantifies the peak hour traffic flows within the study area. Table 4-12 summarises morning and afternoon peak one hour traffic volumes for typical weekday on Princes Highway, Illawarra Highway, Tongarra Road and New Lake Entrance Road. Figure 4-8 and Figure 4-9 graphically show morning peak one hour (8 am to 9 am) and afternoon peak one hour (4 pm to 5 pm) traffic flows on these key roads and intersections within the study area. Generally, there is a strong peak traffic flow in the northbound direction on both Illawarra Highway and Princes Highway (refer to Figure 4-8) in the morning peak. Similarly, data suggests a strong peak traffic flow in the southbound direction on both Illawarra Highway and Princes Highway (refer to Figure 4-8) in the afternoon peak.

The following key points noted from existing traffic data in Table 4-12:

- During the morning peak, Princes Highway at Macquarie Rivulet Bridge (north of Illawarra Highway) carried about 2,800 vehicles per hour in the northbound direction and about 2,400 vehicles per hour in the southbound direction. During the afternoon peak, about 3,000 vehicles per hour were recorded in the southbound direction. About 2,300 vehicles per hour were recorded in the northbound direction
- Between Illawarra Highway and New Lake Entrance Road, Princes Highway carried lower order traffic volumes. In the morning peak, northbound direction carried traffic volumes in the order of 1,800 to 1,900 vehicles per hour. The southbound direction carried traffic volumes in the order of 1,700 to 1,900 vehicles per hour. The reverse traffic distribution was observed during the afternoon peak
- During morning peak Illawarra Highway south of Princes Highway carried about 1,000 vehicles per hour in northbound direction and about 500 vehicles per hour in southbound direction. The reverse traffic distribution was observed during the afternoon peak
- The directional traffic flows on the Tongarra Road were found similar during both morning and afternoon peaks in the order of 500 to 600 vehicles per hour.

Table 4-12 Peak Hour Traffic Volumes (vehicles)

ID	Road	Location	Typical Weekday Daily Traffic (Wednesday)					
			AM Peak 1 Hour			PM Peak 1 Hour		
			NB/EB	SB/WB	Total (2way)	NB/EB	SB/WB	Total (2 way)
1	Illawarra Highway	West of Terry Street	610	619	1,229	494	812	1,306
2	Terry Street	South of Tongarra Road	883	329	1,212	583	678	1,261
3	Tongarra Road	East of Terry Street	575	473	1,048	581	578	1,159
4	Illawarra Highway	South of Princes Highway	1,009	550	1,559	628	968	1,596
5	Princes Highway	At Macquarie Rivulet Bridge	2,858	2,409	5,267	2,322	3,031	5,353
6	Princes Highway	South of Illawarra Highway	1,905	1,915	3,820	1,798	2,167	3,965
7	Princes Highway	South of Tongarra Road	1,803	1,747	3,550	1,715	2,080	3,795
8	New Lake Entrance Road	East of Prince Highway	1,695	1,213	2,908	1,524	1,733	3,257

Source: Traffic survey April 2014

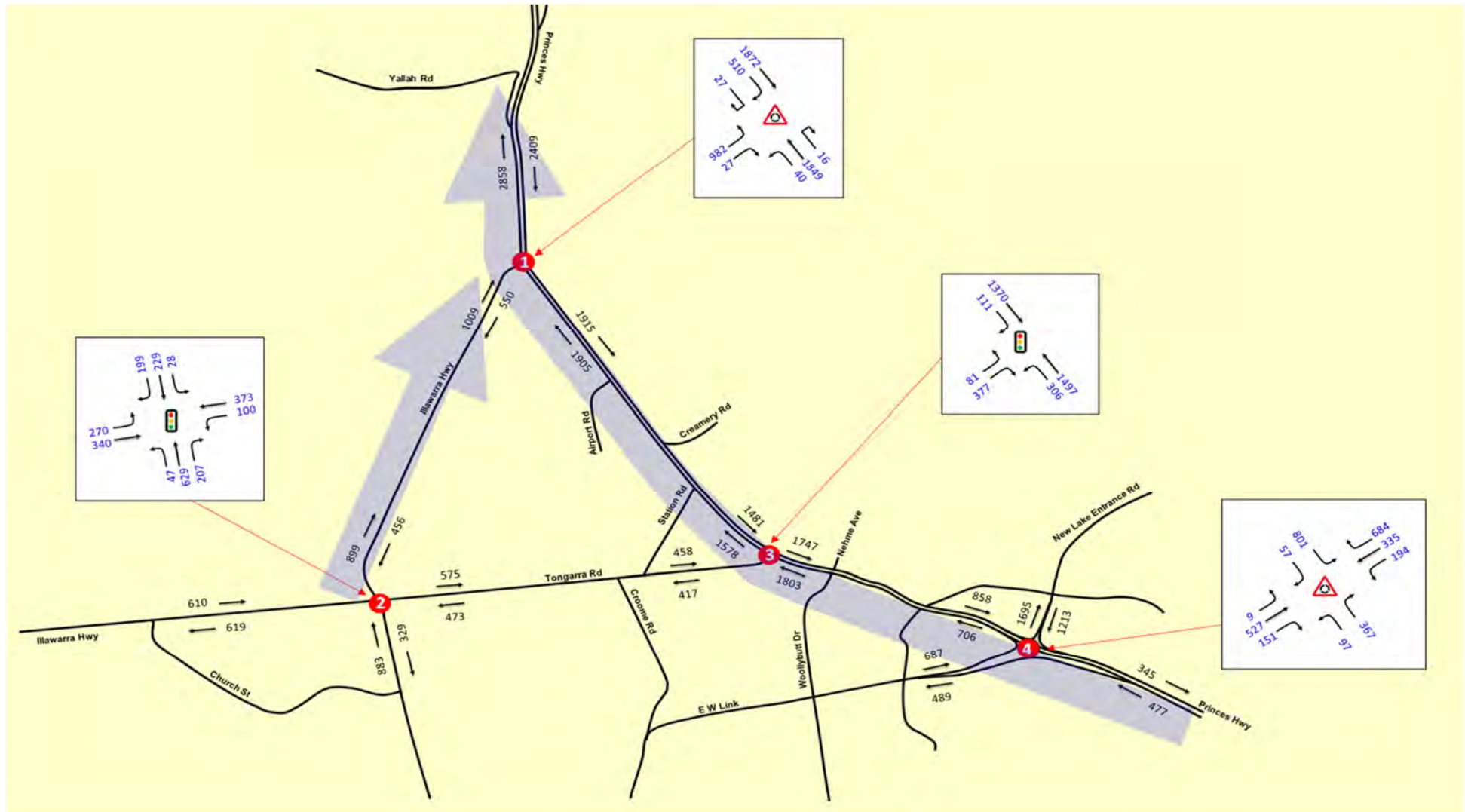


Figure 4-8 Existing 2014 AM Peak Traffic Flows (8-9am)

