Appendix A – Addendum Traffic and Transport Assessment Report

Albion Park Rail bypass

September 2017

NSW GOVERNMENT

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Hyder Cardno Joint Venture
ABN 58 300 126 782

ROADS AND MARITIME SERVICES

ALBION PARK RAIL BYPASS

Addendum Traffic and Transport Assessment Report

Author	Christos Apostolopoulos / Jackie Liang	
Checker	Tim Sullivan	
Approver	Austen Shoebotham	

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EXTERNAL REVISIONS

Revision	Date	Description	Prepared By	Approved By
01	17/02/17	First Draft issued to Roads and Maritime Services. Awaiting minor modelling updates and new figures.	KL/CS	TS
02	19/03/17	Second Draft to address Roads and Maritime Services comments.	KL/JL	TS
03	03/04/17	Final report to address Roads and Maritime Services comments.	KL/JL	TS
04	24/04/2017	Revised Draft for Roads and Maritime based on Design Change	KL/JL/CA	TS
05	10/05/2017	Final Draft to address Roads and Maritime comments based on Design Change	JL/CA	TS
06	29/05/2017	Draft for final Roads and Maritime sign-off	CA	TS
07	14/06/2017	Amended draft for Roads and Maritime sign off	CNB	TS
08	19/06/2017	Final	CNB	AS
09	31/08/2017	Revised final report to include additional commentary on option testing	CA/TS	TS
10	5/09/2017	Revised final report to address Roads and Maritime Services comments.	CA	

CONTENTS

GLOSSARY AND ACRONYMS

ADT	Average Daily Traffic
ATC	Daily automatic traffic counts for one week period
AM	Morning peak hour
Bypass	Albion Park Rail bypass
Base case	Road conditions without the project
DoS	Degree of Saturation
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
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
NTI	Northern Tie In
NSW	New South Wales
NZTA	New Zealand Transport Agency
OD	Origin-destination
PM	Afternoon peak hour
Project	Albion Park Rail bypass
Princes Motorway	M1 Princes Motorway
RB	Roundabout
Roads and Maritime	NSW Roads and Maritime Services (formerly NSW Roads and Traffic Authority, RTA)
RtS	Response to Submissions
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

TCS	Traffic Control Signals
TDG	Traffic Design Group
TfL	Transport for London
TMP	Traffic Management Plan
TRACKS	Strategic Traffic Modelling Software developed by TDG Gabites (TDG)
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

EXECUTIVE SUMMARY

Overview

This report has been prepared as an addendum to the *Albion Park Rail Bypass Environmental Impact Statement Technical Paper 1 – Traffic and Transport* (Hyder Cardno Joint Venture, 2015). This report details changes to the traffic and transport assessment and impacts of the proposed construction and operation of the Albion Park Rail bypass (the project).

Inputs for residential and employment forecasts have been refined based on further stakeholder liaison and analysis. These have been incorporated in the revised traffic modelling assessment.

The traffic modelling approach was enhanced in this assessment through the use of Aimsun traffic modelling software to supplement the TRACKS network modelling. The Aimsun model was widely used to inform the concept design development and to visually and empirically verify key traffic performance measures.

The Aimsun traffic model is generally used to assess the operational performance of the project in 2041. The 2041 modelling results are compared to the Environmental Impact Statement (EIS) assessment for the corresponding design year, however the comparison should be considered in the context of major changes since the EIS, including:

- Residential and employment forecasts in existing and proposed development areas
- Modelling software and methodology
- Design refinements to the Albion Park Rail bypass layout and future local network geometry.

Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARs) for the proposed alignment and interchanges were issued on 18 March 2015. This report demonstrates that all the Traffic and Transport components of the SEARS are met. In summary this includes:

- The road layout, infrastructure and integration with the existing road network
- Impacts and mitigation of effects on adjacent land uses
- The need to cater for future traffic growth with proof through traffic modelling
- Impacts and benefits to pedestrians and cyclists
- Details of construction traffic impacts.

All community and stakeholder inputs have been considered. Where relevant and within the project scope of works, this has resulted in design changes.

Design Refinements

Following the EIS exhibition and as a result of design review, Roads and Maritime has refined a number of aspects of the project as exhibited in the EIS to minimise project impacts where possible. The key design refinements proposed include:

- Reconfiguration of the interchange at Albion Park to minimise the impact on agricultural land and allow northbound traffic to exit the motorway onto Tongarra Road
- Reduction of the project footprint within agricultural land
- Refinements to intersection arrangements in response to further detailed traffic modelling.

Proposed design refinements related to this traffic assessment are detailed in Section 3 of this report.

Updated Traffic Modelling

The model used during the EIS assessment was a cordoned or 'windowed' sub area of the joint Wollongong Shellharbour Strategic Transport Model (WOLSH) model. This 'windowed model' was critically reviewed by Wollongong City Council during the display period of the EIS. Wollongong City Council made a submission identifying some discrepancies between the WOLSH model results and the figures reported in the EIS. A number of meetings were held with Wollongong City Council, Roads and Maritime Services (Roads and Maritime), Hyder Cardno Joint Venture (HCJV) and the NSW Department of Planning and Environment to resolve these issues.

To understand traffic dynamics at critical locations, Aimsun software has been used as an additional analysis and assessment tool to assist in the design development of the revised project scheme post-EIS. Aimsun has the ability to model congested networks where queues spillback between intersections and to assess complex interchange configurations. The Aimsun model has been used to model a 20 year design horizon in the year 2041.

Travel Time Savings

An assessment of travel time savings on the route between Yallah Bay Road and Oak Flats interchange was undertaken by analysing average peak hour travel time in the TRACKS models, both with and without the project. The justification for using TRACKS as the basis for travel time results is given in Section 4.3.

The project (2041) is likely to save at least 11 minutes 42 seconds northbound in the AM peak (64% reduction) and 10 minutes 36 seconds southbound in the PM Peak (61% reduction).

Construction Traffic Impacts

An assessment of the construction traffic impacts indicates that work fronts and truck routes have negligible changes in truck volumes when compared to the EIS (see Section 6).

1 INTRODUCTION

1.1 REPORT PURPOSE AND OBJECTIVES

This report forms an addendum to the Environmental Impact Statement (EIS) Technical Paper 1 – Traffic and transport (Hyder Cardno Joint Venture, 2015) and the EIS should be read in conjunction with that report.

This report sets out the traffic and transport implications of the proposed Albion Park Rail bypass and has been prepared to meet the following objectives:

- Document the changes to the traffic assessment since the EIS exhibition including revised modelling approach to address stakeholder comments
- Document the traffic and transport impacts associated with the project design refinements
- 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 BACKGROUND

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 an extension of the M1 Princes Motorway between Yallah and Oak Flats to bypass Albion Park Rail, also known as the Albion Park Rail bypass (the project). The bypass would 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 bypass 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.

The previous report, Environmental Impact Statement Technical Paper 1 – Traffic and Transport, October 2015 (Hyder Cardno Joint Venture, 2015) details potential traffic and transport impacts of the project. The EIS (including the Traffic and Transport technical paper) was placed on public exhibition for community and stakeholder comment between October and November 2015. The EIS details the key construction and operational impacts including issues associated with traffic and transport, biodiversity, socio-economic, flooding and noise.

1.3 THE PROJECT

Roads and Maritime propose to build a 9.8 kilometre extension of the Princes Motorway between Yallah and Oak Flats that would bypass Albion Park Rail (Figure 1-1). Key features of the project as detailed in the EIS include:

- Two lanes in each direction divided by a median (with space to upgrade to three lanes in each direction in future)
- Three interchanges provided at Yallah, Albion Park and Oak Flats would connect the local road network with the motorway
- 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 Rail Line
- Improved pedestrian and cycle connections
- Improvements to directly impacted sporting facilities at the Croom Regional Sporting Complex and changes to the southern access.

Following the EIS display, a review of the design was undertaken in response to feedback following stakeholder consultation. As a result of this review process, Roads and Maritime has refined a number of aspects of the project as exhibited in the EIS. Design refinements have been developed to minimise EIS impacts where possible and in response to:

- Consultation with the community during the EIS exhibition period
- Submissions received during and following the EIS exhibition period
- Landowner discussions during property acquisition and adjustment since exhibition of the environmental impact statement
- Continued development of the concept design.

Figure 1-1 Albion Park Rail Bypass Project - Complete Alignment

The key design refinements and delivery approach proposed include:

- Reconfiguration of the central interchange (referred to as the Albion Park interchange in this report) to minimise the impact on agricultural land and allow northbound traffic to exit the motorway onto Tongarra Road
- Reduction in the project footprint within agricultural land
- Some refinements to intersection arrangements in response to further detailed traffic modelling.

The Response to Submissions report (RtS) documents issues and responses raised during the exhibition of the EIS. This report forms an appendix to the RtS and details the additional traffic engineering investigations undertaken as part of this process. The traffic investigations post EIS exhibition are detailed in Section 4.

1.4 TRAFFIC INVESTIGATIONS POST EIS

Previously, the Hyder Cardno Joint Venture (HCJV) Traffic team, assisted by sub consultants Traffic Design Group (TDG), utilised strategic traffic modelling software – TRACKS – to model major traffic assignment and flows associated with the project. The combination of the TRACKS strategic model with SIDRA intersection modelling software formed the basis of the traffic analysis for the EIS investigations.

To supplement the previous traffic modelling and assess the network operation and performance of the project network at a micro-simulation level, HCJV has developed an Aimsun micro-simulation model to cover the key road corridors within the project study area. The Aimsun model coverage is shown in Figure 1-2.

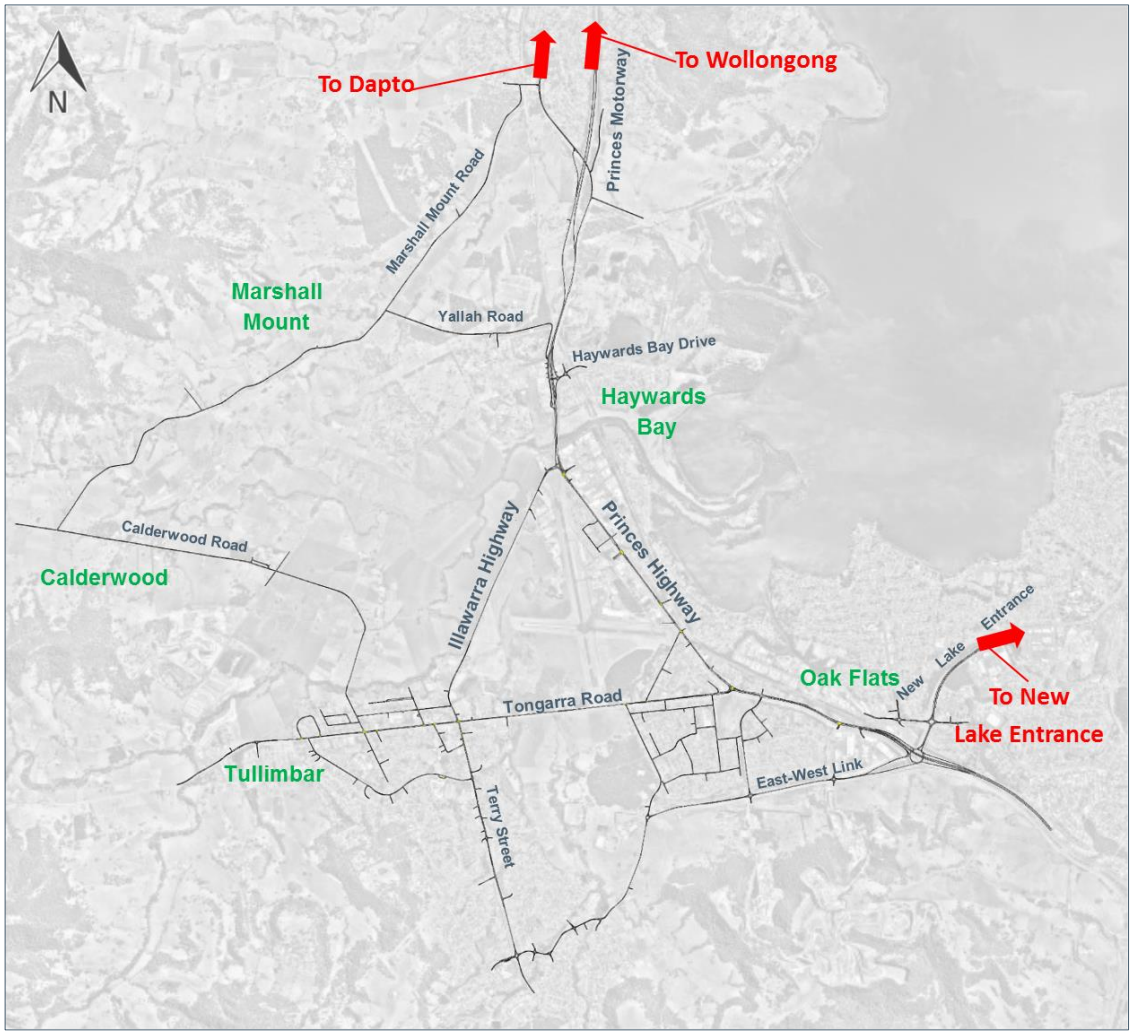


Figure 1-2 Albion Park Rail bypass Aimsun Model Study Area

The Aimsun model was developed in accordance with Traffic Modelling Guidelines (Roads and Maritime Services, 2013), and assessed by the Roads and Maritime Services Network Operations team and Road Network Analysis Section in Parramatta. The model was approved as 'fit for purpose' for future year option testing. This is the industry benchmark, indicating a robust base model that reliably simulates real world traffic conditions.

1.5 STRUCTURE OF THE REPORT

This traffic and transport assessment of the proposed construction and operation phases of the project contains the following nine sections.

- ***Section 1 Introduction*** provides an overview of the project, and study objectives.
- ***Section 2 Assessment Requirements*** provides the traffic and transport requirements identified in SEARS.
- ***Section 3 Design Refinement Assessment*** describes the design changes made since the EIS exhibition.
- ***Section 4 Updated Traffic Modelling*** describes the development of the microsimulation traffic model and the key differences in modelling approach since the EIS. This section also describes the revision to land use assumptions and stakeholder input for the model.
- ***Section 5: Comparison of Operational Impacts 2041, EIS versus the Project*** compares the operational performance results between ultimate year 2041 and the EIS.
- ***Section 6 Assessment of Construction* Impacts** summarises traffic impacts during the construction phase of the project.
- ***Section 7 Mitigation Measures*** summarises the proposed environmental management measures of the project.
- ***Section 8 Reference*** includes various traffic reports, guidelines used in this assessment.

1.6 RELEVANT GUIDELINES

The following guidelines and standards were used for the traffic and transport assessment:

- Roads and Maritime (2013), Traffic Modelling Guidelines, NSW Roads and Maritime Services.
- Transportation Research Board (2010), Highway Capacity Manual, Transport Research Board.
- Roads and Maritime (2002), Guide to Traffic Generating Developments, Issue 2.2, NSW Roads and Maritime Services.
- AustRoads (2003), Guide to Traffic Engineering Practice, AustRoads
- AustRoads (2013a), Guide to Traffic Management Part 3 – Traffic Studies Analysis, AustRoads.
- AustRoads (2013b), Guide to Traffic Management Part 6 – Intersections-Interchanges-Crossings, Austroads.
- Roads and Maritime (2009), Supplements Guide To Road Design Part 4C – Interchanges, NSW Roads and Maritime Services.
- New Zealand Transport Agency (2014), Transport Model Development Guidelines, New Zealand Transport Agency.

2 ASSESSMENT REQUIREMENTS

2.1 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Secretary's Environmental Assessment Requirements (SEARs) for the proposed project alignment and interchanges were issued on 18 March 2015. This informed the traffic and transport assessment requirements, identifying and addressing potential traffic impacts associated with the project.

In addition to assessments carried out in the EIS, Table 2-1 shows SEARs for traffic and transport matters and identifies where they are addressed in this report. The project objectives, justification and a full list of SEARs for the project is provided in the EIS.

Table 2-1 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 3
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 3 ▪ Section 4.4
▪ 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;	▪ Section 5

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 *Aviation Impact Assessment, Albion Park Rail bypass* *(REHBEIN Airport Consulting, 2015) and associated addendum report (REHBEIN Airport Consulting, (2017) Albion Park Rail Bypass – Design Refinements Addendum Aviation Assessment*.
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	▪ Section 6

3 DESIGN REFINEMENTS

This section summarises the key changes to the project following the EIS public exhibition in 2015. Section 3.1 to Section 3.8 describe the key design refinements related to this traffic assessment. The traffic and transport implications of these are further discussed in Section 5.

Table 3-1 Summary of Design Refinements

ID number	Location	Design refinement	Justification	Project Phase
Main				
1	North of Frazers Creek	Reduction in project footprint on agricultural land	Changes to the project boundary are proposed to reduce the impact on agricultural land through a modified alignment. Due to the impact of the proposed route on dairy lands located to the north of Albion Park and in response to submissions received, the design was reviewed to determine whether the layout could be improved to minimise the impacts of the route on these lands. This design refinement is one of several design refinements that facilitate a reduction in the impact on dairy land.	Construction and operation
2	Illawarra Highway near Yallah	Changed layout of interchange Albion Park A changed layout arrangement, including: a. Realignment of the northbound entry ramp connecting the Illawarra Highway to the motorway b. The northbound exit ramp relocated to Tongarra Road c. Realignment of the southbound exit ramp to the Illawarra Highway d. An additional intersection to allow connection of the northbound exit ramp to Tongarra Road.	Changes to the interchange at Albion Park are proposed to reduce the impact to agricultural land, and to eliminate a potential traffic weaving issue that could occur under the environmental impact statement design arrangement.	Construction and operation
3	Croom Regional Sporting Complex	a. Revised layout of Croom Regional Sporting complex	Detailed design of the Croom Regional Sporting Complex has progressed since the display of the environmental impact statement, with improved functionality.	Construction and operation
Minor				

ID number	Location	Design refinement	Justification	Project Phase
4	Eastern side of Princes Highway, north of Yallah Bay Road	Removal of ancillary site AS02	This ancillary site was identified for use during construction of the project north of Albion Park Rail but has since been removed based on discussions held with the landowner in this location.	Construction
5	Western side of alignment	Removal of ancillary site AS05	This ancillary site was identified for use during construction of the project north of Albion Park Rail but has since been removed based on discussions held with the landowner in this location. The removal of this site would also reduce impacts on agricultural lands.	Construction
6	Various locations along the motorway alignment	Modifications to culverts	Culverts are required along the alignment to mitigate impacts to surface water flows as a result of construction of the motorway. Changes to the design require modifications to the proposed culverts to ensure the required flooding targets are achieved.	Construction and operation
7	Illawarra Highway between Albion Park and the north of Albion Park Rail	Relocation of shared cycle and pedestrian path between Albion Park and the north of Albion Park Rail	Roads and Maritime carried out a review of the project to minimise impact on the dairy enterprise. The proposed shared path between Terry Street and the Illawarra Highway (shown in Figure 5-16 of the environmental impact statement) has been relocated to the eastern side of the motorway to reduce the project footprint and co-locate the shared path with the existing Illawarra Highway and access for utilities. Measures to reduce the potential risk of interaction between farm operations and users of the shared path will be investigated during detailed design such as cycle friendly cattle crossings.	Operation
8	Between the southbound exit ramp and northbound entry ramp of the interchange at Albion Park	Removal of ancillary site AS07	The site has been reviewed and due to its small size and lack of access, was determined to be undesirable for use as an ancillary site.	Construction

ID number	Location	Design refinement	Justification	Project Phase
9	Croom Reserve north, east of Princes Highway	Adjusted project footprint for dedicated haul routes. The project footprint has been widened to ensure enough space for dedicated haul routes for trucks and equipment during construction of the project.	The environmental impact statement project boundary was not sufficient to allow for dedicated haulage routes Dedicated haul routes would improve road safety during construction of the project as trucks and equipment would not need to use public roads to access construction sites.	Construction
10	East of Croome Road (and Swansea Farmhouse)	Expanded ancillary site AS13. A large parcel of land would be included in the project footprint for use as an ancillary site.	Additional land is potentially available at this location following the exhibition of the environmental impact statement. This would allow a much larger area for construction activities with minimal additional environmental impacts.	Construction
11	Southern extent of Woollybutt Drive	Adjusted project footprint. The project footprint would be extended to include the required work.	The inclusion of this area within the project boundary ensures it is clearly identified as work required for the project, and would form part of the project approval.	Construction
12	Holcim Quarry access at new East-west Link	Addition of traffic lights. Traffic lights would be provided on the new East West Link at the access point to the Holcim Quarry.	Traffic lights are proposed at this location in response to submissions from this quarry operator regarding concerns about traffic performance and safe access.	Operation
13	Woollybutt/ Princes Highway	Adjusted project footprint. The project footprint would be extended to include the required work.	The inclusion of this area within the project boundary ensures it is clearly identified as work required for the project, and would form part of the project approval.	Construction
14	Cleary Brothers Quarry access at new East-West Link	Addition of traffic lights. Traffic lights would be provided on the new East West Link at the access point to the Cleary Brothers Quarry.	Traffic lights are proposed at this location due to a review undertaken based on submissions from the Holcim Quarry regarding concerns about traffic performance and safe access.	Operation

ID number	Location	Design refinement	Justification	Project Phase
15	Southern extent of Durgadin Drive	Adjusted project footprint. The project footprint would be extended to include the required work.	The inclusion of this area within the project boundary ensures it is clearly identified as work required for the project, and would form part of the project approval.	Construction
16	West of Oak Flats interchange, south side of mainline	Adjusted project footprint. The project footprint would be reduced along the western side of the project alignment, between the Cleary Brothers Quarry access and just north of Horsley Creek.	Upon review, it was found that this area is not required for construction of the project. The project footprint has been adjusted to minimise impacts on private property and agricultural land.	Construction and operation
17	Interchange at Oak Flats	Change to roundabout layout. Changes are proposed at the roundabout at Oak Flats, including: ▪ A new slip lane for southbound traffic on the existing Princes Highway turning left into New Lake Entrance Road ▪ A second lane for northbound traffic travelling onto the new East West Link from the existing Princes Highway.	Further detailed traffic assessment has identified additional changes to the interchange configuration are required to achieve good performance in the future as traffic demand increases.	Construction and operation
18	Project wide	Extended work hours. It is proposed that extended work hours be implemented across the whole of the project.	Extended work hours across the project would reduce the overall construction timeframe as well as reduce the duration of construction impacts such as noise, visual, air quality (dust), soil erosion and traffic.	Construction

ID number	Location	Design refinement	Justification	Project Phase
19	Off Yallah Road and Princes Highway, Yallah	Minor footprint adjustment.	Upon review, it was found that the project boundary was too small to allow for construction of the motorway just north of Yallah Road so the project footprint was increased here in two small areas and there was one area to the north that was found to be not required, thus ensuring that there was no net increase impact on the Endangered Ecological Community	Construction and operation
20	Between the motorway, Croome Road and the East West Link..	This ancillary site is no longer proposed.	The site was reviewed and the site has been chosen for a temporary on site detention basin.	Construction
21	Croom Regional Sporting Complex	Expanded Ancillary Site AS10 A parcel of land within the project footprint next to AS10 would be included in this ancillary site.	Additional land is required for the construction of Croom Regional Sporting Complex and this additional area has been identified for this purpose.	Construction

3.1 DESIGN HORIZON

The anticipated opening year of the project is 2021. A 20-year design horizon has been modelled to ensure that forecast 2041 traffic volumes are adequately accommodated.

