

5 TRAFFIC MODELLING AND FORECASTING PROCESS

This chapter provides details of the traffic modelling and forecasting approach which was adopted for project performance assessment. Four types of traffic modelling software and outputs have been considered including strategic transport model (TRACKS), intersection analysis (SIDRA), merge / diverge analysis (HCM 2010) and microsimulation (Paramics) traffic models. Together, these traffic modelling applications have been used to determine the expected traffic operational performance with and without the project in operation.

5.1 TRAFFIC MODELLING APPROACH

A two stage traffic modelling and forecasting approach has been used. The modelling determined existing and future traffic conditions on key roads and intersections with and without the project in operation. Figure 5-1 provides an overview of traffic modelling approach used for this study.

A two stage traffic modelling and forecasting approach involved:

- TRACKS strategic transport model (the TRACKS model). The TRACKS windowed model for the study area provided current and future traffic demand with and without the project. The TRACKS windowed model represents the core modelling study area of this project. Figure 5-2 shows the network boundary for the windowed model. The TRACKS model has considered related road upgrade projects being planned, new release areas (population and employment growth) in the local area (including Albion Park and Albion Park Rail) and regional traffic impact.
- Detailed traffic analysis and modelling. This focused on the operational performance of key roads, intersections, new motorway (the project) and associated interchanges during peak periods based on projected traffic volumes from TRACKS model. For detailed intersection capacity analysis, SIDRA software was used. For merging and diverging analysis, Highway Capacity Manual (HCM2010) was used. For microsimulation modelling, Paramics software was used.

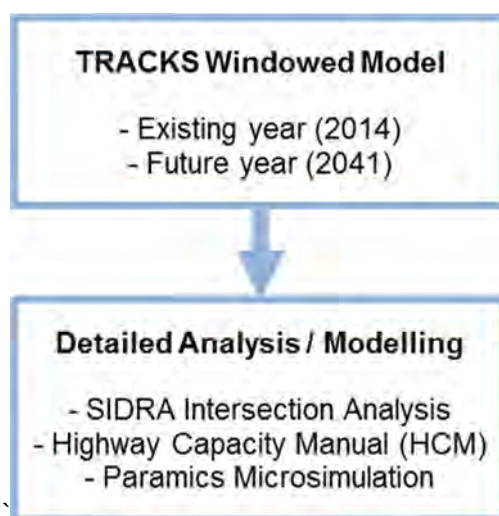


Figure 5-1 Overview of Traffic Modelling Approach

5.1.1 TRACKS MODEL

The Wollongong and Shellharbour Strategic Transport model (WOLSH) was developed by TDG using TRACKS software (TRACKS model). The TRACKS model covers road network which includes the Wollongong and Shellharbour local government areas. For the purpose of this study, TDG augmented the TRACKS model for existing 2014 traffic conditions. The existing 2014 TRACKS model was calibrated and validated using new 2014 traffic survey. One future development model which represents year 2041 traffic conditions has been built for the purpose of this project. The future development model was built based on the known land use forecast for the entire Wollongong and Shellharbour areas. The future development model includes planned new release areas including Calderwood, Marshall Mount and West Dapto. Section 5.4.1 documents details assumptions used in the future development model.

5.1.2 TRACKS WINDOWED MODEL

A TRACKS windowed model (sub-area) was developed by TDG for the study area network (refer to Figure 5-2) based on the entire TRACKS model. The TRACKS windowed model represents the core modelling study area of this project. Further model calibration and validation was undertaken for 2014 traffic conditions by TDG in TRACKS windowed model retaining local traffic flows and route choices within the study area. The TRACKS windowed model specifically quantifies traffic for an average weekday, by way of modelling the morning and afternoon peaks explicitly, then expansion factors are applied to represent average daily traffic.

The following TRACKS windowed models were used in the traffic assessment including:

- Existing year 2014 morning and afternoon peak models
- Future development model for morning and afternoon peak. The future development model formed the basis of options development, scenario testing and economic evaluation. The year 2041 represents the future development model. Section 0 documents future growth and further justification on the selection of future year for modelling purpose.

The future development model was used to undertake more detailed assessments using SIDRA, HCM and Paramics where required.

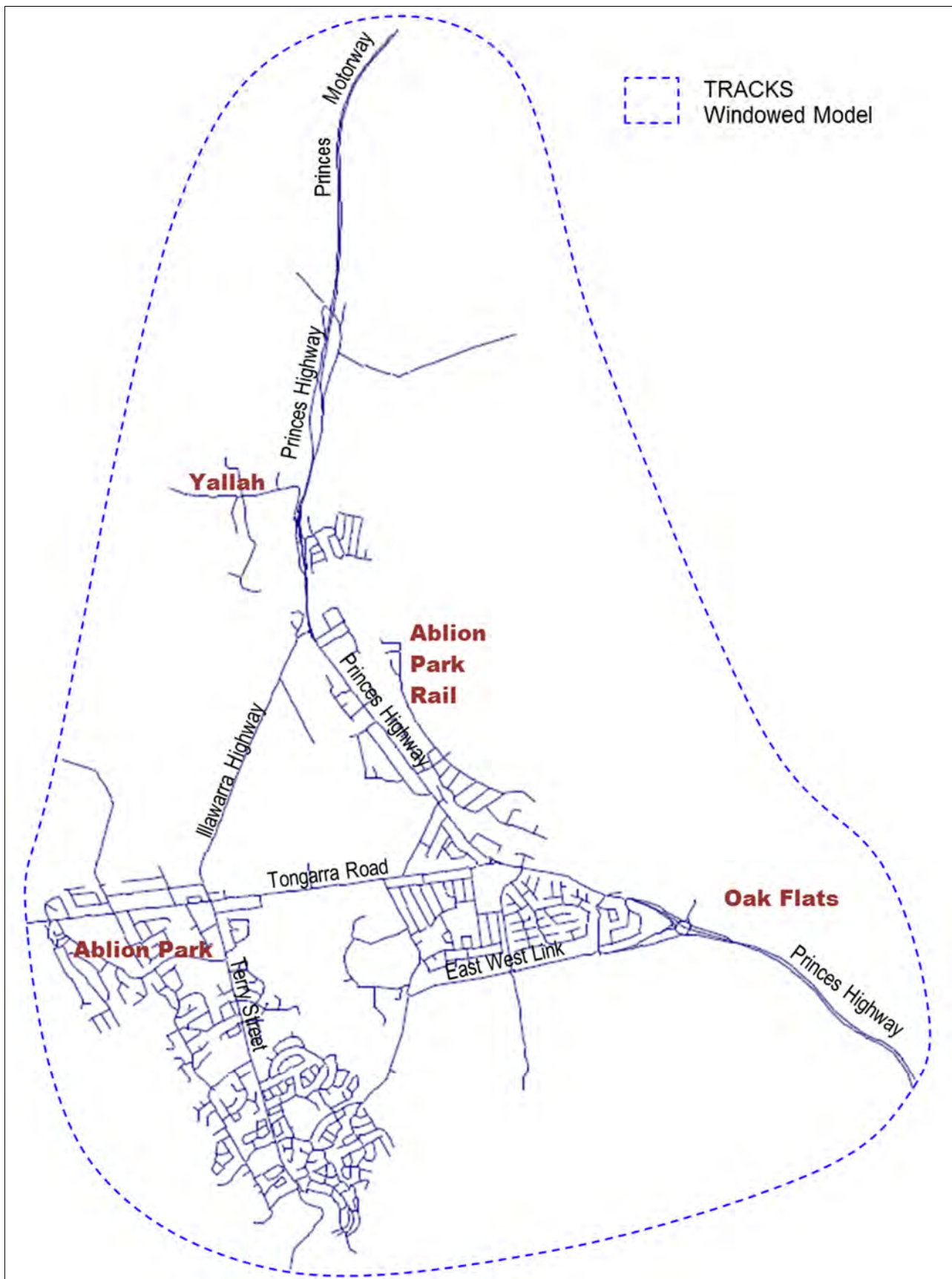


Figure 5-2 TRACKS Model for the Study Area

5.1.3 SIDRA MODEL

Detailed intersection capacity analysis was undertaken using SIDRA for three interchanges (at Yallah, Albion Park and Oak Flats) and key intersections along the A1 Princes Highway between Yallah and Oak Flats.

5.1.4 PARAMICS MODEL

Paramics models were developed for two discrete areas as follows:

- Northern Interchange PARAMICS model - A Paramics model was developed for the northern interchange at Yallah by HCJV team. The model was used for to test merging manoeuvres at the interchange.
- Yallah Road PARAMICS model - A Paramics model developed by Bitzios Pty Ltd for the Yallah Road / Howards Bay Road interchange with the A1 Princes Highway at Yallah. The model was referenced in the design and assessment of the Yallah Road area.

5.1.5 MERGING / DIVERGING ANALYSIS

Merging and diverging analysis was undertaken using US Highway Capacity Manual (HCM 2010) to provide detailed network operation issues and mitigation to design. The analysis has been undertaken for the following areas:

- Yallah interchange
- Albion Park interchange
- Oak Flats interchange.

5.2 FUTURE LAND USE

The traffic congestion on the highway is predicted to intensify as a result of continuing population growth in the Wollongong and Shellharbour LGAs, with developments being planned at Calderwood, West Dapto, Tullimbar and Tallawarra (refer to Figure 5-3). It is estimated that these would add up to 30,000 new home sites when fully developed.

- **West Dapto Urban Release Area** – The West Dapto area is an urban release project which is located to the west of the current Dapto Township. The proposed development is currently in the planning stages and is proposed as include 19,000 dwellings giving residence to 50,000 people and creating 8,500 jobs. Yallah-Marshall Mount is part of the West Dapto Urban Release Area and consists of a 1005 hectare site with approximately 3,200 – 3,500 dwellings.
- **Shellharbour Hospital Redevelopment** – Planning is currently underway for a major redevelopment of the Shellharbour Hospital. The proposed development would result in a significant increase in beds at the existing location. Funding has also been provided for a new Ambulatory Care facility at the hospital.
- **Calderwood Development** – The Calderwood Urban Development Project consists of approximately 700 hectares of rural land which extends across both Wollongong and Shellharbour LGA's. The development is located north west of Albion Park, in the vicinity of Calderwood Road. Approval has been provided for 4,800 residential dwellings and 50 hectares of mixed use land.

- **Tallawarra Lands Development** – The Tallawarra Lands site is located between Koonawarra and Haywards Bay and consists of a 580 hectares site currently owned by TruEnergy and the former Power Station. The development is expected to include 40 hectares of commercial and industrial land, 16 hectares of retail development and over 1,000 dwellings. In addition, 23 hectares for Open space and 300 hectares for Environmental conservation.
- **Tullimbar Village Development** – Tullimbar is located to the south west of Albion Park and is an area proposed for a significant residential subdivision. It is proposed for the area to house approximately 5,000 residents in 2,000 dwellings and also includes plans for a town centre and local school. The area will include a mixed use centre with shops, childcare centre, town hall and leisure centre.
- **Haywards Bay** – The Haywards Bay residential development is located immediately east of the Princes Motorway at the northern end of the study area. The residential catchment has direct access to the Princes Motorway via a grade separated interchange. The Haywards Bay development currently contains in the order of 250 dwellings, with the ability for the area to continue to develop to around 400 dwellings. This translates that about 60 per cent has been developed.



Figure 5-3 Future Developments

5.3 RELATED PROJECTS

Two road projects interact with the proposed Albion Park Rail bypass project including:

- **Yallah Road upgrade** – It is anticipated this project will be driven by the proposed development of the Yallah-Marshall Mount precinct of the West Dapto Urban Release Area. An upgrade of the intersection connecting the A1 Princes Highway and Yallah Road intersection would be required. The Yallah Road upgrade will be developed by Wollongong City Council, however to ensure appropriate integration with the Albion Park Rail bypass, the section of the Yallah Road upgrade between Larkins Lane and the A1 Princes Highway is being included in the planning approval for this project.
- **Albion Park bypass via Tripoli Way** – The need for a future bypass of Albion Park (Tripoli Way) has been identified in Shellharbour City Council's Local Environmental Plan and is included in the recent Section 94 Contributions Plan, 2013 (refer to Figure 5-4). The planning of the Albion Park Rail bypass has taken into account potential connection of Tripoli Way to the Albion Park Rail bypass. The premise is to provide a bypass for the township of Albion Park. Significant future development and land use changes are proposed in the Calderwood area, west and north-west of Albion Park. The upgrade of future Tripoli Way including connection to Terry Street is driven by the proposed development in the Calderwood area in order to provide access to and from this changing land use. With the increase in residential, business and commercial land uses proposed as a result of Calderwood development, it is likely that the role of Albion Park town centre as a commercial and retail hub is likely to increase in the future. It can be expected that additional retail and commercial based trips to and from Albion Park will be generated. As a result, it is desirable to consider the role of Tongarra Road through Albion Park in the context of its functionality as a 'main street' in a town centre environment. The role of future Tripoli Way to reduce the through traffic volumes through the Albion Park town centre is an important consideration for the Albion Park Rail bypass project. Figure 5-4 below shows the proposed Tripoli Way bypass of Albion Park. The future development models used in the analysis considered both future projects.

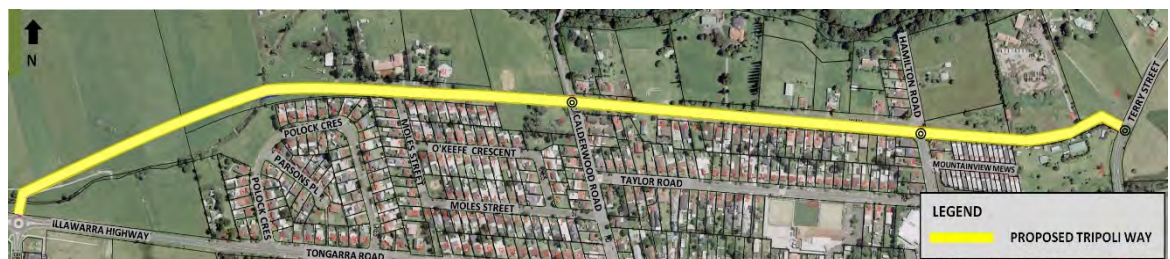


Figure 5-4 Proposed Tripoli Way

5.4 FUTURE TRAFFIC GROWTH

5.4.1 SELECTION OF FUTURE YEAR

Future traffic volumes on key roads within the study area will be influenced by a combination of regional and local traffic growth. Future traffic growth in the study area was sourced from TRACKS windowed models. TRACKS provided forecast traffic volumes on key roads for existing (2014) and future development model year.. The future development model was developed based on land use projection which includes full development potential for Calderwood, West Dapto including Marshall Mount, and Tallawarra development areas.

To assist in identifying a future development model year, traffic growth analysis was undertaken on key roads (at nine screenline locations) across the study area network for two time periods including:

- Traffic growth between 2014 and 2036 for a period of 22 years
- Traffic growth between 2014 and 2046 for a period of 32 years

The predicted growth rates from above mentioned two periods were compared with historical growth rates observed across the study area road network Previous Section 3.5 documented historical growth rates analysis undertaken between 2000 and 2014.

Further growth rate has been reported at the following nine screenline locations including:

- Screenline 1 – Western boundary including Illawarra Highway, Church Road and Jamberoo Road (west of Terry Street)
- Screenline 2 - Tongarra Road, Church Road and Ashburton Drive west of Terry Street
- Screenline 3 - Tongarra Road and East West Link west of Croome Road.
- Screenline 4 - New Lake Entrance Road east of Princes Highway
- Screenline 5 - Princes Motorway and Princes Highway at Yallah Bay Road
- Screenline 6 - Princes Highway north of Yallah Road
- Screenline 7 - Princes Highway at Macquarie Rivulet Bridge (north of Illawarra Highway)
- Screenline 8 - Princes Highway south of Illawarra Highway and Illawarra Highway south of Princes Highway
- Screenline 9 - Princes Highway south of East West Link.

Screenlines 1 to 4 captured traffic growth for the east-west corridor (along Tongarra Road) primarily contributed by local new release areas being planned within the study area.

Screenlines 5 to 9 captured traffic growth for the north-south corridor (along Princes Highway/Princes Motorway) primarily contributed by both regional traffic and local new release areas being planned within the study area.

Figure 5-5 shows predicted traffic growth across the study area network between 2014 and 2036 for a period of 22 years.

Figure 5-6 shows predicted traffic growth across the study area network between 2014 and 2046 for a period of 32 years.

The growth rate analysis suggested key outcomes as follows:

- The historical growth data between 2000 and 2014 indicated that in the last 14 years traffic on the Princes Highway has grown between 1.2 per cent and 1.5 per cent per annum. Historical traffic growth on the Illawarra Highway and Tongarra Road was found to be 1.1 per cent per annum and 0.7 per cent per annum respectively.
- In general, the historical data suggests higher order traffic growth trend (between 1.2 per cent and 1.5 per cent per annum) along the north-south corridor (via Princes Highway) and lower order growth along the east-west corridor (0.7 per cent per annum) via Tongarra Road.
- Significantly higher growth rates are predicted on the east west corridor via Tongarra Road due to planned development of Tulimbah and Calderwood. The growth data between 2014 and 2036 (22 years period) suggests traffic growth between 1.6 per cent and 3.4 per cent annum. In the event that the urban development take a longer time to be completed, the growth data between 2014 and 2046 (32 years) suggests traffic growth between 1.1 per cent and 2.3 per cent annum. The predicted traffic growth on the east-west corridor in 2036 and 2046 was found significantly higher than observed historical growth.
- Between 2014 and 2036 (22 year period), the data suggests future growth on the Princes Highway along the north-south corridor between 1.0 per cent and 1.9 per cent per annum. In the event planned urban development take longer time to be completed, the growth data between 2014 and 2046 (32 years) suggests traffic growth between 0.7 per cent and 1.3 per cent annum. The predicted growth in 2036/2046 along the north-south corridor appears to be consistent with the historical observed growth.

Additional TRACKS modelling data was investigated for future development model years) at two key locations on the M1 Princes Motorway and Princes Highway:

- Station 07.594, Princes Motorway, North of Northcliffe Drive
- Princes Motorway & Princes Highway, North of Yallah Bay Road.

The future growth results for the above mentioned model years are shown in Figure 5-7. The following colour codes are shown on Figure 5-7:

- The blue colour represents forecast traffic at every five years for 2021, 2026 and 2036
- Green colour represents forecast traffic for future development model
- The predicted growth rate is shown for 22 years between 2014 and 2036.

The analysis showed that:

- At Station 07.594, Princes Motorway, North of Northcliffe Drive, the 2036 forecast volumes were found to be lower than ultimate development (2036+) model. The future development model represents at year 2040/2042
- At Princes Motorway and Princes Highway, North of Yallah Bay Road, the 2036 forecast volumes are found similar to the future development model which represents at year 2036/2037.

In agreement with Roads and Maritime, year 2041 was identified to be the representative of future development model.

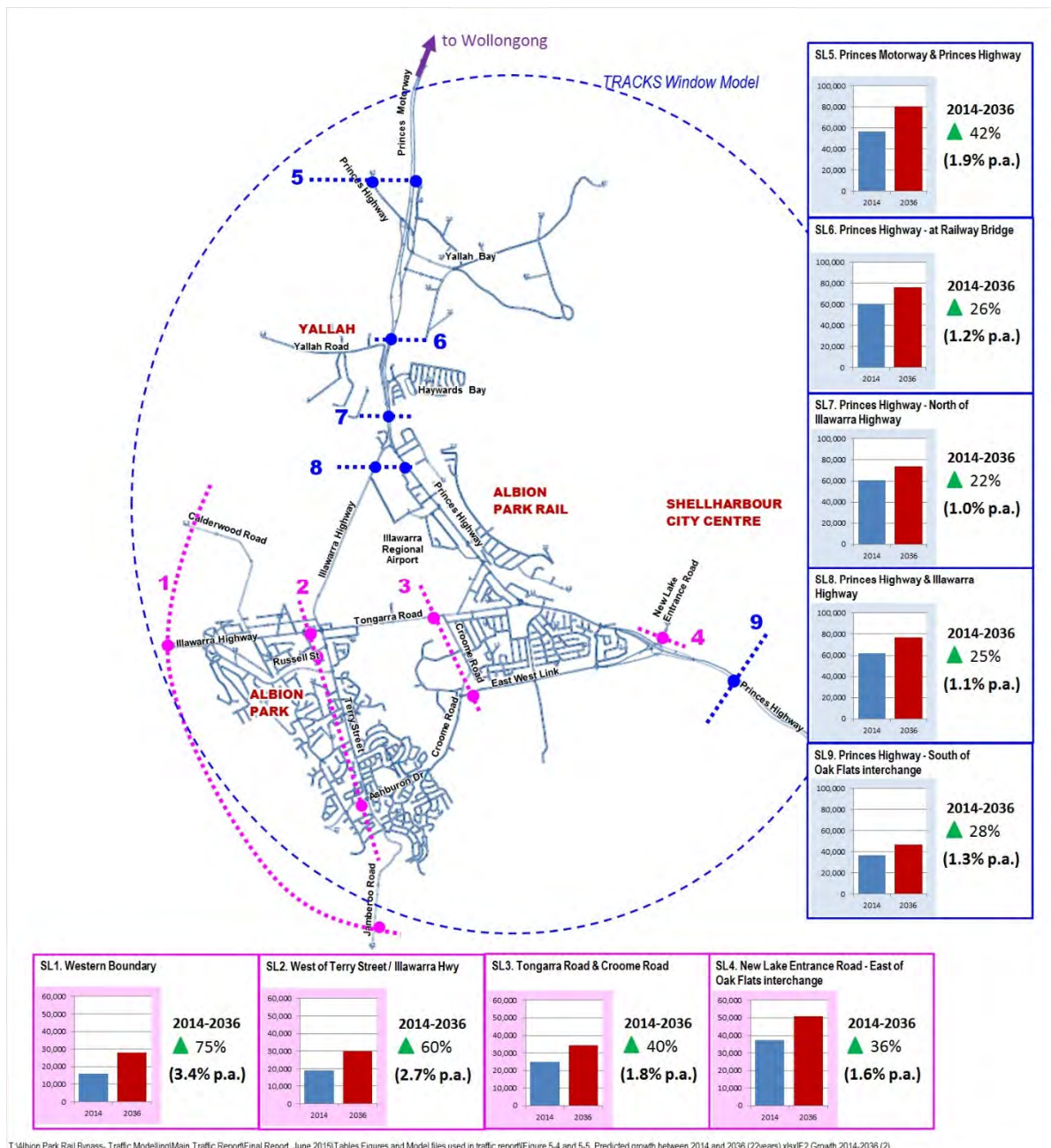


Figure 5-5 Predicted Growth between 2014 and 2036 (22 years)