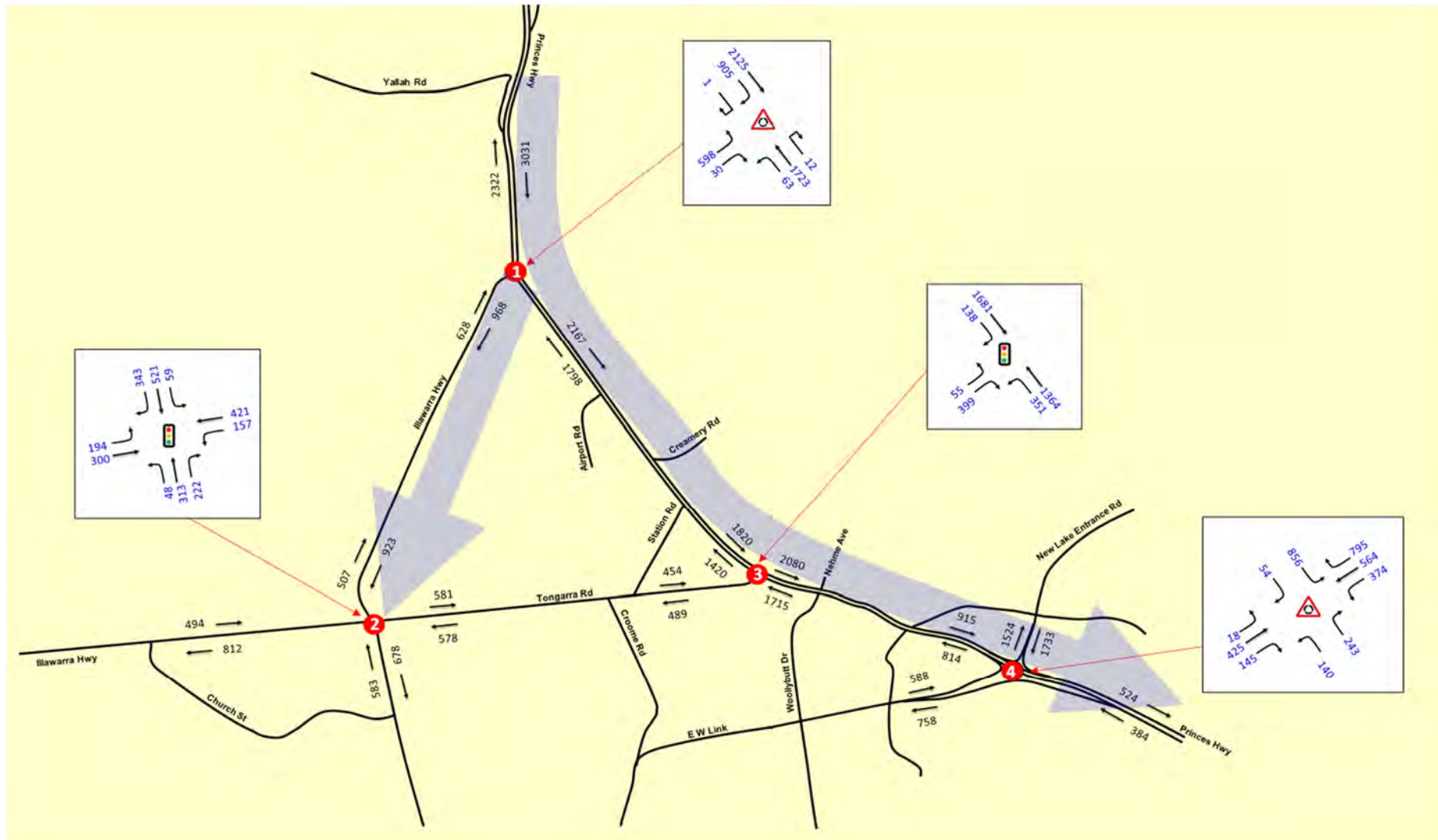


Figure 4-9 Existing 2014 PM Peak Traffic Flows (4-5pm)

4.3 NETWORK OPERATION

4.3.1 TRAVEL SPEED

The section of Princes Motorway and A1 Princes Highway between Yallah and Oak Flats is about 7.6 kilometres long with variations of speed limits along the route. There are three distinct sections as follows:

- Princes Motorway southern section to the Illawarra Highway intersection. This 2.5-kilometre section is a four-lane divided road
- Princes Highway/ Illawarra Highway intersection to Tongarra Road intersection (at Albion Park Rail). This 2.7-kilometre section is a four-lane largely undivided road
- Princes Highway/ Tongarra Road intersection to East West Link intersection (at Oak Flats). This 2.4-kilometre section is a four-lane divided road.