3.2 YALLAH INTERCHANGE

As described in Table 3-1 (ID 6), minor boundary changes to the east of the eastern roundabout have been made at the Yallah interchange to reduce the impacts on the Tallawarra Lands development area. These changes do not affect the road geometry or capacity.

3.3 ALBION PARK INTERCHANGE

Design refinements at Albion Park interchange are summarised in Table 3-1 (ID 8, 9, 10, 15).

This design refinement proposes a change of location for the northbound exit ramp. In the EIS, a free-flow exit ramp was proposed to connect to the Illawarra Highway, north of Terry Street. The revised location is approximately 700 metres south and intersects with Tongarra Road via at-grade traffic signals.

The northbound entry ramp and southbound exit ramp are also proposed to be located closer to the mainline, reducing the space required for the alignment.

The previously proposed ramp layouts at Albion Park interchange are shown in Figure 3-3 with the refined layout shown in Figure 3-4.

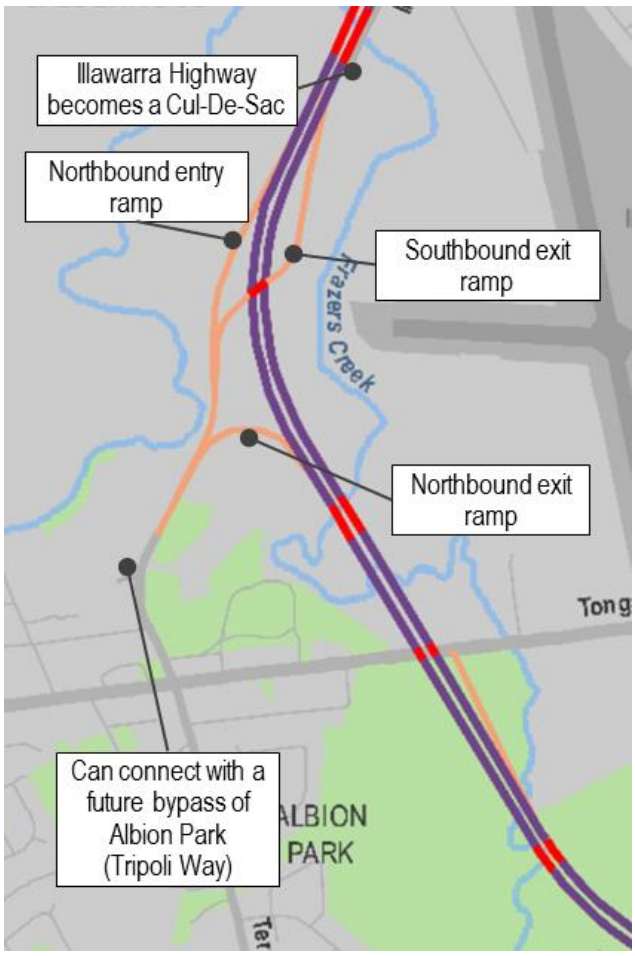


Figure 3-3 Environmental Impact Statement (EIS) Design - Albion Park Interchange

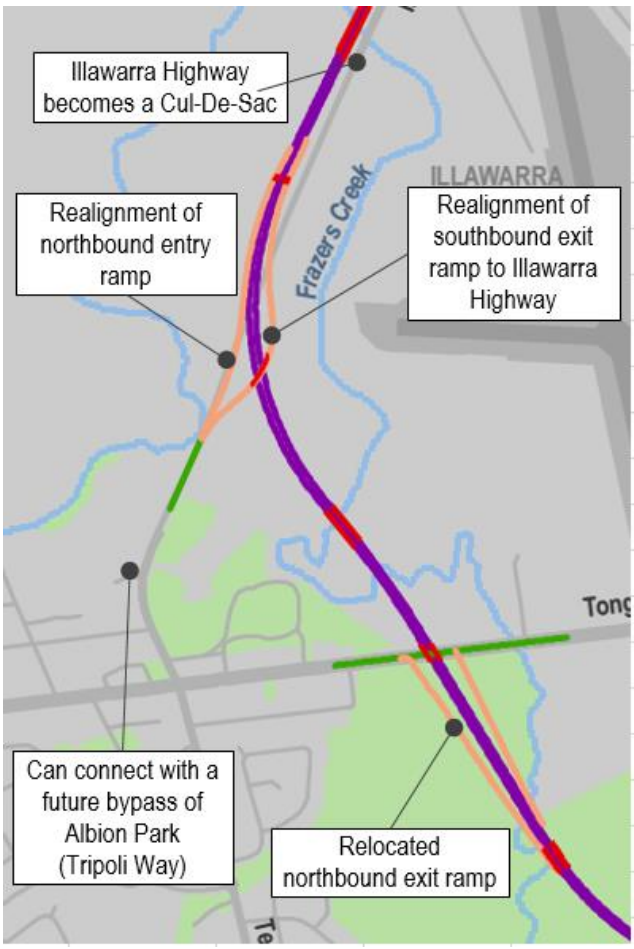


Figure 3-4 Ramp Reconfiguration at Albion Park Interchange

3.4 TRIPOLI WAY

Shellharbour City Council is planning for a future bypass of Albion Park town centre, on the existing Tripoli Way alignment extending from Terry Street in the east to Broughton Avenue in the west. The proposed interchange at Albion Park is designed to allow connection with Tripoli Way at Terry Street. The proposed alignment of Tripoli Way is shown in Figure 3-5.

For this traffic assessment, the design of Tripoli Way is assumed to be built with two lanes in each direction from Terry Street to Broughton Avenue by 2041. The additional local road upgrades in conjunction with Tripoli Way are described in Section 4.5. Further investigation and design of Tripoli Way is being undertaken by Shellharbour City Council.

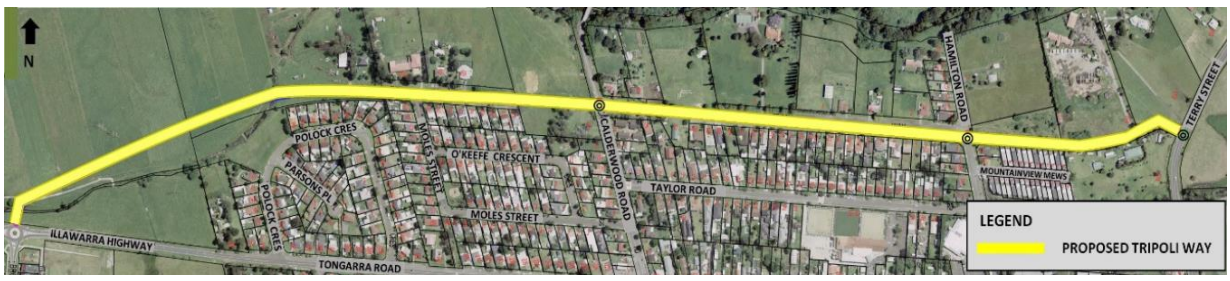


Figure 3-5 Proposed Tripoli Way

3.5 YALLAH ROAD

A realignment of Yallah Road is required to provide a suitable crossing of the bypass. Roads and Maritime has included a realignment of the existing two lane Yallah Road into the project, which improves the road geometry, supporting safe access to the Yallah Marshall Mount precinct.

In addition to the realignment, Wollongong City Council has identified that in the future Yallah Road would need to be upgraded to four lanes to facilitate the West Dapto Urban Release Area. Roads and Maritime has designed the realignment of Yallah Road to facilitate this upgrade to four lanes however this future upgrade is the responsibility of Wollongong City Council.

In order to facilitate the connection of the upgraded four lanes on Yallah Road, Wollongong City Council has developed an intersection design in conjunction with Roads and Maritime to join Yallah Road to the existing Princes Highway. This includes traffic signal arrangements connecting Yallah Road to the Princes Highway.

To take into consideration the potential Yallah Road upgrade, the offset arrangement with traffic lights in accordance with the design developed by Wollongong City Council has been included as a likely network improvement for the future (as described in Table 4-3) traffic assessment, however does not form any part of this project.

3.6 OAK FLATS

The northbound exit ramp from the Princes Highway at Oak Flats is now proposed to include two lanes near the roundabout intersection. This would reduce queues and delays for vehicles using this exit.

The southbound exit ramp from the Princes Highway is now proposed to include a left turn roundabout bypass lane onto New Lake Entrance Road.

The eastbound approach to the roundabout from New Lake Entrance Road is now proposed to include a left turn roundabout bypass lane onto the southbound entry ramp onto the Princes Highway.

The previously proposed layout at Oak Flats interchange is shown in Figure 3-6 with the refined layout shown in Figure 3-7.

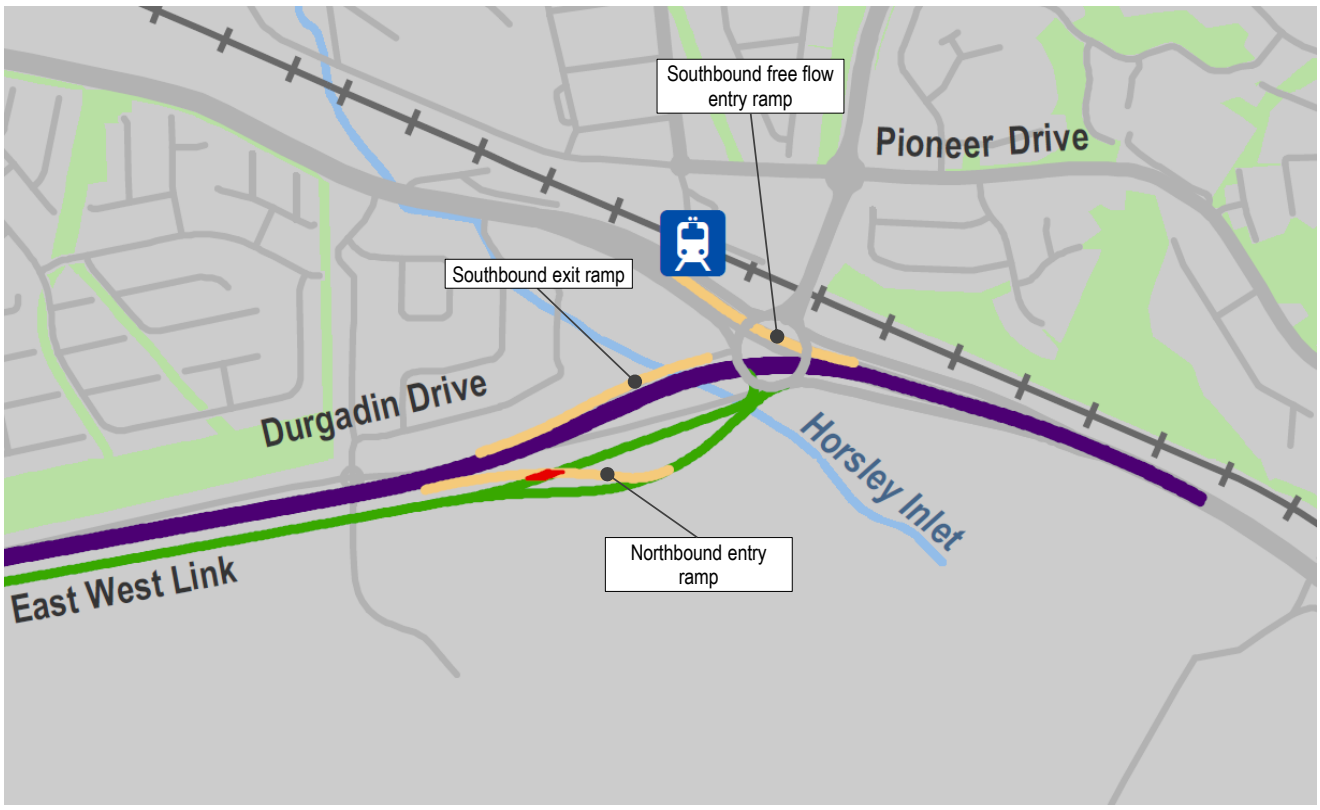


Figure 3-6 Environmental Impact Statement (EIS) Design – Oak Flats Interchange

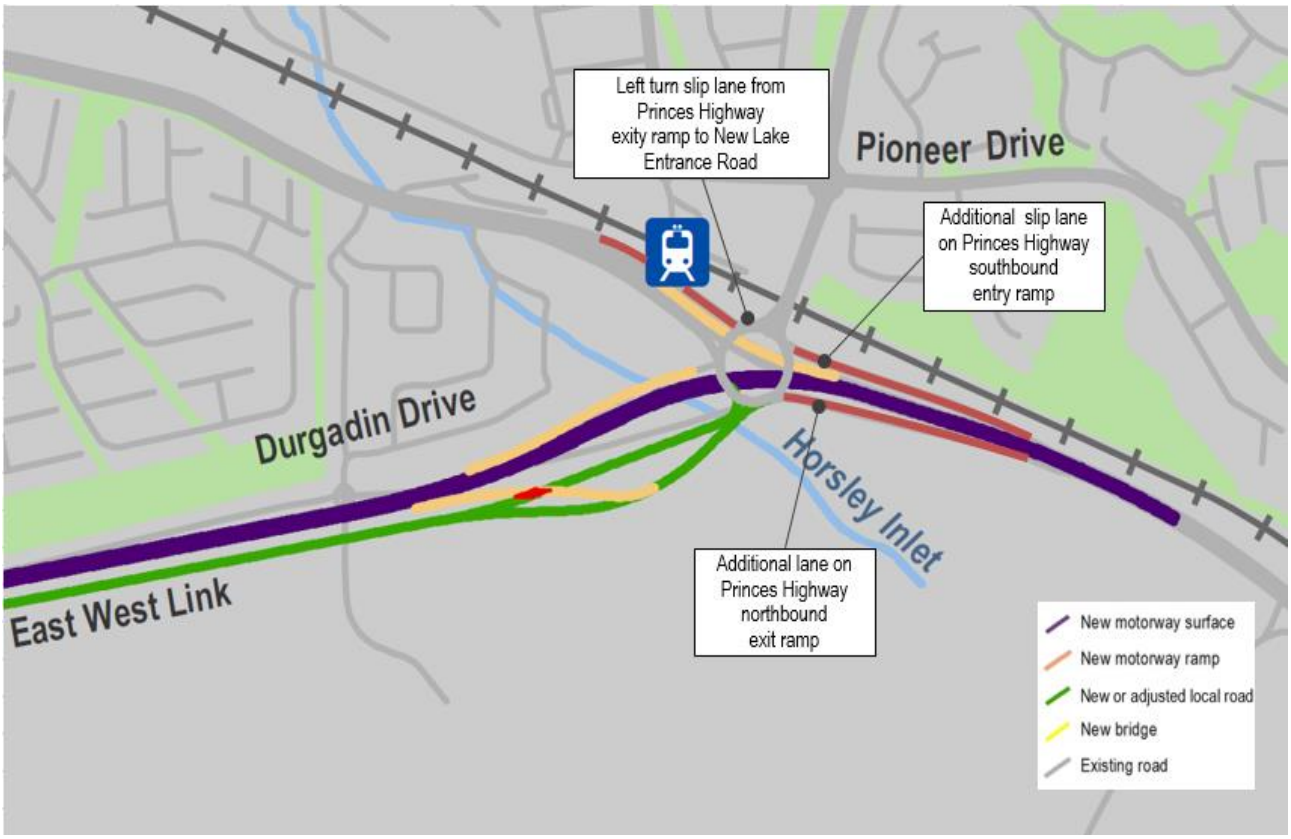


Figure 3-7 Reconfiguration at Oaks Flat Interchange

3.7 QUARRY ACCESS

The East-West Link alignment maintains current connectivity replacing the access points to the existing quarries. As detailed in Section 5.4, the Holcim Quarry and the Cleary Brothers Quarry would have signalised intersections provided at their respective access points on the East West Link. Deceleration lanes would be provided for safe approach to the intersections.

3.8 PEDESTRIAN AND CYCLISTS

Since the EIS review, a number of design changes to pedestrian and cycling infrastructure are now proposed due to community and stakeholder input.

Changes to the project since EIS are shown in Figure 3-8.

Figure 3-8 **The proposed key Pedestrian and Cycle Network**

Post EIS design changes to the pedestrian and cycle network that would apply to the project are discussed below. The locations of these changes is shown in Figure 3-9.

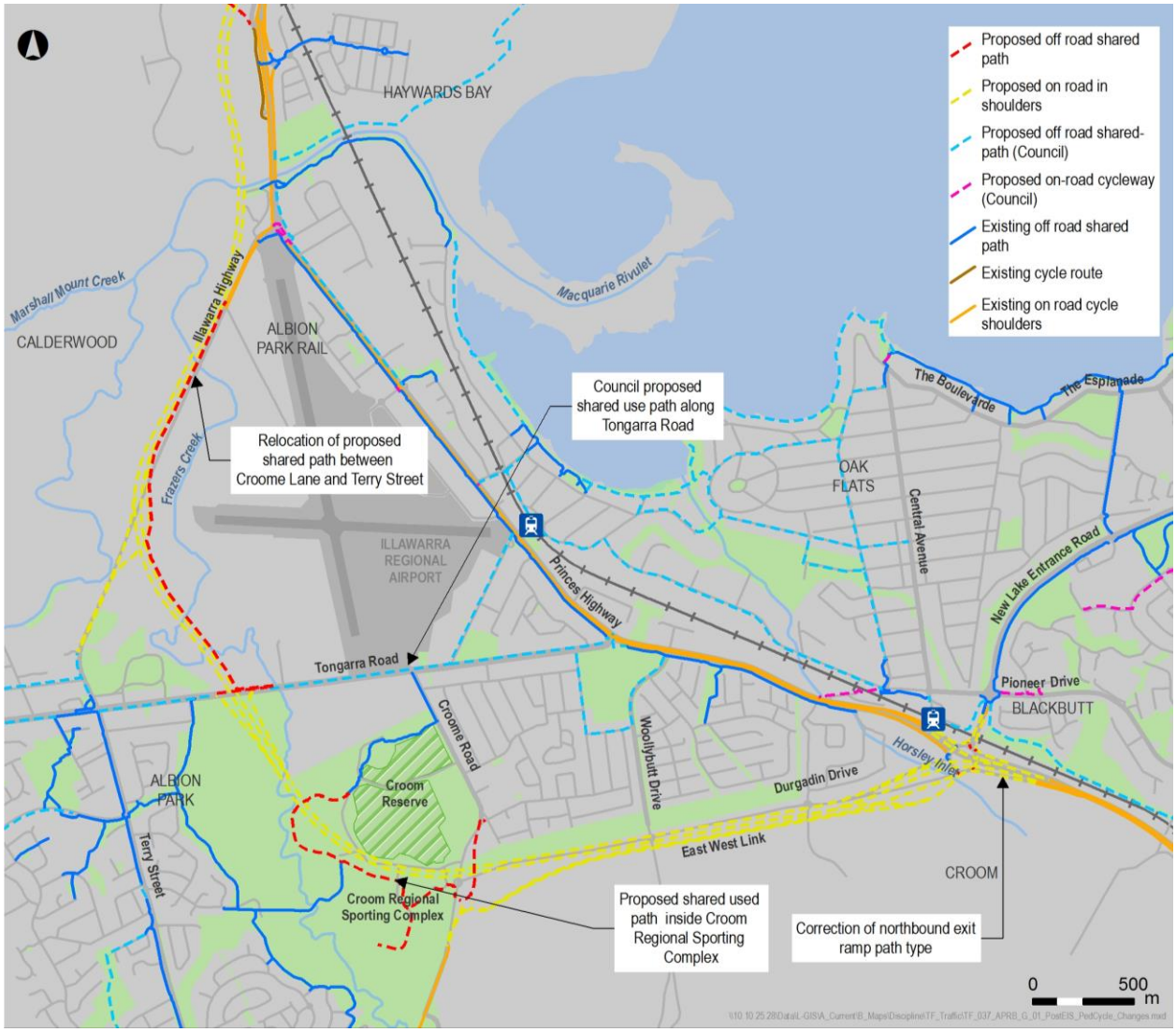


Figure 3-9 **Key Changes to the Pedestrian and Cycle Network since EIS**

Relocation of proposed shared path between Albion Park Rail at Croome Lane and Albion Park at Terry Street

In the EIS, a shared-use path was proposed to connect Albion Park Rail and Albion Park along the north western side of the bypass along the old Illawarra Highway alignment.