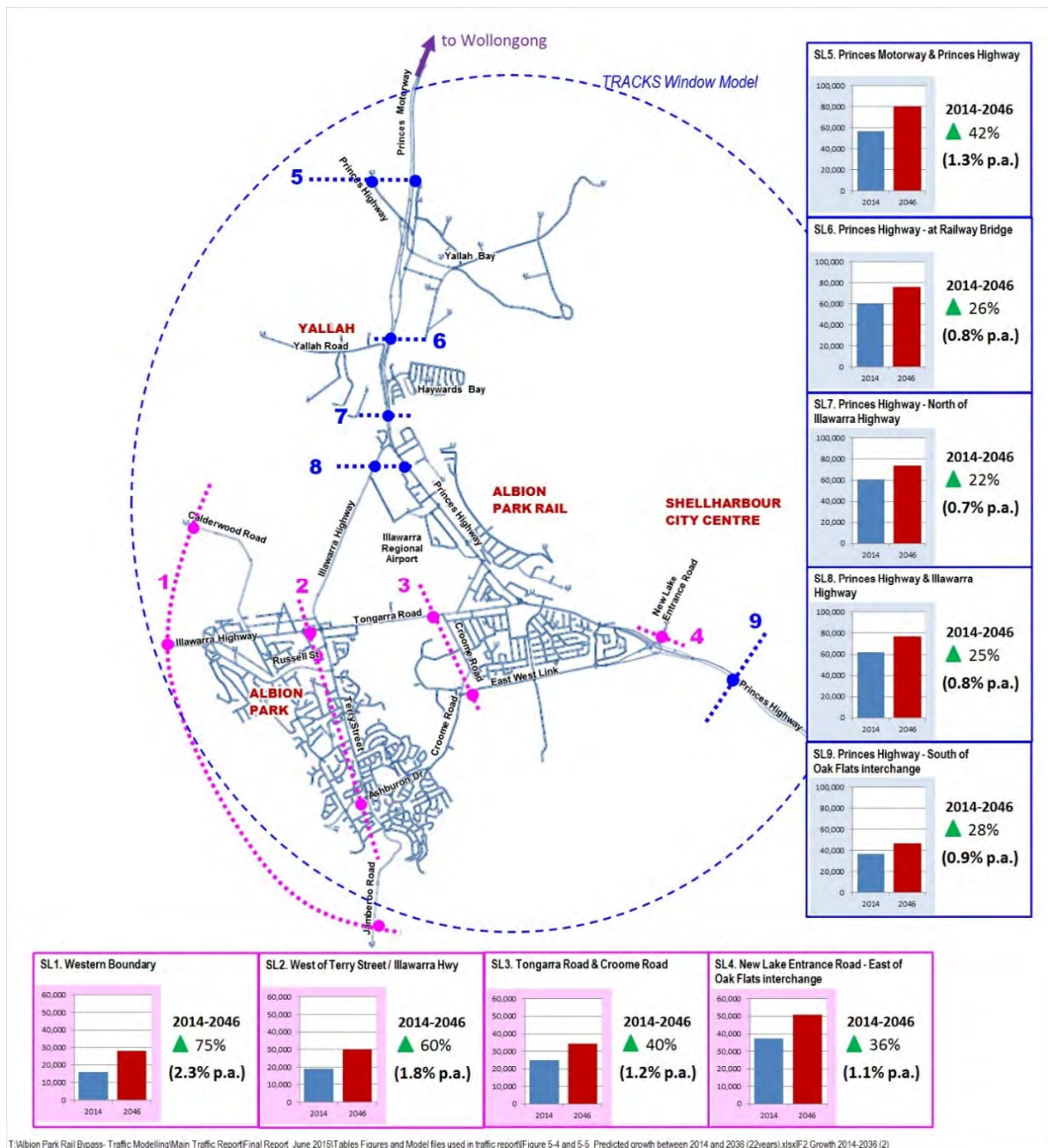


Figure 5-6 Predicted Growth between 2014 and 2046 (32 years)

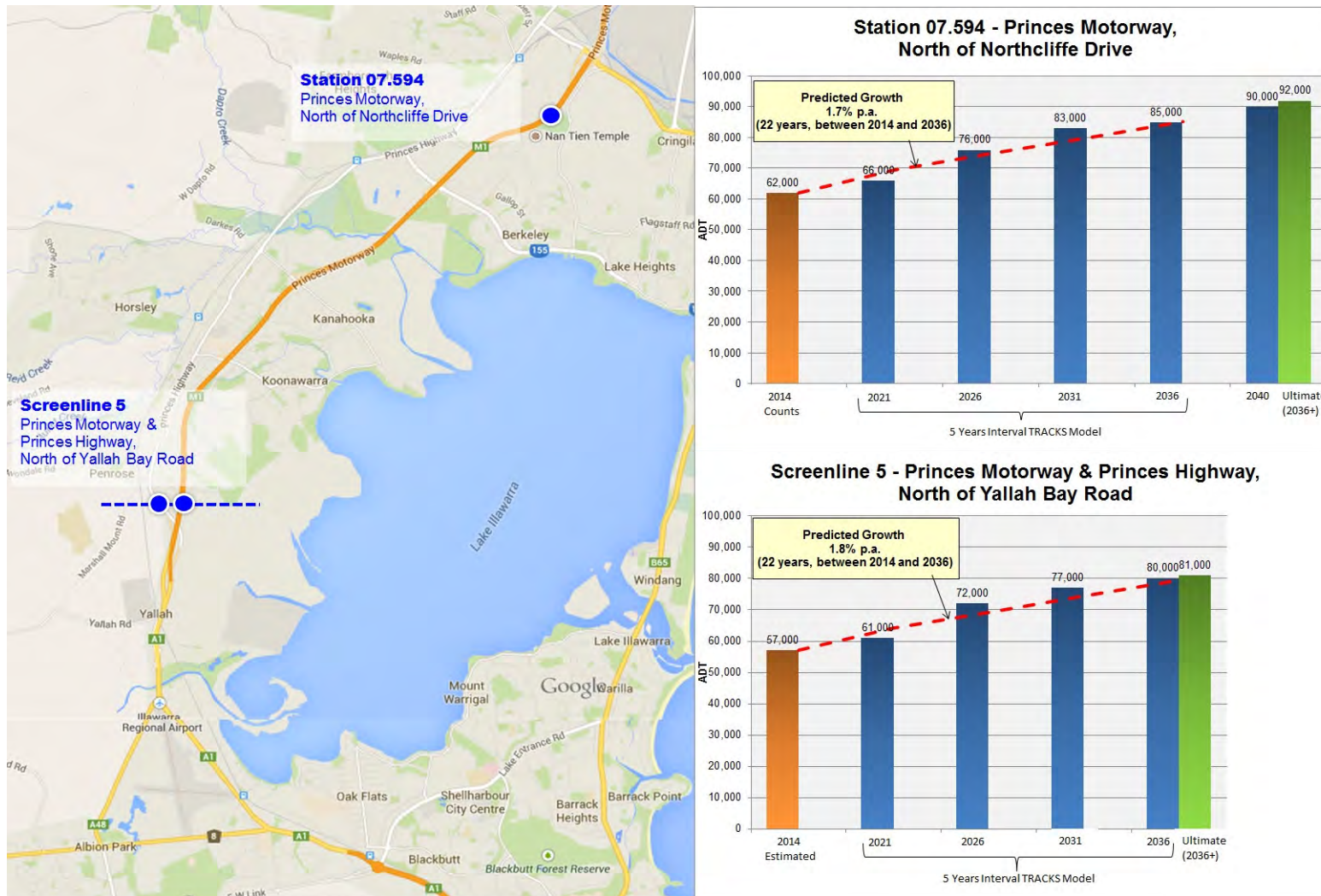


Figure 5-7 Future Traffic Growth Analysis

5.4.2 TRAFFIC GROWTH ACROSS THE NETWORK

Figure 5-8 shows predicted growth rate across the study area network between 2014 and 2041 for a period of 27 years.

The analysis has found significant traffic growth along the east-west corridor travelling between Albion Park and Shellharbour, as well as on the M1 Princes Motorway north of Yallah. These growth rates included additional traffic from new release areas of Calderwood, Tallawarra and Tullimbar.

The model predicted high growth rate between 2.2 per cent and 2.8 per cent per annum along the east-west corridor in the close proximity to new release areas (screenlines 1 and 2). Further east from new release areas, traffic growth on the east-west corridor is predicted between 1.3 per cent and 1.4 per cent per annum (screenlines 3 and 4). The traffic growth was found to be between 0.8 per cent and 1.6 per cent per annum along the north-south corridor between Yallah and Oak Flats depending on locations.

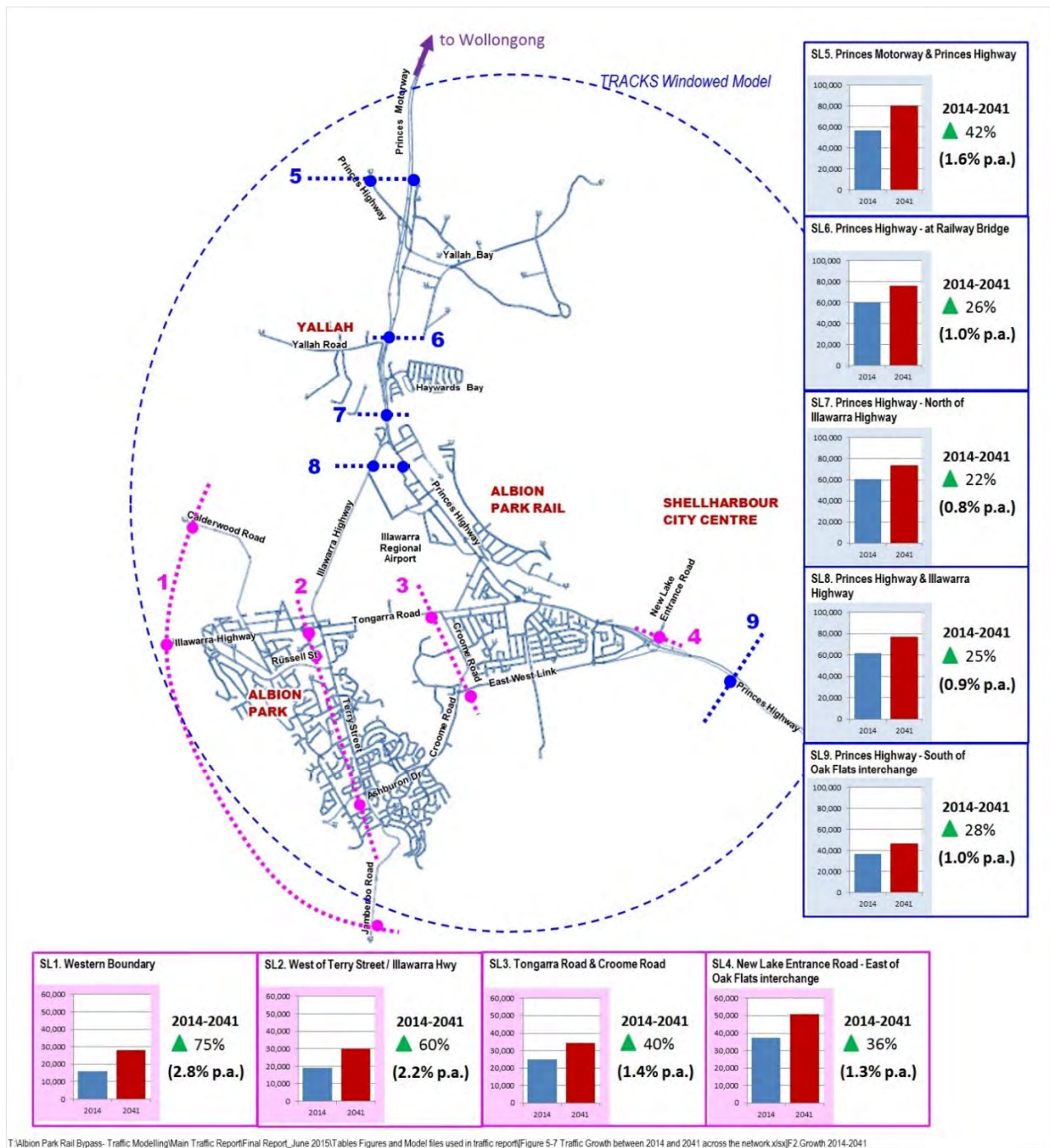


Figure 5-8 Traffic Growth between 2014 and 2041 across the Network

6 ASSESSMENT OF OPERATIONAL IMPACTS

This chapter provides an assessment of the resulting traffic, transport and road safety impacts which are anticipated to occur as a result of operation of the project.

6.1 OPERATIONAL IMPACTS

Traffic increases of the magnitude forecast over the 27 year period (2014 to 2041) would clearly place significant demands on the existing Princes Highway network through Albion Park Rail. Based on the predicted growth from 2014 to 2041, the traffic volumes on the A1 Princes Highway at Macquarie Rivulet Bridge over the 27-year period would increase from approximately 59,000 vehicles per day (current) to 72,000 vehicles per day (2041), Level of Service would drop to F and road conditions would create an impediment to economic development in the region. The A1 Princes Highway is predicted to be highly congested and there would be increased delays and queuing along the highway between Yallah and Oaks Flats. Additionally, turning and cross movements at key intersections would be more than double those of today creating substantial additional local traffic delays.

6.1.1 TRAFFIC VOLUMES ON THE PROJECT

An analysis of the effect of the project shows its construction would divert most through traffic movements away from the existing Princes Highway. Table 6-19 shows predicted daily traffic on the project for 2020 (opening year) and 2041 future development year. In 2020 project would carry between 34,000 and 41,000 vehicles per day on a typical weekday increased to 45,000 and 53,000 vehicles per day in 2041.

Table 6-19 Forecast Traffic Volumes on the Project

Location	Forecast Average Daily Traffic (ADT)	
	2020 Opening Year	2041 Future Development Year
New motorway, at Macquarie Rivulet Bridge	40,600	53,100
New motorway, south of Tongarra Road	33,800	45,100

Note: The 2020 opening year traffic volumes have been interpolated between 2014 and 2041 with bypass TRACKS models.

6.1.2 IMPACTS ON ROAD NETWORK

The implementation operation of the project will result in a decrease in vehicles using the existing Princes Highway through Albion Park Rail, and on Tongarra Road and East West Link through Albion Park and Oak Flats. The project is expected to reduce between 31,000 and 52,000 vehicles per day on the existing Princes Highway between Yallah and Oak Flats. The anticipated reduction will improve traffic conditions to adjacent network and provides a high standard travel with reduced travel time on the project.

Figure 6-1 Forecast Daily Traffic (ADT) with and without Project in 2041 shows forecast traffic volumes with and without the project in 2041. The corresponding traffic reduction and increase in 2041 attributable to the project is also shown on Figure 6-1.

- The project would be effective in reducing a significant proportion of north-south through and regionally generated traffic from the Princes Highway and the Illawarra Highway between Yallah and Oak Flats. Additionally, a significant proportion of east-west traffic would be reduced from East-West Link Road and Tongarra Road. The project would reduce traffic on the existing Princes Highway route between Yallah and Oak Flats in the order of 56 to 74 per cent depending on locations. This would significantly improve local traffic amenities along the Princes Highway. The model predicted traffic reduction on the Tongarra Road west of Terry Street would be up to 54 per cent, in the event that the future Albion Park bypass via Tripoli Way was built.
- The Illawarra Highway north of Tongarra Road is forecast to experience traffic increase up to 48 per cent due to the proposed entry and exit ramps with the Illawarra Highway predominantly due to the urban development at Calderwood and Tulimbah. The model has predicted minor traffic increase between 2 per cent and 4 per cent on the M1 Princes Motorway and Princes Highway north of Yallah due to redistribution traffic effect via northern interchange.

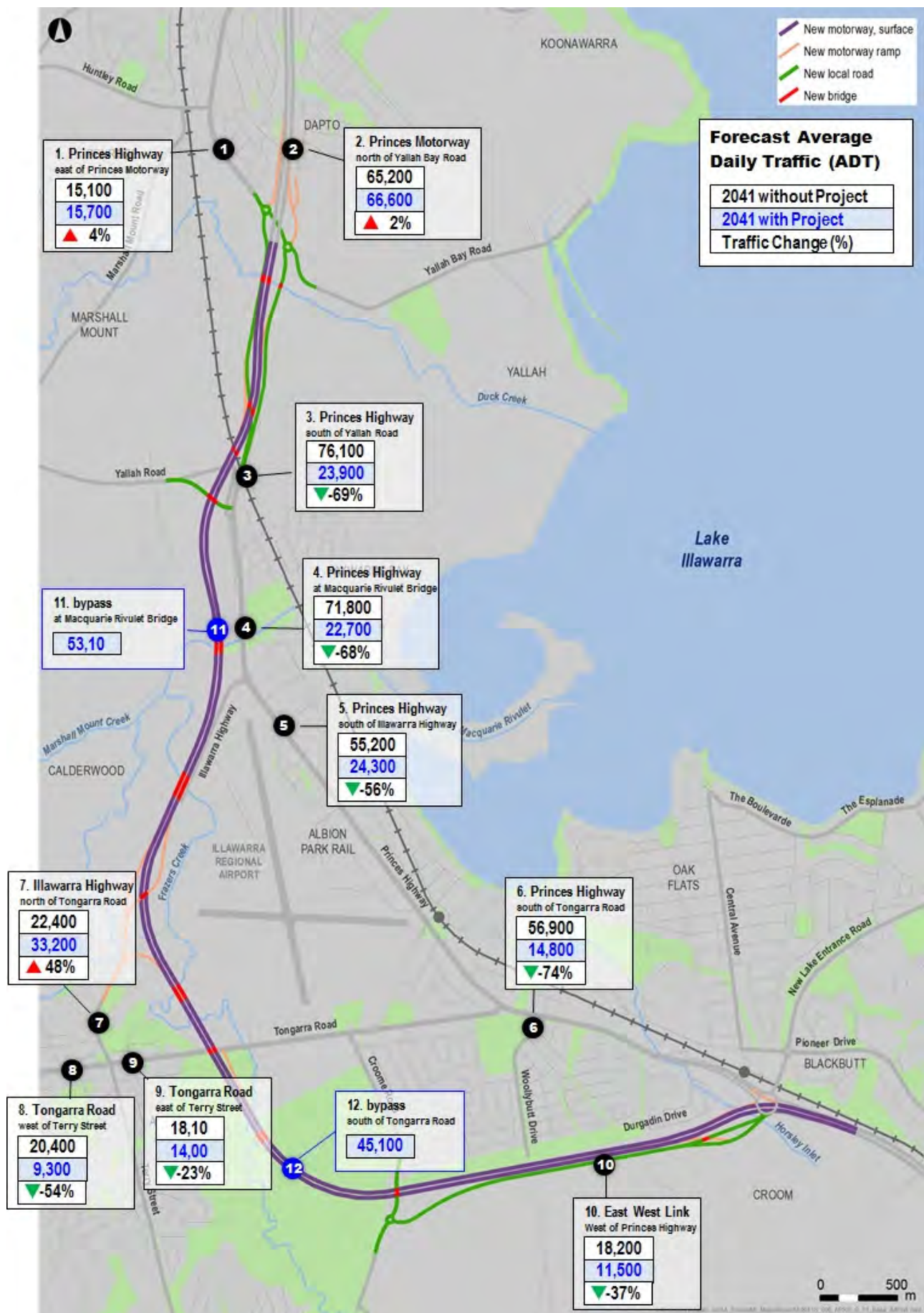


Figure 6-1 Forecast Daily Traffic (ADT) with and without Project in 2041

6.2 OPERATIONAL PERFORMANCE

6.2.1 OVERALL NETWORK

Overall operational performance of the project can be described in terms of the predicted average travel speed, effectively a measure of the efficiency offered by the road network including local roads within the study area.

The average travel speed for the entire study area road network is presented in Figure 6-2 with and without project for 2020 (opening year), 2030 (10 years after opening) and 2041 (future development model year). Without the project, average network speed would decline from 51 km/hr in 2014 existing year to approximately 36 km/hr by 2041 future development model year.

The project would maintain average speeds on the new motorway at a more acceptable level from 98 km/hr in 2020 (opening year) to 95 km/hr in 2041 (future development model year). Figure 6-3 shows average travel speed on the new motorway for 2020 (opening year), 2030 (10 years after opening) and 2041 (future development model year).

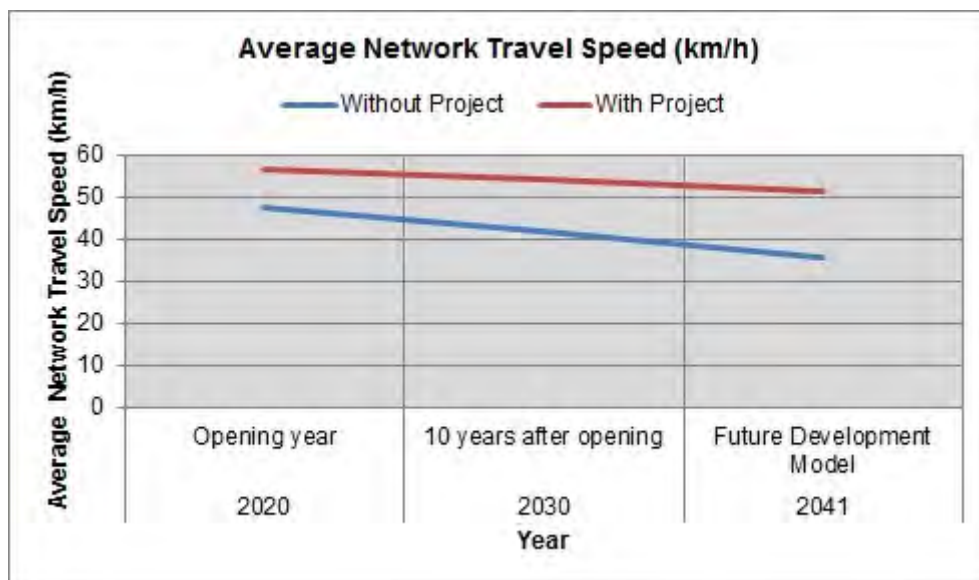


Figure 6-2 Average Network Travel Speed (km/h) for the Entire Study Area Road Network

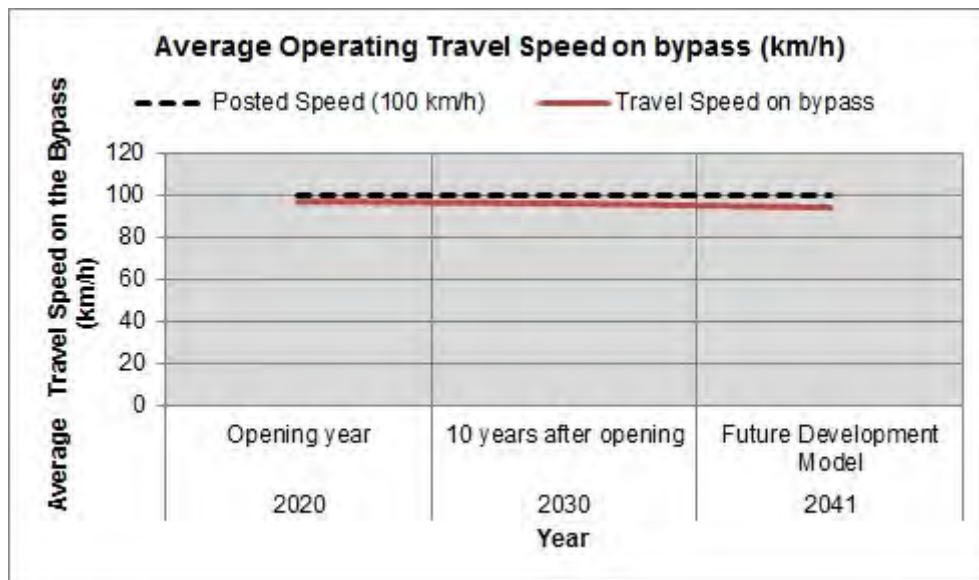


Figure 6-3 Average Operating Travel Speed on New Motorway/Bypass (km/h)

6.2.2 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 a project, and in this study their aggregate performance was estimated through the traffic model.