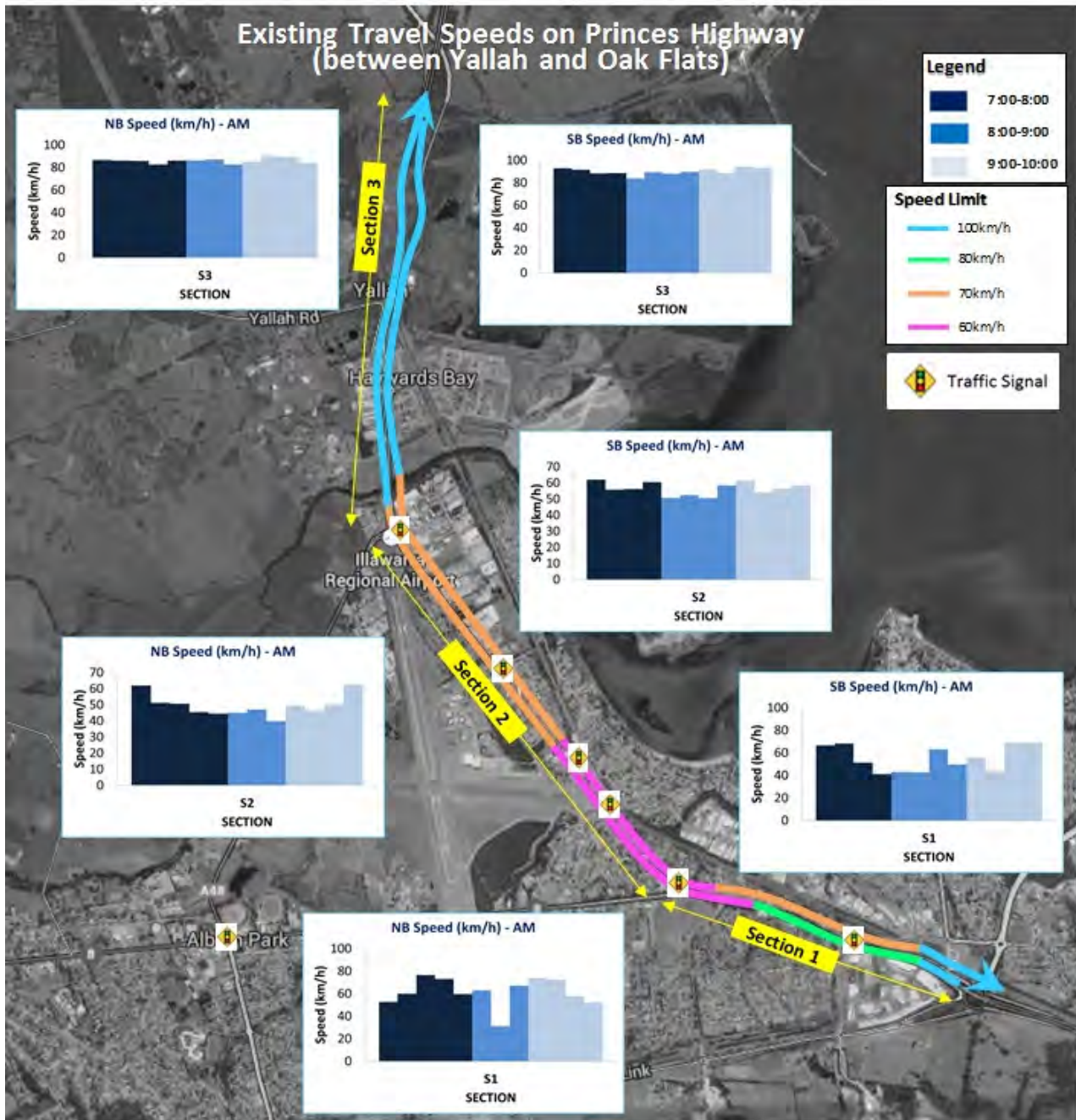
The Princes Motorway north of Yallah has speed limit of 100 km/h. Between Yallah and Illawarra Highway, the posted speed on the A1 Princes Highway continues as 100 km/h. Through the township of Albion Park Rail, the A1 Princes Highway passes through a lower speed urbanised area and six sets of traffic signals. Between Illawarra Highway and East West Link, the posted speed limit varies between 60 km/h and 80 km/h. The posted speed limit increases to 100 km/h south of East West Link.

Figure 4-10 and Figure 4-11 show speed limit variations on the Princes Highway between Yallah and Oak Flats for morning peak three hours (7 am to 10 am) and afternoon peak three hours (4 pm to 7 pm). Travel speed is reported for every 15 minute for both morning and afternoon peaks.

The following points are noted from existing travel speed analysis showed in Figure 4-10 and Figure 4-11:

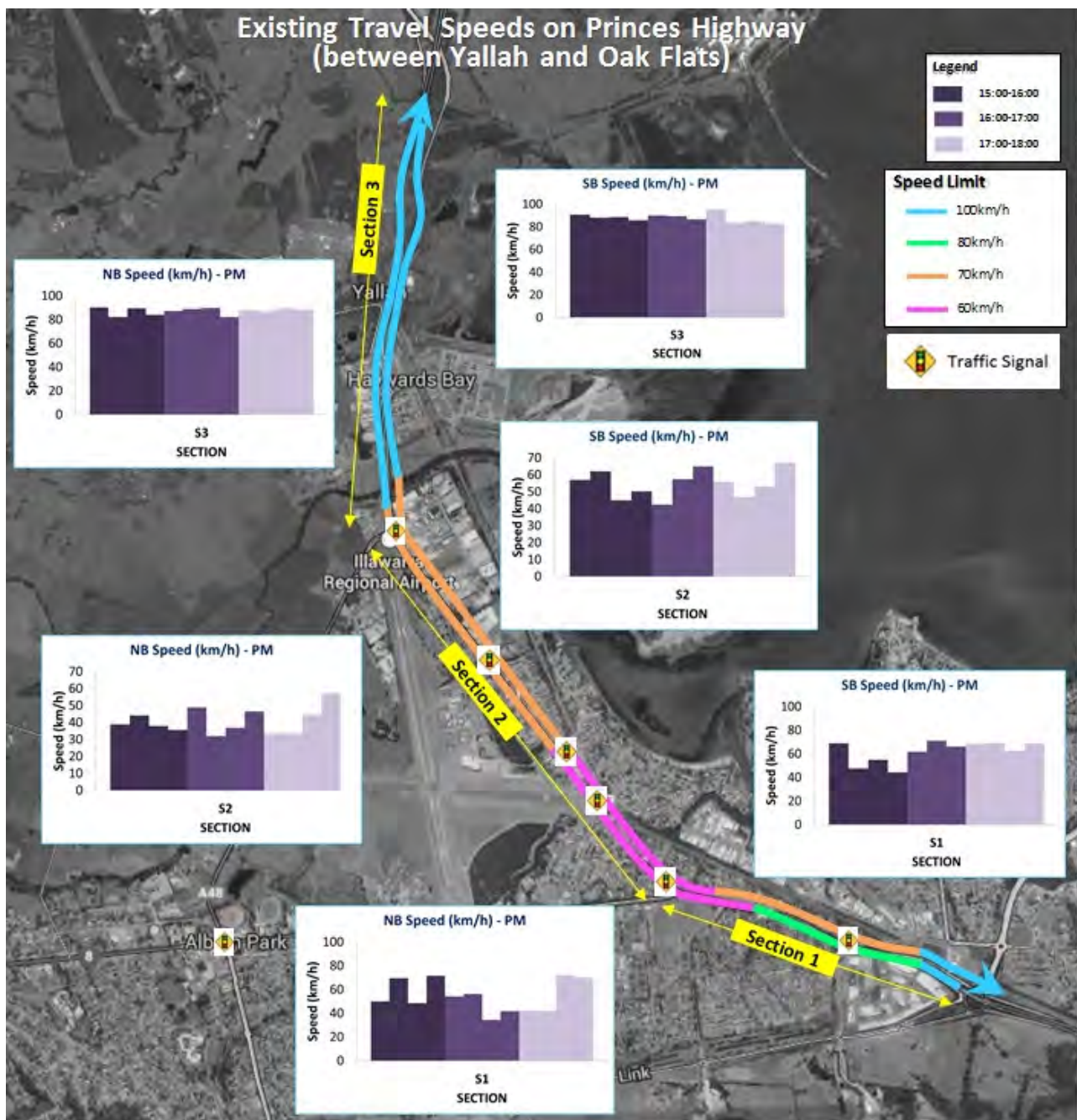
- Motorists travelling on the A1 Princes Highway between Yallah and Oak Flats experience a range of driving conditions and speed limits. The speed data indicates that generally motorists on the A1 Princes Highway travel about 10 km/h to 20 km/h lower than the posted speed limits in both morning and afternoon peak.
- In the morning peak travel speed on the A1 Princes Highway:
 - Between Yallah Bay Road and Illawarra Highway were about 80 km/h to 90 km/h in both northbound and southbound directions
 - Through the township of Albion Park Rail, travel speed reduces due to through and local traffic conflicts and six sets of traffic signals. Between Illawarra Highway and Tongarra Road, average travel speed reduces to 40 km/h to 60 km/h in the northbound direction and 50 km/h to 60 km/h in the southbound direction
 - Between Tongarra Road and New Lake Entrance Road, average travel speed in the northbound direction was found in the order of 55 km/h to 75 km/h. In the southbound direction, travel speed was observed in the order of 40 km/h to 70 km/h.
- In the afternoon peak travel speed on the A1 Princes Highway:
 - Between Yallah Bay Road and Illawarra Highway average travel speed in both northbound and southbound directions was found in the order of 80 km/h to 90 km/h

- Through the township of Albion Park Rail between Illawarra Highway and Tongarra Road travel speeds reduces to 30 km/h to 50 km/h in the northbound direction and 40 km/h to 60 km/h in the southbound direction
- Between Tongarra Road and New Lake Entrance Road, travel speeds in the northbound direction were found in the order of 40 km/h to 60 km/h. In the southbound direction, travel speeds were observed in the order of 60 km/h to 70 km/h.



Source: Traffic survey April 2014.

Figure 4-10 Existing Travel Speed on the Prince Highway – Morning Peak



Source: Traffic survey April 2014

Figure 4-11 Existing Travel Speed on the Prince Highway – Afternoon Peak

4.3.2 TRAVEL TIME

Table 4-13 summarises existing 2014 travel time on the A1 Princes Highway between Yallah and Oak Flats (7.6 kilometres section) for morning peak three hours (7 am to 10 am) and afternoon peak three hours (4 pm to 7 pm). For comparison purpose, the 2013 travel time on the Princes Highway is also shown in Table 4-3.

Currently (2014) it takes 9 minutes in the northbound morning peak and 7.5 minutes in the southbound afternoon peak to travel the 7.6 kilometre section of the existing Princes Highway between Yallah and Oak Flats. In 2013, observed travel time was 9.4 minutes in the northbound morning peak and 7.6 minutes in the southbound afternoon peak. The 2014 travel time was found to be consistent with the 2013 travel time on the Princes Highway section between Yallah and Oak Flats, albeit marginally lower by half a minute in the northbound direction. The southbound travel time in 2013 and 2014 was found similar.

Table 4-13 Existing 2014 Travel Time on Princes Highway between Yallah and Oak Flats

Travel Direction via Princes Highway	Distance (kilometres)	AM Peak (minutes)	
		2014 Observed	2013 ⁽¹⁾ Observed
Northbound (from Oak Flats to Yallah)	7.6 km	9.0	9.4
Travel Direction via Princes Highway	Distance (kilometres)	PM Peak (minutes)	
		2014 Observed	2013 Observed
Southbound (from Yallah to Oak Flats)	7.6 km	7.5	7.6

Note 1: The 2013 travel time data was sourced from Albion Park Rail Bypass, Road Corridor Review, December 2013. The minor difference in observed travel time between 2013 and 2014 could be due to the difference in survey period and number of runs. The 2013 survey was undertaken in March versus 2014 survey was undertaken in July. The number of runs undertaken in 2013 was 16 runs versus 12 runs in 2014. The 2013 survey was undertaken in Wednesday (13 March) and Thursday (14 March) for two hours morning and two hours afternoon. The 2014 survey was undertaken in Thursday (7 July) for three hours morning and three hours afternoon.

4.4 LEVEL OF SERVICE

In order to quantify the current road network deficiency within the study area, the existing traffic performance at key intersections was assessed for 2014 traffic conditions. The assessment involved the development and interrogation of purpose built traffic models using SIDRA intersection analysis software. The 2014 queue length survey data has been used to validate the existing operational performance of the assessed intersections.

Level of Service (LoS) is reported in accordance with the Roads and Maritime's guideline (Guide to Traffic Generating Developments, Issue 2.2, Roads and Maritime, October 2002). It recommends that for priority intersections such as a roundabout and sign controlled intersections, the Level of Service (LoS) value is determined by the critical movement with the highest delay whereas for a signalised intersection, LoS criteria are related to the average intersection delay measured in seconds per vehicle.