EIS submissions received from the community and dairy industry representatives raised safety concerns regarding the potential conflict between livestock/agricultural machinery and pedestrians and cyclists at the proposed underpass in the vicinity of Frazers Creek.

Roads and Maritime carried out a review of the project to minimise impact on the dairy enterprise. The proposed shared path between Terry Street and the Illawarra Highway (shown in Figure 5-16 of the environmental impact statement) has been relocated to the eastern side of the motorway to reduce the project footprint and co-locate the shared path with the existing Illawarra Highway and access for utilities. Measures to reduce the potential risk of interaction between farm operations and users of the shared path will be investigated during detailed design such as cycle friendly cattle crossings.

Proposed shared-use path along Tongarra Road

Since the EIS release, Shellharbour City Council in collaboration with Roads and Maritime has undertaken design work to provide a continuous off-road shared-use path along Tongarra Road to link Albion Park Rail and Albion Park. Roads and Maritime are providing funding for this shared path, which would connect Albion Park with an off road shared path along Tongarra Road and connect with the existing shared path running north and south on the existing Princes Highway through Albion Park Rail.

The shared path to be constructed as part of the project would now connect with the Tongarra Road shared path rather than the Illawarra Highway as identified in the environmental impact statement.

Refinement to shared use path arrangements inside Croom Regional Sporting Complex (CRSC)

The layout of cycle and pedestrian paths inside CRSC has been refined as part of the detailed design development of the facility. Connectivity to the local road network and across the motorway remains consistent with the EIS.

Correction of EIS figure path type

Within the EIS Traffic and transport report, a section of shared use path was shown on the northbound Exit Ramp at Oak Flats interchange. This was a mapping error, which has been corrected.

4 UPDATED TRAFFIC MODELLING

4.1 BACKGROUND

The Wollongong and Shellharbour Council (WOLSH) TRACKS model, which includes the entire Wollongong City Council and Shellharbour City Council area, was used as the starting point to model the impact of the project.

A separate TRACKS model was extracted from the WOLSH TRACKS model. This was simplified to only include the study area and a sufficient surrounding catchment to assess the surrounding road network and impact of the project.

The EIS traffic assessments utilised TRACKS traffic modelling software to model major traffic assignment and flows associated with the implementation of the project. For the more detailed intersection analysis, SIDRA intersection modelling software was utilised.

Following the public exhibition of the EIS, the project TRACKS model was updated. This included revisions to residential and employment forecasts and alterations to the model network, which are further discussed in Sections 4.2 to 4.7.

To assist in the project post-EIS design development, an Aimsun microsimulation model was developed to supplement the project TRACKS model. Aimsun provides additional outputs that are not available in the TRACKS modelling package as well as improved accuracy with certain performance metrics.

Additional traffic surveys were undertaken in October 2016 to improve the calibration and validation of the Aimsun model. The majority of data used for the Aimsun calibration was 2014 data and so 2014 is the base case. Where 2016 data was used, the data was adjusted to account for growth in the intermediate years.

The following sections outline the revised traffic modelling approach.

4.2 TRAFFIC MODELLING APPROACH

The key steps below outline the modelling approach adopted, following the EIS traffic assessment, and community and stakeholder input, to arrive at the design refinements identified in Section 3:

1. **Response to stakeholder submissions:** Consultation with Wollongong City Council was undertaken to address the traffic modelling comments raised in their submission.
2. **Confirmation of residential and employment forecasts and network geometry:** Establish agreement with Wollongong City Council on the spatial residential and employment forecasts, network geometry. Refer to Section 4.4 for details.
3. **Review and update TRACKS model and assumptions:** Review and update the project TRACKS modelling approach and assumptions to reflect the agreed land use and employment forecasts and network geometries. Refer to Section 4.4 for details.
4. **Aimsun base model development:** Commence Aimsun Base Model network development to reflect existing conditions. This included additional traffic surveys to supplement the calibration and validation process.
5. **Future Year Option Testing:** Upon approval by Roads and Maritime of the Aimsun Base Model, commence future year option testing to inform design.

The Aimsun microsimulation model was employed by the HCJV traffic team as a tool to assist in the design development of the revised project scheme. It provides certain advantages over SIDRA when assessing complex interchanges and congested local networks where queue spillback between adjacent intersections is likely. Further information is provided in the following sections.

4.3 REPORTING APPROACH

A revised traffic modelling approach was used to assess the proposed design refinements. The new modelling approach and revised input data (land use and network configuration) have resulted in changes to the traffic modelling results. During the original concept design phase, TRACKS was used as the principal traffic forecasting and modelling software. TRACKS is defined as a macroscopic or strategic level model, using land use forecasts to generate future year traffic volumes across a wide geographical area. However, TRACKS does not provide detailed outputs at a finer level to indicate road network behaviour. For this reason, during the EIS preparation, SIDRA software was used in conjunction with TRACKS to analyse individual intersections. This approach has limitations, for example the coarse nature of turning volumes and minor road flows exported from TRACKS and the limited ability of SIDRA to assess complex interchanges or the downstream impact of adjacent intersections.

Aimsun modelling software has wide functionality and can simultaneously model at a strategic and microscopic level. This is advantageous because traffic demand from the TRACKS model can be imported directly into Aimsun in the form of trip matrices. Additional inputs, including queue length surveys, site observations and traffic signal phasing plans, are used to understand and replicate detailed traffic dynamics at key locations. The model was widely used to inform the concept design development and to visually and empirically verify key traffic performance metrics. This was the key advantage of using Aimsun as an additional assessment tool.

The Aimsun model assessed one future year scenario; 2041, which is 20 years post opening of Albion Park Rail bypass. TRACKS was used to model future base case scenarios, otherwise known as “Do Nothing” or “Without Project” models. Due to the physical capacity constraints inherent within the Aimsun model, and the high traffic demand in the future model without the bypass (base case),traffic in the model experienced excessive congestion and as a result a percentage of the future demand was not able to enter the network. Considering that Aimsun reports traffic performance statistics for vehicles that enter the network and complete their trips, the reported statistics are not comparable with the proposed options where all/most demand was able to enter the network..

The difficulties associated with modelling future base case scenarios in microsimulation models are well known in the traffic modelling industry and best practice guidance is still emerging in this area. The decision to use available data from TRACKS was taken only after significant time was spent trying to develop a Do Nothing Aimsun model. Local mitigation measures or “Do Minimum” upgrades were extensively tested in order to prevent gridlock in the model.

The Do Nothing 2041 Aimsun model still yielded unreliable results with 15% of vehicles not being able to enter the traffic model due to the levels of congestion. Therefore, the decision was taken to use the TRACKS without bypass model outputs, which are likely to be conservative in terms of capturing the project benefits, but do include 100 per cent of future year demands being assigned to the network.

Several key aspects of the TRACKS model were updated during the second concept design phase. The revision of dwelling and employment figures in the West Lake Illawarra region affected both traffic generation and assignment within the study area. Furthermore, the TRACKS model assignment weightings were adjusted, resulting in far more trips assigned to

longer but faster routes. Finally, the future year network geometry was adjusted from the previous EIS TRACKS model. This was based on a “most likely’ infrastructure outcome, as agreed with Wollongong City Council and Roads and Maritime.

The revised traffic modelling methodology, including refinement of the TRACKS model and the development of the Aimsun model, is detailed in Section 4.6 and Section 4.7.

As far as possible this report tries to replicate the structure and format of the equivalent EIS technical appendix. However, the proposed delivery of the project results in a slightly different reporting approach compared with the EIS.

The TRACKS model was used to quantify the following operational performance metrics including:

- Road network travel times
- Road network average speeds
- Traffic assignment through the network.

The Aimsun model was used for:

- Peak hour volumes for Average Daily Traffic estimation
- Assessment of capacity and Level of Service (LoS) at key ramp, merge and intersection locations.

4.4 RESIDENTIAL AND EMPLOYMENT FORECAST

A review of the EIS residential dwellings and employment land forecasts was undertaken to establish previous land use assumptions. Table 4-1 summarises the development and employment land release rates from the EIS for the West Lake Illawarra region including West Dapto (stages 1 to 5), Calderwood and Tallawarra.

Table 4-1 EIS Residential and Employment Forecasts

Residential Development	2041 EIS Forecast (Released Dwellings)
West Dapto, stage 1	3,804
West Dapto, stage 2	3,396
West Dapto, stage 3	4,041
West Dapto, stage 4	3,200
West Dapto, stage 5	3,500
Tallawarra	1,000
Calderwood	7,700
Tullimbar	-
Total Residential Development	**26,641**
Employment Land	**2041 EIS Forecast (Developable Hectares)**
Heavy Industrial	44.4
Light Industrial	134.4

The Department of Planning and Environment (DP&E) provided Roads and Maritime with updated 2016 annual forecast rates based on dwelling numbers. Wollongong City Council supplemented these forecasts to include existing released development and to reflect Council's knowledge of development and employment area release rates in the West Lake Illawarra region.

Consultation between Roads and Maritime and Wollongong City Council was undertaken to agree on the updated land use and employment forecasts for the project design horizon 2041. The agreed forecasts for dwelling numbers and employment land for the West Lake Illawarra Region are outlined in Table 4-2. These numbers were adopted in the traffic assessment.

Table 4-2 Agreed Residential and Employment Forecasts

Residential Development	2041 Forecast (Released Dwellings)
West Dapto, stage 1	3121
West Dapto, stage 2	1962
West Dapto, stage 3	2830
West Dapto, stage 4	470
West Dapto, stage 5	2930
Tallawarra	600
Calderwood	5068
Tullimbar	1410
Total Residential Development	18,391
Employment Land	**2041 Forecast (Developable Hectares)**
Heavy Industrial	34.4
Light Industrial	131.5

4.5 NETWORK GEOMETRY

Wollongong City Council identified network geometry discrepancies between the WOLSH TRACKS model and the project EIS TRACKS model. Roads and Maritime and Wollongong City Council formed agreement on key network geometry items which may affect major traffic flows and assignment in the model. These network geometry changes included works not listed in the scope of the project but rather have been identified as 'most likely' changes for the future road network. For example, to take into consideration the potential Yallah Road upgrade, the offset arrangement with traffic lights in accordance with the design developed by Wollongong City Council has been included in the traffic assessment of the project.

A list of recommended 'most likely' network geometries was agreed which address these discrepancies. Table 4-3 below outlines the key network geometry items updated since the EIS. These network geometry items were incorporated into the Albion Park Rail bypass TRACKS and Aimsun models for the purposes of the traffic assessment.

Table 4-3 Key network geometry changes since EIS

Network Geometry Item	EIS	2041 Network Geometry
Princes Motorway north of interchange with Princes Hwy.	Three lanes northbound, two lanes southbound	Three lanes in each direction
Lane configuration of Princes Highway between Kanahooka Road and Kembla Grange Place	Two lanes in each direction	One lane in each direction
Lane configuration of Fowlers Road Extension between Cleveland and Fairwater Drive	One lane in each direction	Two lanes in each direction
Intersection of New Lake Entrance Road / Pioneer Drive	Existing roundabout	Traffic lights
Lane configuration of Tripoli Way	One lane in each direction	Two lanes in each direction
Intersection of Yallah Road / Princes Highway	Existing geometry	Offset arrangement with traffic lights in accordance with design developed by Wollongong City Council
Roundabout at Illawarra Highway/ Princes Highway	Existing signalised roundabout	The Illawarra Highway/ Princes Highway signalised roundabout would operate as a conventional roundabout.
Terry Street near Church Street*	Existing geometry	Dual circulating roundabout southbound to remove bottleneck just north of Church Street / Terry Street.
Terry Street near Taylor Lane*	Existing geometry	Widening of the southbound carriageway to allow for a right turn lane into Taylor Lane.
Intersection of Tongarra Road / Terry Street	Existing geometry	Banned right turns on northern and southern legs of intersection by 2041.

* This was a late mitigation measure developed by HCJV and was not subject to consultation with local government stakeholders.

4.6 TRACKS MODELLING REFINEMENT

Following the public exhibition of the EIS, adjustments have been made to the TRACKS model in order to:

- Address EIS submission inputs from Wollongong City Council, specifically related to their TRACKS model
- Update residential and employment forecasts and network geometries in the model to align with the most recent information received from Wollongong City Council, DP&E and Roads and Maritime
- Increase the level of accuracy in the TRACKS model through changes to time and distance cost weightings and a revalidation process prior to the demand output for the micro-simulation Aimsun modelling. This is discussed in the following sections.

4.6.1 MODEL CONVERGENCE METHODOLOGY

Wollongong City Council identified a difference in peak hour volumes reported in the EIS and their TRACKS model. Wollongong City Council's interrogation of the TRACKS model concluded that the differences in peak hour volumes was mainly attributed to the TRACKS convergence method.

A review of the EIS TRACKS model shows that it was converged on a base network model which excluded the project. As a result, the trip matrices extracted from the EIS TRACKS model produced lower traffic volumes compared to one which had been converged using a network model with the bypass in place. The project TRACKS model was revised to align with Wollongong City Council's TRACKS model convergence method incorporating the bypass.

4.6.2 TIME AND DISTANCE COST ADJUSTMENT

Revisions were made to include time and distance cost weighting adjustment to the traffic assignment. Roads and Maritime does not have default values for time and distance weightings.

The EIS TRACKS model used historic time and distance values of 1.00: 0.85, a ratio which was provided by economists in the 1990s. The use of this ratio resulted in a high percentage of through trips remaining assigned to the Princes Highway. Logically, most drivers would choose the quickest route over the shortest route i.e. a longer high speed motorway instead of a slower but shorter more congested route. The project would provide a simpler driving experience with less speed variations and provide a time advantage despite being the longer distance route, hence is likely to attract most through traffic. As such, time to distance parameters were adjusted to represent more probable traffic assignment.

Roads and Maritime do not document default time and distance values for use in modelling calibration and no other local region values were available. Based on New Zealand Transport Agency (NZTA) typical values for time to distance weightings, the TRACKS model was updated with a time to distance weighting of 1.0 : 0.3 for light vehicles and 1.0 : 0.6 for heavy vehicles. The change in the time and distance parameters resulted in changes to travel patterns throughout the model, which had an impact to the level of local area validation achieved in the EIS TRACKS model. As such, recalibration was required to revalidate the model.

4.6.3 LOCAL AREA REVALIDATION

The Roads and Maritime Modelling Guidelines provide a set of Highway assignment validation guidelines for use in NSW. These guidelines draw heavily on the Traffic Modelling Guidelines, Transport for London (TfL) Traffic Manager and Network Performance Best Practice. The TfL guidelines have been tailored for predominantly models of generally several hundred nodes in the urban London environment. Networks are generally quite small, have relatively small zones and rely on very comprehensive sets of calibration and validation count data that must be consistent and accurate to within +-50vph.

The TRACKS model used for the project does not have the same characteristics as this type of urban model. Therefore it was considered more appropriate to use NZTA Guidelines, which differentiate between different types of models and set validation criteria more suitable for relatively undeveloped rural areas, with a corresponding lack of available traffic survey data. It is

relevant to note that the original WOLSH model, on which the project TRACKS model is based, was originally calibrated and validated to NZTA Guidelines because it pre-dated the issue of RMS strategic modelling guidelines. It is also relevant that the recalibration of the project TRACKS model was primarily required because of the adjusted time and distance cost weightings, which were taken from the NZTA Guidelines. As such, the reference material and guidelines used have been consistent throughout the project TRACKS model development process.

The results of the calibration of the TRACKS model against NZTA criteria are shown in Table 4-4.

Table 4-4 NZTA target criteria compared with calibrated model results

Criteria		New Zealand Transport Agency Criteria	AM Peak Results	PM Peak Results
GEH[1] (Individual counts of link volumes) (modified for 1 hr flows only)	≤ 5.0	80%	77%	79%
	≤ 7.5	85%	91%	91%
	≤ 10.0	90%	98%	98%
	≤ 12.0	95%	100%	100%
Counts <700vph within 100vph		80%	73% (22/30)	72% (2/29)
Counts 700 – 2700vph within 15%		80%	100% (15/15)	100% (16/16)
Counts >2700vph within 400vph		80%	100% (2/2)	100% (2/2)
R^2		> 0.9	0.982	0.978
Overall Network Totals % RMSE		< 25	10.2	11.3

Compared against NZTA criteria, the model generally provides a very good level of calibration in the AM and PM Peaks.

The results of the revalidation are believed to represent the best validation possible using the available data and existing TRACKS model.

4.7 AIMSUN MODEL

4.7.1 AIMSUN BENEFITS

The revalidated TRACKS base model formed the basis of the demand inputs to the Aimsun base model.

The micro-simulation Aimsun model allows for performance outputs and visual confirmation of traffic flows and mitigation exploration, which is not available in TRACKS. These include

[1] GEH Statistic compares traffic modelling forecasts with surveyed traffic volumes in a non-linear calculation. It is considered a more appropriate measure than applying a fixed percentage of accuracy. It is widely accepted by traffic modelling professionals.

producing performance measures such as vehicle queue length to inform auxiliary lane requirements and Level of Service (LoS) calculations to understand intersection and ramp operation performance.

The AIMSUN model's key benefit was to inform the design refinements, specifically road layout and geometry outlined in Section 3.

4.7.2 MODEL DEVELOPMENT

The Aimsun model was developed in accordance with the *Roads and Maritime Traffic Modelling Guidelines, February 2013 Version 1.0*. Two peak hour models (AM and PM weekday) were calibrated and validated to reflect 2014 base year conditions.

Using the Aimsun model extents as the subarea model boundary, origin-destination matrices were produced from the TRACKS model for use in the Aimsun model.

The Aimsun base model has been reviewed by Roads and Maritime and was assessed as fit for purpose for subsequent future year modelling.

Figure 4-1 outlines the Aimsun base model development process undertaken.

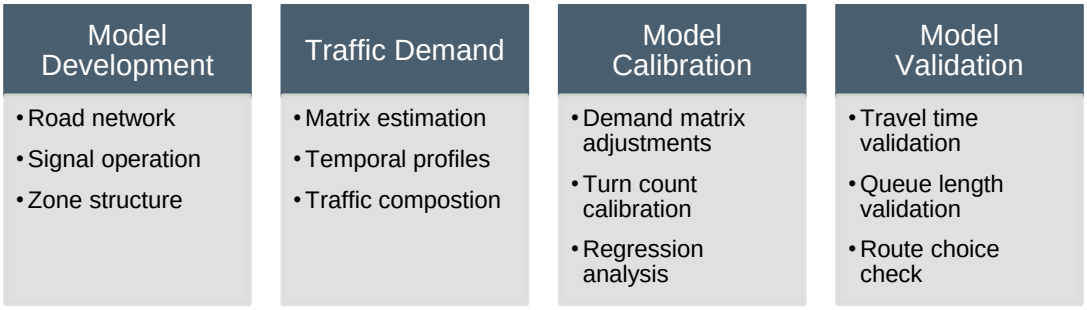


Figure 4-1 Albion Park Rail bypass Aimsun Base Model Develop Approach

The base model development involves providing inputs to replicate the 2014 base case road network. Two core areas were defined to improve the accuracy of the model in these areas:

- Princes Highway between Illawarra highway and Tongarra Road
- Illawarra Highway/ Tongarra Road between Terry Street and Calderwood Road.

Figure 4-2 shows the Aimsun model extents and core area.