Table 6-20 Vehicle Kilometres Travel (VKT) and Vehicle Hours Travelled (VHT) with and without Project

Model Years	Annual		
	VKT	VHT	Average Travel Speed (km/h)
2014 without project	343,597,771	6,705,790	51
2014 with project	356,523,438	6,115,797	58
Saving (positive ▼ = saving)	-12,925,667	589,993	7
% Saving	▲-4%	▼9%	▼14%
2041 without project	476,194,104	13,380,301	36
2041 with project	494,333,651	9,571,655	52
Saving (positive ▼ = saving)	-18,139,547	3,808,647	16
% Saving	▲-4%	▼28%	▼45%

Source: TRACKS windowed model.

Table 6-20Table shows a comparison of annual vehicle kilometres travel (VKT) and vehicle hours travelled (VHT) with and without the project for 2014 existing year and 2041 future development model year. The analysis indicated the project would be effective in reducing vehicle hours travelled (VHT) by 28 per cent and improve average travel speed on the overall network by 45 per cent in 2041.

There is a marginal increase (about 4 per cent) in the vehicle kilometres travel (VKT) due to the longer travel distance via the proposed bypass compared to the existing Princes Highway route.

6.2.3 TRAVEL TIME SAVINGS

Table 6-21 presents future 2041 travel time on the existing Princes Highway route and new motorway between Yallah and Oak Flats. The travel time saving attributable to the new motorway is also shown in Table 6-21.

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

The project also provides a substantial saving in time over the current travel time observed during travel time surveys with 3 minutes being saving on a northbound journey in the morning peak and 1.5 minute being saved on a southbound journey in the afternoon peak this being up to a 33 per cent travel time saving.

Figure 6-4 shows graphically travel routes via existing princes Highway and new motorway between Yallah (point A) and Oak Flats (point B).

Table 6-21 Travel Time Benefits offered by the Project

Model Years	Between Yallah and Oak Flats	Travel Time (minutes)	
		AM Peak	PM Peak
	via roads	Northbound	Southbound
2014 observed		9.0	7.5
2041 without project	Route 1 – via existing Princes Highway	18.2	16.7
2041 with project	Route 2 – via new motorway	6.3	6.4
Saving in 2041 (positive ▼ = saving)		▼ 11.9	▼ 10.3
% Saving		▼ 65%	▼ 62%

Note: Northbound = from Oak Flats to Yallah. Southbound = from Yallah Oak Flats

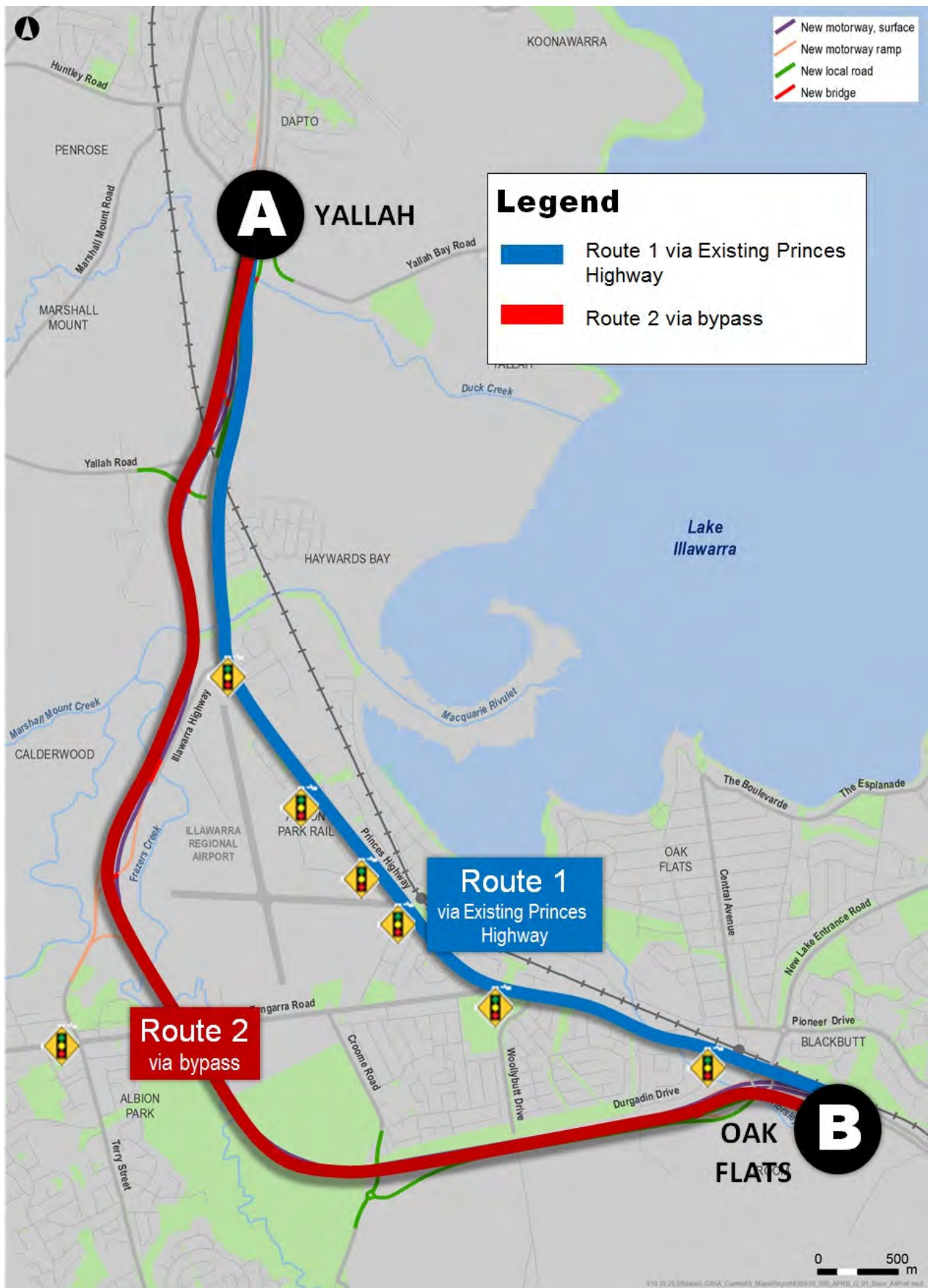


Figure 6-4 Travel Routes between Yallah and Oak Flats

6.2.4 INTERSECTION PERFORMANCE ALONG PRINCES HIGHWAY

If the road conditions stay the same and no bypass is constructed, it is expected that traffic capacity of the southbound merge on the Princes Motorway at Yallah would be at capacity or have major congestion during the afternoon peak period. In addition to that seven local at-grade intersections on the A1 Princes Highway between Yallah and Oak Flats are analysed using SIDRA to demonstrate intersection performance with and without the project for 2041 traffic conditions. Table 6-22 shows predicted 2041 Level of Service at key intersections along the Princes Highway with and without project.

The analysis found that for a “no build” condition the Princes Highway would be highly congested and there would be increased delays at key intersections along the highway between Yallah and Oaks Flat. The majority of analysed intersections would have substantial local traffic delays with Level of Service F for both morning and afternoon peak periods. The project will be effective in improving Level of Service to A/B at the majority of analysed intersections on the A1 Princes Highway between Yallah and Oak Flats.

Table 6-22 Predicted Intersection Level of Service for 2041

Intersection	Control	Time Period	Without Project		With Project	
			Delays (Seconds)	LoS	Delays (Seconds)	LoS
Princes Highway / Illawarra Highway	Roundabout	AM	184	F	7	A
		PM	185	F	7	A
Princes Highway / Tongarra Road	Signals	AM	33	C	12	A
		PM	58	F	12	A
Princes Highway /Miall Way	Priority ⁽¹⁾	AM	22	B	11	A
		PM	>200	F	13	A
Princes Highway /Creamery Road	Signals ⁽¹⁾	AM	104	F	18	B
		PM	>200	F	25	B
Princes Highway /Airport Road	Signals ⁽¹⁾	AM	124	F	19	B
		PM	>200	F	18	B
Princes Highway /Station Road	Signals ⁽¹⁾	AM	>200	F	25	B
		PM	>200	F	56	D
Princes Highway /Woollybut Drive	Priority ⁽¹⁾ (existing)/ proposed new signals (future)	AM	>200	F	31	C
		PM	>200	F	32	C

Note: (1): in 2041 without project, SIDRA model indicated substantial delay. Once intersections exceed capacity, then delay increases much faster than actual traffic increase. Source SIDRA INTERSECTION 6.0.24.4877 Model: Tripoli Way -

6.3 CAPACITY AND LEVEL OF SERVICE

6.3.1 MAIN CARRIAGEWAY

The capacity and Level of Service of the new motorway has been assessed using relevant guidelines including AustRoads Traffic Studies Part 3 and the Highway Capacity Manual (HCM 2010).

Table 6-23 presents Level of Service results for the main carriageway in 2020 (opening year), 2030 (10 years after opening) and 2041 (future development model year). Figure 6-5 shows graphically location of carriageway sections (north, central and south) where Level of Service is reported.

At opening year 2020, the new motorway would operate with a Level of Service B and C and these Level of Service would hold until 2041 albeit with a Level of Service D during the PM peak. The Level of Service D is predicted for north and central bypass sections for PM peak in 2041. A sensitivity test has been undertaken for main carriageway Level of Service for a 10 per cent increase or decrease in traffic volumes. The Level of Service remained at D for a 10 per cent traffic increase for both north and central bypass sections however improved to Level of Service C for a 10 per cent traffic decrease. Allowance has been made in the concept design for upgrading to six lanes in the future.

Table 6-23 Level of Service on the Main Carriageway

Level of Service on the Main Carriageway							
Bypass Section	Location	Midblock Level of Service					
		2020 Opening year		2030 10 years after opening		2041 future development model year	
		NB	SB	NB	SB	NB	SB
AM Peak							
North	North of Yallah Interchange	B	B	B	C	C	C
Central	North of Illawarra Highway	C	B	C	B	C	B
South	West of Oak Flats Interchange	B	B	B	B	C	B
PM Peak							
North	North of Yallah Interchange	A	C	B	C	B	D
Central	North of Illawarra Highway	B	C	B	C	B	D
South	West of Oak Flats Interchange	B	B	B	B	B	C

Note: NB = northbound, SB = southbound.

6.3.2 RAMP CAPACITY

The capacity of entry and exit ramps for three grade separated interchanges was analysed with reference to the AustRoads Traffic Studies Part 3 and the Highway Capacity Manual (HCM 2010) guidelines.

Table 6-24, Table 6-25 and Table 6-26 present Level of Service results for entry and exit ramps in 2020 (opening year), 2030 (10 years after opening) and 2041 (future development model

year) for Yallah, Albion Park and Oak Flats interchanges. Figure 6-5 shows graphically location of entry and exit ramps where Level of Service is reported.

The assessment indicates the entry and exit ramps would operate at adequate capacity with a maximum Level of Service C until 2041 for all three interchanges with the exception of the northbound entry ramp at Albion Park interchange which is found to be D in 2041. A sensitivity test has been undertaken for the northbound entry ramp Level of Service for a 10 per cent increase or decrease in traffic volumes. The Level of Service remained at D for a 10 per cent traffic increase for the northbound entry ramp at Albion Park interchange however improved to Level of Service C for a 10 per cent traffic decrease.

At opening year 2020, all entry and exit ramps for three interchanges would operate at adequate capacity and Level of Service A/B, albeit Level of Service C for the northbound entry ramp at Albion Park interchange.

Table 6-24 Ramp Capacity – Yallah Interchange

Ramp ID	Yallah Interchange	Number of ramp lanes	Mid Block Ramp Level of Service		
			2020 Opening year	2030 10 years after opening	2041 future development model year
AM Peak					
1	Northbound Entry Ramp	1	A	A	A
2	Southbound Exit Ramp	1	A	B	C
3	Northbound Exit Ramp ¹	1	B	B	B
4	Southbound Entry Ramp	1	A	A	A
5	Northbound Entry Ramp ²	1	B	B	C
PM Peak					
1	Northbound Entry Ramp	1	A	A	A
2	Southbound Exit Ramp	1	B	B	C
3	Northbound Exit Ramp ¹	1	B	B	B
4	Southbound Entry Ramp	1	B	B	B
5	Northbound Entry Ramp ²	1	A	B	C

¹ From M1 Motorway to Princes Highway ² From Princes Highway to M1 Princes Motorway

Table 6-25 Ramp Capacity – Albion Park Interchange

Ramp Capacity – Albion Park Interchange					
			2020	2030	2041
			Opening year	10 years after opening	future development model year
AM Peak					
6	Northbound Entry Ramp	1	C	C	D

Ramp ID	Albion Park Interchange	Number of ramp lanes	Mid Block Ramp Level of Service		
			2020 Opening year	2030 10 years after opening	2041 future development model year
7	Southbound Exit Ramp	2	A	A	A
8	Northbound Exit Ramp	1	A	B	C
9	Southbound Entry Ramp	1	B	B	B
PM Peak					
6	Northbound Entry Ramp	1	B	C	C
7	Southbound Exit Ramp	2	B	B	B
8	Northbound Exit Ramp	1	A	B	B
9	Southbound Entry Ramp	1	B	B	C

Table 6-26 Ramp Capacity – Oak Flats Interchange

Ramp Capacity – Oak Flats Interchange					
Ramp ID	Oak Flats Interchange	Number of ramp lanes	Mid Block Ramp Level of Service		
			2020 Opening year	2030 10 years after opening	2041 future development model year
AM Peak					
10	Northbound Exit Ramp	1	B	B	B
11	Southbound Entry Ramp	1	A	B	B
12	Southbound Entry Ramp (Princes Hwy)	1	A	A	A
13	Northbound Exit Ramp (Princes Hwy)	1	A	A	B
14	Southbound Ramp (Princes Hwy)	1	A	A	A
PM Peak					
10	Northbound Exit Ramp	1	B	B	C
11	Southbound entry Ramp	1	A	B	B
12	Southbound Entry Ramp (Princes Hwy)	1	A	A	A
13	Northbound Exit Ramp (Princes Hwy)	1	A	A	B
14	Southbound Ramp (Princes Hwy)	1	A	A	A



Figure 6-5 Main Carriageway and Ramps Analysis Locations

6.4 FUTURE NETWORK CHANGES

A number of changes or upgrades to the local road network are required to support the project. These changes include realignments and creating cul-de-sacs. A number of property accesses would also be changed as part of the project.

A. Princes Highway – between Dapto and Albion Park Rail

The existing Princes Highway would be adjusted as part of the project works. The revised Princes Highway would maintain the separation between northbound and southbound carriageways. The speed limit on the Princes Highway may be reduced to reflect the change to local traffic.

The project would replace the function of the existing Princes Highway. The revised Princes Highway would provide an alternative route parallel to the motorway for local traffic between the Dapto and Albion Park Rail towns. The Princes Highway would provide direct access to the M1 Motorway at the northbound and southbound carriageways.

B. Yallah Bay Road – intersection with existing Princes Highway

Yallah Bay Road connection to the Princes Highway would change from a T-intersection with the Princes Highway to a roundabout connection with the Princes Highway

The realigned Yallah Bay Road would provide direct connectivity to the Yallah Interchange providing access to the Tallawarra Power station and the future proposed Tallawarra Lands development.

C. Cormack Avenue – intersection with Princes Highway

The existing Cormack Avenue approach to the Princes Highway is proposed to be part of the M1 Motorway southbound exit ramp. Cormack Avenue would connect to the southbound exit ramp providing a left in and left out movements to and from the residential area on the eastern side of Dapto.

D. Yallah Road – intersection with existing Princes Highway

Yallah Road would be realigned and upgraded between Larkins Lane and the Princes Highway and include a bridge over the M1 Motorway. The proposed road upgrade provides two lanes in each direction, including an upgraded intersection with the existing Princes Highway

The realigned Yallah Road is proposed to cater for the significant traffic growth forecasted for the developments in the Mount Marshall area providing direct access to the Princes Highway south and north.

E. Illawarra Highway – from the intersection with the existing Princes Highway to the intersection with Croome Lane

The section of the Illawarra Highway (Terry Street) north of Tongarra Road would be altered to provide connectivity for the new interchange at Albion Park.

The project would replace the function of this section of the Illawarra Highway and physically sever it connecting to the M1 Motorway northbound exit and entry ramps and the southbound exit ramp to the local road network.

The Illawarra Highway north of Croome Lane and the Princes Highway would be retained providing access to the properties located within Croome Lane.

F. Tongarra Road – from 500 metres to the east of the intersection with Terry Street for about 350 metres

Tongarra Road would be upgraded to provide a right-turn lane to the southbound entry ramp, and a shared path it would maintain one lane in each direction.

An intersection would be provided on Tongarra Road to allow access to the M1 Motorway southbound entry ramp. Tongarra Road would remain as per the existing road level to avoid impact on flooding and would continue as the main corridor connecting Albion Park and Albion Park Rail Towns

G. Croome Road – at the intersection with the existing East West Link

Croome Road would cross the motorway on a new bridge to maintain connectivity between Albion Park (south) and Albion Park Rail. The road would be upgraded and a new roundabout is proposed at the East West Link and Croome Road intersection to a single lane in each direction and a shared path which would connect to the Croom Regional Sporting Complex and Albion Park (south). Additionally it is proposed a reconfiguration of internal access roads of the Croom Sporting Complex.

Croome Road would maintain connectivity between Albion Park (south) and Albion Park Rail.

The offline construction of Croome Road overbridge would not impact the operations of the existing Croome Road during construction of the bridge

H. New East West Link – south of the existing East West Link between Croome Road and the Oak Flats Interchange

The existing East West Link would be removed and replaced by a new road about 25 metres to the south of the motorway to become the new (proposed) East West Link. The proposed East West Link would have one lane in each direction.

The new East West link is proposed to replace the existing East West Link to continue providing connectivity between Croome Road and the Oak Flats Interchange.

Two new intersections are proposed along the New East West Link providing access points to the existing quarries.

I. Woollybutt Drive – intersection with Spotted Gum Drive

Woollybutt Drive (south) would be closed to traffic with a cul-de-sac termination of the road at Spotted Gum Drive due to the proximity to the proposed M1 Motorway main carriageways.

The road reserve south of the intersection could be landscaped and converted to parkland.

The Woollybutt Drive and Princes Highway intersection is proposed to be signalised providing an alternative access to and from the Princes Highway

J. Durgadin Drive upgrades

Durgadin Drive would be closed with a cul-de-sac termination of the road. Alternative access would be available to the industrial area via the existing signalised Princes Highway and Colden Drive intersection.

The local road network changes identified above shown from A to J are illustrated in

Figure 6-6

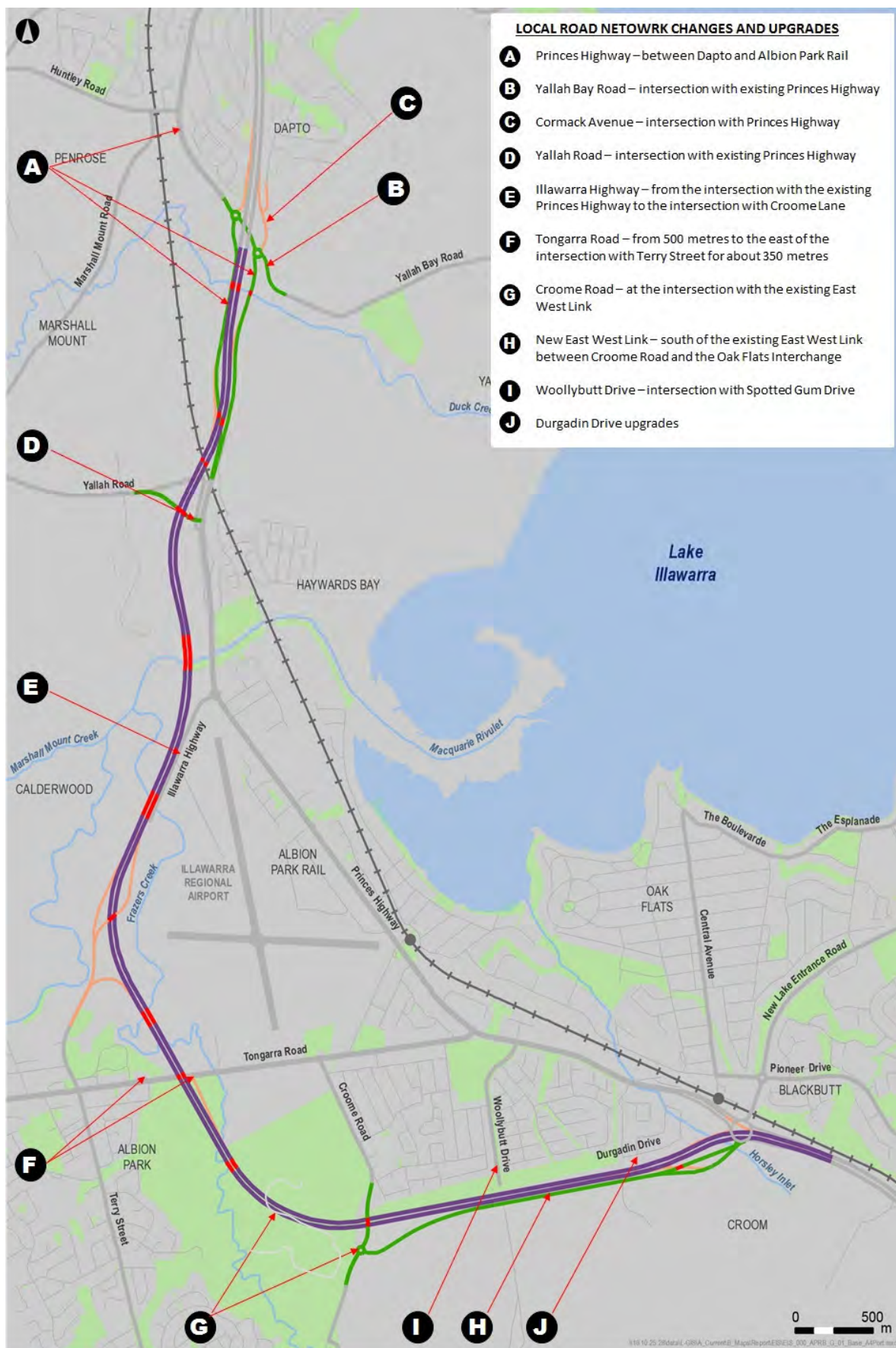


Figure 6-6 Local Road Network Changes and Upgrades

6.5 INTERCHANGES

The project would include three grade-separated interchanges, connecting the local road network with the M1 Motorway and Princes Highway at Yallah, Albion Park, Albion Park Rail and Oak Flats. These are described below.

6.5.1 INTERCHANGE AT YALLAH

6.5.1.1 Upgrade Description

The northern interchange at Yallah would be located in the north of the project and connect the M1 Motorway to the existing Princes Highway. The interchange would provide entry and exit ramps connecting the Princes Highway and Yallah Bay Road. It would provide free-flowing connections for motorists, on and off the motorway, via:

- A northbound entry ramp with a single lane entry
- A southbound exit ramp connecting the motorway to the new eastern roundabout on the Princes Highway
- A northbound free-flow lane from the Princes Highway would join the M1 Motorway as an additional lane
- A southbound entry ramp connecting from the Princes Highway to the motorway
- A northbound exit ramp connecting the M1 Motorway to the Princes Highway via the new western roundabout
- Interim arrangement connecting Cormack Avenue to the southbound exit ramp with left in and left out movements only. The Tallawarra Lands development would drive the final alignment of the Cormack Avenue
- The eastern roundabout, which would provide a connection for traffic on Yallah Bay Road and the southbound exit ramp, which would increase once the proposed Tallawarra area is developed.