The performance of an intersection is measured by the intersection average delay per vehicle which in turns leads to a "Level of Service" measure for the intersection. These measures are showed in Table 4-14.

Table 4-14 Level of Service Criteria

Level of Service	Average Delay (seconds)	Traffic Implication
A	<14	Good operation
B	15-28	Good operation with acceptable delays and spare capacity
C	29-42	Satisfactory operation
D	43-56	Operating near capacity
E	57-70	Operating at capacity
F	>70	Extra capacity required

In general, the traffic capacity on the Princes Motorway / A1 Princes Highway between Yallah and Oak Flats is heavily constrained. The 2013 Albion Park Rail Bypass Road Corridor Review Report has identified traffic issues that impact the performance of the Princes Motorway /A1 Princes Highway including:

- 1** Southbound merge on the Princes Motorway. Southbound traffic merging from the Princes Highway (from Dapto) onto the Princes Motorway currently experiences congestion during afternoon peaks. Due to the volume of traffic merging onto the Princes Motorway the through traffic are slowed down by vehicles trying to merge at lower speeds.
- 2** Illawarra Highway intersection with the Princes Highway. This intersection is currently configured as a roundabout with traffic signal operation to manage traffic flows during the peak periods. The most congested movement is the northbound traffic on the Princes Highway that is in direct conflict with the traffic heading south on the Princes Highway turning right onto the Illawarra Highway.
- 3** Creamery Road. Creamery Road has a capacity problem for southbound traffic. This traffic has to wait for both traffic travelling north on the Princes Highway turning right into Creamery Road and those exiting Creamery Road. The southbound traffic experiences

congestion in the afternoon peak. Parking is located adjacent to the southbound travel lanes south of Creamery Road. These parking spaces are narrow and have a high level of turnover, so the friction arising from vehicles parking and merging with highway traffic results in reduced capacity of the adjacent travel lane on the highway.

- 4 Airport Road intersection. The Airport Road intersection has capacity concerns for northbound traffic travelling on the Princes Highway, which is stopped by traffic turning right into Airport Road travelling south on the Princes Highway as well as traffic exiting Airport Road. The intersection is close to capacity for one hour during the morning peak.

In addition to the above traffic capacity problems identified in the 2013 Corridor Review Report, four intersections with the Princes Highway was analysed for 2014 conditions including:

- Princes Highway / Illawarra Highway. This intersection is currently configured as a roundabout with traffic signal operation to manage traffic flows during the peak periods
- Princes Highway / Tongarra Road. This intersection is currently operates as a traffic signal controlled intersection
- Princes Highway / East West Link (Oak Flats interchange). This intersection is currently configured as a roundabout interchange.

The Terry Street / Tongarra Road has also been identified as a critical intersection and currently operates as a traffic signal controlled intersection.

Figure 4-12 shows location of above four intersections assessed for 2014 traffic conditions. Detailed Level of Service analysis for four intersections is described in the following Section. The existing 2014 traffic volumes showed in Figure 4-8 and Figure 4-9 formed the basis of morning peak and afternoon peak Level of Service analysis.



Figure 4-12 Key Intersections Analysed within the Study Area

4.4.1 PRINCES HIGHWAY / ILLAWARRA HIGHWAY INTERSECTION

The traffic movements at Princes Highway and Illawarra Highway intersection are controlled by a two-lane roundabout. Two southbound traffic lanes on the A1 Princes Highway provide uninterrupted progression through the intersection. (Refer to Figure 4-13).



Figure 4-13 Existing Princes Highway / Illawarra Highway Intersection

The roundabout has been upgraded with traffic signals installed to reduce delays and congestion in both morning and afternoon peak periods. The roundabout performance has significantly improved with traffic signal control, but it still experiences congestion in the morning peak. Currently heavy northbound traffic volumes on the A1 Princes Highway (about 1,700 to 1,800 vehicles per hour) compete with southbound right turning movement from Princes Highway to Illawarra Highway (about 500 to 900 vehicles per hour). The morning peak congestion is contributed by heavy northbound traffic on the A1 Princes Highway which is in direct conflict with the traffic heading south on the A1 Princes Highway turning right onto the Illawarra Highway. The southbound through traffic bypasses the roundabout and does not impact the operation of this roundabout.

The existing (2014) queue length data, undertaken every 15 minutes, indicated that queues varied at Princes Highway / Illawarra Highway intersection in both morning and afternoon peak period. The queue length data indicates longer queues on the A1 Princes Highway (southern approach) and Illawarra Highway (western approach) in both morning peak period (refer to Figure 4-14) and afternoon peak period (refer to Figure 4-15).

Queue Length Surveyed in 2014 at Illawarra Highway/Princes Highway intersection 8.15-8.30 AM



Source: Traffic survey July 2014

Figure 4-14 Existing AM Peak Queue Length at Princes Highway and Illawarra Highway Intersection

Queue Length Surveyed in 2014 at Illawarra Highway/Princes Highway intersection 4.15-4.30 PM



Source: Traffic survey July 2014

Figure 4-15 Existing PM Peak Queue Length at Princes Highway and Illawarra Highway Intersection

The SIDRA modelling undertaken for the A1 Princes Highway / Illawarra Highway roundabout indicates it operates with a Level of Service D (51 seconds delay) in the morning peak and a Level of Service B (28 seconds delay) in the afternoon peak.

Table 4-15 shows existing 2014 delay and Level of Service results by each approach at Princes Highway / Illawarra Highway roundabout for morning and afternoon peak periods.

Table 4-15 Existing 2014 Levels of Service of Princes Highway / Illawarra Highway intersection

ID	Intersection	Control Type	Approach	2014 Existing			
				AM Peak		PM Peak	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-1	Princes Highway and Illawarra Highway	Roundabout / Signals during peak periods	North-Princes Highway	19	B	17	B
			South-Princes Highway	51	D	28	B
			West-Illawarra Highway	60	C	19	B
			Overall Intersection	60	D	28	B

Note: For roundabout control, delay and LoS of worst performance movement is reported.
Source: SIDRA

4.4.2 PRINCES HIGHWAY / TONGARRA ROAD INTERSECTION

The A1 Princes Highway with Tongarra Road intersection currently operates as traffic signals (refer to Figure 4-16).