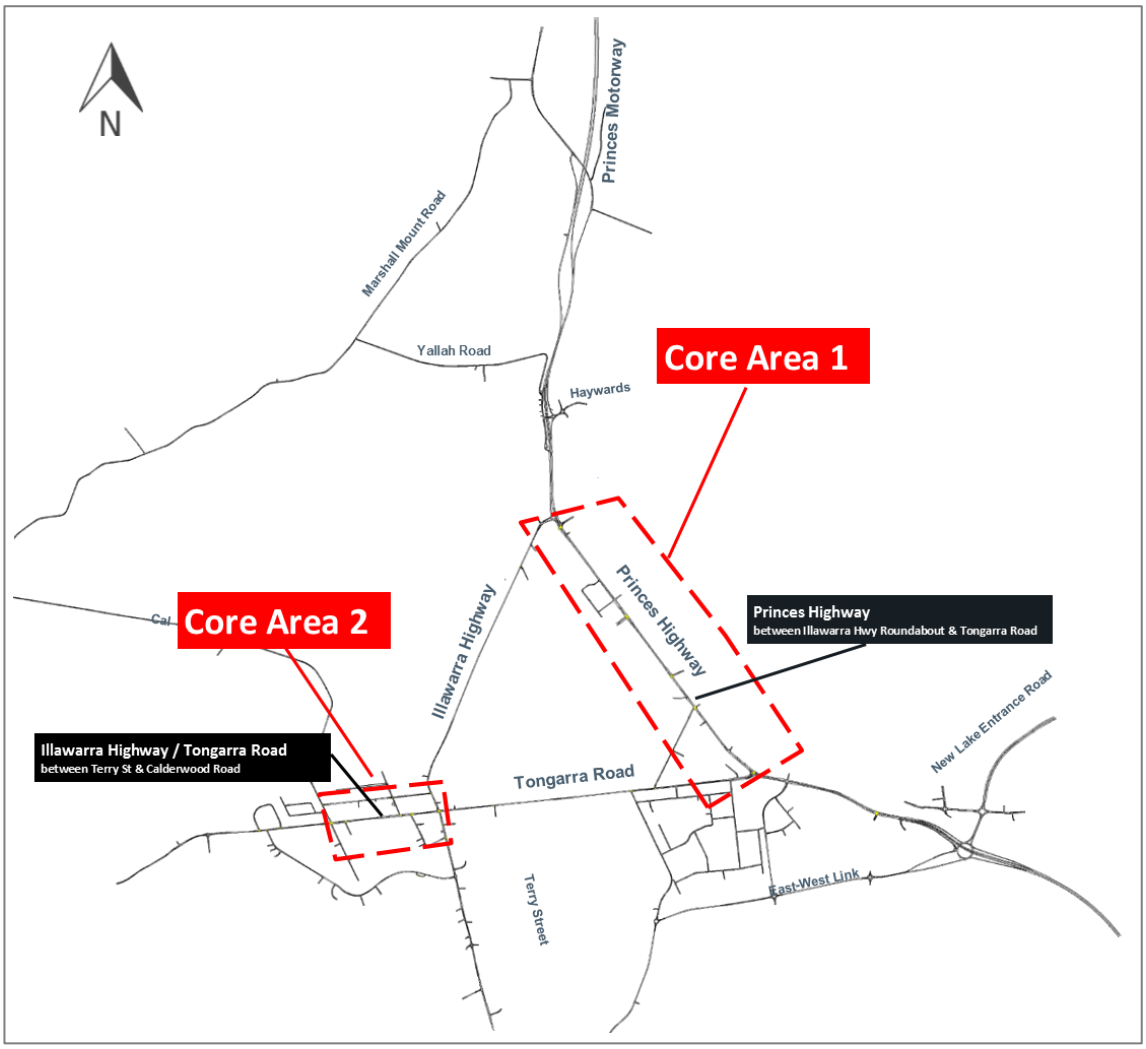


Figure 4-2 Aimsun Model Extents and Core Area Definition

The traffic demands for AM and PM peak period uses origin-destination matrices extracted from the 2014 TRACKS base model. A process of demand adjustment iterations was undertaken to match surveyed traffic volumes in the network.

To facilitate the calibration and validation process of the Aimsun base model development, additional surveys were undertaken. Section 4.7.3 describes the additional classified intersection counts and queue length surveys required to calibrate and validate the base model to reflect 2014 base year conditions.

Following the Aimsun base model development process, the Aimsun base model files and report underwent a review process by Roads and Maritime to confirm that the model was fit for purpose for subsequent future year modelling.

4.7.3 ADDITIONAL SURVEYS

Additional traffic surveys were undertaken to improve the accuracy of the Aimsun base model development. The AM Peak (7:00am to 9:00am) and PM Peak (4:00pm to 6:00pm) surveys included:

- Classified intersection turning movement counts
- Queue lengths.

Classified intersection turning movement counts were undertaken at the intersections identified in Table 4-5 and Figure 4-3.

Table 4-5 Additional Classified Intersection Count Survey Locations

Intersection ID	Count Location	Intersection Type
1	Tongarra Road and Russell Street	Signalised
2	Princes Highway and Haywards Bay Drive	Roundabout
3	Princes Highway and Creole Road, Mallee Street	Priority Control
4	Pioneer Drive and Central Avenue	Roundabout
5	Calderwood Road and North Macquarie Road	Priority Control
6	Pioneer Drive and New Lake Entrance Road	Roundabout
7	Haywards Bay Drive and Yallah Road	Priority Control
8	Marshall Mount Road and Yallah Road	Priority Control
9	Marshall Mount Road and Huntley Road	Priority Control
10	Illawarra Highway and Church Street	Priority Control
11	Calderwood Road and Marshall Mount Road	Priority Control
12	Princes Highway and Huntley Road	Priority Control
13	Terry Street and Church Street	Roundabout

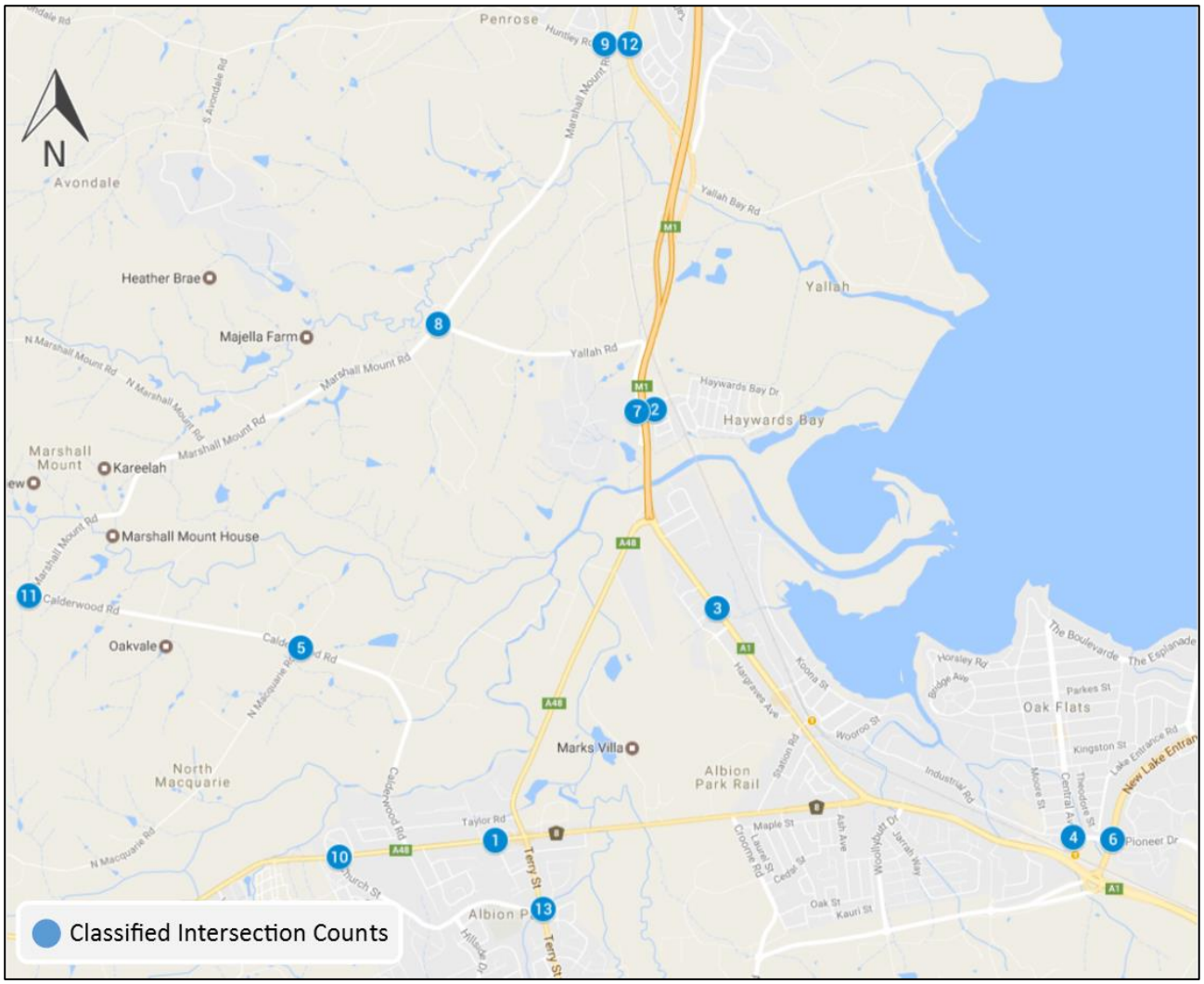


Figure 4-3 Additional Classified Intersection Count Survey Locations

Queue length surveys were undertaken at the intersection identified in Table 4-6 and Figure 4-4.

Table 4-6 Additional Queue Length Survey Locations

Intersection ID	Count Intersection
1	Princes Highway / Illawarra Highway
2	Princes Highway / Tongarra Road
3	Princes Highway / East-West Link / New Lake Entrance Road
4	Illawarra Highway / Tongarra Road / Terry Street

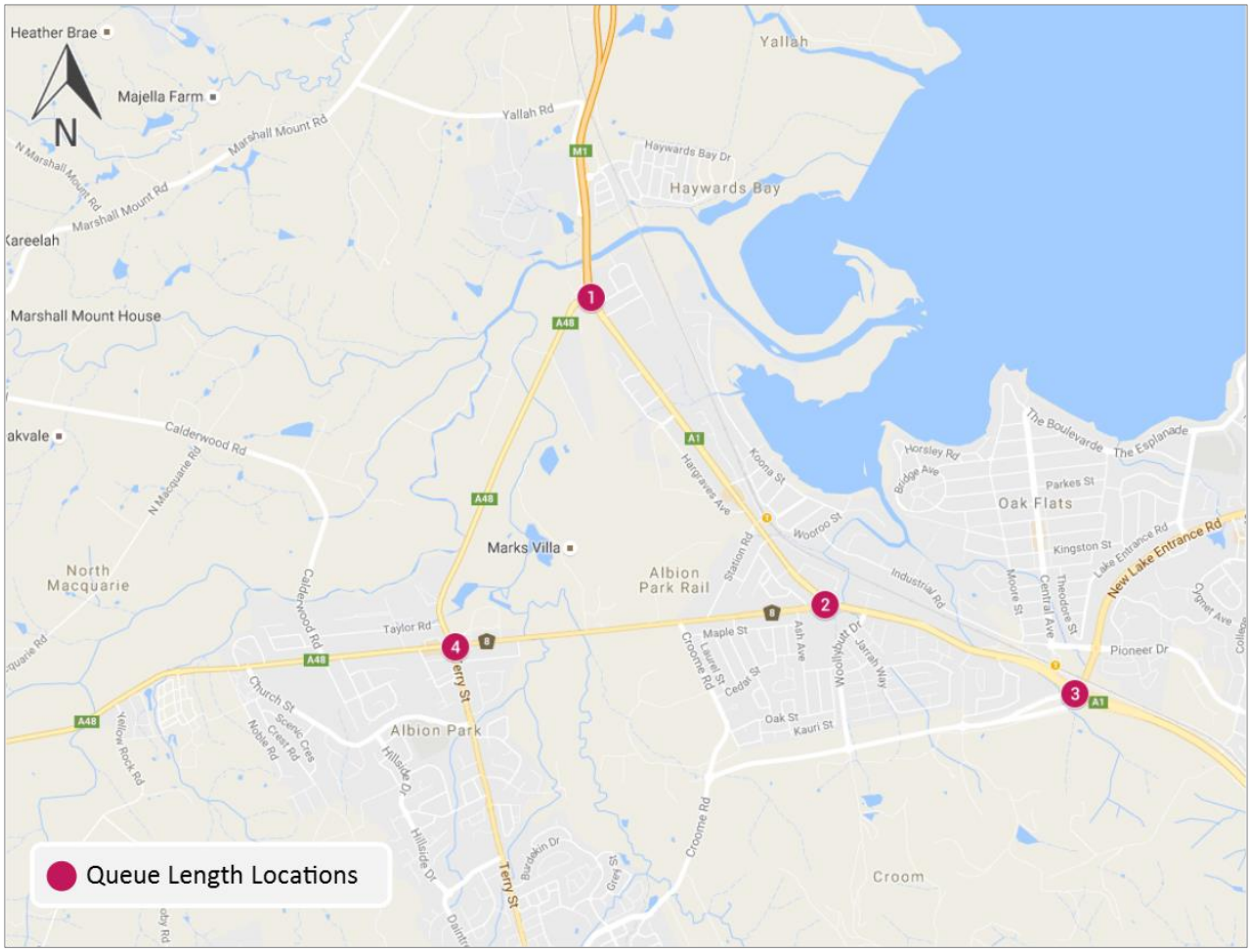


Figure 4-4 Additional Queue Length Survey Locations

5 COMPARISON OF OPERATIONAL IMPACT (2041 EIS VS THE PROJECT)

This chapter provides the traffic assessment and comparison of the 2041 project scheme with the previous 2041 EIS assessment.

5.1 OPERATIONAL IMPACT

5.1.1 TRAFFIC GROWTH 2014-2041

Average Daily Traffic (ADT) growth between 2014 and 2041 is shown for key locations in Figure 5-1. The ADT volumes referenced below are taken from the project base and 2041 'Do Nothing' TRACKS models to allow a like for like comparison.

Albion Park Rail Bypass - Predicted Traffic Increase between 2014 and 2041 at Key Locations (Based on TRACKS Do Nothing Model (2016))

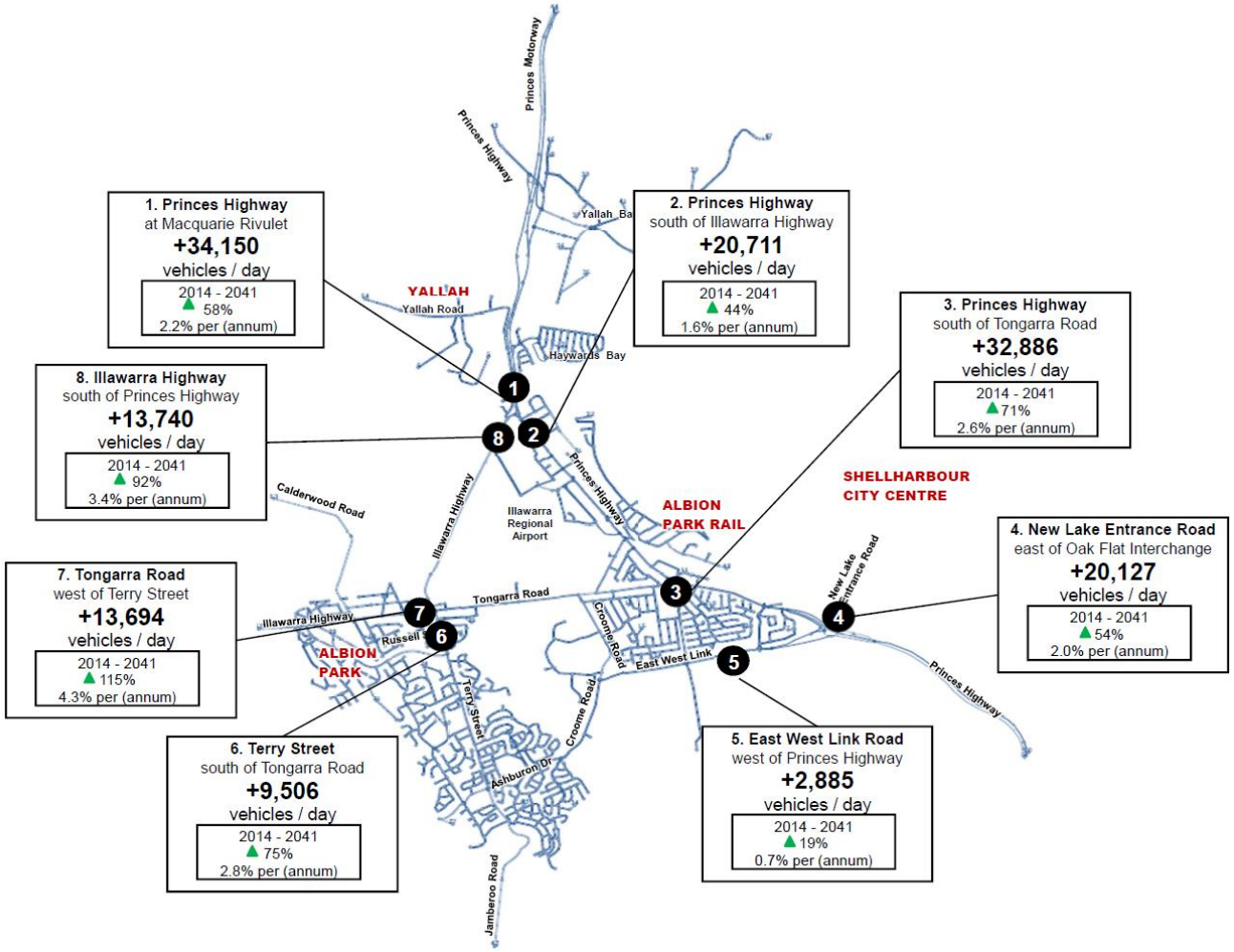


Figure 5-1 2014-2041 ADT Growth

Traffic growth is forecast to be significant throughout the study area. This is predictable, given the large-scale development planned in the West Lake Illawarra Region. The extent of the

development is described in Section 4.4. This growth provides a major justification for the project and sets the scene for the assessment of operational impacts that follows.

5.1.2 TRAFFIC VOLUMES ON THE BYPASS

In 2041, the project is forecast to carry between 60,000 and 77,000 vehicles on a typical weekday. This is a notable increase over the EIS forecast. This is attributable to:

- The modelling process, notably the weighting of time over distance to dictate traffic assignment on the network (see Section 4.6)
- The AM and PM peak hour to daily conversion factor. Based on 2014 tube counts conversion factors, which considers the northbound and southbound traffic in the AM and PM peak periods recorded at discrete locations. This compares to a conversion factor ranging between 5.5 and 5.8 which was applied during the EIS modelling.

Table 5-1 Forecast Traffic Volumes on the Albion Park Rail bypass

Location	2041 EIS Forecast Average Daily Traffic (vehicles)	Proposed 2041 Revised Design Forecast Average Daily Traffic (vehicles)
New motorway, at Macquarie Rivulet Bridge	53,100	76,700
New motorway, south of Tongarra Road	45,100	61,300

Source: Based on 2041 Aimsun peak hour volumes.

5.1.3 IMPACTS ON THE ROAD NETWORK

Based on the revisions in traffic estimation, Figure 5-2 shows forecast average daily traffic volumes with and without the project in 2041. The figure also displays the ADT volumes from the EIS model and the 'EIS Equivalent' model (which contained the updated land use and parameters from the post-EIS work but maintained the same project geometry as the EIS). The proposed design shows higher traffic volumes on both the bypass and existing Princes Highway when compared to the volumes provided for the EIS. This is predominantly the result of the changed traffic modelling methodology.

ADT calculated volumes were considerably higher in the Do-Nothing model compared to the proposed design along the existing Princes Motorway and Princes Highway, as the bypass is expected to attract much of the traffic on this existing route.

No significant ADT volume differences are highlighted around the Albion Park Town Centre area between the Do-Nothing and APRB scheme models. The ADT volume differences varied between 5% and 15% along the town centre study area. The major difference was identified at the East-West Link, which showed a 50% additional ADT traffic in the Do-Nothing model, this indicating that people currently traveling on the East West Link are expected to use the new bypass.