Local traffic movements between Dapto and Albion Park Rail would be split south of the railway crossing. Northbound Princes Highway traffic would follow the existing Princes Highway under the motorway onto the western roundabout to access the motorway. The northbound exit ramp would provide access to Dapto for motorway traffic. The southbound motorway exit ramp would connect to the Princes Highway.

The configuration of the proposed interchange at Yallah is shown in Figure 6-7.

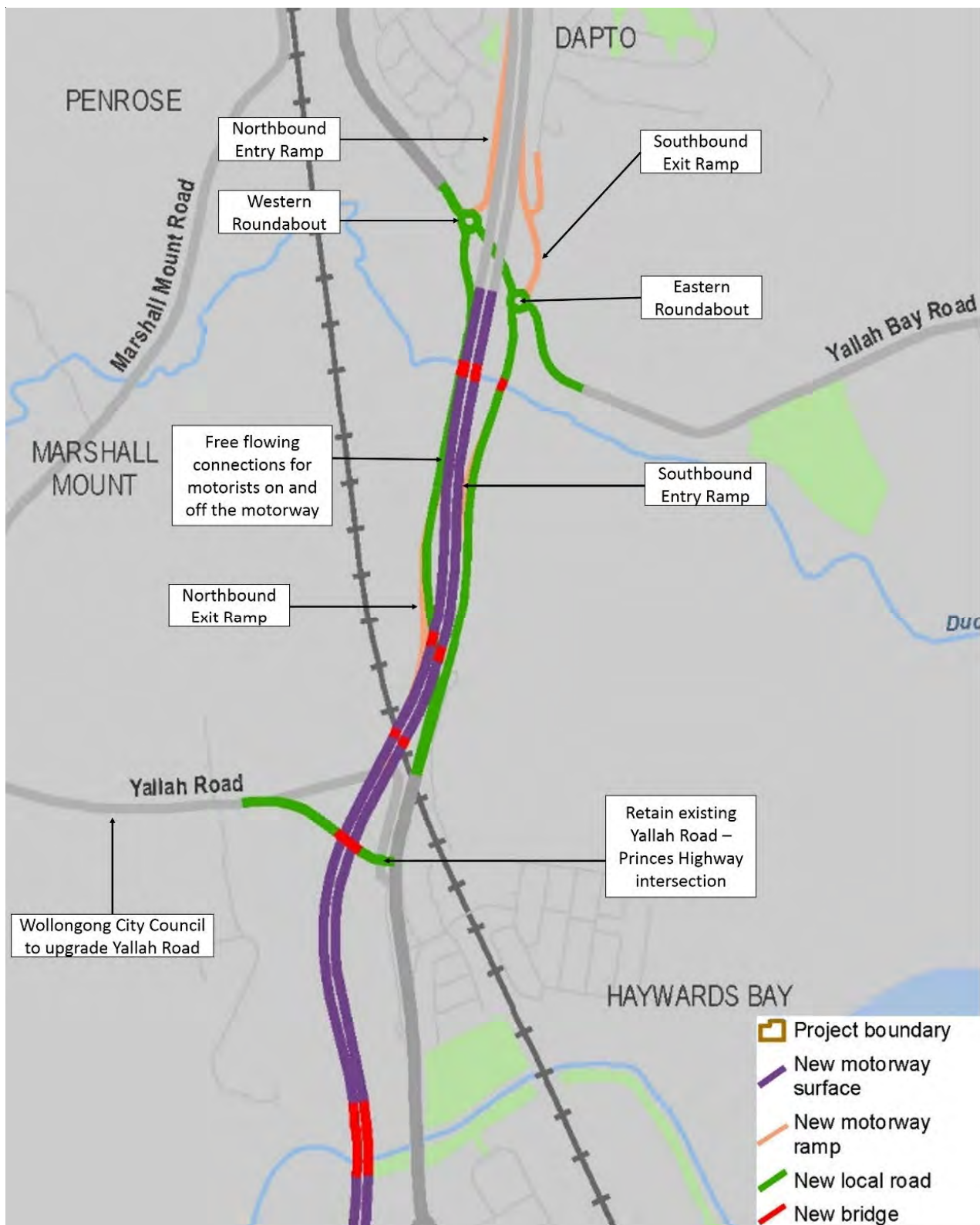
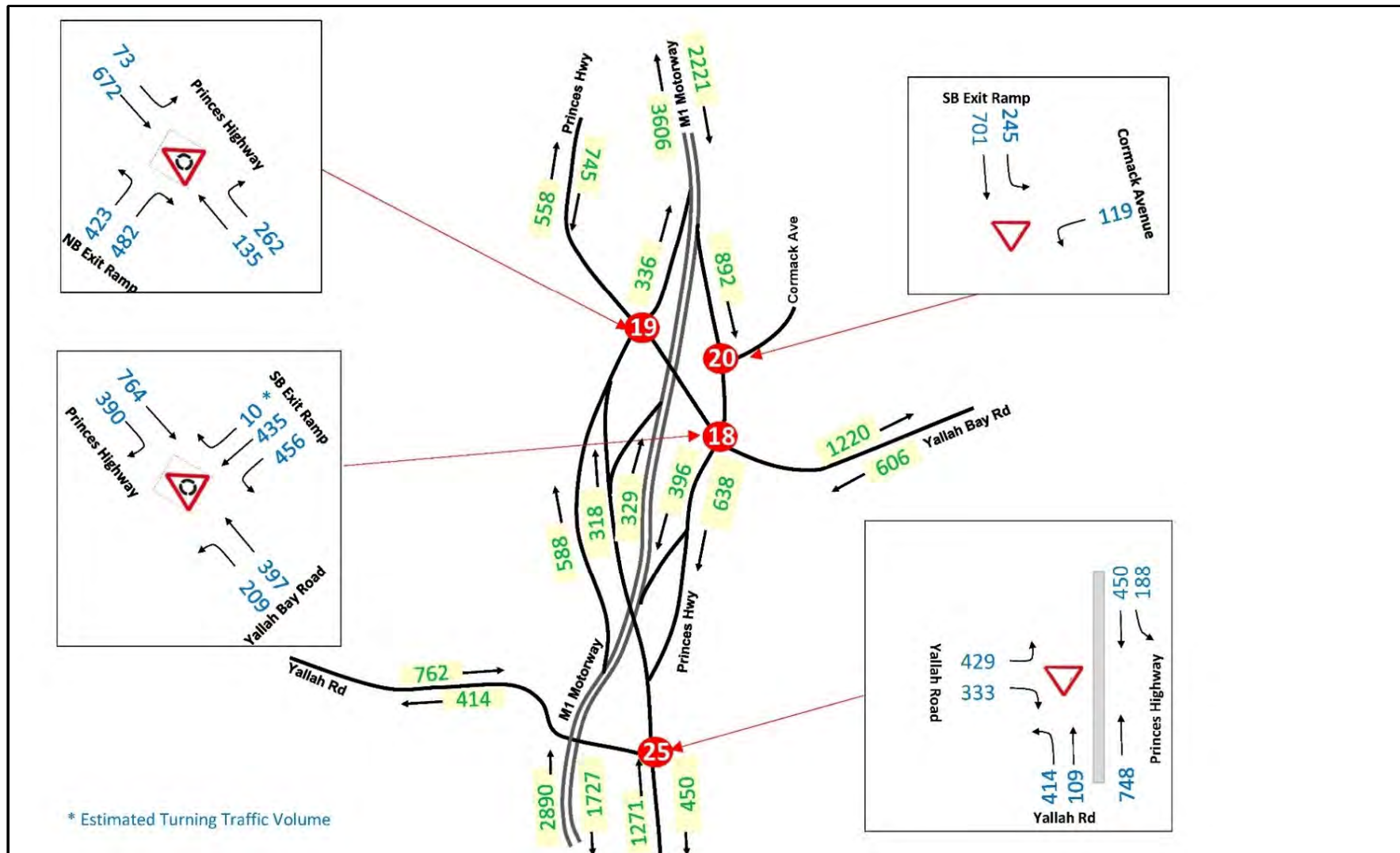


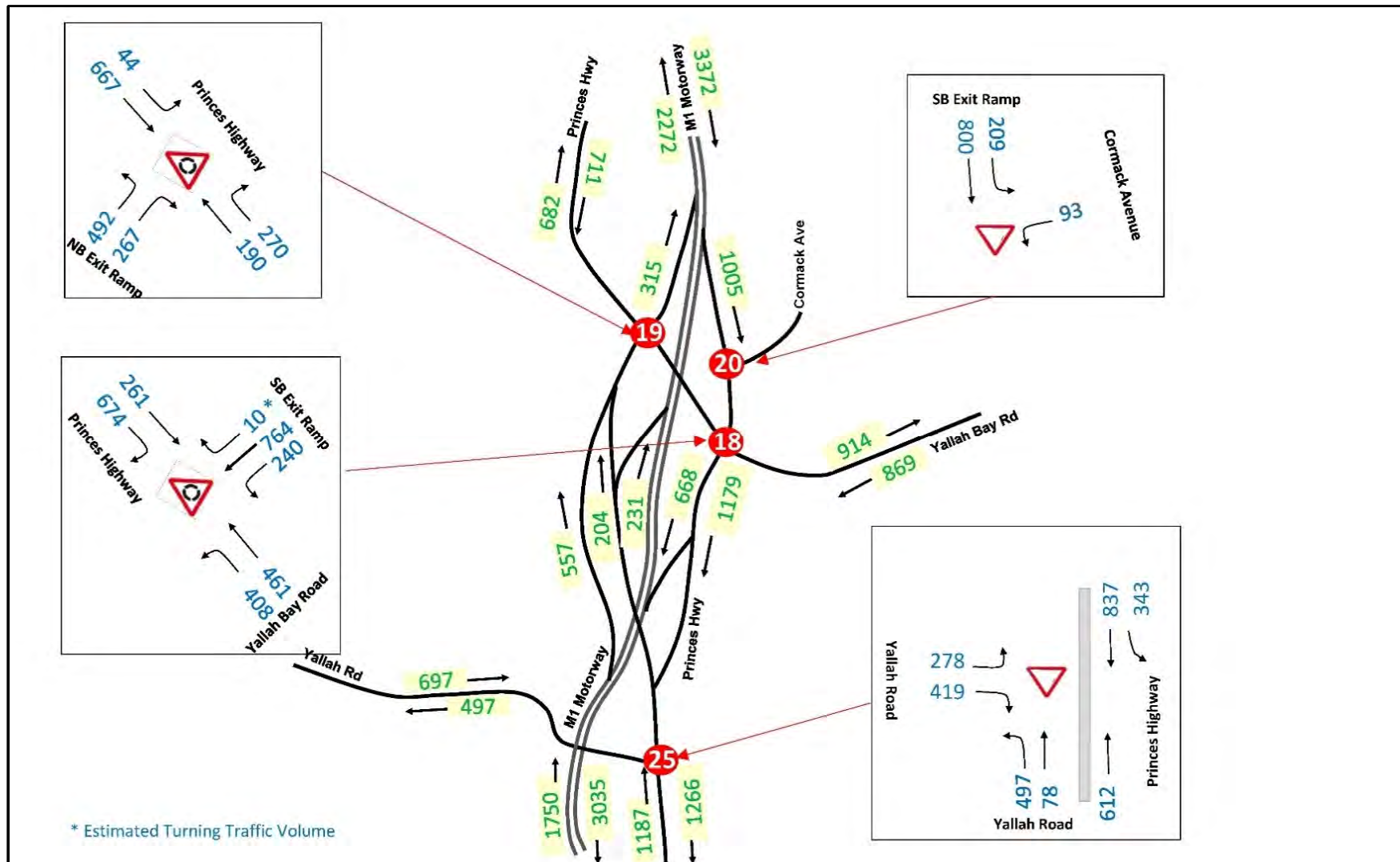
Figure 6-7 Interchange at Yallah

Figure 6-8 and Figure 6-9 show 2041 peak hour traffic volumes at key intersections of the Yallah Bay Road interchange.



Source: AM Peak, Excel Calculations Stick Diagrams Yallah Interchange

Figure 6-8 Traffic Volumes at Yallah Interchange, 2041 AM Peak



Source: PM Peak, Excel Calculations Stick Diagrams Yallah Interchange

Figure 6-9 Traffic Volumes at Yallah Interchange, 2041 PM Peak

6.5.1.2 Traffic Implications of Yallah Interchange

The Level of Service of key intersections for the Yallah interchange in are summarised in Table 6-27. An indicative intersection layout from SIDRA is showed in Table 6-28. Table 6-10 shows Level of Service results for eastern and western roundabouts for two circulating lanes configurations.

Eastern Roundabout

The 2041 SIDRA modelling results indicate that the proposed two circulating lanes roundabout will operate with Level of Service B in the AM and PM peak.

A sensitivity assessment was undertaken for one lane circulating roundabout at eastern end and found adverse intersection performance at opening year 2020 (Level of Service B in AM and Level of Service F in PM).

Further sensitivity test was undertaken assuming the existing T-intersection configuration at Princes Highway / Cormack Avenue. The modelling indicated adverse intersection performance for a T-intersection at opening year 2020 (Level of Service B in AM and Level of Service F in PM) similar to the one lane roundabout.

Western Roundabout

The 2041 SIDRA modelling results indicate that the proposed two circulating lanes roundabout will operate Level of Service A in the AM and PM peak.

A sensitivity assessment was undertaken for one lane circulating roundabout at the western end. Modelling results indicated Level of Service A for both AM and PM peak at opening year 2020. Further analysis indicated that one lane roundabout at the western end would have service life up to 2030 (10 years after opening). Further upgrade to two lanes roundabout would be required beyond 2030.

Cormack Avenue Access

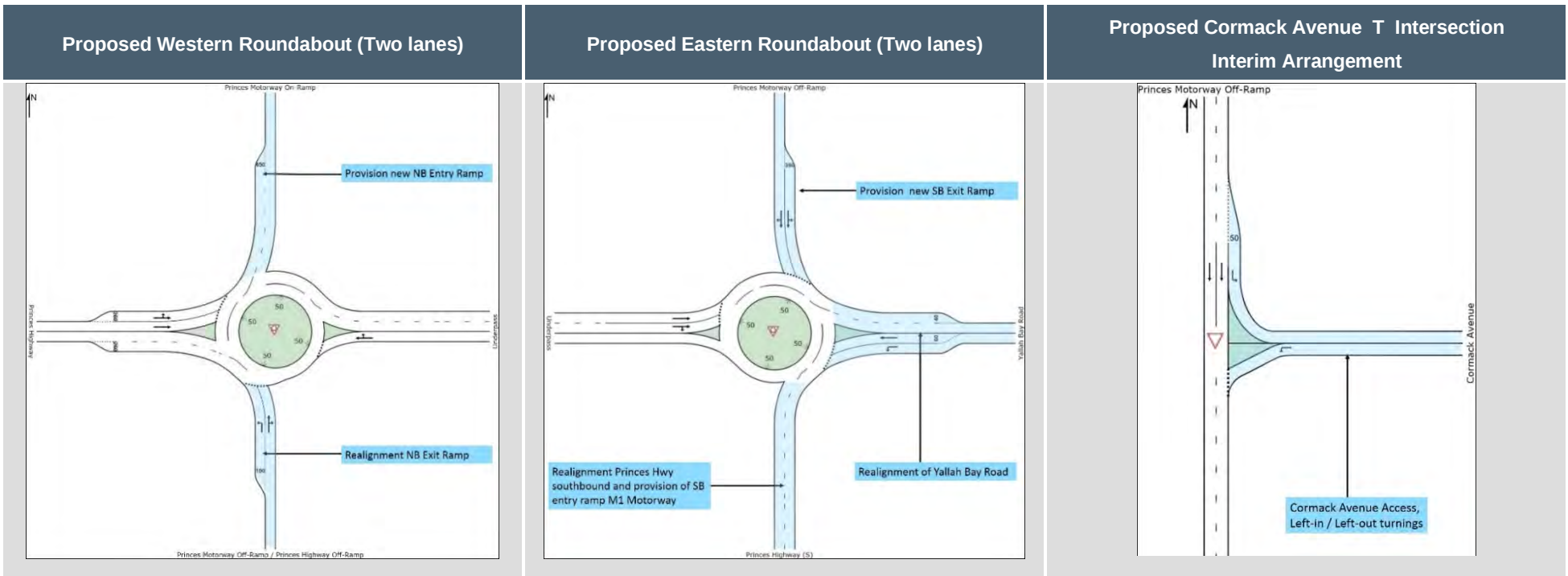
Initially an interim (left in /left out) access arrangement is proposed with the Cormack Avenue. The 2041 SIDRA modelling results indicate that the proposed intersection that provides access to Cormack Road will operate with Level of Service A in the AM and PM peak. The closure of Cormack Avenue is an approval condition of the Tallawarra development and as such this connection is an interim arrangement until the development proceeds.

Table 6-27 Yallah Interchange Performance in 2041

Yallah Interchange	Control Type	Peak Period	Average Delay (s)	Level of Service (LoS)
Eastern Roundabout	New Roundabout (2 lane)	AM	17	B
		PM	22	B
Western Roundabout	New Roundabout (2 lane)	AM	11	A
		PM	12	A
Cormack Av Access	New 'T' Intersection (sign control, left in/left out)	AM	7	A
		PM	7	A

Source: SIDRA INTERSECTION 6.0.24.4877
Model: Northern Interchange

Table 6-28 Intersection Layouts Modelled in SIDRA



Source SIDRA INTERSECTION 6.0.24.4877
Model: Northern Interchange

6.5.1.3 Merging Sections

Two merging sections are identified at the Yallah Interchange as shown in Figure 6-10:

- Princes Motorway northbound merging section – Princes Motorway / Northbound Entry ramp (entry ramp merging with three through lanes)
- Princes Motorway southbound merging section (entry ramp merging with two through lanes).

The entry ramp from Princes Highway (Albion Park Rail) northbound is a free flow lane.

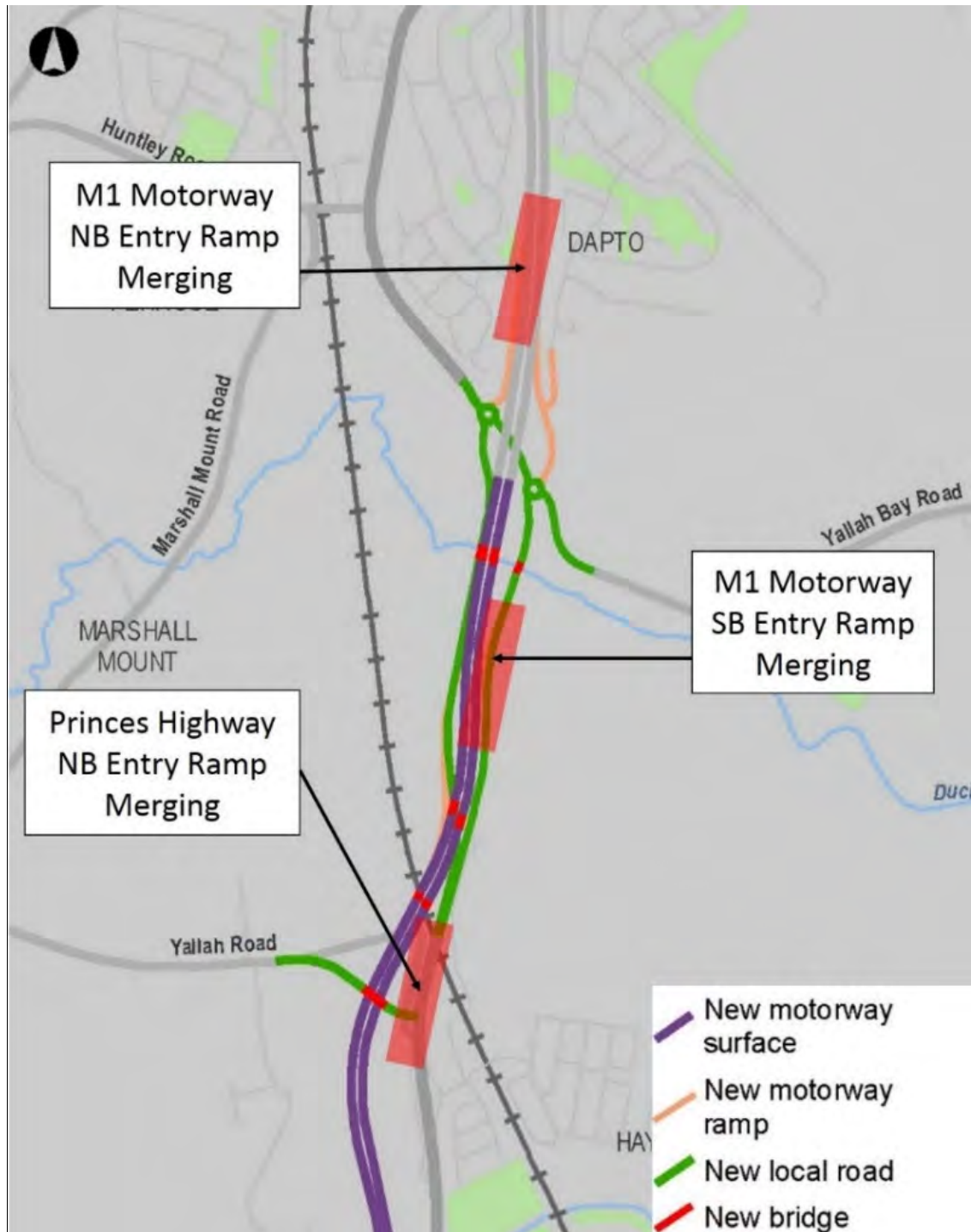


Figure 6-10 Merge Locations at the Yallah Interchange

The Level of Service for northbound and southbound merge sections are showed in Table 6-29. The results indicate that merging segments would operate satisfactorily with Level of Service B and C in the AM and PM peak period.