Figure 4-16 Existing Princes Highway / Tongarra Road Intersection, Albion Park Rail

The existing (2014) queue length data, undertaken every 15 minutes, indicated that queues varied at Princes Highway / Tongarra Road intersection in both morning and afternoon peak period. The queue length data indicates longer queues on the A1 Princes Highway (northern

approach) and Princes Highway (southern approach) in both morning peak period (refer to Figure 4-17) and afternoon peak period (refer to Figure 4-18).

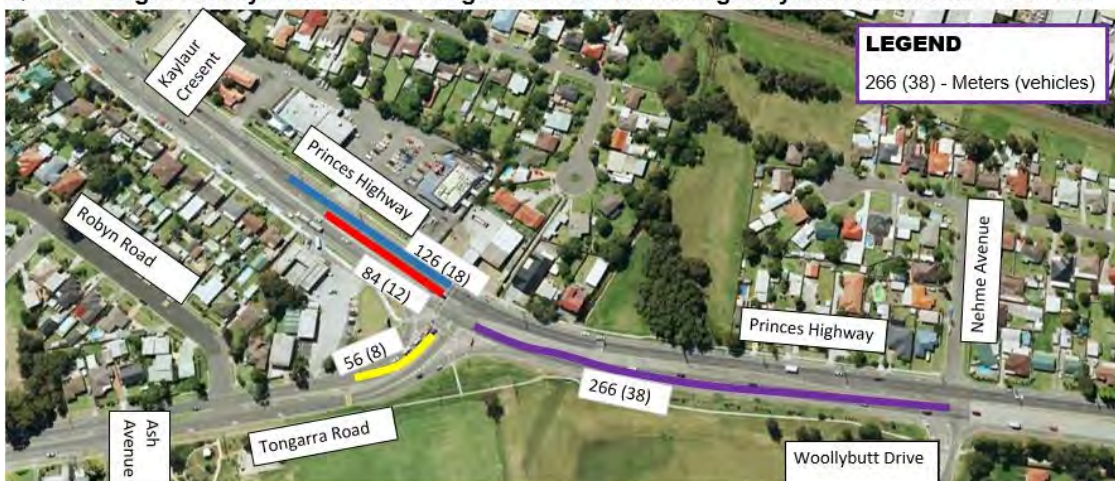
Queue Length Surveyed in 2014 at Tongarra Road/Princes Highway intersection 8.30-8.45AM



Source: Traffic survey July 2014

Figure 4-17 Existing AM Peak Queue Length at Princes Highway /Tongarra Road Intersection

Queue Length Surveyed in 2014 at Tongarra Road/Princes Highway intersection 4.30-4.45 PM



Source: Traffic survey July 2014

Figure 4-18 Existing PM Peak Queue Length at Princes Highway /Tongarra Road Intersection

SIDRA modelling undertaken for the A1 Princes Highway / Tongarra Road signalised intersection indicates it operates with a Level of Service B (20 to 25 seconds delay) for the entire intersection in both morning and afternoon peak periods. However, capacity problems are identified for the western approach (right turn movement out of Tongarra Road) and northern approach (right turn movement from Princes Highway to Tongarra Road). The observed Level of Service was found to be E (61 seconds delay) for the southbound right turn movement from Princes Highway to Tongarra Road (about 110 to 150 vehicles per hour) and Level of Service C/D (40 to 47 seconds delay) for southbound right turn movement out of Tongarra Road (about 370 and 400 vehicles per hour).

Table 4-16 shows existing 2014 delay and Level of Service results by each approach at Princes Highway / Tongarra Road signals for morning and afternoon peak periods.

Table 4-16 Existing 2014 Levels of Service of Princes Highway / Tongarra Road intersection

ID	Intersection	Control Type	Approach	2014 Existing			
				AM Peak		PM Peak	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-3	Princes Highway and Tongarra Road	Signals	South -Princes Highway	15	B	22	B
			West -Tongarra Road	40	C	47	D
			North -Princes Highway (through)	5	A	7	A
			North -Princes Highway (right-turn)	61	E	58	E
			Overall Intersection	25	B	20	B

Source: SIDRA.

4.4.3 PRINCES HIGHWAY / EAST WEST LINK (OAK FLATS INTERCHANGE)

The A1 Princes Highway/ East West Link/ New Lake Entrance Road (known as Oak Flats interchange) currently operates as full interchange with roundabout control (refer to Figure 4-19). The Oak Flats interchange provides entry and exit points for Albion Park motorists via East West Link and Shellharbour city centre motorists via New Lake Entrance Road respectively.