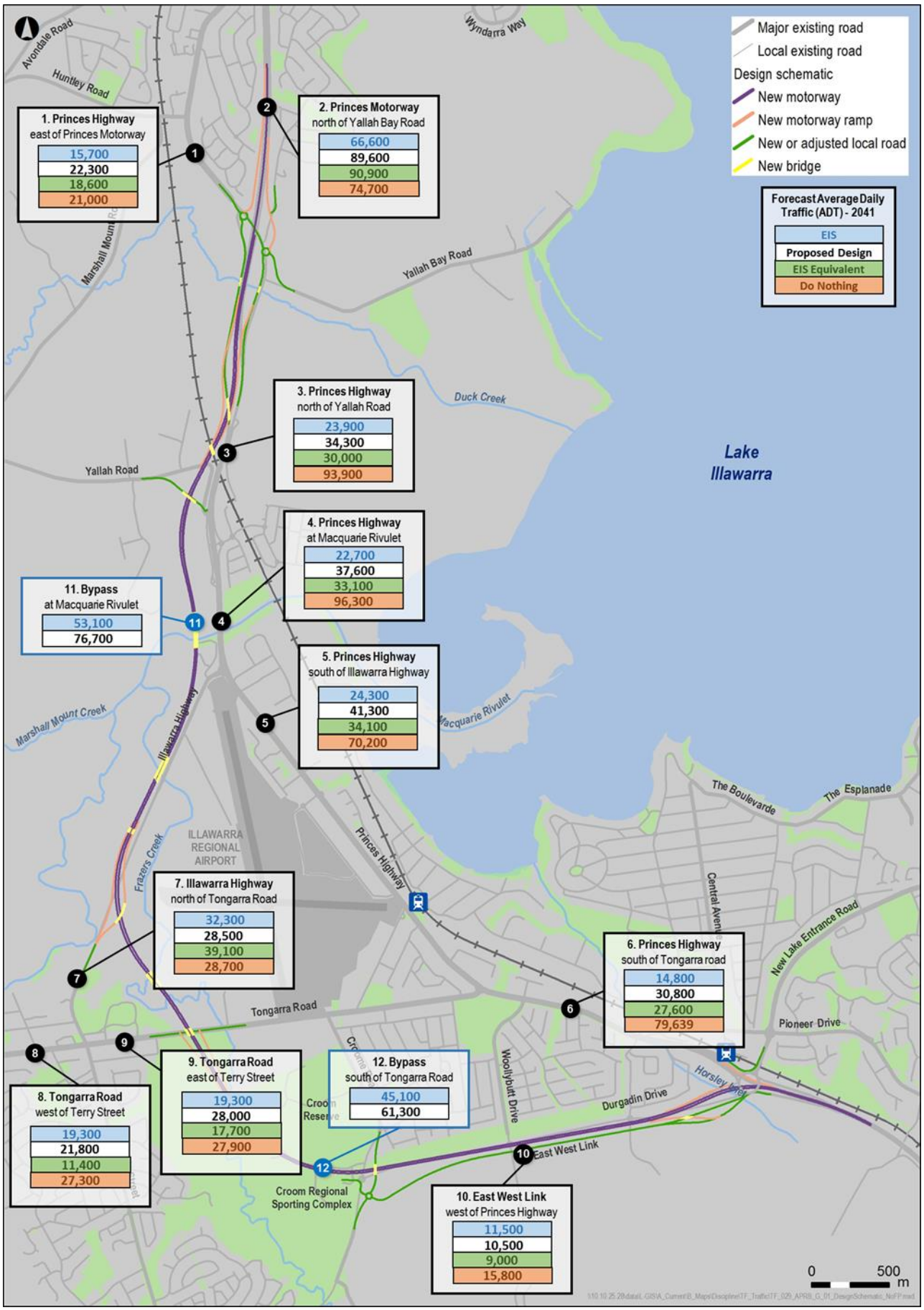


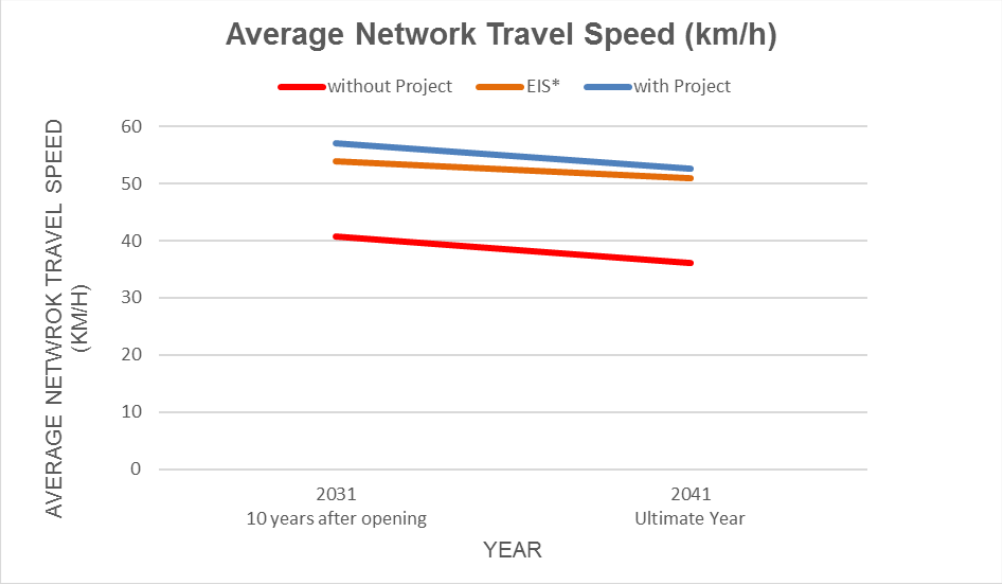
Figure 5-2 Forecast Average Daily Traffic (ADT) in 2041 Ultimate Year

5.2 OPERATIONAL PERFORMANCE

5.2.1 OVERALL NETWORK

The overall operational performance of the project can be described in terms of the predicted average travel speed of all vehicles within the study area. This would result in average speeds in the network of 57 km/h in 2031 and 53 km/h in the year 2041.

This data is presented in Figure 5-3 with and without the project for 2031 (10 years after opening year) and 2041 (ultimate year). The EIS average network travel speeds in the respective design years are also shown for comparison.



Source: TRACKS windowed model (2016),

Figure 5-3 Average Network Travel Speed (km/h) for the Entire Study Area Road Network

5.2.2 AGGREGATE ROAD NETWORK PERFORMANCE

The vehicle kilometres travel (VKT) and vehicle hours travelled (VHT) for the entire road network including all roads within the study area are used to determine overall economic benefit for this project. In this study, their aggregate performance was estimated using the TRACKS model.

For a like-for-like comparison of percentage difference in VKT, VHT and average travel speeds values, baseline values for without project scenarios will correspond to the respective design. The 2041 EIS is compared to the 2041 without EIS baseline. The 2041 with the project is compared to the 2041 without the project baseline.

Table 5-2 Vehicle Kilometres Travel (VKT) and Vehicle Hours Travelled (VHT) with and without Project

Model Years	Annual		
	VKT	VHT	Average Travel Speed (km/h)
2041 without EIS (baseline)	476,194,104	13,380,301	36
2041 with EIS	494,333,651	9,571,655	52
Difference	18,139,547	3,808,647	+16
% difference with EIS	**+4%**	**-28%**	**+44%**
2041 without project (baseline)	512,596,923	14,150,516	36
2041 with project	568,872,954	10,809,563	53
Difference	56,276,031	3,340,953	+17
% difference with project	**+11%**	**-24%**	**+47%**

Source: TRACKS windowed model (2016),

5.2.3 TRAVEL TIME AND SPEED

Figure 5-4 shows the travel routes of the analysis, Yallah (point A) and Oak Flats (point B).

Table 5-3 presents the ultimate year 2041 travel times on the existing Princes Highway route and the new project route between Yallah and Oak Flats for the EIS design and with the revised project design. Results are reported for each peak in the highest volume direction. These being northbound in the AM peak and southbound in the PM peak.

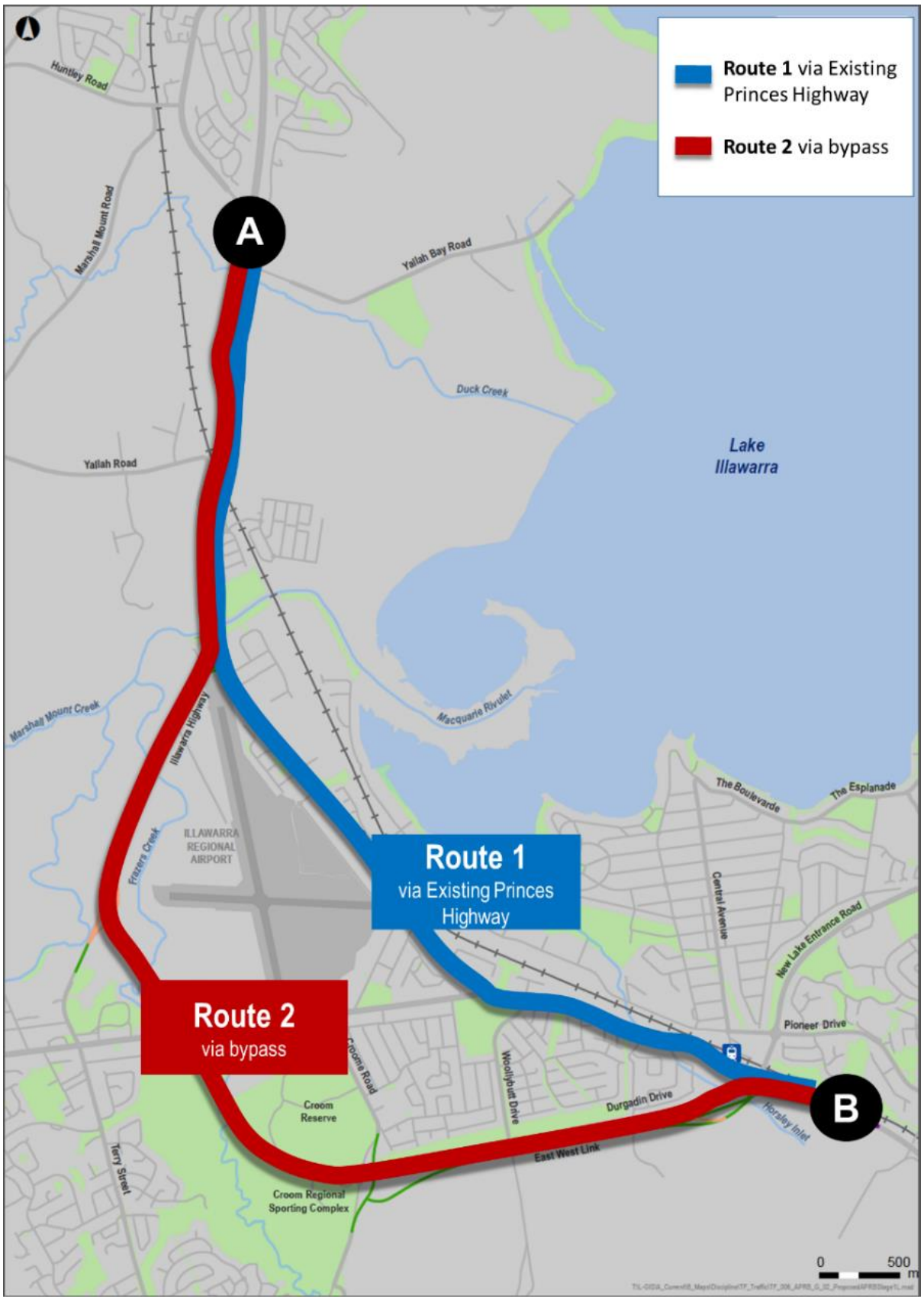


Figure 5-4 Travel Routes between Yallah and Oak Flats

The travel time savings have been calculated using the TRACKS strategic model, which may underestimate the level of delay caused by heavy congestion in the future year 'Do Nothing' scenarios. As such, the values reported below represent the minimum travel time savings that

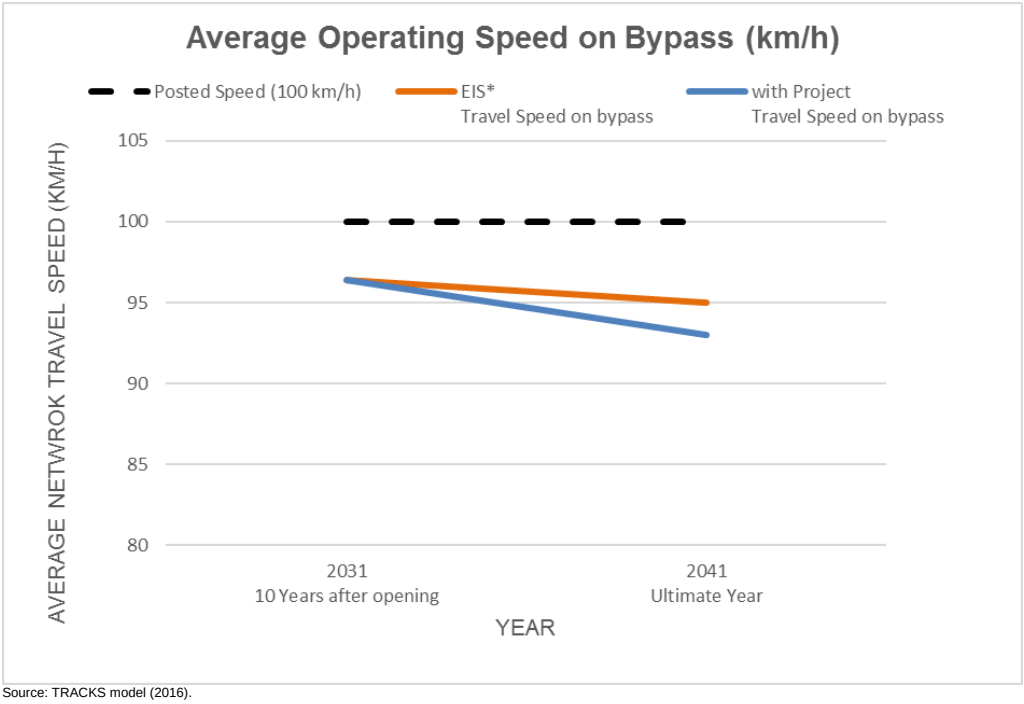
can be anticipated as a result of the project. Section 4.3 explains why the TRACKS Do Nothing models were used to assess the potential travel time savings of the project.

Table 5-3 Travel Time between Yallah and Oak Flats in 2041 with the project

Model Years	Between Yallah and Oak Flats	Travel Time (minutes)	
		AM Peak	PM Peak
	via roads	Northbound	Southbound
2041 without project (EIS)	Route 1 – via Princes Highway	18 minutes 12 seconds	16 minutes 42 seconds
2041 with project (EIS)	Route 2 – via bypass	6 minutes 18 seconds	6 minutes 24 seconds
EIS savings		11 minutes 54 seconds	10 minutes 18 seconds
% EIS savings		**65%**	**62%**
2041 without project	Route 1 – via Princes Highway	18 minutes 24 seconds	17 minutes 18 seconds
2041 with project	Route 2 – via bypass	6 minutes 42 seconds	6 minutes 42 seconds
Project savings		11 minutes 42 seconds	10 minutes 36 seconds
% With project savings		**64%**	**61%**

Source: 2016 TRACKS model

Figure 5-5 shows the average travel speed of both directions and both AM and PM peaks on the bypass for 2031 and 2041. The bypass is expected to maintain average travelling speeds of 96 km/h in 2031 and 93 km/h in 2041. The EIS calculated average travel speeds on the bypass in the respective design years are also shown for comparison.



Source: TRACKS model (2016).

Figure 5-5 Average Operating Travel Speed (km/h) on bypass

Average vehicle speeds by peak periods and direction along the bypass have been modelled as:

- AM Peak: southbound, 96.5 km/h, northbound, 89.3 km/h.
- PM Peak: southbound, 88.6 km/h, northbound, 97.5 km/h.

5.3 CAPACITY AND LEVEL OF SERVICE

The following section documents the 2041 network performance results. Figure 5-6 shows the locations of focus areas where detailed traffic analysis was undertaken using Aimsun. These locations are Northern interchange (also referred to as the Yallah interchange), Albion Park interchange and Oak Flats interchange, which are described in Sections 5.3.1, 5.3.2 and 1.1.1 respectively.

The traffic assessment provides the following performance outputs on the key areas:

- Main carriageway midblock Level of Service (LoS)
- Ramp midblock LoS
- Merging sections midblock LoS; and
- Intersection LoS.

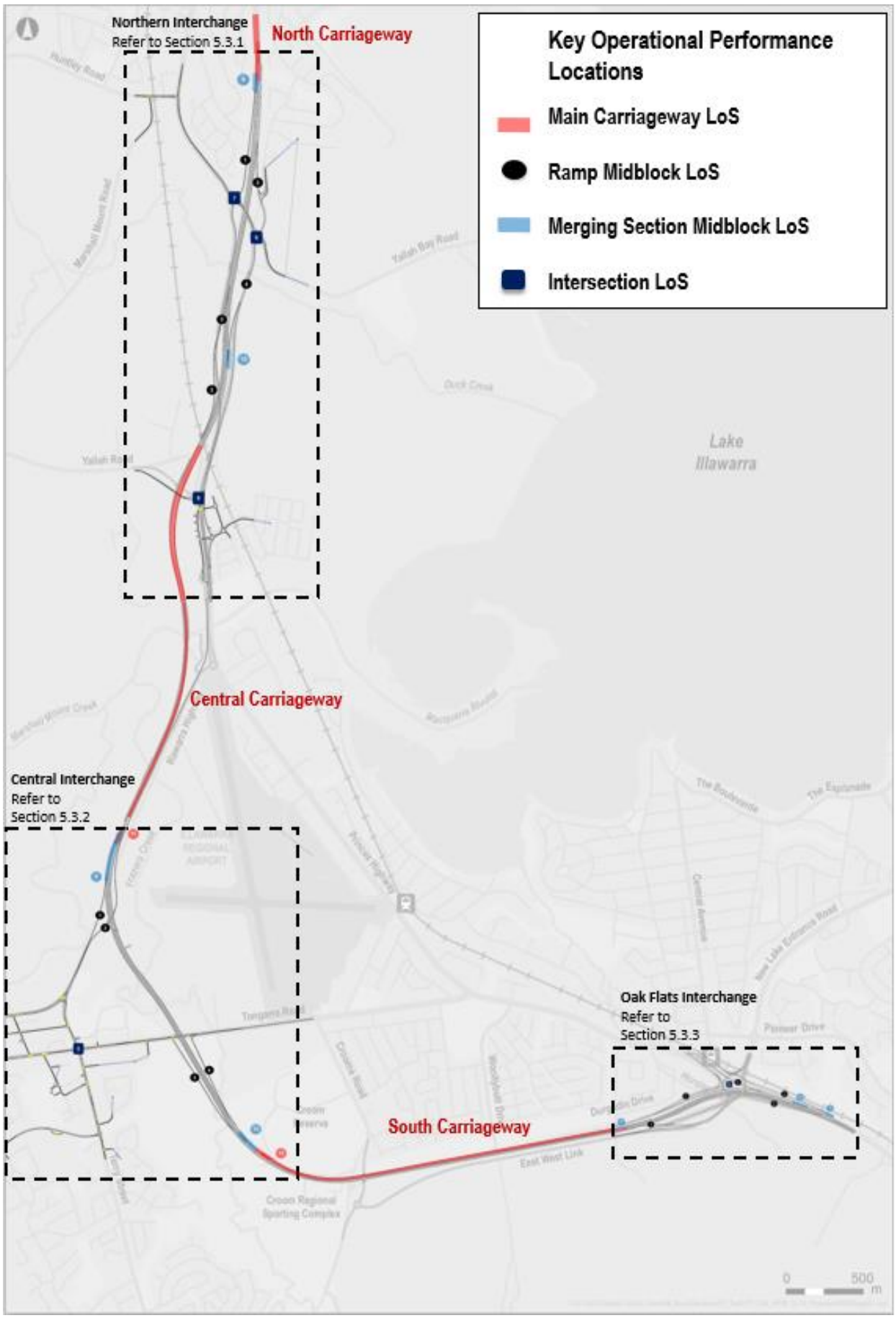


Figure 5-6 2041 Key Locations for Traffic Analysis

5.3.1 NORTHERN INTERCHANGE

Figure 5-7 highlights the key ramp locations, main carriageway, merging sections and intersection at the Northern interchange. Since the EIS, there have been layout adjustments to the eastern roundabout at Yallah interchange, however the connectivity remains unchanged from the EIS. The intersection Level of Service (LoS) results are presented for the worst movement for priority controlled (including roundabout) intersections and as an overall LoS (average delay across all approaches) for signalised intersections.

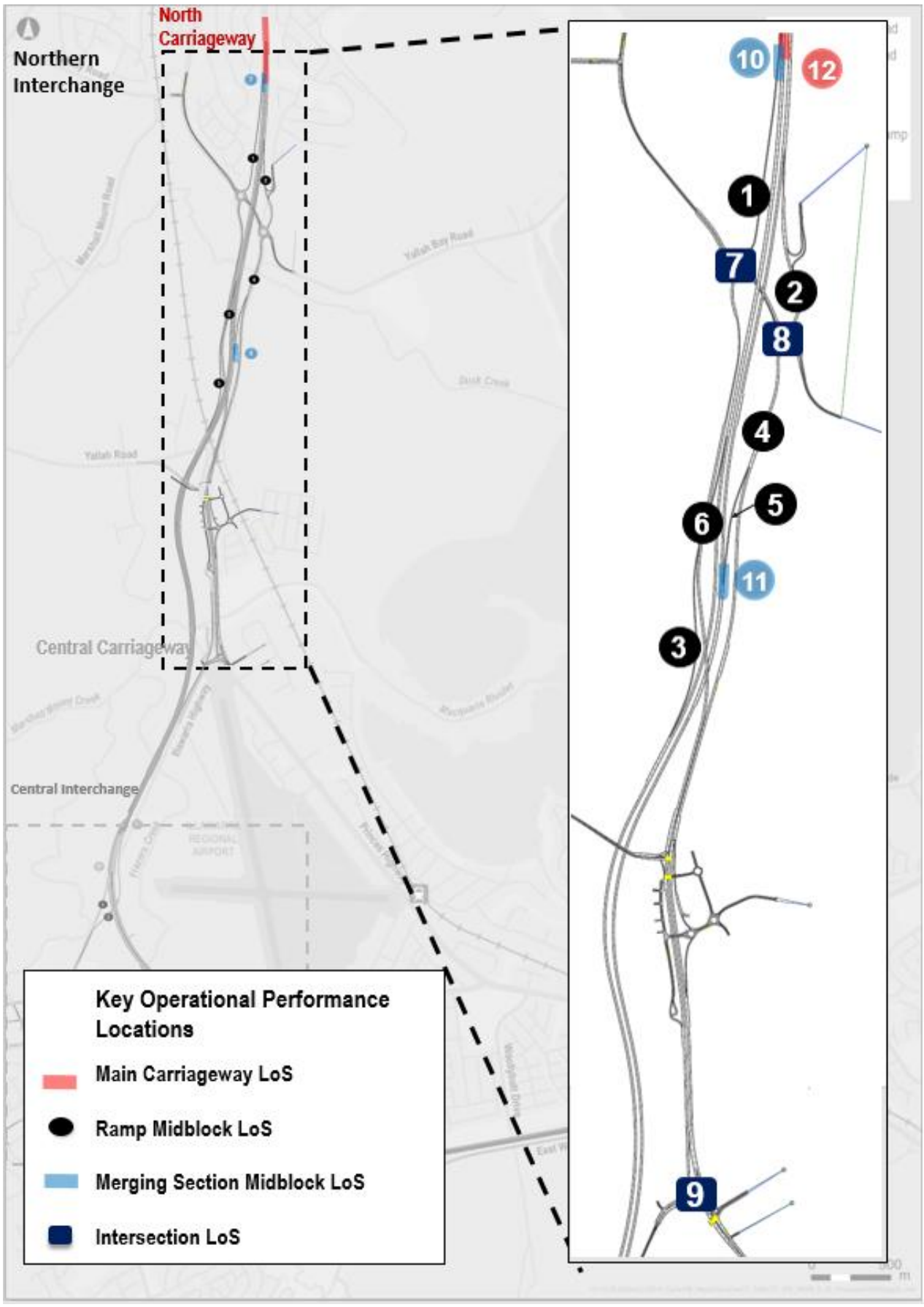


Figure 5-7 Northern Interchange Performance Locations

Table 5-4 and Table 5-5 summarise the results for the Northern interchange in the 2041 Aimsun model in comparison with the 2041 EIS results.