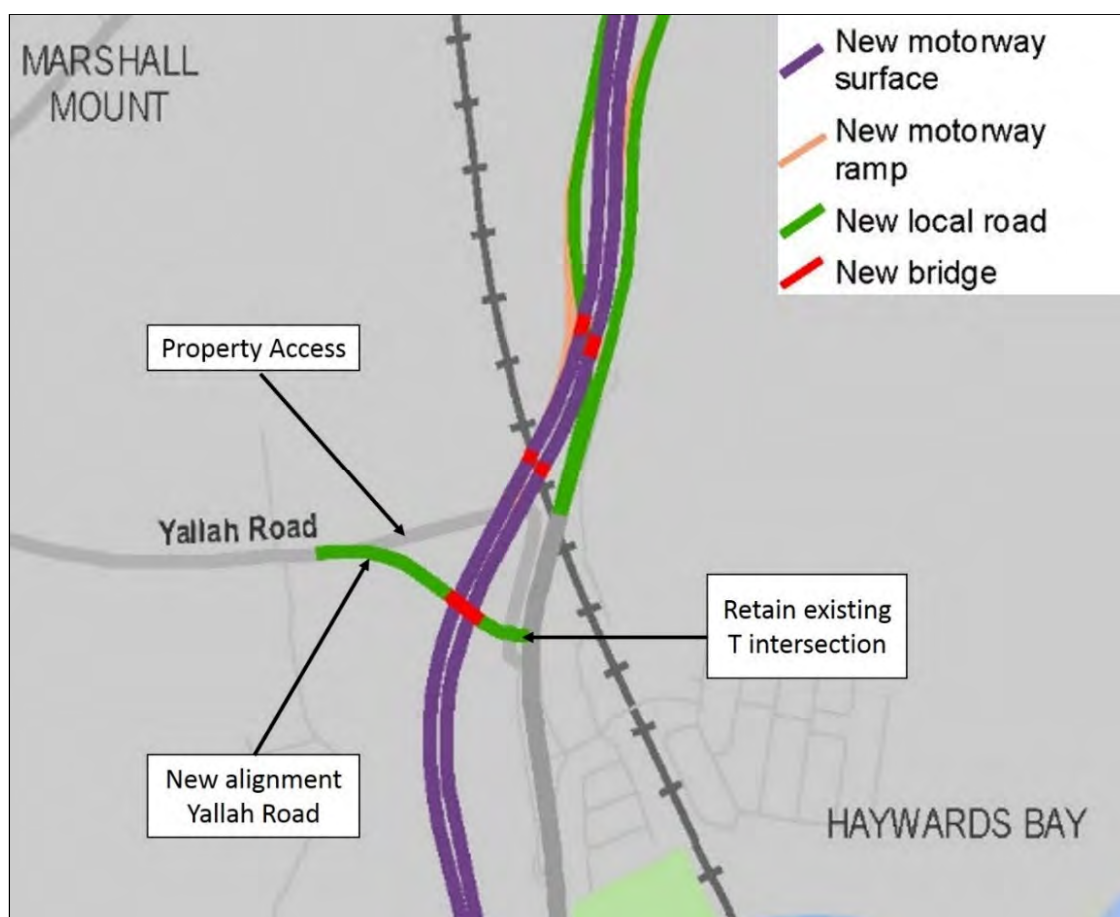
Table 6-29 Yallah Interchange Merging Section Performance in 2041

Merging Segment	LoS	
	AM Peak	PM Peak
Princes Motorway Northbound Merging Section – Princes Motorway / Northbound Entry ramp	C	B
Princes Motorway Southbound Merging Section	B	C
Princes Highway Northbound Merging Section (Yallah Road)	C	B

Source: HCM Calculations

6.5.1.4 Yallah Road

As part of this project, Yallah Road will be connected across the new motorway on an overbridge and retain its existing intersection control with the A1 Princes Highway. Yallah Road remains a two lane road (one lane in each direction) with posted speed limit reduced to 60 km/h. Figure 6-11 shows the existing intersection control and connection of the Yallah Road with the A1 Princes Highway.



Source 80% Concept Design Preferred Option March 2015

Figure 6-11 Yallah Road Connection with the Princes Highway

6.5.1.5 Traffic Implications of Yallah Road

The Yallah Road intersection with the A1 Princes Highway has been analysed for a sign control arrangement. The Level of Service in 2041 for a sign control intersection at Yallah Road /A1 Princes Highway is shown in Table 6-30 and an indicative intersection layout from SIDRA is shown in

Table 6-31. The 2041 SIDRA analysis indicates that a sign control intersection at Yallah Road / A1 Princes Highway will provide Level of Service A in both AM and PM peak periods.

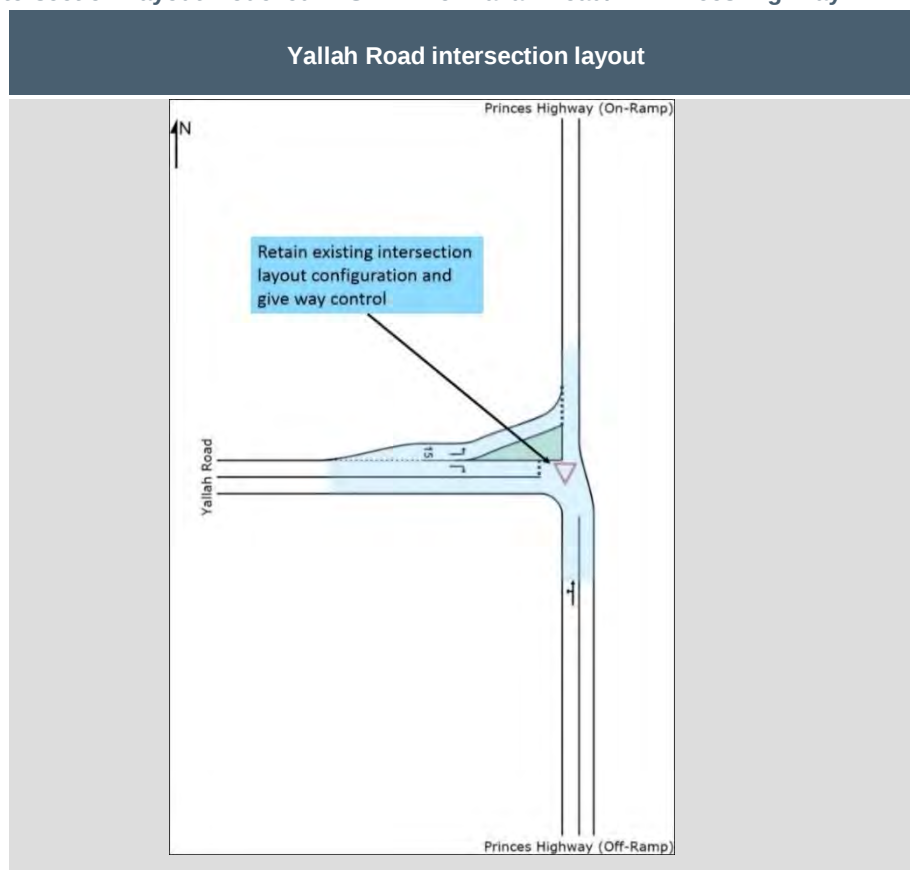
The upgrading needs of the Yallah Road will be driven by the future development proposed in the Marshall Mount/ Calderwood areas. The ultimate design of the Yallah Road has allowed for future upgrade of the road to four lanes (two lanes in each direction), including an upgraded intersection with the A1 Princes Highway. Roads and Maritime will monitor traffic performance at the Yallah Road / A1 Princes Highway intersection, the timing of the upgrading needs of this intersection will be assessed in the future depending on the level of development in the Marshall Mount / West Dapto.

Table 6-30 Yallah Road and Princes Highway Intersection Performance in 2041

Yallah Road Intersection	Control Type	Peak Period	Average Delay (s)	Level of Service (LoS)
Yallah Road Intersection	Sign control	AM	6	A
		PM	6	A

Source SIDRA INTERSECTION 6.0.24.4877
Model: Yallah Road

Table 6-31 Intersection Layout Modelled in SIDRA for Yallah Road/A1 Princes Highway



Source SIDRA INTERSECTION 6.0.24.4877
Model: Yallah Road

6.5.2 INTERCHANGE AT ALBION PARK

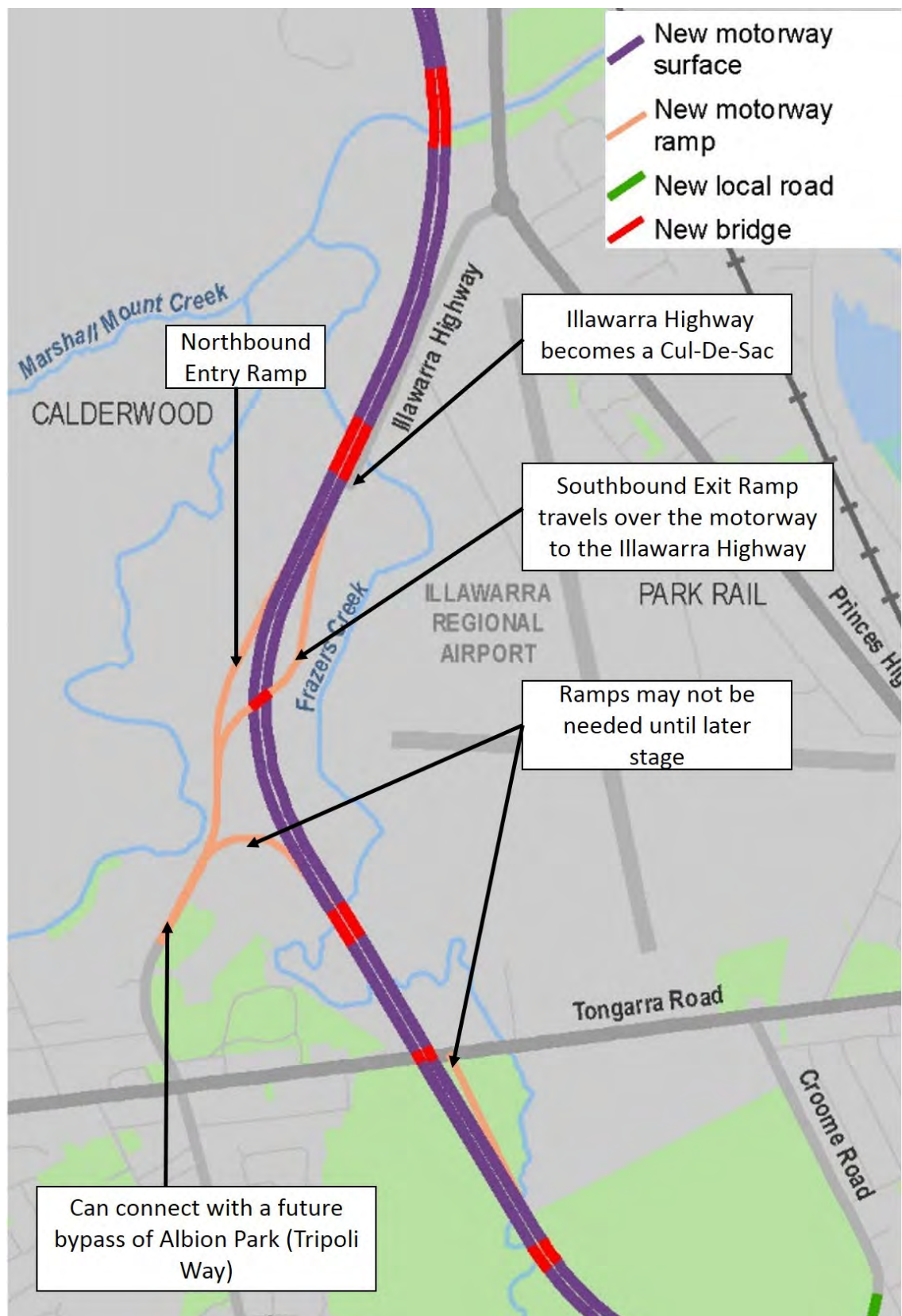
6.5.2.1 Upgrade Description

The central interchange at Albion Park would include a northbound entry ramp and a southbound exit ramp at the Illawarra Highway (Terry Street). The entry and exit ramps would be as follows:

- A northbound entry ramp would connect the Illawarra Highway (Terry Street) to the M1 Motorway
- A northbound exit ramp would connect traffic leaving the motorway to the Illawarra Highway (Terry Street)
- A southbound entry ramp would connect Tongarra Road to the motorway
- A southbound exit ramp would cross over the M1 Motorway connecting to the Illawarra Highway (Terry Street).
- The section of the Illawarra Highway between Princes Highway and Croome Lane would operate as local access to the properties located adjacent to the airport field

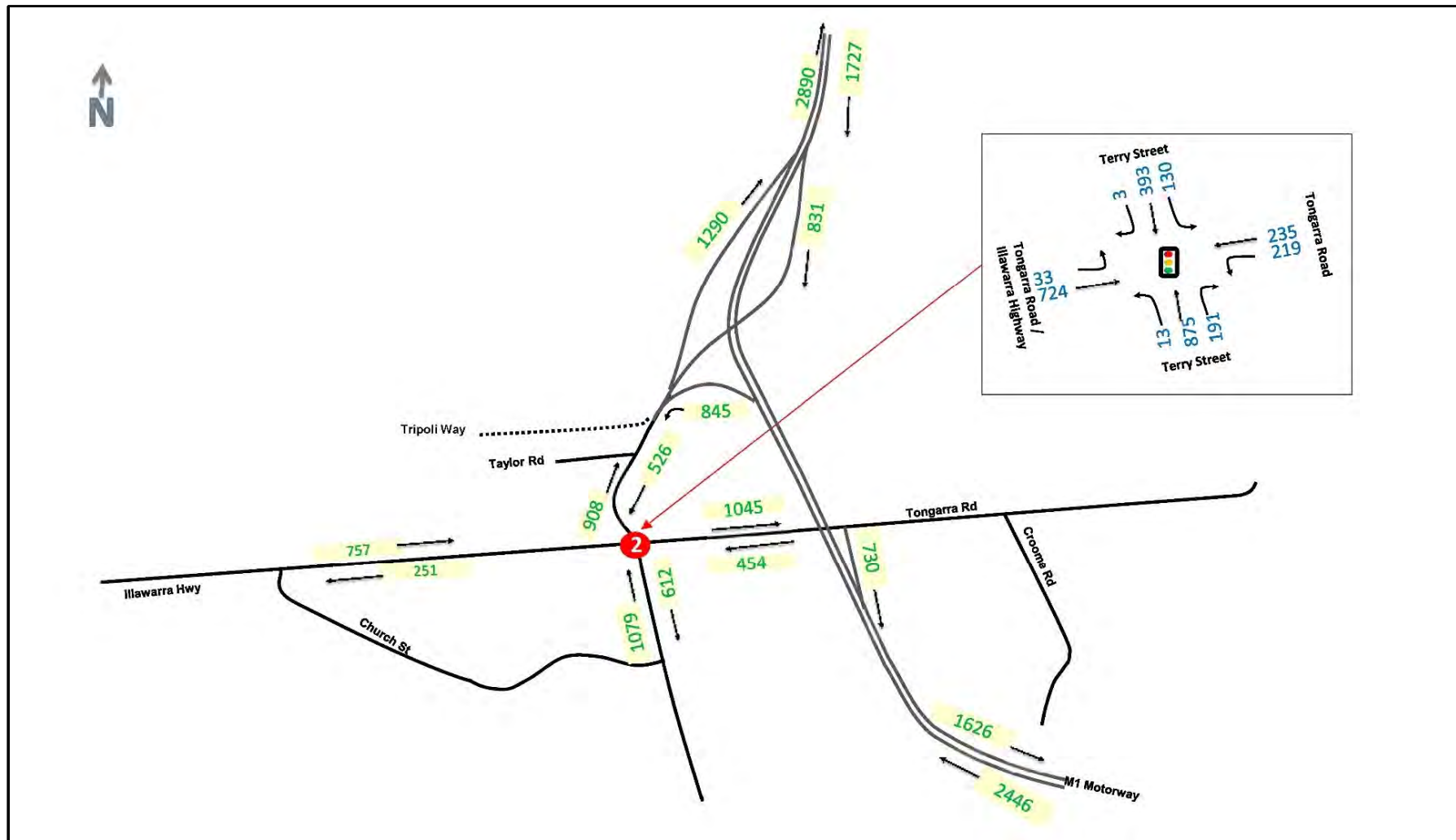
Shellharbour City Council is planning for a future bypass of Albion Park town centre (along the route of the existing Tripoli Way). The proposed interchange at Albion Park is designed to allow connection with this future bypass of Albion Park town centre at Terry Street.

The configuration of the proposed interchange at Albion Park is shown in [Figure 6-12](#).



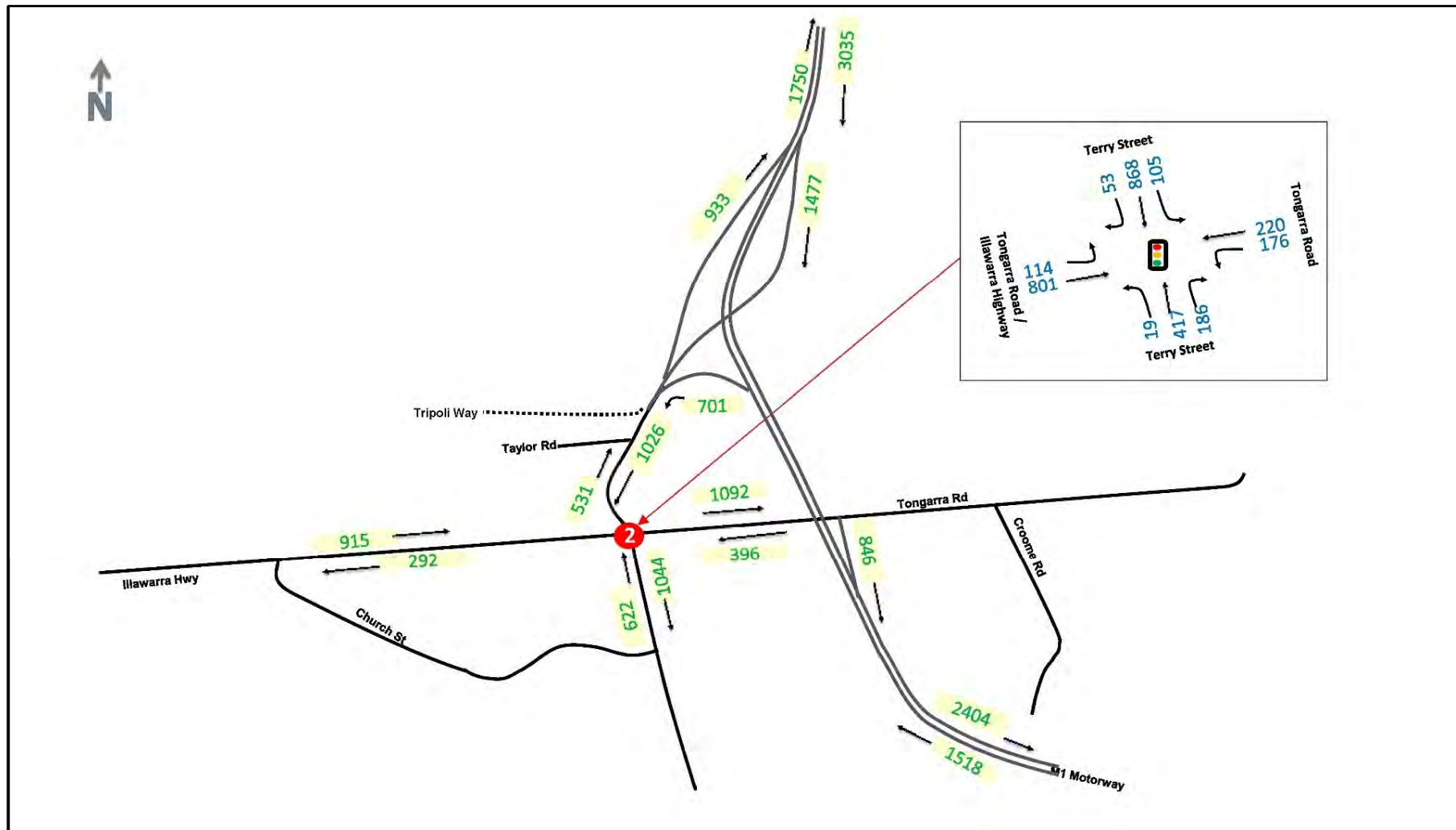
Source 80% Concept Design Preferred Option March 2015

Figure 6-12 Albion Park Interchange



Source: AM Peak, Excel Calculations Stick Diagrams Albion Prk OakFlats-

Figure 6-13 Traffic Volumes at Albion Park Interchange, 2041 AM



Source: PM Peak, Excel Calculations Stick Diagrams Albion Prk OakFlats

Figure 6-14 Traffic Volumes at Albion Park Interchange, 2041 PM

6.5.2.2 Terry Street and Tongarra Road Intersection

The Albion Park interchange ramps would tie-in with northern and eastern approaches of the Terry Street / Tongarra Road intersection. The future performance of Terry Street / Tongarra Road signalised intersection will be driven by development traffic from Calderwood. The capacity problem at the Terry Street / Tongarra Road signalised intersection is identified by 2020.

The Terry Street / Tongarra Road signalised intersection has limited scope for physical capacity enhancement. The two permitted right turns from Terry Street (to the east and west) are associated with high traffic volumes and there are limited options to re-route these turning traffic to adjacent road network. The bypass without the northbound exit ramp with Illawarra Highway will not alter existing traffic distribution through the Terry Street / Tongarra Road intersection. The proposed Albion Park interchange ramps particularly the northbound exist ramp would redistribute traffic patterns at the Terry Street / Tongarra Road intersection. There will be substantial increase in right turning traffic from north to west which likely to impact intersection performance adversely attributable to the northbound exit ramp Two interim options were tested (in isolation and in combination) which could increase the traffic capacity of the Terry Street / Tongarra Road signalised intersection:

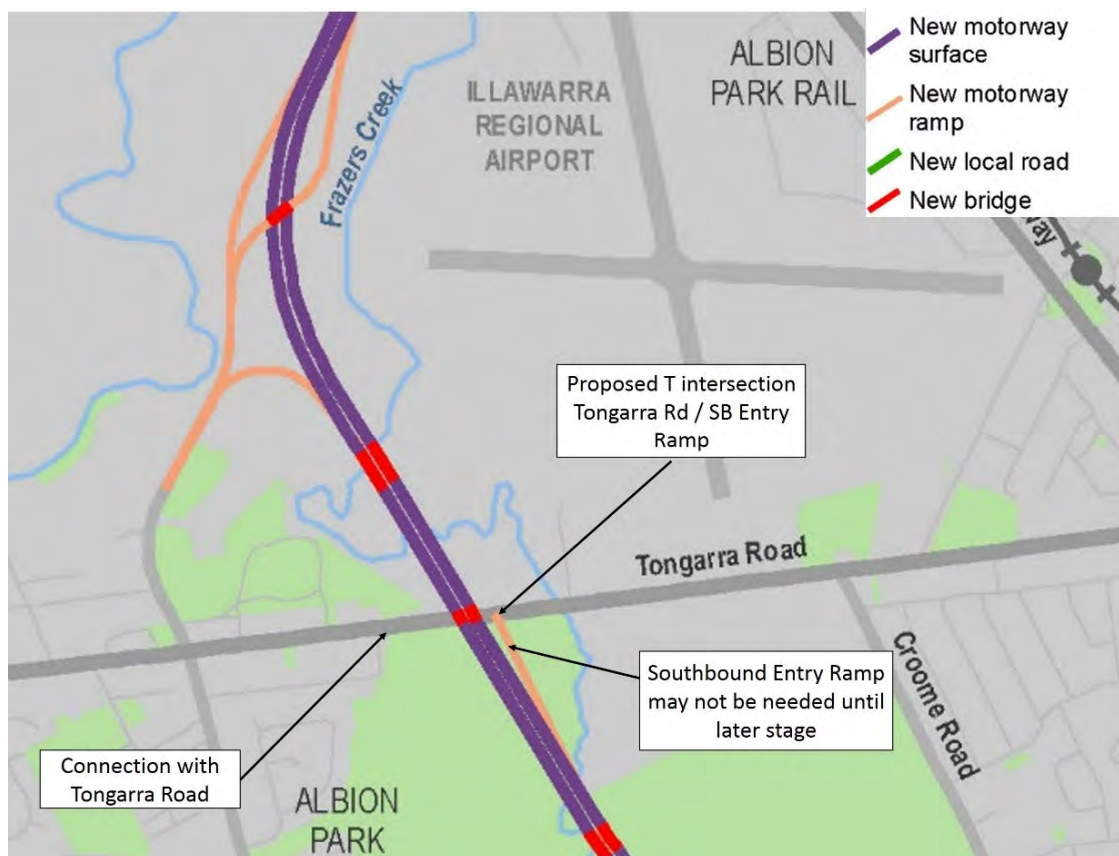
- Increasing the right turn capacity by providing double right turn lanes on the northern approach
- Increasing the proportion of traffic using Taylor Road rather than Tongarra Road.