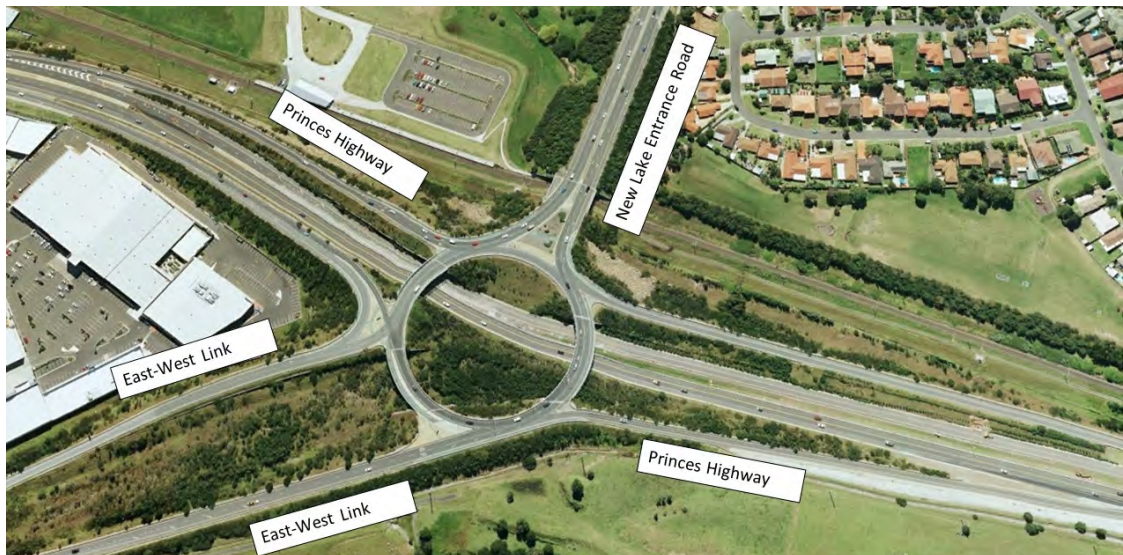


Figure 4-19 Existing Princes Highway/East West Link (Oak Flats) Interchange

The existing (2014) queue length data, undertaken every 15 minutes, indicated that queues varied at Oak Flats interchange in both morning and afternoon peak period. The queue length data indicates longer queues on the A1 Princes Highway on the northbound exit ramp in both morning and afternoon peak periods (refer to Figure 4-20 and Figure 4-21). Due to the roundabout operation, traffic on the New Lake Entrance Road receives priority over Princes Highway northbound exit ramp leading longer delay and queues to the Princes Highway northbound exit ramp traffic. The longer queue length on the northbound exit ramp (southern approach) is contributed by substantial northbound right turn volumes out of New Lake Entrance Road (about 800 and 900 vehicles per hour).

Queue Length Surveyed in 2014 at Princes Highway/East West Link/New Lake Entrance Road intersection 8.45-9.00 AM



Figure 4-20 Existing AM Peak Queue Length at the Oak Flats Interchange

Queue Length Surveyed in 2014 at Princes Highway/East West Link/New Lake Entrance Road intersection 4.00-4.15 PM



Source: Traffic survey July 2014

Figure 4-21 Existing PM Peak Queue Length at the Oak Flats Interchange

SIDRA modelling undertaken for Oak Flats interchange indicates it operates with a Level of Service E (60 seconds delay) in both morning and afternoon peak. The Level of Service E is observed for the Princes Highway northbound exit ramp traffic (about 400 to 470 vehicles per hour) primarily contributed by heavy northbound right turn volumes out of New Lake Entrance Road (about 800 and 900 vehicles per hour).

Table 4-17 shows existing 2014 delay and Level of Service results by each approach at Oak Flats interchange for morning and afternoon peak periods.

Table 4-17 Existing 2014 Levels of Service for Oak Flats Interchange

ID	Intersection	Control Type	Approach	2014 Existing			
				AM Peak		PM Peak	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-3	Princes Highway and East West Link (Oak Flats interchange)	Roundabout	North-Princes Highway southbound exit ramp	16	B	15	B
			East-New Lake Entrance Road	10	A	14	A
			South-Princes Highway northbound exit ramp	60	E	60	E
			West-East West Link	31	C	23	B
			Overall Intersection	60	E	60	E

4.4.4 TERRY STREET / TONGARRA ROAD INTERSECTION

Currently Terry Street / Tongarra Road is a signalised intersection (refer to Figure 4-22). Two of the four possible existing right turns are already banned, being the westbound right turn from Tongarra Road into Illawarra Highway (north), and the eastbound right turn from Tongarra Road into Terry Street (south). The two remaining permitted right turns from Terry Street (to the east and west) are associated with higher order traffic volumes and there are limited options to re-route these turning traffic flows in the existing road environment without impacting on local amenity by diverting traffic through existing local roads.



Figure 4-22 Existing Terry Street and Tongarra Road Intersection, Albion Park

The existing (2014) queue length data, undertaken every 15 minutes, indicated that queues varied at Terry Street/ Tongarra Road intersection in both morning and afternoon peak period. The queue length data indicates relatively longer queues on the Tongarra Road (eastern/western approaches) and Illawarra Highway (northern approach) in both morning and afternoon peak period (refer to Figure 4-23 and Figure 4-24).

Queue Length Surveyed in 2014 at Illawarra Highway/Terry Street/Tongarra Road intersection 8.45-9.00 AM



Figure 4-23 Existing AM Peak Queue Length at Tongarra Road and Terry Street, Albion Park

Queue Length Surveyed in 2014 at Illawarra Highway/Terry Street/Tongarra Road intersection 4.45-5.00 PM



Source: Traffic survey July 2014,

Figure 4-24 Existing PM Peak Queue Length at Tongarra Road and Terry Street, Albion Park

The SIDRA modelling undertaken for Terry Street / Tongarra Road signalised intersection indicates it operates with a Level of Service C (37 to 41 seconds delay) in both morning and afternoon peak periods. The model has revealed poor level service F (83 seconds delay) for Illawarra Highway (northern approach) and Level of Service E (59 seconds delay) for Tongarra Road (western approach). Table 4-7 shows existing 2014 delay and Level of Service results by each approach at Terry Street / Tongarra Road intersection for morning and afternoon peak periods.

Table 4-18 Existing 2014 Levels of Service for Terry Street / Tongarra Road Intersection

ID	Intersection	Control Type	Approach	2014 Existing			
				AM Peak		PM Peak	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-2	Terry Street /Tongarra Road and Illawarra Highway	Signal	North- Illawarra Highway	83	F	37	C
			East-Tongarra Road	22	B	43	D
			South-Terry Street	18	B	43	D
			West-Tongarra Road	59	E	23	B
			Overall Intersection	41	C	37	C

Source: SIDRA.

4.5 SUMMARY OF EXISTING NETWORK OPERATION

The standard of the A1 Princes Highway between Yallah and Oak Flats is inconsistent with the M1 Princes Motorway to the north and the A1 Princes Highway to the south. Between Sydney and Nowra there are free flowing traffic conditions and limited traffic signals. The only remaining traffic signals between Heathcote and Bomaderry are located at Albion Park Rail.

The section of Princes Motorway and A1 Princes Highway between Yallah and Oak Flats is about 7.6 kilometres long with variations of speed limits along the route. There are three distinct sections as follows:

- Princes Motorway southern section to the Illawarra Highway intersection. This 2.5-kilometre section is a four-lane divided road
- Princes Highway/ Illawarra Highway intersection to Tongarra Road intersection (at Albion Park Rail). This 2.7-kilometre section is a four-lane largely undivided road
- Princes Highway/ Tongarra Road intersection to East West Link intersection (at Oak Flats). This 2.4-kilometre section is a four-lane divided road.