Table 5-4 Northern Interchange Performance Results – AM Results

ID	Location		EIS		Current Design	
Ramp Midblock Level of service		**No. of lanes**	**LoS**		**LoS**	
1	Northbound entry ramp	1	A		A	
2	Southbound exit ramp	1	C		B	
3	Northbound exit ramp	1	B		C	
4	Southbound entry ramp	1	A		C	
5	Southbound entry ramp	1	-*		B	
6	Northbound exit ramp	1	C		C	
Intersection Level of service		**Type**	**Average Delay (seconds)**	**LoS**	**Average Delay (seconds)**	**LoS**
7	Western roundabout	Roundabout	11	A	13	A
8	Eastern Roundabout	Signalised	17	B	25	B
9	Illawarra Highway / Princes Hwy	Roundabout	7	A	15	B
Merging Section Level of Service			**LoS**		**LoS**	
10	Northbound entry ramp		B		C	
11	Southbound entry ramp		C		B	
Main Carriageway Sections Midblock LoS			**LoS**		**LoS**	
12	North		Northbound: C Southbound: C		Northbound: C Southbound: B	

Source: Aimsun Model (2016).

* This ramp location has been changed equivalent performance results not comparable to the EIS

Table 5-5 Northern Interchange Performance Results – PM Results

ID	Location		EIS		Current Design	
Ramp Midblock Level of service		**No. of lanes**	**LoS**		**LoS**	
1	Northbound entry ramp	1	A		A	
2	Southbound exit ramp	1	C		B	
3	Northbound exit ramp	1	B		B	
4	Southbound entry ramp	1	B		C	
5	Southbound entry ramp	1	-*		B	
6	Northbound exit ramp	1	C		C	
Intersection Level of service		**Type**	**Average Delay (seconds)**	**LoS**	**Average Delay (seconds)**	**LoS**
7	Western roundabout	Roundabout	12	A	11	A
8	Eastern Roundabout	Signalised	22	B	26	B
9	Illawarra Highway / Princes Highway	Roundabout	7	A	11	A
Merging Section Level of Service			**LoS**		**LoS**	
10	Northbound entry ramp		B		B	
11	Southbound entry ramp		C		C	
Main Carriageway Sections Midblock LoS			**LoS**		**LoS**	
12	North		Northbound: B Southbound: D		Northbound: C Southbound: C	

Source: Aimsun Model (2016).

* This ramp location has been changed equivalent performance results not comparable to the EIS.

The midblock performance of the ramps (ID 1-6) all operate at an adequate LoS C or better in both AM and PM peak periods.

The merging sections (ID 10 and 11) on the motorway for the northbound and southbound entry ramps operate at LoS C or better in both peak periods.

The eastern roundabout at the Northern interchange (ID 8) is forecast to operate at LoS B in both AM and PM peak periods, with an average delay of 25 seconds in the AM peak hour and 26 seconds in the PM peak hour.

Ramp metering has been implemented at this roundabout on the northern and western approaches to allow sufficient opportunity for Yallah Bay Road traffic to exit. As shown in Table 5-6, all approaches perform at LoS C or better. It is anticipated that this metering will be further considered and refined at detailed design, including consideration of delaying the implementation of metering until it is necessary.

Table 5-6 Eastern Roundabout at Northern Interchange

ID	Intersection – Roundabout	Approach	AM		PM	
			Average Delay (seconds)	LoS	Average Delay (seconds)	LoS
8	Northern Interchange – eastern roundabout	North – southbound exit ramp	23	B	23	B
		East – Yallah Bay Road	26	B	32	C
		West – underpass approach	31	C	31	C
Overall Intersection			**25**	**B**	**26**	**B**

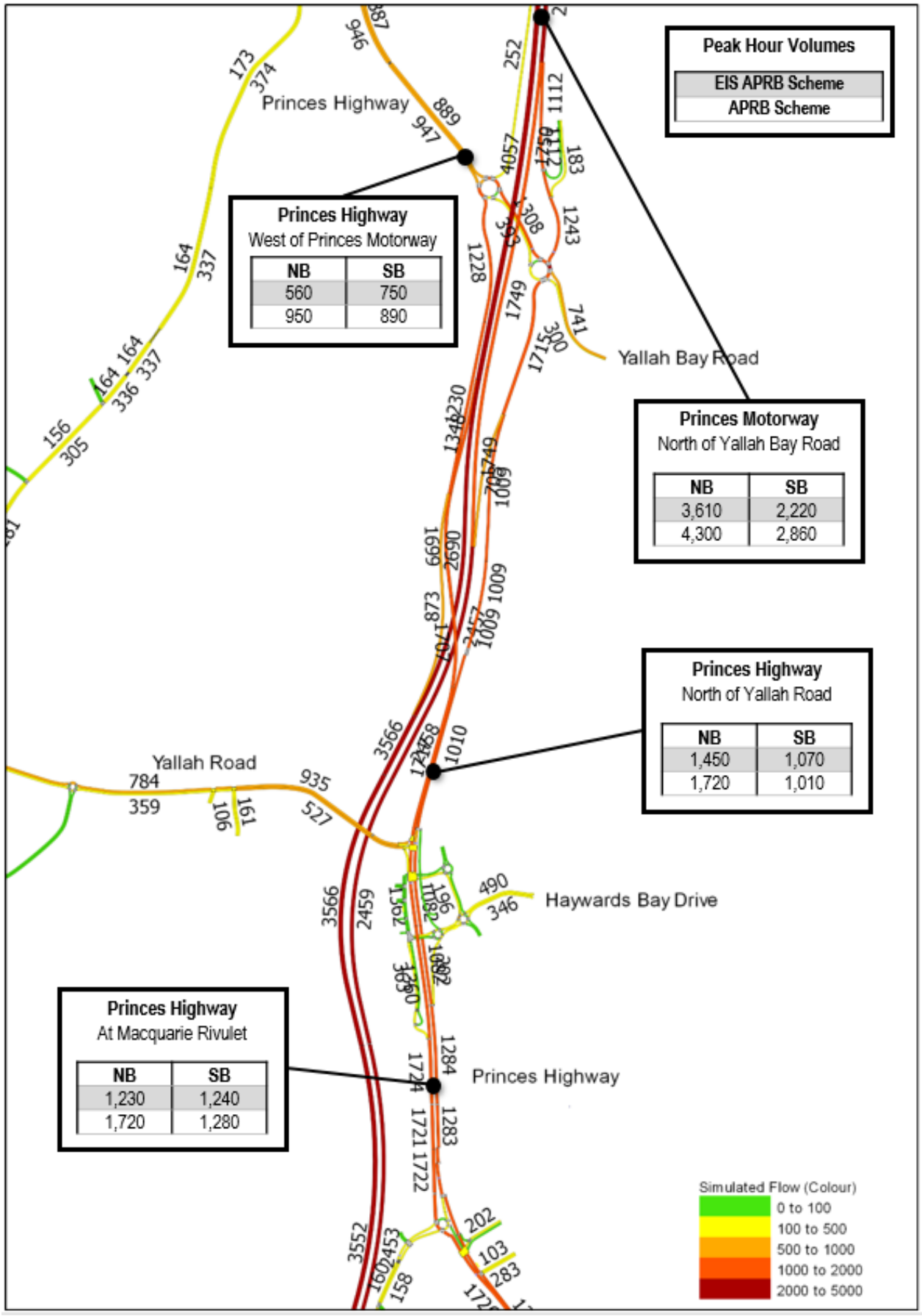
Figure 5-8 and Figure 5-9 shows the 2041 Aimsun with project AM and PM peak hour volumes plots at Northern interchange.

Princes Motorway and Princes Highway

There are approximately 3,600 vehicles travelling northbound and 2,500 vehicles travelling southbound in the AM Peak along Albion Park Rail bypass. The highest demand along Princes Highway in the AM Peak is 1,700 and 1,300 vehicles northbound and southbound respectively.

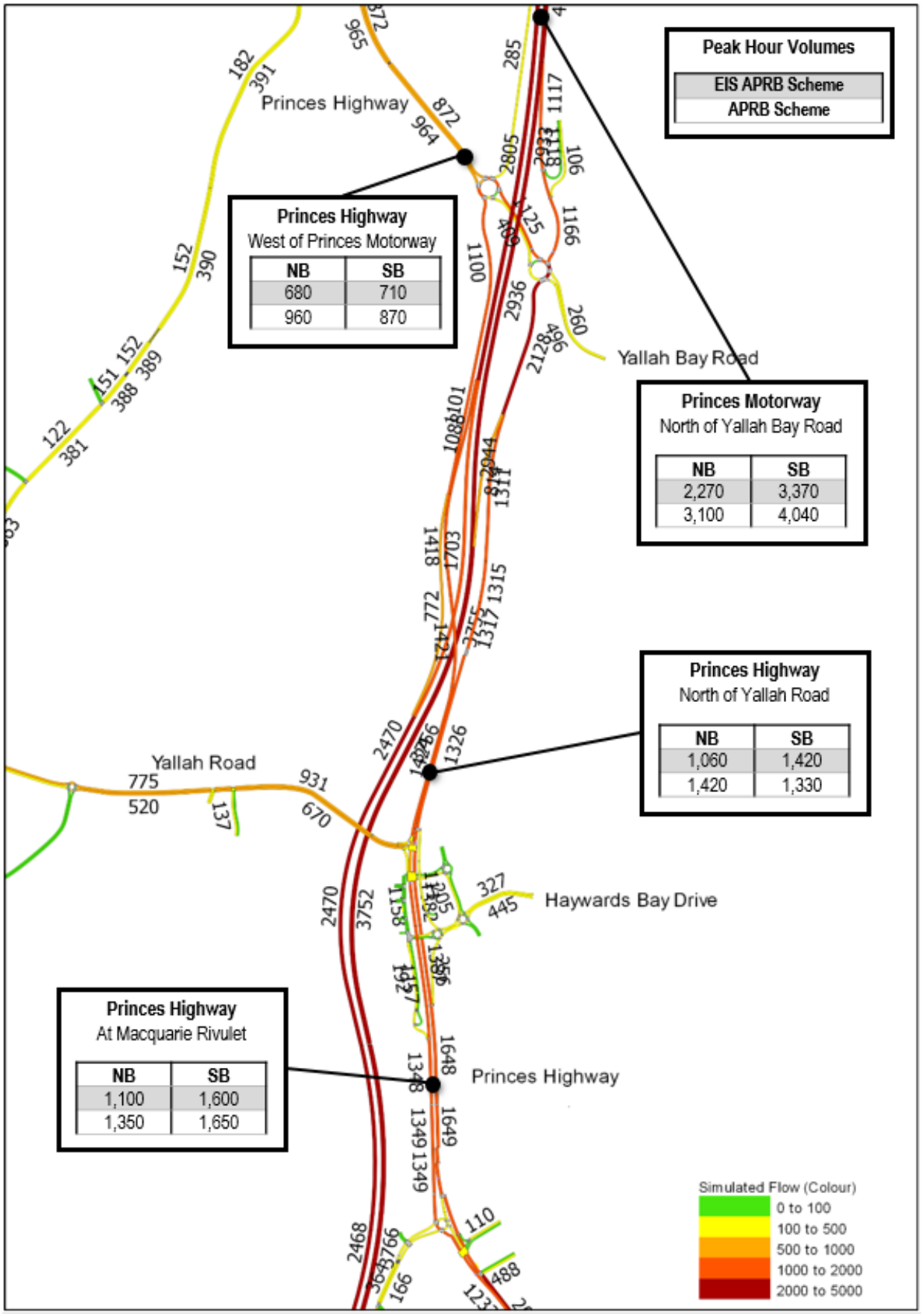
In the PM Peak, there are approximately 3,800 vehicles travelling southbound and 2,500 vehicles northbound on the Albion Park Rail bypass. LoS C is reported on the main carriageway for both northbound and southbound directions (ID 12). Roads and Maritime will monitor the performance of the motorway and assess the need for future widening to three lanes (which has been allowed for in the design) or other ways of increasing traffic capacity when required. It is likely that widening Princes Motorway to three lanes in each direction may be required, and there is provision for future widening to occur in the median of the bypass. The highest demand along Princes Highway in the PM Peak is 1,400 and 1,700 vehicles northbound and southbound respectively.

It should be noted that the LoS difference on the southbound approach of the main carriageway (ID12) between the EIS and the 2041 Aimsun model is due to the number of lanes and therefore traffic capacity provision that were assumed in each scenario. In the EIS, only two traffic lanes (SB) were considered during the modelling stage as opposed to the 2041 revised design Aimsun model that inlcuded three lanes. Since the LoS calculation is based on a volume to capacity ratio, it was calculated that the LoS (AM and PM peaks) of the southbound mainline approach in the 2041 revised design was improved when compared to the EIS even when accommodating higher traffic volumes.



Source: Aimsun Model (2016)

Figure 5-8 2041 Aimsun Model - Northern Interchange Volume Plot (AM)



Source: Aimsun Model (2016)

Figure 5-9 2041 Aimsun Model - Northern Interchange Volume Plot (PM)

5.3.2 ALBION PARK INTERCHANGE

Figure 5-10 shows the key ramp locations, main carriageway, merging sections, ramps and intersection assessed.

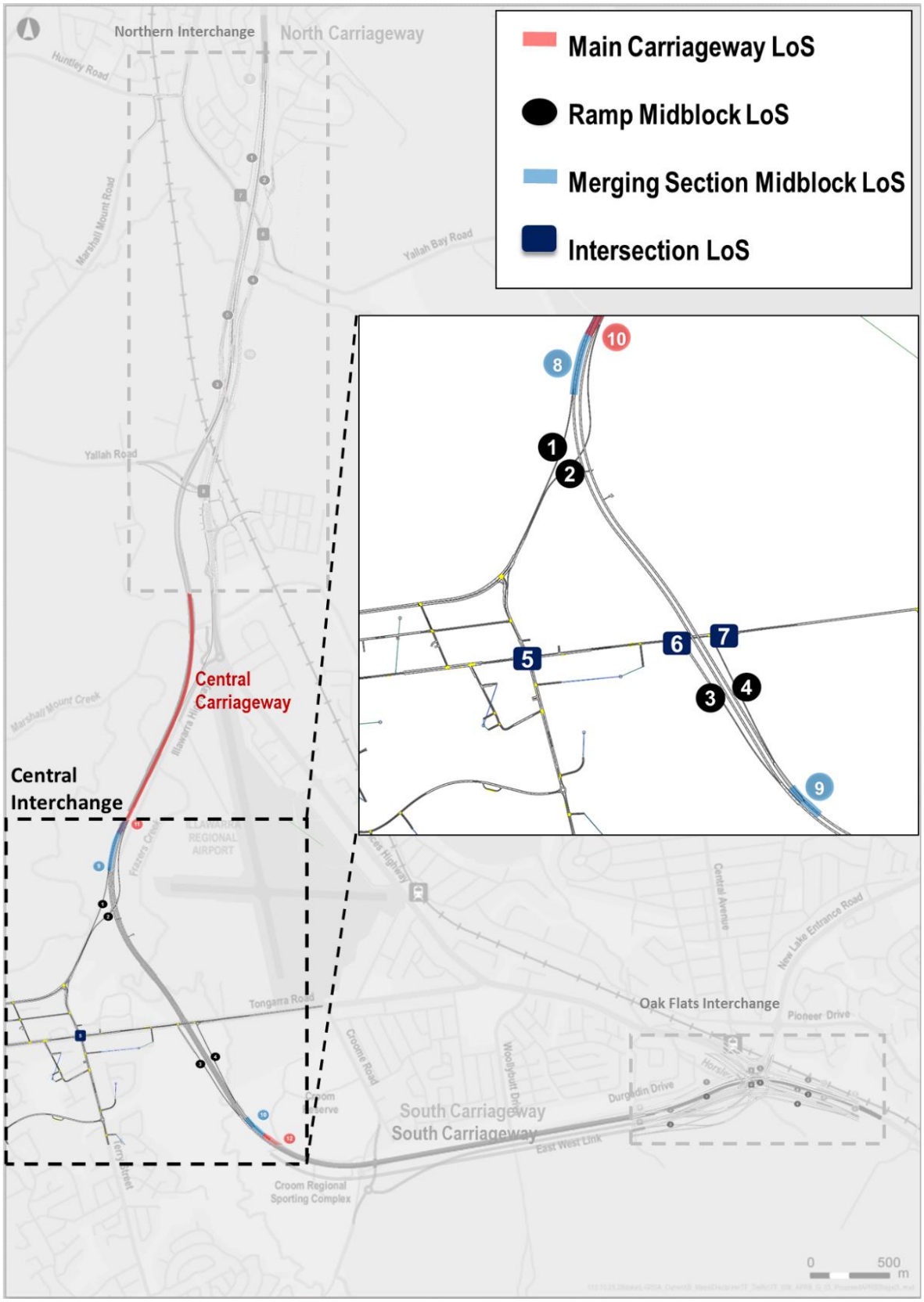


Figure 5-10 Albion Park Interchange Performance Locations

Table 5-7 and Table 5-8 shows the 2041 Aimsun AM and PM peak hour results for the project in comparison with the 2041 EIS results.

Table 5-7 Albion Park Interchange Performance Results – AM Results

2041	Location		EIS		Current Design	
Ramp Midblock Level of Service		**No. of lanes**	**LoS**		**LoS**	
1	Northbound entry ramp	1	D		E	
2	Southbound exit ramp	1	A		B	
3	Northbound exit ramp	1	C		C	
4	Southbound entry ramp	1	B		A	
Intersection Level of Service		**Type**	**Average Delay (seconds)**	**LoS**	**Average Delay (seconds)**	**LoS**
5	Terry St / Tongarra Rd[1]	Signalised	51	D	40	C
6	Tongarra Rd / northbound exit ramp	Signalised	-*	-*	12	A
7	Tongarra Rd / southbound entry ramp	Signalised	31	C	10	A
Merging Section Level of Service			**LoS**		**LoS**	
8	Northbound entry ramp		C		C	
9	Southbound entry ramp		B		B	
Main Carriageway Sections Midblock LoS			**LoS**		**LoS**	
10	Central		Northbound: C Southbound: B		Northbound: D Southbound: C	

Source: Aimsun Model (2016).

[1] Proposed right turn bans on all approaches.

* This ramp location has been changed equivalent performance results not comparable to the EIS.

Table 5-8 Albion Park Interchange Performance Results – PM Results

2041	Location		EIS		Current Design	
Ramp Midblock Level of Service		**No. of lanes**	**LoS**		**LoS**	
1	Northbound entry ramp	1	C		D	
2	Southbound exit ramp	1	B		C	
3	Northbound exit ramp	1	B		C	
4	Southbound entry ramp	1	C		B	
Intersection Level of Service		**Type**	**Average Delay (seconds)**	**LoS**	**Average Delay (seconds)**	**LoS**
5	Terry St / Tongarra Rd[1]	Signalised	51	D	25	B
6	Tongarra Rd / northbound exit ramp	Signalised	-*	-*	18	B
7	Tongarra Rd / southbound entry ramp	Signalised	35	C	14	A
Merging Section Level of Service			**LoS**		**LoS**	
8	Northbound entry ramp		B		B	
9	Southbound entry ramp		C		C	
Main Carriageway Sections Midblock LoS			**LoS**		**LoS**	
10	Central		Northbound: B Southbound: D		Northbound: C Southbound: D	

Source: Aimsun Model (2016).

[1] Proposed right turn bans on all approaches.

* This ramp location has been changed, equivalent performance results not comparable to the EIS.

All entry and exit ramps (ID 1-4) are expected to operate at an adequate LoS C or better with the exception of the northbound entry ramp (ID 1), where LoS E and LoS D is expected in the AM and PM peak periods respectively. Motorists can still expect to travel at acceptable speeds of 75 km/h in the AM peak and 79 km/h in the PM peak compared to a posted speed of 80km/hr at this ramp location.

The merging sections (ID 8 and 9) on Albion Park Rail bypass for the northbound and southbound entry ramps operate at LoS C or better in both peak periods.

The main carriageway (ID 10) mid-block performance north of the Albion Park interchange is LoS D northbound in the AM peak and LoS D southbound in the PM peak. LoS D is the level at which speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to manoeuvre within the traffic stream is limited and drivers experience reduced physical and psychological comfort levels.. Motorists can expect to travel at speeds of 88 km/h northbound and 80 km/h southbound, compared to a posted speed of 100 km/h at these

locations. The level of service on the mainline during peak hours highlights that by 2041 the two lane motorway will be experiencing congestion. Roads and Maritime will monitor the performance of the motorway and assess the need for future widening to three lanes (which has been allowed for in the design) or other ways of increasing traffic capacity when required.

The existing traffic network in Albion Park town centre will come under increasing pressure in the future as a result of large scale residential development such as Calderwood and Tullimbar. A pinch point for this congestion would be Terry and Tongarra Road intersection. Traffic growth is expected to increase substantially for this east west corridor movement as these residential developments are completed. Roads and Maritime is currently undertaking a corridor study for the Illawarra Highway this will review the future need of the corridor through Albion Park.