Increasing the right turn capacity provided marginal traffic benefit only extending intersection service life for a limited timeframe (approximately 2 years). However there are physical constraints on the implementation of this interim option. The local traffic diversion via Taylor Road would require substantial upgrades to key intersections including Taylor Road / Terry Street, Taylor Road / Hamilton Road, Taylor Road / Calderwood Road and Calderwood Road / Tongarra Road intersections. This option was not viable due to significant costs and impact to the local amenity.

The interim upgrading options tested would provide very limited improvement to the traffic capacity at Terry Street / Tongarra Road signalised intersection. The assessment found the Albion Park interchange configuration connecting the future Tripoli Way provides the best traffic outcome. The concept design has allowed for potential connection with a future bypass of Albion Park (Tripoli Way).

6.5.2.3 Tongarra Road and Southbound Entry Ramp

A 'T' intersection with priority control is proposed at Tongarra Road/ southbound entry ramp. Figure 6-15 shows the proposed road network connectivity at Tongarra Road /southbound entry ramp intersection.



Source: 80% Concept Design Preferred Option March 2015

Figure 6-15 Proposed Tongarra Road / Southbound Entry Ramp Intersection

6.5.2.4 Traffic Implications of Albion Park Interchange

The Level of Service in 2041 for key intersections as part of the Albion Park interchange is summarised in Table 6-32. An indicative intersection layout from SIDRA is shown in Table 6-33.

The analysis found that:

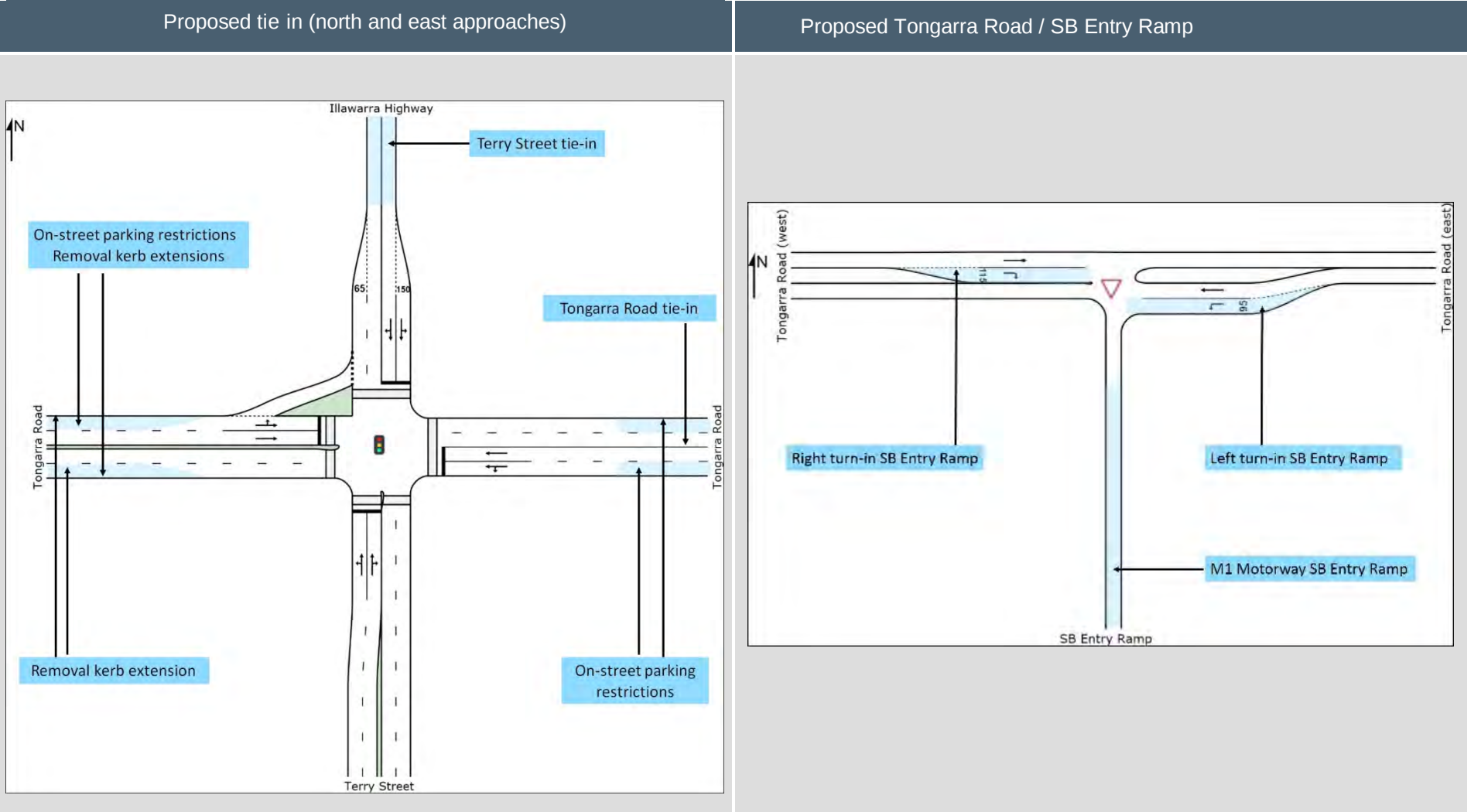
- The traffic capacity of Terry Street / Tongarra Road signalised intersection will be driven by both background traffic growth and additional traffic from planned new release areas (Calderwood). The historical traffic growth analysis undertaken for the last 14 years between 2000 and 2014 suggested traffic has grown on Tongarra Road and Illawarra Highway between 0.7 per cent and 1.1 per cent per annum. The modelling data indicated substantially higher future growth in the order of 2.0 per cent and 2.5 per cent per annum, attributable principally to the additional traffic from new release areas (Calderwood).
- In the event that future traffic growth at Terry Street / Tongarra Road signalised intersection is achieved between 2 per cent and 2.5 per cent per annum, as predicted, this signalised intersection will have adverse Level of Service F by 2020. The modelling analysis indicated that without the Tripoli Way, Terry Street / Tongarra Road signalised intersection performance would be adversely impacted by 2020.
- In the event northbound exit ramp connecting to the Illawarra Highway at the Albion Park interchange was constructed alone (without Tripoli Way), the analysis identified significant adverse impact to the Terry Street / Tongarra Road signalised intersection due to traffic redistribution attributable to the northbound exit ramp.
- If Tripoli Way cannot be constructed to open in a similar timeframe to the project northbound exit ramp, it is recommended northbound exit ramp is not opened until such time that Tripoli Way is constructed, to avoid a substantial adverse impact on the performance of the Terry Street/ Tongarra Road signalised intersection.
- The northbound exit ramp which links to the future Tripoli Way provides the best traffic outcome. It is recommended that the construction of the Tripoli Way upgrade should be timed to coincide with construction of the northbound exit ramp from new motorway to Terry Street.
- No changes to the intersection of Croome Road/ Tongarra Road are proposed, as traffic volumes at this location are not expected to increase as a result of construction of the project.

Table 6-32 Albion Park Intersections Performance in 2041

Albion Park Intersection	Control Type	Peak Period	Average Delay (s)	Level of Service (LoS)
Terry St / Tongarra Road With Tripoli Way	Signals	AM	51	D
		PM	51	D
Tongarra Road / SB Entry Ramp	Give Way Control	AM	31	C
		PM	35	C
Tongarra Road / Croome Road	Give Way Control	AM	12	A
		PM	14	A

Source: SIDRA INTERSECTION 6.0.24.4877
Model: Tripoli Way

Table 6-33 Albion Park Intersections Layouts Modelled in SIDRA



Source: SIDRA INTERSECTION 6.0.24.4877
Model: Albion Park Interchange

6.5.2.5 Merging Sections

Three merging sections are identified with Albion Park interchange showed in Figure 6-16



Figure 6-16 Merge Sections at Albion Park Interchange

The 2041 modelling results indicated that the three merging segments would operate with Level of Service B and C for both AM and PM peak period. Table 6-34 shows merging sections Level of Service results for 2041.

Table 6-34 Level of Service for Merging Sections in 2041

Merging Segment	LoS	
	AM Peak	PM Peak
NB entry ramp merging	C	B
NB and SB exit ramps merging/ Illawarra Highway	B	C
SB entry ramp merging	B	C

Source: HCM Calculations

6.5.3 OAK FLATS INTERCHANGE

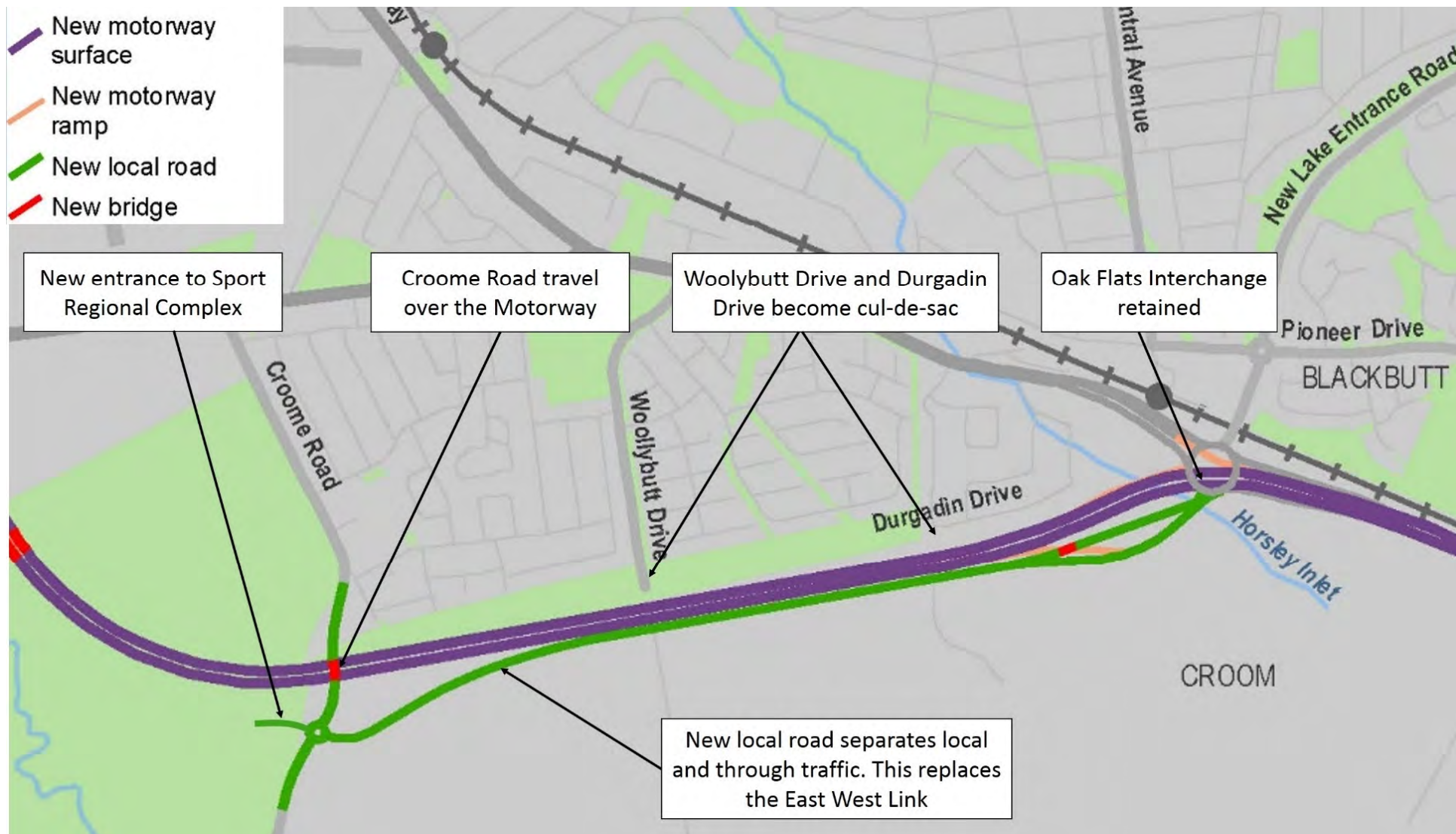
6.5.3.1 Upgrade Description

The Southern Interchange at the existing Oak Flats Interchange would be reconfigured to incorporate the M1 Motorway, ramp adjustments and the new East-West Link alignment. This would provide full access between the M1 Motorway, Princes Highway, New Lake Entrance Road and the new East West Link:

- A new East West Link which runs parallel to the M1 Motorway on the southern side, connecting the interchange with Croome Road
- A northbound entry ramp, which would share a connection from the Oak Flats Interchange with the proposed new East West Link
- The existing northbound exit ramp (unchanged by this project)
- The existing southbound entry ramp (unchanged by this project)
- A southbound entry ramp from the Princes Highway onto the M1 Motorway after passing under the Oak Flats Interchange
- A southbound exit ramp, which would be a modification of the existing eastbound connection of East West Link to the interchange.

The configuration of the proposed Oak Flats Interchange is shown in Figure 6-17.

Figure 6-19 and Figure 6-20 show 2041 peak hour traffic volumes at key intersections at Oak Flats interchange.



Source: 80% Concept Design Preferred Option March 2015

Figure 6-17 Interchange at Oak Flats



6.5.3.2 Croom Regional Sporting Complex

The M1 Motorway route would bisect the Croom Regional Sporting Complex. A number of sporting fields and facilities would be directly impacted by the project, including the cricket/AFL oval and the northern extents of the junior rugby league playing fields and netball courts.

To ensure its ongoing use, the project would reconfigure the Croom Regional Sporting Complex. Roads and Maritime has worked closely with Shellharbour City Council and the sporting groups that use the facilities to develop a master plan for the reconfiguration of the Croom Regional Sporting Complex that would provide sporting fields and facilities adequate to the existing provisions. Roads and Maritime is continuing to work with these groups to minimise impacts on users of the venue during the construction period.

The reconfiguration of the Croom Regional Sporting Complex would include construction of new sporting fields and associated buildings and amenities to replace those directly impacted by the motorway, as well as new internal roads, pedestrian/cycle paths and parking.

A master plan for the reconfiguration of the Croom Regional Sporting Complex was developed in consultation with Shellharbour City Council, and was publically displayed. Following the community consultation, a number of proposed changes were received by the project team for consideration. Council has formally endorsed the master plan.

The concept layout for the sporting complex, including a number of changes made in response to consultation submissions, is shown in Figure 6-18 below.



Figure 6-18 Croom Regional Sporting Complex concept plan

6.5.3.3 Colden Drive – Closure of Connection to East-West Link

Closure of Durgadin Drive will remove the connection between the commercial developments and the East West Link (refer to Table 6-36). As a result, traffic entering or exiting the Colden Drive / Durgadin Drive commercial precinct will be diverted to use the existing intersection with the A1 Princes Highway, west of the Oak Flats interchange.

6.5.3.4 Princes Highway/ Woollybutt Drive Intersection

The existing East West Link Road will be closed and a new Service Road will be constructed as part of the project. The southern connection point of Woollybutt Drive will be permanently closed. The existing priority controlled intersection at Princes Highway / Woollybutt Drive has been assessed for the following scenarios (refer to Table 6-37):

- With the closure of the East West Link Road connection and all traffic detoured via Princes Highway / Woollybutt Drive intersection (give way, no traffic signals)
- With the closure of the East West Link Road and upgrade the A1 Princes Highway / Woollybutt Drive intersection to new traffic signals.

6.5.3.5 Service Road – Quarry Access Intersections

The proposed new East-West Link configuration contains two intersections which provide access to quarry operations. The proposed intersection layout for both quarry access points would consist of channelized right turn with 110 metre turning lane and an auxiliary left turn with

deceleration lane of 50 metres (refer to Table 6-38. Table 6-35 summarises the reported trip generation on the busiest quarry day.

Table 6-35 Estimated Quarry Trip Generation

	AM Peak		PM Peak	
	In	Out	In	Out
East Quarry (Cleary Bros)	54	45	35	61
West Quarry (Holcim)	30	23	26	35

Source: Cleary Bros Quarry Albion Park Rail – Proposed Increase to Annual Production Levels Traffic Impact Assessment (GTA Consultants, 2012)

Sensitivity analysis was also undertaken to assess the performance of channelised right-turn lanes in the event there was increased in the scale of the quarry operations.

6.5.3.6 Croome Road/ Tongarra Road Intersection

The Croome Road / Tongarra Road intersection will be retained without modification. The intersection will experience a decrease in traffic volume as a result of the project.

The SIDRA modelling results and traffic implications of Oak Flats interchange, Croom Regional Sporting Complex, Colden Drive, Woollybutt Drive and quarry access are documented in the following section.

Table 6-36 Colden Drive/Princes Highway Intersection Modelled in SIDRA

Existing signals at Colden Drive/Princes Highway

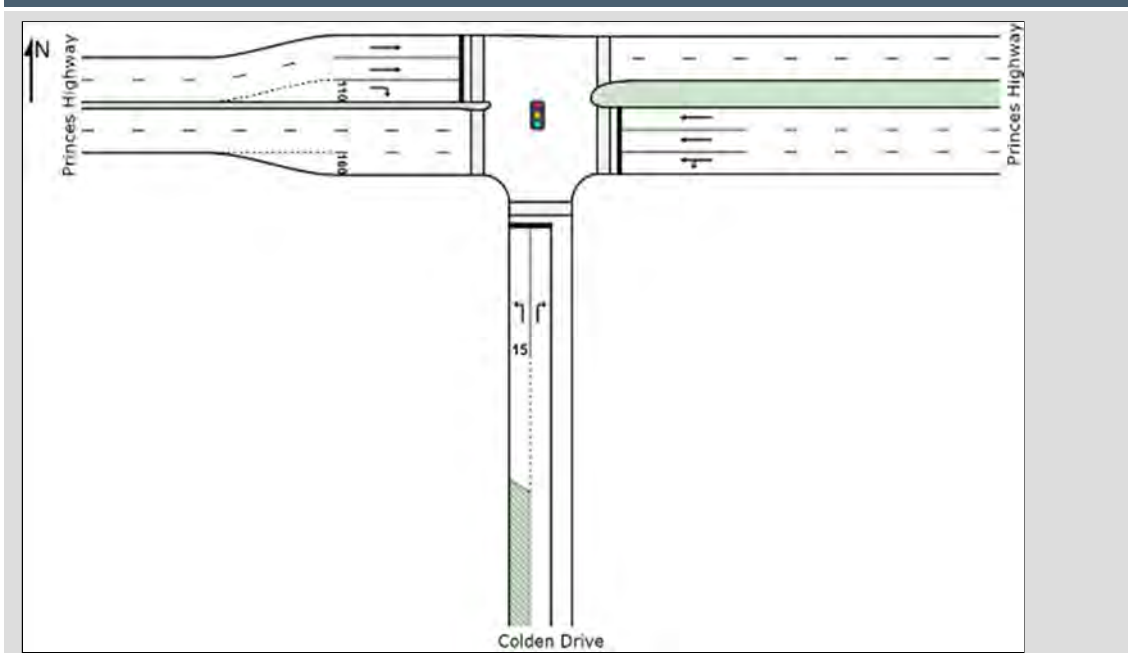
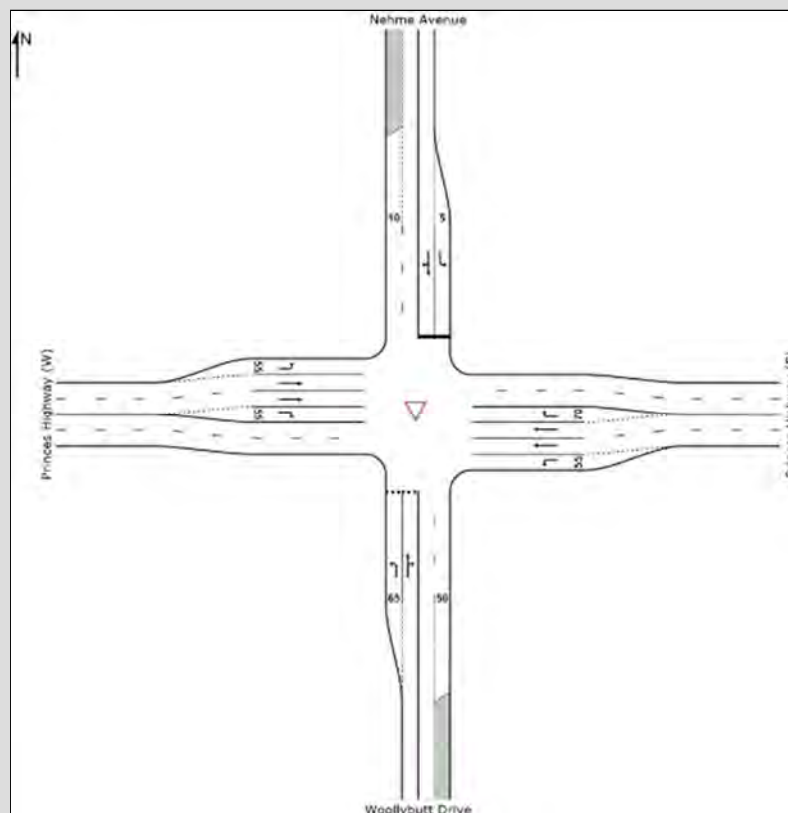