The Princes Motorway through Yallah has a speed limit of 100 kilometres per hour. Through the township of Albion Park Rail, the A1 Princes Highway passes through low posted speed urbanised area and six sets of traffic signals. Between Yallah and Oak Flats the posted speed limit on the A1 Princes Highway varies between 60 kilometres per hour and 80 kilometres per hour. The posted speed limit increases to 100 kilometres per hour south of Oak Flats.

The A1 Princes Highway is a strategic bus corridor, used by high-frequency bus services that connect major regional centres. A number of bus stops are located on both sides of the highway.

In 2014 the A1 Princes Highway at Macquarie Rivulet Bridge carried about 59,000 vehicles per day in a typical weekday condition. Traffic volume has increased by an average of 600 vehicles per day per year between 2000 and 2014, which equates to an average growth rate of 1.4 per cent per annum over a 14 year period. Traffic flows on the A1 Princes Highway are highest during major holiday periods, including the school holidays at Christmas, Easter and Labour Day in October. The nearest counting site on the M1 Princes Motorway (Station 07.594, north of Northcliffe Drive) indicates 25 per cent more vehicles during the Christmas and New Year period in comparison to the typical weekday traffic condition. In 2014 about 4,800 Heavy vehicles was counted being 9 per cent of daily traffic on the A1 Princes Highway at Macquarie Rivulet Bridge.

A travel time and speed survey undertaken in 2013 and 2014 indicated that:

- The existing Princes Highway experiences traffic congestion and delays during weekday peak traffic periods
- Currently (2014) it takes 9 minutes in the northbound morning peak and 7.5 minutes in the southbound afternoon peak to travel the 7.6 kilometre section of the existing Princes Highway between Yallah and Oak Flats. In 2013, observed travel time was 9.4 minutes in the northbound morning peak and 7.6 minutes in the southbound afternoon peak. The 2014 travel time was found consistent with the 2013 travel time on the Princes Highway section between Yallah and Oak Flats, albeit marginally lower by half a minute in the northbound direction. The southbound travel time in 2013 and 2014 was found similar.

- Travel speed during the weekday peak period through the township of Albion Park Rail (between Illawarra Highway and Tongarra Road) reduces to 30-50 kilometres per hour in the northbound direction and 40-60 kilometres per hour in the southbound direction
- Motorists on the A1 Princes Highway between Yallah and Oak Flats travel about 10 to 20 kilometres per hour lower than the posted speed limits during peak times.

In general, the traffic capacity on the Princes Motorway / A1 Princes Highway between Yallah and Oak Flats is heavily constrained. The 2013 Albion Park Rail Bypass Road Corridor Review Report has identified traffic issues that impact the performance of the Princes Motorway /A1 Princes Highway including:

- Southbound merge on the Princes Motorway. Southbound traffic merging from the Princes Highway (from Dapto) onto the Princes Motorway currently experiences congestion during afternoon peaks. Due to the volume of traffic merging onto the Princes Motorway the through traffic are slowed down by vehicles trying to merge at lower speeds.
- Illawarra Highway intersection with the Princes Highway. This intersection is currently configured as a roundabout with traffic signal operation to manage traffic flows during the peak periods. The most congested movement is the northbound traffic on the Princes Highway that is in direct conflict with the traffic heading south on the Princes Highway turning right onto the Illawarra Highway.
- Creamery Road. Creamery Road has capacity problem for southbound traffic. This traffic has to wait for both traffic travelling north on the Princes Highway turning right into Creamery Road and those exiting Creamery Road. The southbound traffic experiences congestion in the afternoon peak. Parking is located adjacent to the southbound travel lanes south of Creamery Road. These parking spaces are narrow and have a high level of turnover, so the friction arising from vehicles parking and merging with highway traffic results in reduced capacity of the adjacent travel lane on the highway.
- Airport Road intersection. The Airport Road intersection has capacity concerns for northbound traffic travelling on the Princes Highway, which is stopped by traffic turning right into Airport Road travelling south on the Princes Highway as well as traffic exiting Airport Road. The intersection is close to capacity for one hour during the morning peak.

In addition to the above traffic capacity problems identified in the 2013 Corridor Review Report, four intersections with the Princes Highway were analysed for 2014 conditions including:

- Princes Highway / Illawarra Highway
- Princes Highway / Tongarra Road
- Princes Highway / East West Link (Oak Flats interchange)
- The Terry Street / Tongarra Road.

Modelling of the 2014 road network operation (using SIDRA software) for four intersections indicate that:

- Princes Highway / Illawarra Highway roundabout performance has improved significantly with traffic signal control, but it still experiences congestion in the morning peak. The morning peak congestion is contributed by heavy northbound traffic on the A1 Princes Highway which is in direct conflict with the traffic heading south on the A1 Princes Highway turning right onto the Illawarra Highway. The intersection operates with a Level of Service D (51 seconds delay) in the morning peak and a Level of Service B (28 seconds delay) in the afternoon peak.

- Princes Highway / Tongarra Road signalised intersection operates with a Level of Service B (20 to 25 seconds delay) in both morning and afternoon peak periods. The traffic model has revealed capacity problems for both western and northern approaches. Model showed Level of Service E (61 seconds delay) for the northern approach (Princes Highway) and Level of Service C/D (40 to 47 seconds delay) for the western approach (Tongarra Road).
- Oak Flats interchange operates with a Level of Service E (60 seconds delay) in both morning and afternoon peak. The level service E is predicted for the A1 Princes Highway northbound exit ramp traffic primarily contributed by heavy northbound right turn volumes out of New Lake Entrance Road. As a roundabout operation, traffic on the New Lake Entrance Road receives priority over Princes Highway northbound exit ramp leading longer delay and queues to Princes Highway northbound exit ramp traffic.
- Terry Street / Tongarra Road signalised intersection operates with a Level of Service C (37 to 41 seconds delay) in both morning and afternoon peak periods. Model showed poor Level of Service F (83 seconds delay) for Illawarra Highway (northern approach) and Level of Service E (59 seconds delay) for Tongarra Road (western approach).