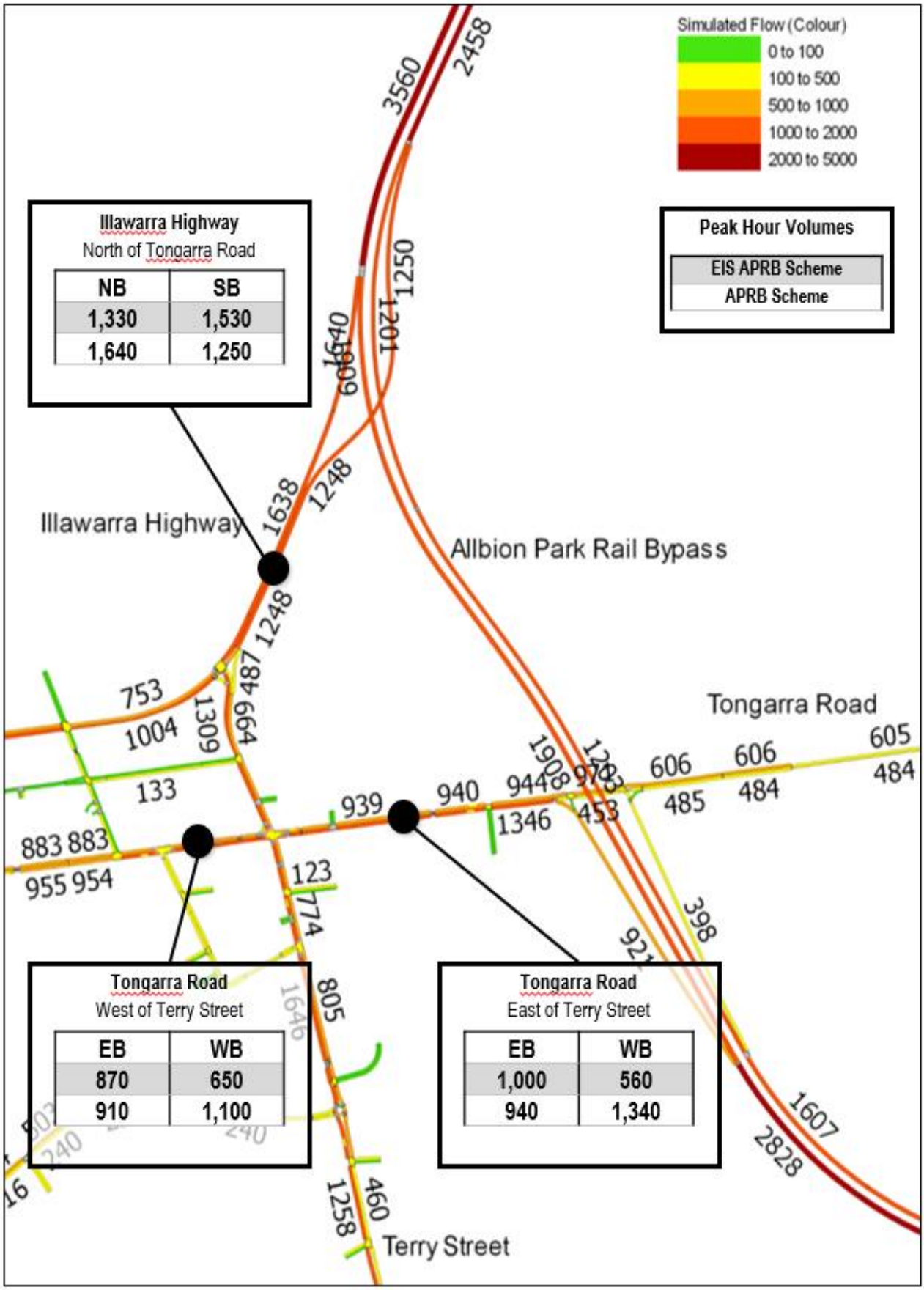
The intersection of Terry Street / Tongarra Road (ID 5) is forecast to operate at LoS C in the AM and LoS B in the PM peak periods, with an average delay of 40 seconds in the AM peak and 25 seconds in the PM peak. For the purposes of modelling the Albion Park Rail bypass, right turns on all legs of this intersection were assumed to be removed by 2041 (restricted right turns on the eastern and western legs are already in place during weekdays). It should be noted that the intersection of Terry Street / Tongarra Road currently experiences congestion within peak periods, it is acknowledged that this is an existing congestion problem for the Illawarra Highway. This intersection is outside of the project scope and banned right turns on the northern and southern legs were only applied for modelling purposes. Roads and Maritime will monitor congestion at the intersection and investigate ways of reducing congestion in the future.

The northbound exit ramp and southbound entry ramp intersections with Tongarra Road (ID 7) are forecast to operate at LoS B or better in the AM and PM peak. Both intersections are signalised by 2041. Additional modelling has shown that removal of traffic signals in this location would not impact overall traffic performance at this intersection. Removal of these signals could be considered at detailed design subject to safety and operational considerations.

The configuration of the northbound exit ramp has changed since the EIS, having been previously designed as a free flow ramp which connected to Terry Street. Detailed modelling and assessment of the free flow option was undertaken and the following issues were identified in the microsimulation model during the AM and PM peaks:

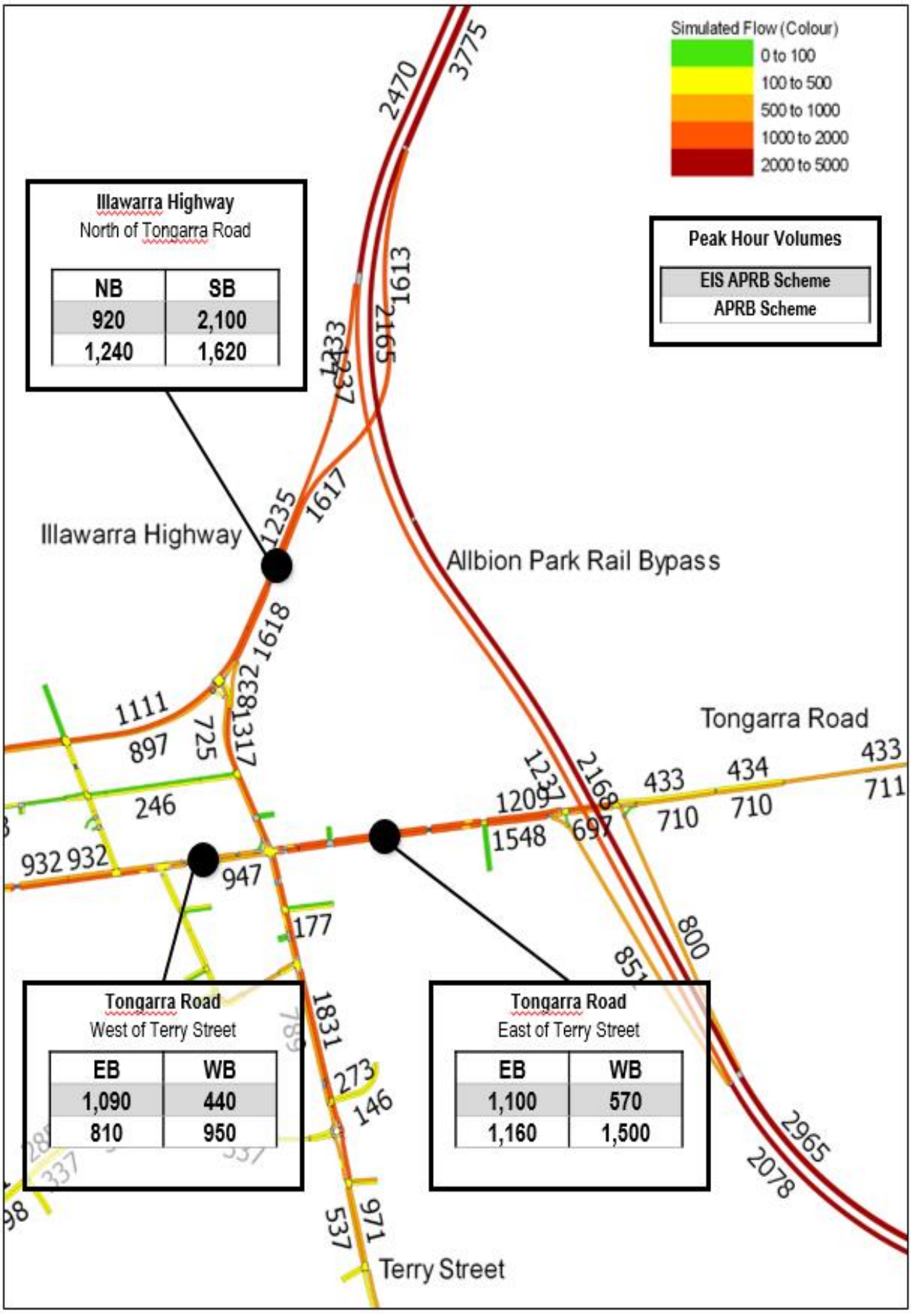
- Extensive queuing and delay on Terry Street on the approach to Tongarra Road.
- Extensive queuing and delay on Tripoli Way west of Terry Street.
- Weaving behaviour on the approach to the Tripoli Way / Terry Street intersection, with long queues extending back to the motorway ramps.

Figure 5-11 and Figure 5-12 show the 2041 Aimsun AM and PM peak hour volumes at Albion Park interchange. There are approximately 2,800 vehicles travelling northbound on the bypass from Oak Flats interchange with 900 diverging and 1,900 merging to and from Albion Park in the AM Peak. Conversely, in the PM Peak, there are approximately 3,800 vehicles travelling southbound from Yallah with 1,600 diverging and 800 merging to and from Albion Park.



Source: Aimsun Model (2016)

Figure 5-11 2041 Aimsun Model – Albion Park Interchange Volume Plot (AM)



Source: Aimsun Model (2016)

Figure 5-12 2041 Aimsun Model – Albion Park Interchange Volume Plot (PM)

Figure 5-13 below shows the forecast average daily traffic (ADT) for the ultimate design year 2041 in the Albion Park town centre in the various scenarios. Forecast ADT was calculated using factored peak hour volume flows from the respective TRACKS models.

With the residential developments of Calderwood and Tullimbar there is a heavy demand in the 2041 traffic model for traffic to move east-west through Albion Park in order to access the motorway. There are two main routes for east-west traffic in the 2041 traffic model including the existing Illawarra Highway (Tongarra Road) and the proposed Tripoli Way, a Shellharbour City Council project. In the EIS design three of the ramps were located close to the Tripoli Way corridor and one was located at Tongarra Road. With the proposed design the northbound exit ramp has been relocated to Tongarra Road, so two ramps are located close to Tripoli Way and two at Tongarra Road. Figure 5-13 shows that traffic volumes on Tongarra Road increase as a result of the relocation of the ramp, compared to the design presented in the EIS.

The proposed design spreads traffic between the two main east west links through Albion Park in the 2041 traffic model more evenly thus reducing likely congestion to either route. It is noted that the proposed location of the northbound exit and southbound entry ramps would allow flexibility for future upgrades to the road network in Albion Park.

Roads and Maritime will continue to monitor the traffic performance through Albion Park and determine the suitability and timing of future road upgrades through Albion Park. This will require coordination with Shellharbour City Council on the proposed future distributor road (Tripoli Way) for the Albion Park urban area and future connection to Albion Park Rail Bypass project. Roads and Maritime is currently undertaking a corridor study for the Illawarra Highway and this will review the future need of the corridor through Albion Park.

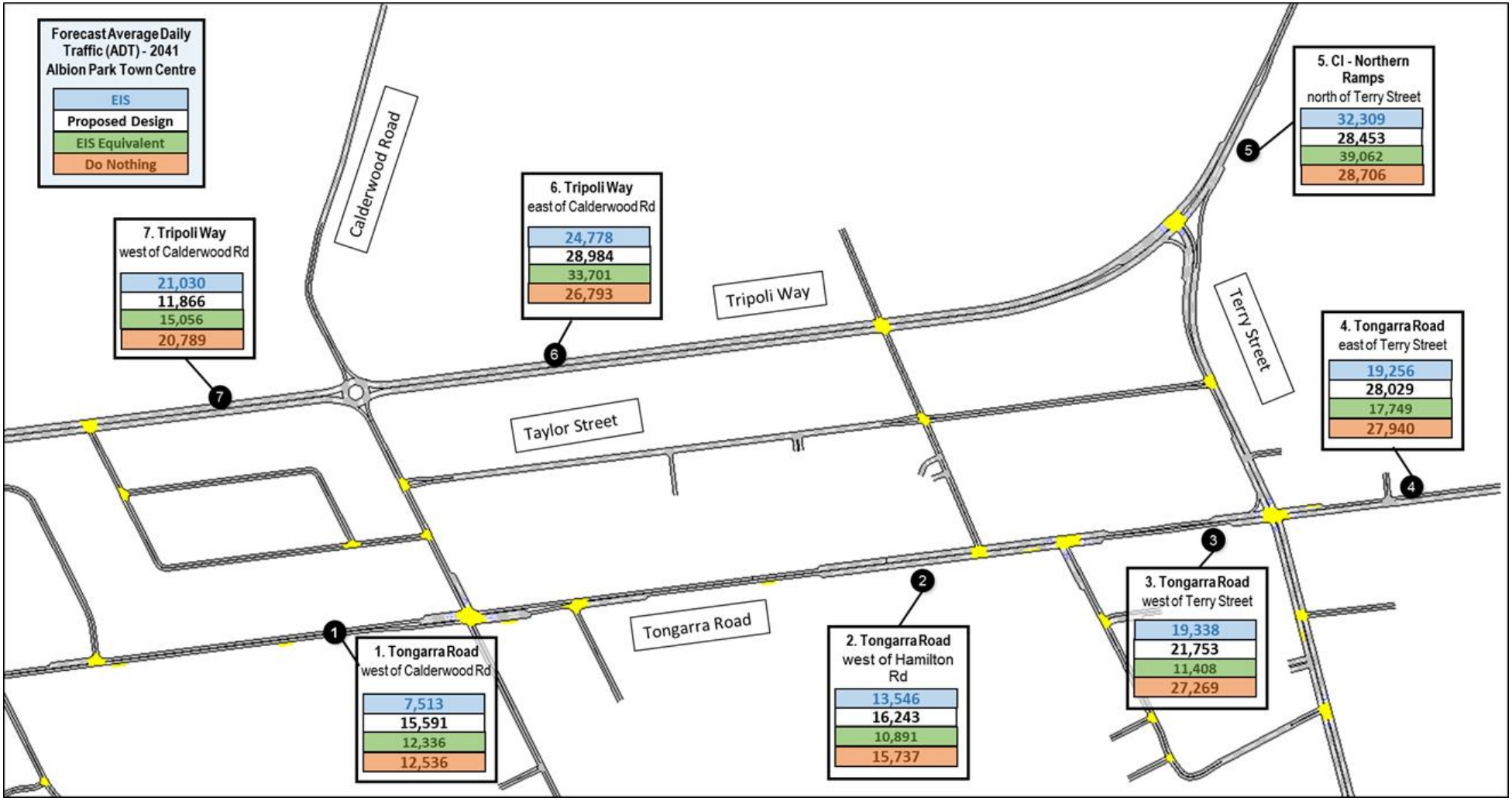


Figure 5-13 2041 Forecast Average Daily Traffic Comparison (Albion Park Town Centre)

5.3.3 OAK FLATS INTERCHANGE

The Oak Flats interchange enables connectivity between Albion Park, Albion Park Rail, Shellharbour and Oak Flats via entry and exit ramps at Oak Flats interchange. Figure 5-14 highlights the key ramp locations, main carriageway, merging sections and ramp locations at Oak Flats interchange.

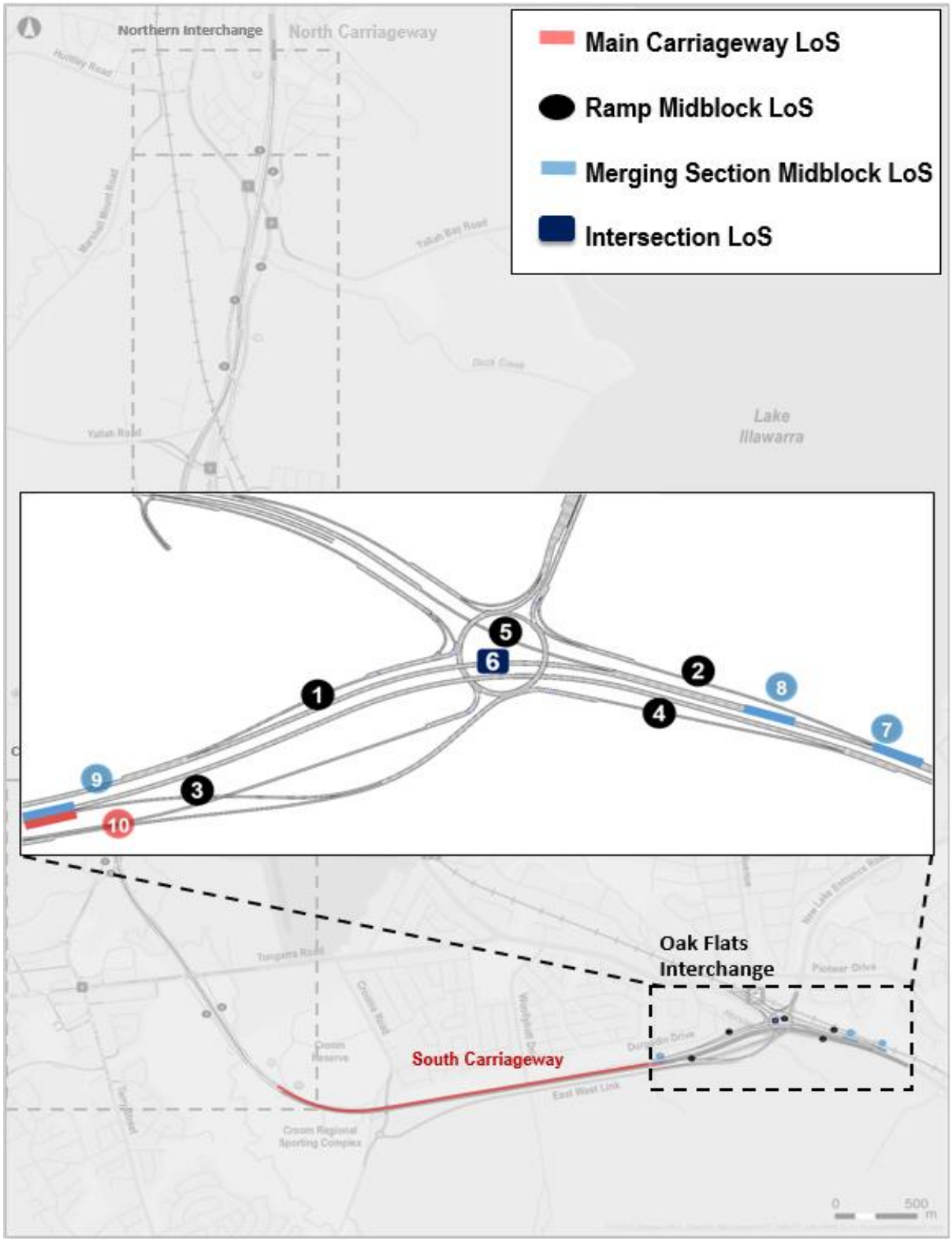


Figure 5-14 Oak Flats Interchange Performance Locations

Table 5-9 and Table 5-10 summarises the Aimsun results for the Oak Flats interchange in the 2041 model in comparison with the 2041 EIS results.

Table 5-9 Oak Flats Interchange Performance Results – AM Results

2041	Location		EIS		Current Design	
Ramp Midblock Level of service		**No. of lanes**	**LoS**		**LoS**	
1	Southbound exit ramp	1	B		A	
2	Southbound entry ramp	1	A		A	
3	Northbound entry ramp	1	-*		C	
4	Northbound exit ramp	1	B		B	
5	Southbound ramp	1	A		A	
Intersection Level of service		**Type**	**Average Delay (seconds)**	**LoS**	**Average Delay (seconds)**	**LoS**
6	Oak Flats Interchange	Metered Roundabout	18	B	39	C
Merging Section Level of Service			**LoS**		**LoS**	
7	Southbound entry ramp (East)		-*		B	
8	Southbound entry ramp (West)		-*		A	
9	Northbound entry ramp		-*		C	
Main Carriageway Sections Midblock LoS			**LoS**		**LoS**	
10	South		Southbound: C Northbound: B		Southbound: C Northbound: B	

Source: Aimsun Model (2016).

*Equivalent performance results not available in the EIS.

Table 5-10 Oak Flats Interchange Performance Results – PM Results

2041	Location		EIS		Current Design	
Ramp Midblock Level of service		**No. of lanes**	**LoS**		**LoS**	
1	Southbound exit ramp	1	C		B	
2	Southbound entry ramp	1	A		A	
3	Northbound entry ramp	1	-*		C	
4	Northbound exit ramp	1	B		A	
5	Southbound ramp	1	A		A	
Intersection Level of service		**Type**	**Average Delay (seconds)**	**LoS**	**Average Delay (seconds)**	**LoS**
6	Oak Flats Interchange	Metered Roundabout	19	B	28	B
Merging Section Level of Service			**LoS**		**LoS**	
7	Southbound entry ramp (South)		-*		C	
8	Southbound entry ramp (North)		-*		B	
9	Northbound entry ramp		-*		B	
Main Carriageway Sections Midblock LoS			**LoS**		**LoS**	
10	South		Southbound: B Northbound: C		Southbound: C Northbound: C	

Source: Aimsun Model (2016).

*Equivalent performance results not available in the EIS.