Table 6-37 Woollybutt Drive/Princes Highway Intersection Modelled in SIDRA

Existing priority controlled intersection at Woollybutt Drive/Princes Highway



New signals at Woollybutt Drive/Princes Highway

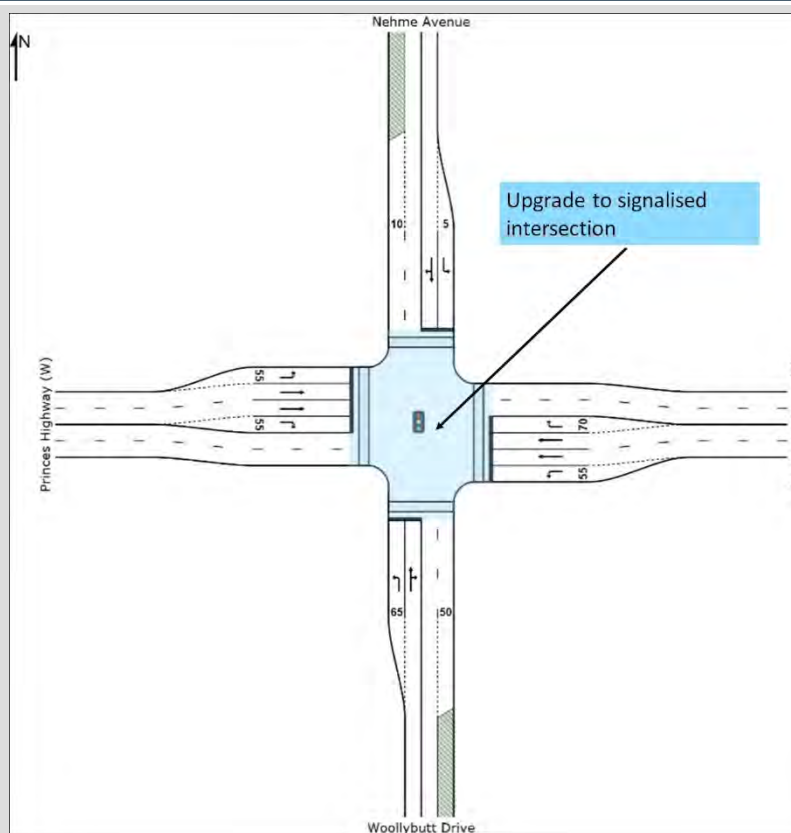


Table 6-38 Proposed Quarry Access Intersection Modelled in SIDRA

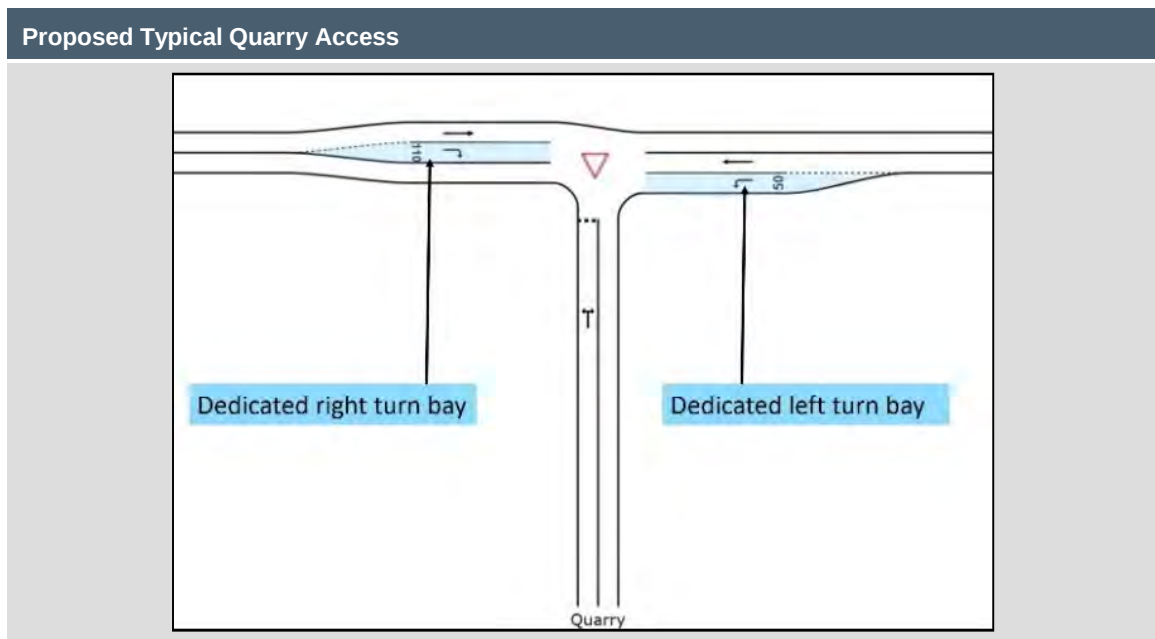
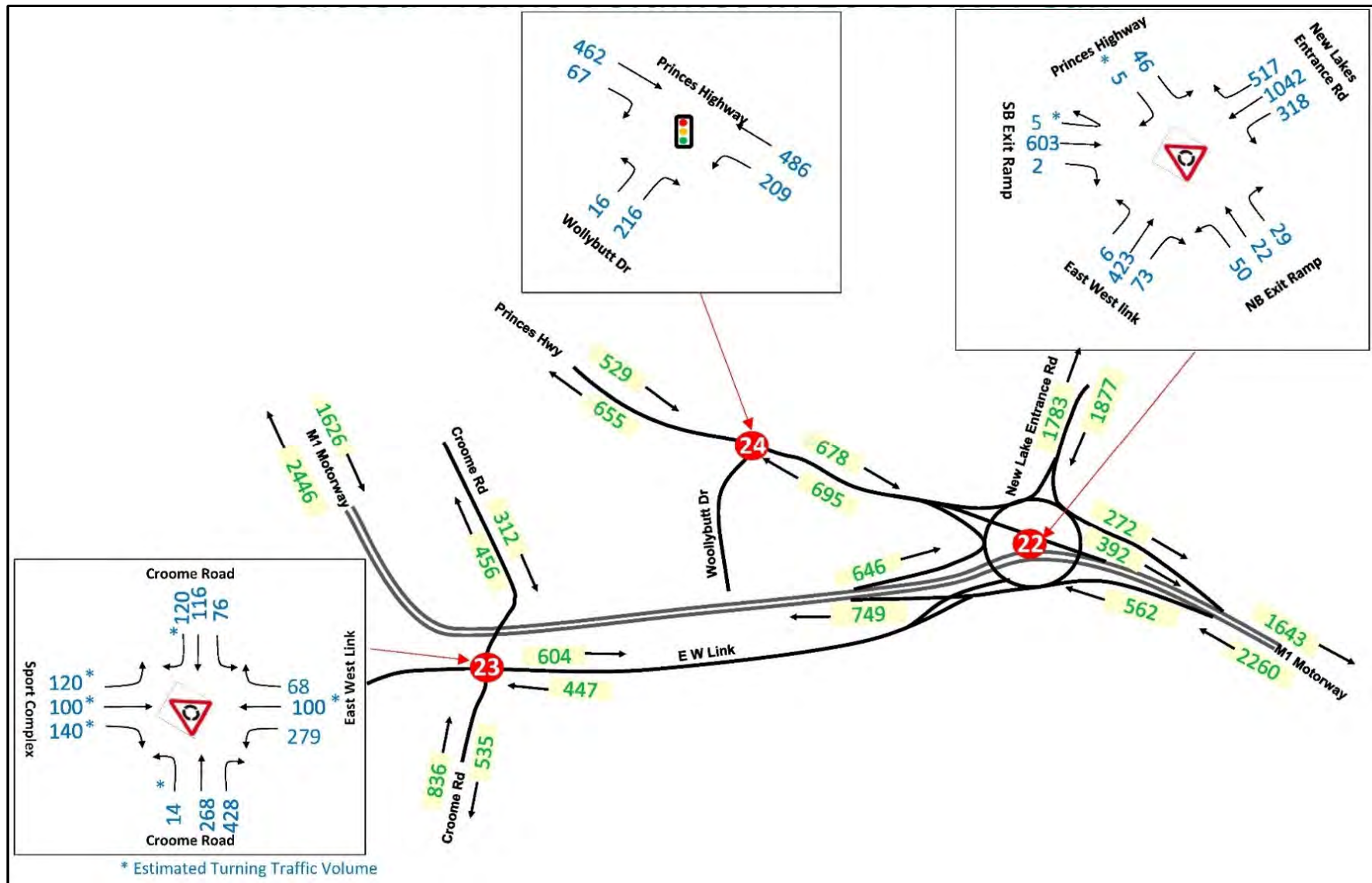
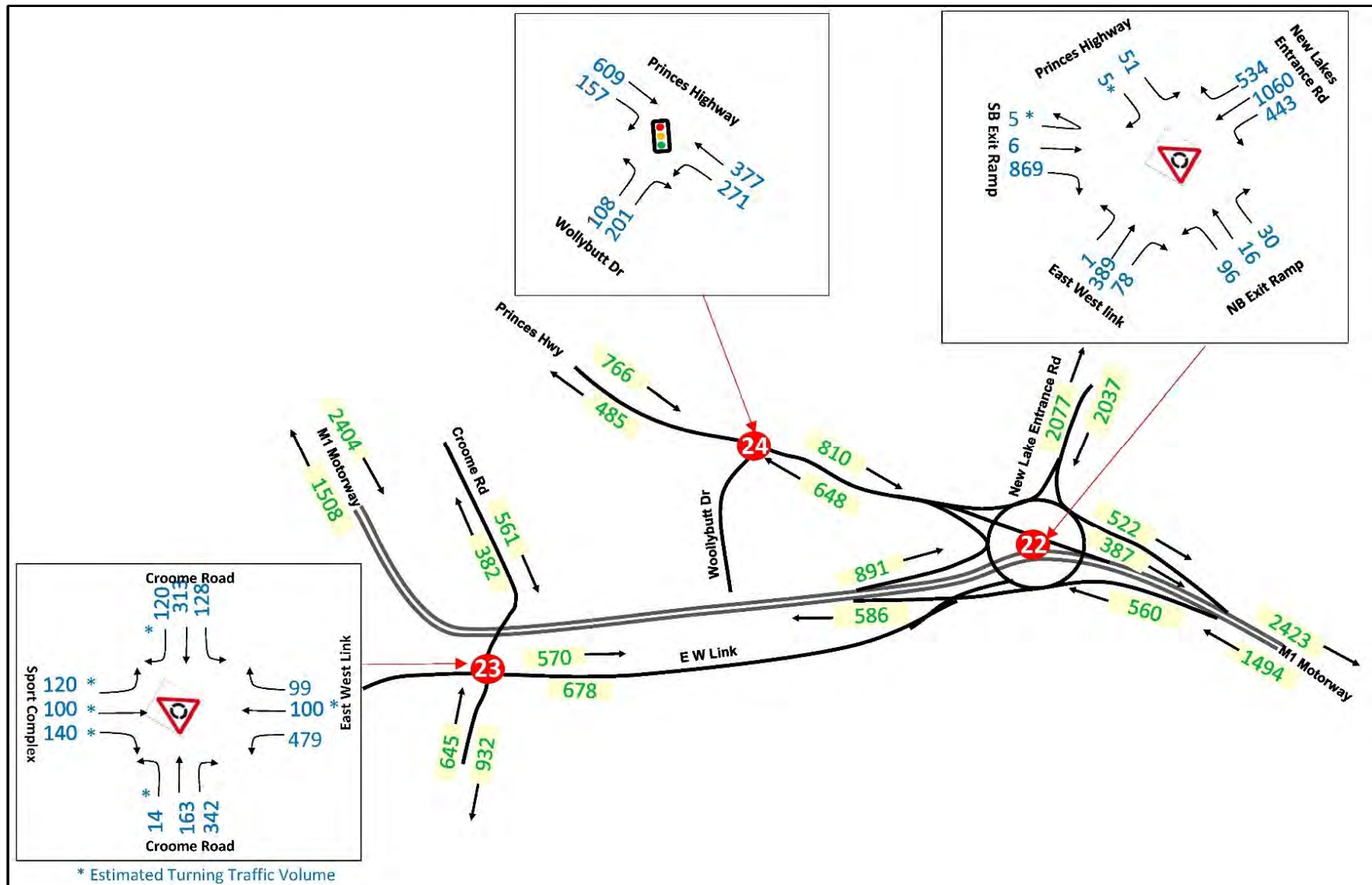


Figure 6-19 and Figure 6-20 show 2041 peak hour traffic volumes at key intersections at Oak Flats interchange.



Source: AM Peak, Excel Calculations Stick Diagrams Albion Prk OakFlats

Figure 6-19 Traffic Volumes at Oak Flats Interchange, 2041 AM



Source: PM Peak, Excel Calculations Stick Diagrams Albion Prk OakFlats-

Figure 6-20 Traffic Volumes at Oak Flats Interchange, 2041 PM

Albion Park Rail Bypass—Traffic and Transport Assessment Report Revision 06

Hyder Cardno Joint Venture-ABN 58 300 126 782

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6.5.3.7 Traffic Implications of Oak Flats Interchange and New East-West Link

The predicted Level of Service in 2041 for Oak Flats interchange and key intersections along the New East West Link are summarised in Table 6-39. The sensitivity analysis undertaken for Croom Regional Sporting Complex new roundabout is shown in Table 6-40.

An indicative intersection layout from SIDRA for assessed intersections is shown in Table 6-41.

Table 6-39 Oak Flats Interchange Components Performance in 2041

Oak Flats Interchange	Control Type	Peak Period	Average Delay (s)	Level of Service (LoS)
Oak Flats Interchange	Existing Roundabout	AM	18	B
		PM	19	B
New East West Link – Croome Road	New Roundabout	AM	14	A
		PM	20	B
New East West Link – Quarry Access	New T Intersection (Sign Control)	AM	28	B
		PM	39	C
Woollybutt Drive – Princes Highway	Scenario 1 Existing Sign Control ⁽¹⁾	AM	> 200	F
		PM	> 200	F
Woollybutt Drive – Princes Highway	Scenario 2 New Signals	AM	30	C
		PM	32	C
Colden Drive – Princes Highway	Existing Signals	AM	10	A
		PM	11	A

Note: (1): in 2041, sign control intersection (SIDRA) model indicated substantial delay. Once intersections exceed capacity, then delay increases much faster than actual traffic increase.
Source: SIDRA INTERSECTION 6.0.24.4877
Model: Oak Flats New Lake Entrance, Croome Road, Woollybutt Drive, Princes - Tongarra

Table 6-40 Croom Regional Sporting Complex Peak Event Sensitivity Assessment

East West Link Croome Road	Control Type	Peak Period	Average Delay (s)	Level of Service (LoS)
General Use (Expanded Car Park)	New Roundabout	AM	17	B
		PM	31	C
Peak Event Entry	New Roundabout	AM	43	D
		PM	54	D
Peak Event Exit	New Roundabout	AM	30	C
		PM	27	B

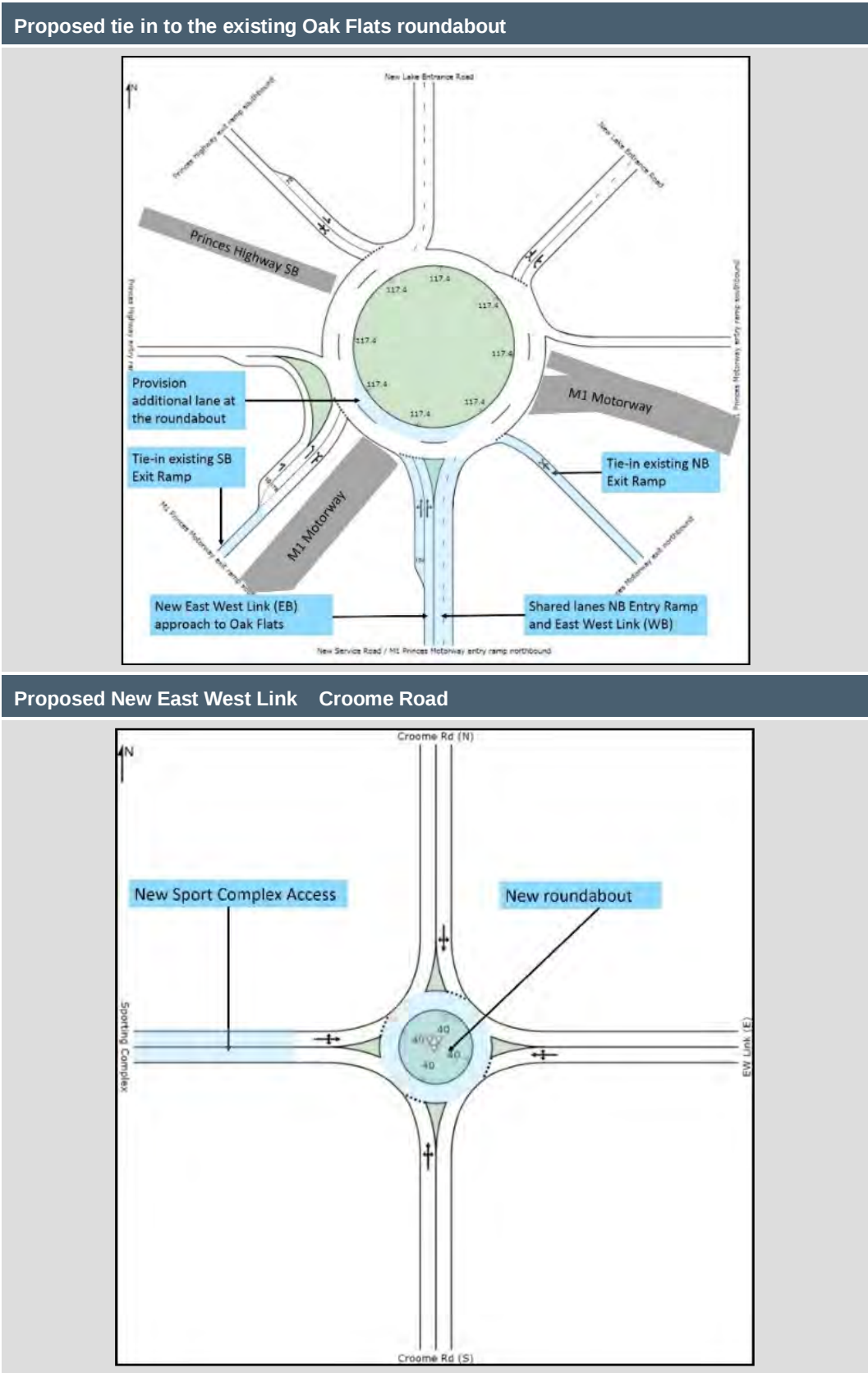
Source SIDRA INTERSECTION 6.0.24.4877

The 2041 SIDRA modelling and traffic assessment has found that:

- Oak Flats roundabout would operate at Level of Service B in both AM and PM peak hour

- Upgrade to the existing intersection of Woollybutt Drive and A1 Princes Highway is required to cater for the closure of Woollybutt Drive / East West Link Road. Two scenarios were tested: retaining existing priority control and installing new signals. The analysis identified the need for new traffic signals which would provide Level of Service C in AM and PM peak periods
- Quarry access points are expected to operate a Level of Service B and C in AM and PM peak. Route choice for quarry vehicles will remain similar to existing accessibility and access to and from the project will be via the Oak Flats interchange
- A Service Road (new East West Link), replacing the existing east West Link Road, is required to facilitate access to existing quarry land uses, as well as to maintain existing levels of accessibility between Croome Road and the Oak Flats interchange
- The closure of the southern end of Durgadin Drive requires traffic accessing the commercial precinct to travel via the Princes Highway. The existing signals would not require modification. The traffic assessment indicates a Level of Service A during both peak periods in 2041. The closure will increase minor travel distance by about 1.1 kilometres for traffic that would have entered the commercial precinct from the southern Albion Park area (Mortlock Drive) to the central portion of Shaban Street.
- The closure of the southern end of Woollybutt Drive requires traffic accessing the local area via the Princes Highway or Cromme Road. The proposed traffic signals at the Woollybutt Drive and Princes Highway intersection would improve the network performance for local traffic movements. The closure would not result in any discernible change in travel distance for trips between the southern Albion Park area (Mortlock Drive) to Albion Park Rail (Koda Road and Woollybutt Drive intersection). Residents in Albion Park Rail wanting to travel south to Kiama from Koda Road and Woollybutt Drive would also have no discernible additional travel distance.
- Closure of the Illawarra Highway between Taylor Road and Croome Lane is likely to impact on those people making short local trips between Albion Park and the northern portion of Albion Park Rail / Haywards Bay. Longer trips would be accommodated through the use of the Albion Park Rail bypass. With the removal of the Illawarra Highway traffic will need to use Tongarra Road and the existing Princes Highway. This would increase the trip length by about 2.4 kilometres.
- The changes to Cormack Avenue to connect to the southbound off ramp at Yallah mean that access would mean that residents are no longer able to access the eastern areas of Dapto from the Princes Highway in the south. Residents will still be able to travel south along Cormack Avenue and have access to Albion Park Rail and south on the Princes Motorway. For those people that are wanting to access the eastern Dapto residential area (Colvin Place) from Albion Park Rail these trips would be via the Princes Highway and Emerson Road bridge, an additional 3.3 kilometres. It is noted that this is a temporary impact until the Tallawarra Lands development constructs an alternative road connection.

Table 6-41 Oak Flats Interchange and New East-West Links Modelled in SIDRA



6.6 IMPACTS ON ROAD SAFETY

Should the project be constructed, the majority of through traffic would be diverted onto the new motorway, reducing traffic volumes on the existing Princes Highway route between Yallah and Oak Flats significantly. This would result in significant crash reduction along the existing Princes Highway route and improves road safety to local traffic.

The majority of crashes reported in the analysis area occurred on the Princes Highway, being 290 crashes or 83 per cent over a period of five years. The four most common types of crashes account for around 81 per cent of the reported crashes on the Princes Highway:

- a) Rear-end (164 – 56.6 per cent)
- b) Intersection, adjacent approaches (29 – 10 per cent)
- c) Opposing vehicles; turning (18 – 6.2 per cent)
- d) Off road on straight, hit object (23 – 7.9 per cent)

Crashes other than the above constitute the remaining 19 per cent.

Appendix C of the Roads and Maritime Accident Reduction Guide suggests the proposed improvements attributed to the project can achieve a target reduction factor of 30 per cent for rear-end and intersection crashes. In addition, a target reduction of 10 per cent on the off road on straight crashes will be feasible. In summary, a target reduction of 59 crashes is attributable to the proposed improvements. Table 6-42 below provides a breakdown of the associated crash reduction.

Table 6-42 Crash Reduction Targets

Crash Description	Crashes	%	Target Reduction	
Rear-end	164	57%	49	116
Intersection, adjacent approaches	29	10%	8	21
Off road on straight, hit object	23	8%	2	21
Opposing vehicles; turning	18	6%		18
Other crash type	56	19%		56
Total	290	100%	59	232

The equivalent annual crash savings attributable to the proposed upgrade is estimated to be \$1.672 million per year.

The project would also reduce future traffic volumes along the Tongarra Road which would also have similar 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 south facing entry ramp from Tongarra Road opened, reducing the incidence 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.

6.7 IMPACTS ON OTHER TRAVEL MODES

6.7.1 HEAVY VEHICLES

The project would provide improved travel times and freight efficiency to regional heavy vehicles. The removal of through heavy vehicle trips would also result in an improvement in amenity along the existing Princes Highway route through a reduction in noise, vibration and emissions associated with heavy vehicle travel. The project has been designed to accommodate larger vehicles and it would form the primary route for through vehicles of the following categories:

- The 4.6m high routes
- The 19m B-double, 23m B-double and 25/26m B-double routes.

Due to the industrial land uses which exist through Albion Park Rail with access from the Princes and Illawarra Highways, it is not proposed to change the classification or accessibility of the existing Princes Highway route to prevent travel by over-dimension or higher mass vehicles, to ensure land uses are able to continue to utilise these heavy vehicle types. Additionally, the access to the existing Princes Highway route through Albion Park Rail is important for heavy vehicles so that they can access fuel and for fatigue management purposes.

6.7.2 PUBLIC TRANSPORT

A review of the public transport network indicates the project would have minimal impacts on the existing taxi, bus and rail network. The key routes via Tongarra Road, Terry Street and Princes Highway would be unaffected. Traffic volumes are forecasted to be between 23 per cent and 54 per cent lower along Tongarra Road and between 56 per cent and 74 per cent lower on Princes Highway. This reduction in traffic volumes along these routes would improve the travel time reliability for buses and taxis especially during peak periods. Access to the Albion Park Railway Station would become increasingly important in the future, as development in Calderwood and other land release areas progress. The removal of general traffic from Tongarra Road and A1 Princes Highway as a result of the project would improve bus journey time reliability. A review of bus maps for the Premier Illawarra bus company indicated that proposed road closures at Illawarra Highway, Colden Drive and Woollybutt Drive would not impact regular timetabled bus routes.