All entry and exit ramps associated with Oak Flats interchange (ID 1-5) operate at LoS C or better in both the AM and PM peak periods.

The Oak Flats metered signalised interchange operates at an overall LoS C in the AM and LoS B in the PM peak periods. As shown in Table 5-11, the worst delay experienced on any approach to the roundabout is about one minute. The majority of road users are expected to experience average delays at this intersection of under 40 seconds during the AM peak and below 30 in the PM peak period.

Table 5-11 Intersection of Oak Flats Interchange

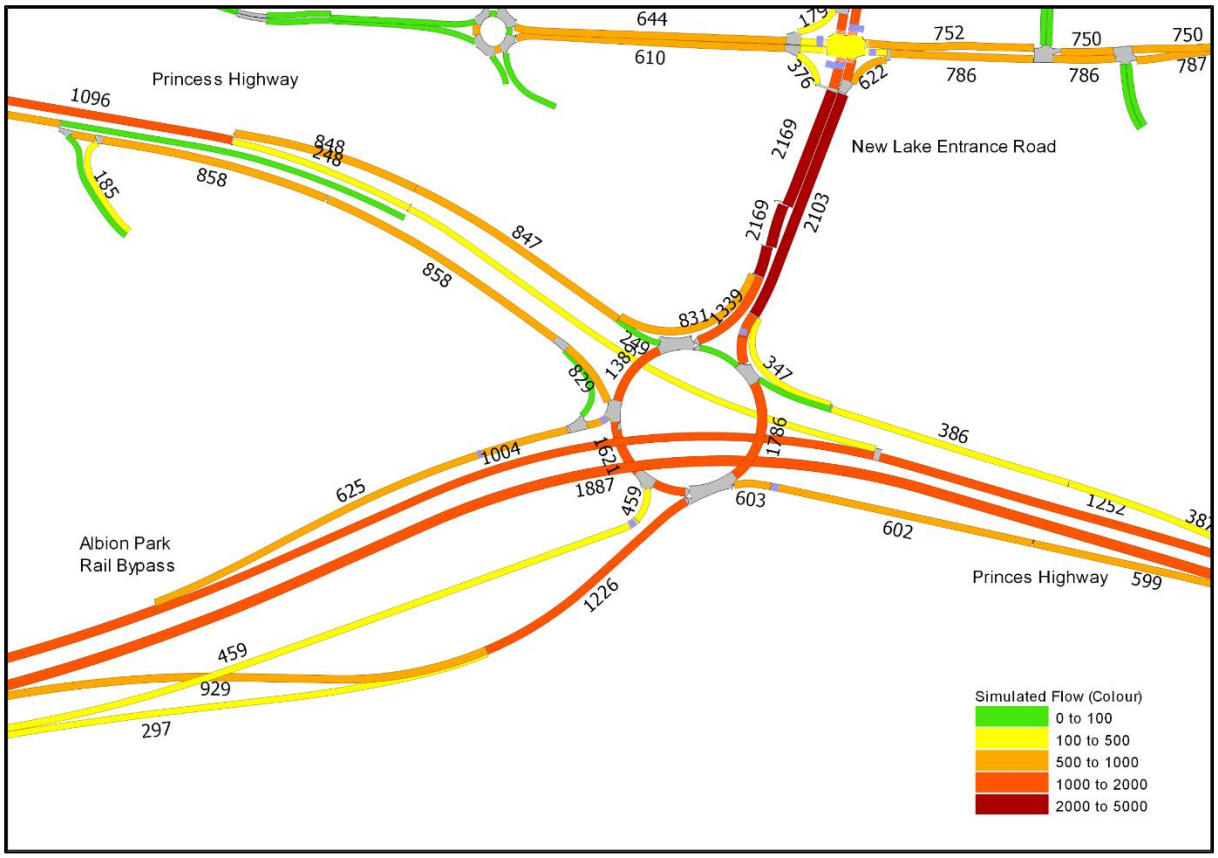
ID	Intersection – Roundabout	Approach	AM		PM	
			Average Delay (seconds)	LoS	Average Delay (seconds)	LoS
9	Oak Flats Interchange	North-east – New Lake Entrance Road	60	E	36	C
		East – northbound exit ramp	61	E	45	D
		South-west – East West Link	61	E	56	D
		West – south bound exit ramp	57	E	46	D
		North-west – southbound exit ramp	11	A	19	B
		Overall Intersection	**39**	**C**	**28**	**B**

The above results reflect signalised metering of key approaches to the Oak Flats roundabout to achieve a minimum suitable interchange performance. Additional traffic modelling undertaken has demonstrated that full signalisation of the roundabout, including signalisation of all approaches, will achieve similar or improved traffic performance for the interchange. Consideration of implementation of full signalisation at this interchange could be made at the detailed design change, subject to road design and safety considerations.

The merges at the Oak Flats interchange (ID 7-9) for traffic accessing Princes Highway southbound and Albion Park Rail Bypass northbound operate at LoS C or better.

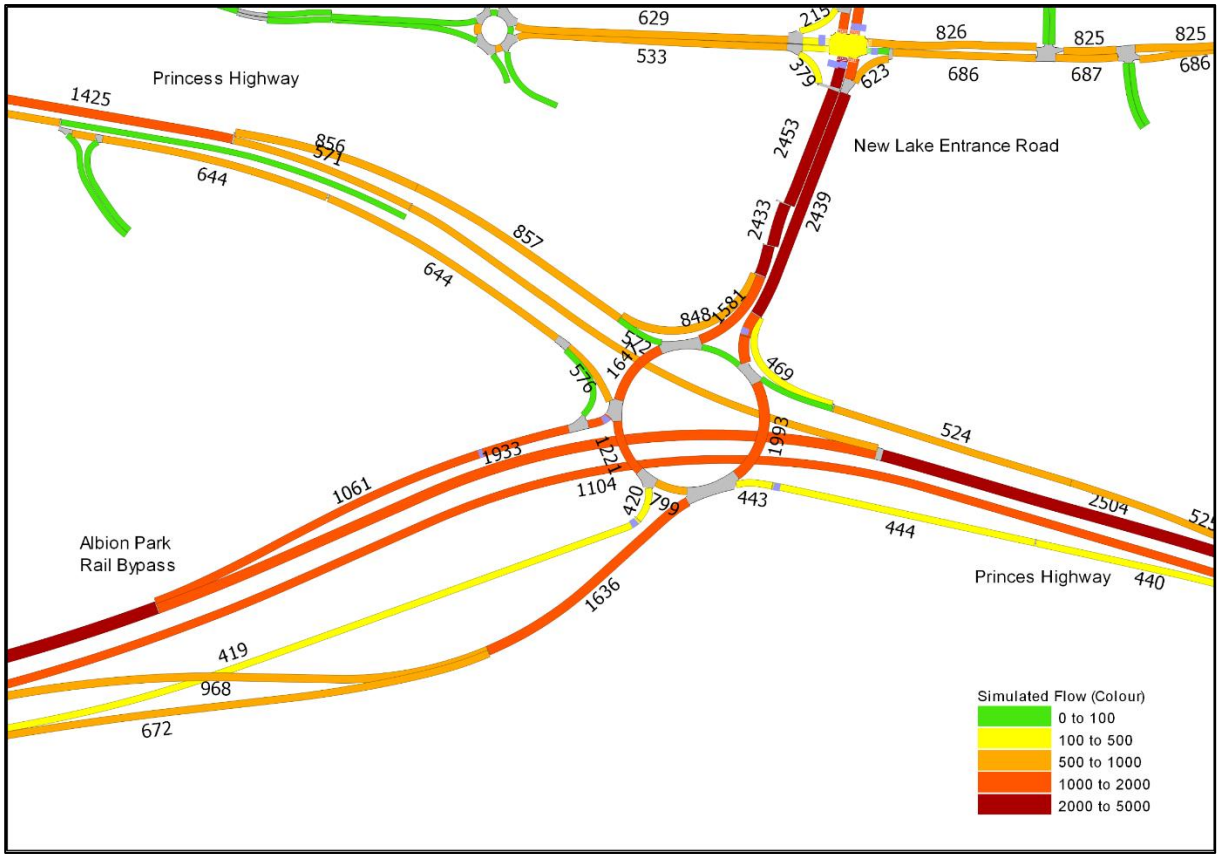
The bypass main carriageway between Albion Park interchange and Oak Flats interchange (ID 10) operates with a midblock LoS C or better in both the AM and PM peak periods

Figure 5-15 and Figure 5-16 shows the 2041 Aimsun AM and PM peak hour volumes plots at Albion Park interchange. There are approximately 2,500 vehicles travelling northbound in the AM Peak and 2,600 southbound in the PM Peak on Albion Park Rail bypass / Princes Motorway.



Source: Aimsun Model (2016).

Figure 5-15 2041 Aimsun Model – Oak Flats Interchange Volume Plot (AM)



Source: Aimsun Model (2016).

Figure 5-16 2041 Aimsun Model – Oak Flats Interchange Volume Plot (PM)

5.4 QUARRY ACCESS

Holcim Quarry provided a submission querying the suitability of the proposed access point to their quarry along East West Link. This led to the reinvestigation of both the Holcim and Cleary Brothers Quarry access points. Each quarry currently has a four leg roundabout controlled intersection at their access point. Due to the bypass, the north leg is to be closed at both locations. The EIS design proposed that priority controlled intersections replace the access points.

Traffic modelling of both access points was reassessed with revised inputs based on the 2014 surveys and outputs from the 2041 Aimsun model. The assessment uses updated traffic generation provided by Holcim based on traffic counts during the AM peak between 14 November 2016 and 18 November 2016. The Cleary Brothers traffic generation remains unchanged, as per the EIS volumes. Table 5-12 shows the traffic generation from the quarries for the reassessment.

Table 5-12 Estimated Quarry Trip Generation

	AM Peak		PM Peak	
	In	Out	In	Out
East Quarry (Cleary Brothers)	54	45	35	61
West Quarry (Holcim)	35	35	21	50

Source: Cleary Brothers Quarry – Proposed Increase to Annual Production Levels Traffic Impact Assessment (GTA Consultants, 2012).

Holcim Quarry – Vehicle movement counts undertaken by Holcim (14 November 2016 to 18 November 2016).

A comparison of the 2041 Aimsun East-West Link volumes with the 2014 Quarry intersection surveys was undertaken to determine the 'worst case' eastbound and westbound traffic volumes. For a conservative assessment, the intersection analysis used the highest East-West link volumes between the two sources.

Table 5-13 East West Link Volumes

East – West Link Volumes	AM		PM	
	Eastbound	Westbound	Eastbound	Westbound
2014 Survey Volumes	808	443	650	776
EIS Volumes	604	447	570	678
2041 Aimsun Volumes	458	299	412	674
Volumes adopted into this assessment	808	443*	650	776

ume was taken based on the difference shown in heavy vehicles movements

SIDRA modelling software was used to assess the intersection of the Holcim and Cleary Brothers quarry accesses. The intersection modelling shows that by using worst case eastbound and westbound East-West Link volumes, Cleary Brothers priority controlled access road and Holcim priority controlled access road would fail at LoS F. The intersection performance summary for the priority controlled intersections is shown in Table 5-14 below.

Table 5-14 Intersection Performance Summary – Priority Controlled Intersections

Intersection	AM			PM		
	DoS	Delay (sec)	LoS	DoS	Delay (sec)	LoS
East-West Link / Cleary Brothers Access	1.213	497.1	F	1.916	1061.8	F
East-West Link / Holcim Access	1.277	538.8	F	0.872	210.9	F

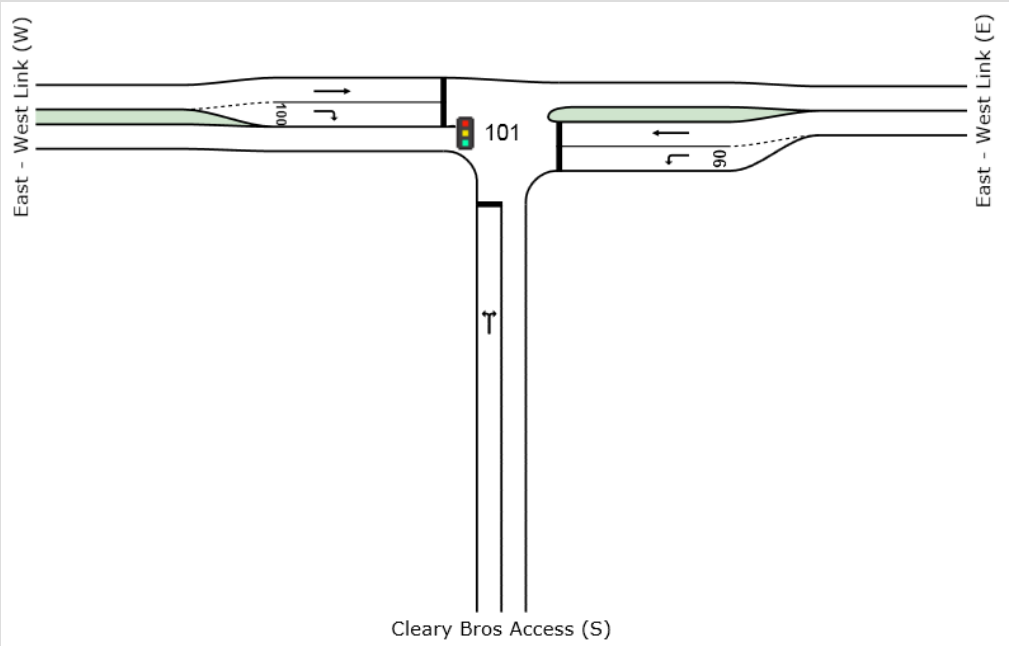
In order to achieve satisfactory intersection performance, the implementation of signals was tested as a mitigation measure. By implementing signals at the quarry access intersections, results show an overall reduction in delay for traffic exiting the quarries. The intersection performance summary for the signalised intersections is shown in Table 5-15 below.

Table 5-15 Intersection Performance Summary – Signalised Intersections

Intersection	AM			PM		
	DoS	Delay (sec)	LoS	DoS	Delay (sec)	LoS
Signalised East-West Link / Cleary Brothers Access	0.640	5.7	A	0.620	6.4	A
Signalised East-West Link / Holcim Access	0.618	5.2	A	0.561	5.1	A

As a result of the revised traffic model, the implementation of traffic lights at opening year is proposed at the quarry access intersections on East-West Link. With the implementation of traffic lights, both quarry access intersections operate at LoS A. Table 5-16 shows the proposed quarry access layouts.

Table 5-16 Proposed Quarry Access with Traffic Lights

Proposed Typical Quarry Access


5.5 UPDATED CRASH DATA

The crash data analysis has been undertaken using crash data provided by Roads and Maritime for a five year period from 2011- 2016.

Crash data was provided for A1 Princes Highway, Illawarra Highway, and Tongarra Road. Figure 5-17 illustrates the location of crashes along the subject area.

Figure 5-17 Crashes by Degree of Injury in the Study Area (2011 – 2016)

5.5.1 CRASH DATA SUMMARY

Between 1 July 2011 and 30 June 2016, a total of 333 crashes have been reported on the A1 Princes Highway, Illawarra Highway and Tongarra Road between Yallah and Oak Flats.

- One (1) fatal crash
- 177 casualty crashes
- 155 non-casualty (tow-away) crashes.

From the Roads and Maritime crash data, five common crash types were identified. The five types of crashes account for over 65 per cent of all reported incidents within the study area and are described below as per the Roads and Maritime crash data tables. For consistency with the Roads and Maritime crash data, the crash type description has been maintained.

5.5.2 PRINCES HIGHWAY CRASHES

The Road and Maritime crash data indicates that the majority of crashes were reported on the A1 Princes Highway, being 284 crashes (equivalent to 85 per cent of the total of crashes).

- One (1) fatal crash.
- 148 casualty crashes.
- 135 non-casualty (tow-away) crashes.

The estimated crash events for 2041 Do Nothing and 2041 with the project have been calculated based on the existing crash rate on the Princes Highway (crashes / 100MVKM). Traffic volumes for the Princes Highway corridor were extracted from the 2014 traffic surveys and 2041 TRACKS model.

The estimated 5-year crash totals that would occur along the Princes Highway in different design scenarios are presented below in Table 5-17.

Table 5-17 Forecast 5-Year Crash Totals on Princes Highway

Princes Highway	Fatal	Casualty	Non-Casualty (Tow-away)
2014 Existing	1	148	135
2041 Do Nothing	2	225	206
2041 With Project	0	72	66

Based on the anticipated reduction in casualty crashes presented in Table 5-17, the equivalent annual crash cost savings as a result of building the Albion Park Rail bypass are $4.5 million per annum in 2041. Calculations are based on an average urban casualty crash cost of $146,300 (Victorian Crash Data 1997-2001) and are presented in 2002 Dollars. These crash cost savings are directly attributable to reduced traffic volumes on Princes Highway between Oak Flats and Yallah.

5.6 IMPACT ON ROAD SAFETY

The above crash reduction targets are applicable to the existing corridor of the Princes Highway. The project would also reduce future traffic volumes along Tongarra Road and East-West Link, which would result in additional road safety benefits. A significant proportion of the future through traffic from the Calderwood area travelling south would be diverted onto the motorway once the southbound entry ramp from Tongarra Road is opened, reducing the incidents of crashes on Tongarra Road and Princes Highway. The improved safety conditions on key roads that provide access to Albion Park Rail and Albion Park is an important benefit of the project.

5.7 IMPACTS ON OTHER TRAVEL MODES

5.7.1 HEAVY VEHICLES

The proposed project arrangement in comparison to the EIS would result in minimal changes and benefits to heavy vehicles. Any vehicles from the south, heading west of Albion Park and exiting at Tongarra Road would now be routed along the Illawarra Highway, as they presently are. They will be able to bypass the Princes Highway and Tongarra Road between the Oak Flats interchange and Tongarra Road exit ramp.

5.7.2 PUBLIC TRANSPORT

Routes 76 and 77, Shellharbour to Albion Park (Loop Service) travels on Tongarra Road, Princes Highway. The service currently turns right from Terry Street (south leg) to Tongarra Road (east leg). Banned right turns have been assumed on this intersection for the 2041 traffic modelling With the banned right turns, route 76 and 77 could be diverted via Russell Street where the right turn on to Tongarra Road is permitted. This intersection is not part of the project Roads and Maritime will monitor the performance of the Terry Street / Tongarra Road intersection and develop further traffic management measures when required.

6 ASSESSMENT OF CONSTRUCTION IMPACTS

Four changes have been identified from the EIS construction assessment, which are outlined in Section 6.1 – Section 6.3. The proposed design changes and the construction impacts have been assessed. It has been deemed that these changes cause no impact to the overall construction impacts and discussions presented in the EIS.

6.1 HOURS OF CONSTRUCTION

Standard construction hours in NSW are:

- 7:00am to 6:00pm Monday to Friday
- 8:00am to 1:00pm Saturday.

This project proposes to include extended construction hours as discussed in the RtS report. These include the following:

- Between 6:00am and 7:00pm Monday to Friday
- Between 8:00am and 5:00pm on Saturdays.

6.2 TEMPORARY ANCILLARY SITES

Four ancillary sites have been removed from the design. These are:

- AS02 – Compound and access point from Cormack Avenue
- AS05 – Compound and access point from local access road and Illawarra Highway. AS05 was previously proposed to be the Main Site Office, which is now AS08
- AS07 – Compound and access point from Illawarra Highway
- AS12 – Compound and access point from East West Link Road.

The references for the ancillary sites have also been updated.

6.3 IMPACTS TO THE EXISTING ROAD NETWORK

6.3.1 ALBION PARK INTERCHANGE

The northbound exit ramp within the Albion Park interchange has been relocated to Tongarra Road. This shift of the ramp has minimal impacts to the construction methodology and as such no changes to the number of trucks and the routes taken by trucks is required.

7 MITIGATION MEASURES

A review of the traffic and transport environmental management measures for the project was undertaken.

Should this project be approved, the environmental management measures in Table 7-18 would guide the subsequent project development phases (design and construction) of the proposed bypass.

Table 7-18 Proposed Summary of Mitigation and Management Measures

Issue	ID no.	Environmental management measure	Responsibility	Timing
Construction traffic management	TT01	A traffic management plan will be prepared (in accordance with Roads and Maritime specification G10) including: ▪ Traffic Control Plans showing the access arrangements to ancillary sites and the location of required signs and devices ▪ Pedestrian and cyclist management plan where necessary to ensure access is maintained where is it safe and feasible during construction ▪ Road safety audit requirements ▪ Any localised improvements / adjustments to existing traffic management arrangements.	Contractor	Construction

8 REFERENCES

- AustRoads (2003), Guide to Traffic Engineering Practice, AustRoads.
- AustRoads (2013a), Guide to Traffic Management Part 3 – Traffic Studies Analysis, AustRoads.
- AustRoads (2013b), Guide to Traffic Management Part 6 – Intersections-Interchanges-Crossings, Austroads.
- Hyder Cardno Joint Venture (2015), *Albion Park Rail Bypass Traffic and Transport Assessment*, NSW Roads and Maritime Services.
- New Zealand Transport Agency (2014), Transport Model Development Guidelines, New Zealand Transport Agency.
- Roads and Maritime (2002), *Guide to Traffic Generating Developments, Issue 2.2*, NSW Roads and Maritime Services.
- Roads and Maritime (2009), *Supplements Guide To Road Design Part 4C – Interchanges,* NSW Roads and Maritime Services.
- Roads and Maritime (2013), *Traffic Modelling Guidelines*, NSW Roads and Maritime Services.
- Transportation Research Board (2010), *Highway Capacity Manual*, Transport Research Board.