6.7.3 PEDESTRIAN AND CYCLE NETWORK

The project development has considered the existing and council-planned pedestrian and cycle facilities impacted by or adjacent to the project and developed proposed facilities to align with these. The key principles used to develop the pedestrian and cycle facilities proposed under this project are:

- Maintain or improve existing or planned network links across the project corridor
- Provide a shared path (bicycle and pedestrian) facility across the motorway at each point the motorway crosses an existing local road
- Allow cycle access along the shoulders of the motorway and major local roads
- Consider planned future developments adjacent to the motorway

The proposed pedestrian and cycle facilities are shown in Figure 6-21.



Figure 6-21 Proposed pedestrian and cyclist routes in study area

As shown in Figure 6-21, once complete, the project would add shared paths and improve pedestrian footpath facilities. The current concept design arrangement includes:

- Cycle access to the new motorway shoulders. The 2.5m wide shoulders of the new motorway will provide an opportunity for experienced/ commuter cyclists to travel between destinations such as Albion Park to Shellharbour and Wollongong, and from Shellharbour towards Albion Park/ Calderwood and Wollongong. The shoulders would also provide a good facility for touring cyclists who may be travelling through the region to destinations further afield, such as Kiama, Sydney or the Southern Highlands
- A new shared path provision adjacent the existing A1 Princes Highway underneath the M1 Princes Motorway connecting from east to west. This will provide off-road pedestrian and cycle connectivity between Dapto and the planned future Tallawarra Lands Development
- Cycle access to the 2 m shoulders of the A1 Princes Highway in both northbound and southbound directions. This will allow cyclists to take advantage of the reduced traffic volumes on the A1 as a result of the motorway and improve connectivity between Dapto and Albion park Rail
- A new shared path adjacent to Yallah Road across the motorway providing improved off road connectivity between the commercial area / Haywards bay and the residents of Larkins Lane.
- A new shared path between the existing Illawarra Highway at Croome Lane, Albion Park Rail, and the Illawarra Highway (Terry Street), Albion Park. This will cross beneath the motorway bridges over Frazers Creek and provide improved off road pedestrian and cycle connectivity between the northern parts of Albion Park and Albion Park Rail.
- A new shared path adjacent to Tongarra Road beneath the motorway, providing improved off-road pedestrian and cycle connectivity between Albion Park and Albion Park Rail
- A network of new shared paths throughout the Croom Regional Sporting Complex, generally running in parallel to the proposed road network as part of the reconfiguration for the complex proposed under this project
- A new shared path adjacent Croome Road across the motorway
- Cycle access to the 2 m shoulders of the new East West Link in both Eastbound and Westbound directions to improve connectivity between Albion Park and Shellharbour.

In total the project will provide approximately 6.3 km of new off road shared paths, significantly improving upon the existing network. All new shared paths built as part of the project would be a minimum of 2.5m wide and generally extend to the project boundary, relying on additional works to be undertaken by councils to connect them to other planned parts of the off road shared path network.

6.7.3.1 Pedestrian Network impacts

The existing off-road paths suitable for pedestrians which are impacted by the project are identified in Table 6-43.

Table 6-43 Pedestrian network impacts and mitigation

Impact	Mitigation
The path through the Croom Regional Sporting Complex which is severed by the new motorway.	Replaced by a new network of shared paths to parallel all new roads within the complex which will provide access around the sporting complex and across the motorway.
The paths around the Croome Road Roundabout which is removed by the new motorway and local roads.	A direct connection between the shared paths within the Croom Regional Sporting Complex and the shared path across the Croome Road overbridge. In addition the Croome Road Roundabout design will consider safe cyclist access around the roundabout.

6.7.3.2 Bicycle Network Impacts

The existing cycle routes and facilities which are impacted by the project are identified in Table 6-44.

Table 6-44 Bicycle network impacts and mitigation

Impact	Mitigation
Existing on-road cycle (shoulder) route along the A1 Princes Highway impacted by the project	The existing route will be maintained. Cyclists will be able to continue to use the highway shoulders, however with the opening of the new motorway, traffic volumes in the adjacent lanes will be significantly reduced. In some parts of the A1 Princes Highway, such as at the Yallah interchange, on road cycle routes will be replaced by off-road shared paths.
Existing on-road (non-signposted) route along Yallah Road severed by the project.	Replaced by new off-road shared path across the Yallah Road overbridge across the proposed bypass.
Shellharbour City Council proposed off-road shared path alongside the Illawarra highway to connect the northern parts of Albion Park and Albion Park Rail is severed by the closure of the Illawarra Highway.	New shared path to be provided along the same route, crossing beneath the motorway at the Frazers Creek bridge, providing the same connectivity as the council proposed route.
On Road cycle route along Tongarra Road impacted by the project.	Replaced by new off-road shared path across the project corridor.
The path through the Croom Regional Sporting Complex which is severed by the new motorway.	Replaced by a new network of shared paths to parallel all new roads within the complex which will provide access around the sporting complex and across the motorway.

Impact	Mitigation
The paths around the Croome Road Roundabout which is removed by the new motorway and local roads.	A direct connection between the shared paths within the Croom Regional Sporting Complex and the shared path across the Croome Road overbridge. In addition the Croome Road Roundabout design will consider safe cyclist access around the roundabout.
On road(shoulder) route for cyclists along East West Link impacted by the relocation of East West Link	Similar on-road connectivity for cyclists will be provided along the new East West Link, improved by the increased shoulder width (2 m) on the new East West Link
Future connection to a Council proposed off-road shared use path along Woollybutt Drive severed by closure of Woollybutt Drive connection to East West Link.	No replacement for this future proposed connection is proposed by this project. Needs re-consideration in future Council planning with the closure of Woollybutt Drive.
On road connections from East West Link into Durgadin Drive no longer possible.	No replacement for this existing connection is proposed by this project. Needs re-consideration in future Council planning with the closure of Durgadin Drive.

7 ASSESSMENT OF CONSTRUCTION IMPACTS

7.1 CONSTRUCTION IMPACTS GENERALLY

The construction of the project would result in traffic and transport impacts to a varying degree and duration. Generally the impacts relating to traffic and transport are:

- Limited temporary increases to travel times for vehicles and cyclists (on-road) due to:
 - Speed limit restrictions around areas where the proposed works join into existing roads and where construction activities need to be completed under traffic; and to a much lesser extent
 - Increased construction traffic resultant from heavy vehicles hauling material to the work sites and additional movements in the vicinity of the temporary ancillary sites and laydown areas
- Changes to the safe operating profile of the road network given the addition of construction traffic including heavy vehicles as well as temporary traffic controls
- Temporary traffic diversions, in particular of the Illawarra Highway and Princes Motorway southbound carriageway near Yallah interchange
- Temporary detours (mainly associated with infrequent construction activities requiring completion outside of normal operating hours)
- Altered property access arrangements during construction
- Possible bus timetable delays due to temporary traffic control measures
- Pedestrians needing to take alternate paths to that already being informally used
- Minor kerbside parking changes on some local roads
- Safety impacts through temporary work areas.

7.2 CONSTRUCTION WORKS STAGING

The start and overall duration of construction would depend on:

- Timing and outcomes of key decisions regarding early work and contract packaging
- The project delivery method (that is, whether it is 'design and construct' or 'design only' then 'construct only').

Notwithstanding the above, construction is anticipated to start by early 2019. The design of the project has carefully considered the requirement to minimise impact on existing traffic, enable safe construction access and egress, and minimise the duration of construction.

Construction would be broadly split into three stages, as outlined below.

7.2.1 STAGE 1

Stage 1 would generally include construction of all greenfield areas and those areas where construction activities would have little impact on existing traffic. The main construction activities in Stage 1 would be to:

- Relocate sporting fields, amenities and access for the Croom Regional Sporting Complex and realign access.
- Construct all areas of the project from the northern extent to the new Frazers Creek twin bridges. This would be limited to areas where existing roads would not be impacted
- Construct bridges at Duck Creek (multiple), Macquarie Rivulet and Frazers Creek (multiple)
- Construct a bridge over the South Coast Railway Line
- Construct bridges over the northbound Princes Highway, Tongarra Road and Croome Road
- Construct the entry and exit ramps which connect the Princes Highway and Illawarra Highway (Terry Street) to the motorway
- Partially complete the dual roundabouts either side of the existing underpass where the Princes Highway and Princes Motorway intersect
- Realign Cormack Avenue, Yallah Bay Road, Yallah Road and Croome Road as required
- Construct the proposed East West Link and associated connection to the Oak Flats Interchange

7.2.2 STAGE 2

The main construction activities in Stage 2 would be to:

- Divert traffic along the existing Illawarra Highway (Terry Street), south of the Princes Highway, onto a short section of temporary road linking to the proposed northbound carriageway of the motorway (See Figure 7-1). This would allow completion of the motorway carriageway and the southbound exit ramp to Illawarra Highway (Terry Street). The detour would re-join the existing Illawarra Highway (Terry Street) about 550 metres north of Taylor Road and operate until the motorway becomes operational
- Detour the existing East West Link traffic between Croome Road and Oak Flats Interchange onto the proposed new East West Link (constructed as part of Stage 1). This would allow for construction of the motorway between the Croom Regional Sporting Complex and the Oak Flats Interchange. This would also result in the immediate closure of Woollybutt Drive and Durgadin Drive north of the motorway * Complete the dual roundabouts either side of the existing underpass of the Princes Highway and Princes Motorway intersection
- Complete all remaining work on the existing Princes Motorway except for the interchange at Yallah southbound entry ramp and tie-in work.

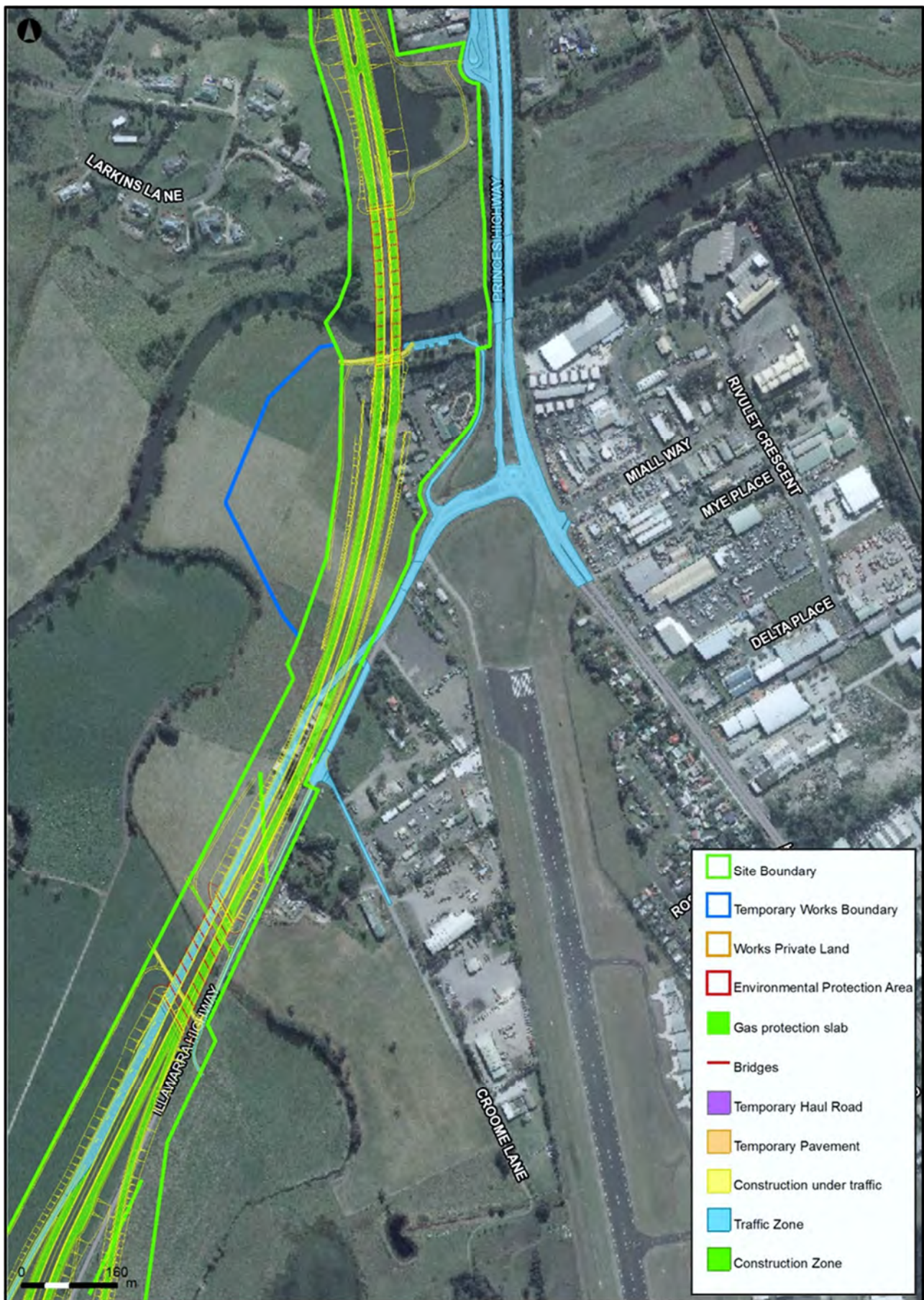


Figure 7-1 Traffic Switch of Illawarra Highway onto New Motorway

7.3 CONSTRUCTION PROGRAM

The main project is delivered in a single construction period. The construction period is anticipated to take approximately 36 months (weather permitting). Should the actual delivery arrangements differ to the above assumptions, the overall construction program may differ.

7.4 HOURS OF CONSTRUCTION

Standard construction hours in NSW are:

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

7.4.1.1 Extended construction hours

The **Interim Construction Noise Guidelines** (Department of Environment and Climate Change, 2009) have been developed by a number of State Government agencies to provide guidance on managing noise from construction work in NSW. The guidelines state that, public infrastructure works are one of the five categories of works that may need to be undertaken outside the recommended standard hours. This need is typically based on a requirement to sustain the operational integrity of public infrastructure, as work to restore operation of the infrastructure provides a benefit to the greater community (that is, more than just local residents).

Roads and Maritime is seeking approval for standard construction hours plus additional time at the start and end of each day (Monday to Friday) and Saturday afternoon ('extended construction hours'). Extended construction hours would apply across the project. Roads and Maritime would undertake targeted consultation with affected residents.

Certain activities would occur during extended construction hours. These hours would be:

- Between 6am and 7pm Monday to Friday
- Between 8am and 5pm on Saturdays
- Outside of known likely major traffic peaks (such as avoiding holiday periods).

It is not proposed to undertake work during extended working hours in close proximity to sensitive receivers. To limit the potential impact to sensitive receivers, extended hours work would be limited in the following areas:

- Along the project route between Colden Drive and Croome Road
- At the interchange at Albion park northbound entry ramp and southbound exit ramp
- Along the project route between Yallah Road and the Macquarie Rivulet.

Extended work hours would be limited to daylight hours, with potentially shorter working periods throughout winter months.

Where possible, an effort would be made to limit the activities conducted in the extended working hours (those outside of the standard construction hours for NSW) to less noisy activities such as refuelling, light vehicle movements and briefing of the workforce (toolbox talks). Noisy activities, such as starting noisy machinery, would be deferred until standard working hours where possible.

Extended construction hours at the start and finish of each working day are considered to be in the public interest as they would:

- Shorten the overall construction period by about 3.5 months or 10 per cent. This would minimise the disruption to the Princes Highway / Princes Motorway and improve access

to the Illawarra region. It would also minimise any adverse impacts on local businesses that may be experienced during the construction period

- Reduce the public's exposure to a lower standard and changed traffic conditions during construction, reducing the potential for crashes
- Potentially reduce the overall cost of construction.

Consultation with affected residents would be undertaken before work starts, as part of the Construction Environmental Management Plan and Community Involvement Framework.

An assessment of the likely noise impacts resulting from these activities is presented in Chapter 12 and Technical Paper 8 - Noise and vibration. The assessment identifies the management measures that would be implemented to minimise these impacts. Before construction takes place a process of consultation would be implemented with potentially affected receivers.

'Out of hours' work

Work outside of both the standard construction hours and extended construction hours would also be required – this is called 'out of hours' work. Out of hours work would occur in accordance with the project approvals and notification requirements of any Environment Protection Licence for construction of the project.

Out of hours work, such as night works, would be required where construction activities would otherwise severely impact traffic flow and / or specific stakeholders (such as airport operations), or put at risk the safety of construction staff and / or the public. Works that would disrupt the operation of the South Coast Rail Line may also be required to be undertaken outside working hours to minimise disturbance to railway operations.

The **Interim Construction Noise Guidelines** (Department of Environment and Climate Change, 2009) provides details on the five categories of work that might be carried out outside the recommended standard hours. These categories are:

- The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads
- Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
- Maintenance and repair of public infrastructure where disruption to essential services and / or considerations of worker safety do not allow work within standard hours
- Public infrastructure works that shorten the duration of construction and are supported by the affected community
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.
- Specific activities requiring special circumstances are described below:
- The erection of bridges over live traffic. Bridge lifts would likely occur at night and may require temporary road closures and / or detours
- The delivery of oversized structural elements requiring police or other professional escorts
- Work requiring the use of over-height equipment such as piling rigs or cranes that would otherwise impact on Illawarra Regional Airport's operational airspace requirements (possibly requiring the closure of the airport's runway(s))
- Major traffic switches where safest practice determines they should occur during periods with the lowest traffic volume

- Some tie-in work to existing roads, including asphaltting
- Emergency work as a result of construction activities or environmental factors, such as flood remediation work.

7.5 CONSTRUCTION ACTIVITIES

Conventional road and bridgework construction techniques would be adopted for the project. The work methodology would comply with the project specific environmental requirements, physical constraints and specific management plans. Table 7-45 provides details of both the construction activities and the type of plant and equipment expected to be used. It gives an indication on the duration each construction activity is expected to take therefore providing an indication of the intensity and scale of the construction effort. Ultimately the exact equipment and plant profile would be determined by the construction contractor.

Table 7-45 Construction Activities

Construction Activity	Predominate plant and equipment required	Approximate duration
Mobilisation and site establishment	Plant: Small cranes and lifting equipment, excavators, front end loaders, road trucks, light vehicles Equipment: Fences, portable sheds, portable ablutions, fuel storage, generators, waste tanks	1 - 2 months
Relocation and protection of existing services	Plant: Excavators, backhoes, front end loaders, dump trucks, road trucks, light vehicles, agitator trucks Equipment: Jack hammers, concrete saws and other small handheld equipment	3 - 6 months
Clearing, grubbing and topsoil stripping	Plant: Excavators, bulldozers, graders, watercarts, front end loaders, dump trucks, fuel trucks, road trucks, scrapers, light vehicles	2 - 3 months
Bulk earthworks and materials haulage	Plant: Excavators, bulldozers, graders, watercarts, front end loaders, vibratory rollers, dump trucks, road trucks, scrapers, fuel trucks, light vehicles Equipment: Hand held compactors	12 - 15 months
Road pavement construction	Plant: Excavators, bulldozers, graders, watercarts, front end loaders, Bomags, road sweepers, fuel trucks, asphalt pavers, bituminous spray sealing trucks, vibratory rollers, road trucks, linemarking machines, light vehicles Equipment: Hand held compactors, jack hammers, concrete saws and other small handheld equipment	6 - 12 months
Drainage structures construction	Plant: Excavators, mobile cranes, front end loaders, vibratory rollers, road trucks, light vehicles, agitator trucks Equipment: Hand held compactors and other small tooling	6 – 8 months

Construction Activity	Predominate plant and equipment required	Approximate duration
Bridge construction works most likely including heavy vehicle deliveries of over-size loads	Plant: Excavators, elevated work platforms, mobile cranes, agitator trucks, piling rigs, concrete pumps, vibratory rollers, road trucks, light vehicles Equipment: Hand held compactors and other small tooling	12 - 15 months
Sporting facilities relocation and construction	Plant: Excavators, bulldozers, graders, watercarts, front end loaders, vibratory rollers, dump trucks, road trucks, elevated work platforms, fuel trucks, road sweepers, asphalt pavers, bituminous spray sealing trucks, linemarking machines, light vehicles Equipment: Small tooling	6 – 8 months
Property access amendments	Plant: Excavators, graders, watercarts, front end loaders, road sweepers, asphalt pavers, bituminous spray sealing trucks, vibratory rollers, road trucks, linemarking machines, light vehicles Equipment: Hand held compactors, jack hammers, concrete saws and other small handheld equipment	3 - 6 months
Signposting	Plant: Excavators, elevated work platforms, mobile cranes, agitator trucks, road trucks, light vehicles Equipment: Hand held compactors, jack hammers and other small tooling	1 - 2 months
Lighting and roadside furniture installation	Plant: Excavators, elevated work platforms, mobile cranes, agitator trucks, road trucks, light vehicles Equipment: Hand held compactors and other small tooling	2 - 3 months
Landscaping, waste disposal and rehabilitation of disturbed areas with no future use	Plant: Excavators, bulldozers, watercarts, front end loaders, graders, road trucks, light vehicles Equipment: Small tooling	2 - 3 months

7.6 ASSUMED LOCATION AND USE OF TEMPORARY ANCILLIARY SITES

Temporary ancillary sites will be used for office accommodation; ablutions; plant and equipment, materials, chemicals, consumables and dangerous goods storage; work force parking, and plant and equipment maintenance / repair works.

The footprint of the temporary ancillary sites would be contained within the site boundary, temporary works areas or local road works areas but would vary in size from one location to the next. Once the area becomes of no further project use, it would be rehabilitated to match the adjacent surrounding area.

The project site office and compound is expected to be positioned on the corner of the Princes and Illawarra Highways. Existing buildings at this location may be utilised. Although contingent on the Contractor's execution strategy, approximately 100 persons could be expected to be

based out of this location for the project duration. Access would be from the Illawarra Highway (existing driveway access point).

Additional temporary ancillary sites areas for equipment, materials and satellite temporary support buildings have been nominated and shown in Figure 7-2 to Figure 7-12. Adjustments to the locations of temporary ancillary sites are possible to better align with the Contractor's preference. This is not expected to significantly change either the anticipated volume of construction traffic or the roads identified to be used to access each of the compound areas.

Table 7-46 Potential Temporary Ancillary Sites

Ancillary site ID and location	Potential uses						
	Material stockpile	Bridges construction support	Main project offices	Possible workshop for plant servicing	Double handling laydown	Supports CRSC facilities construction	Proximity to intensive work zone between Croom and Oak Flats
AS01 – West of the interchange at Yallah	✓						
AS02 – East of the interchange at Yallah	✓						
AS03 – Near Yallah Bay Road	✓						
AS04 – Near the existing Princes Highway and South Coast Railway Line		✓					
AS05 – West of Illawarra Highway intersection	✓	✓					
AS06 – East Illawarra Highway intersection	✓		✓	✓			
AS07 – Near interchange at Albion Park		✓			✓		
AS08 – Near Tongarra Road bridge		✓			✓		
AS09 – At Croom Regional Sporting Complex		✓				✓	
AS10 – Near Croom Regional Sporting Complex						✓	
AS11 – Near East West Link		✓					✓
AS12 – Near East West Link		✓					✓
AS13 – Near East West Link					✓		

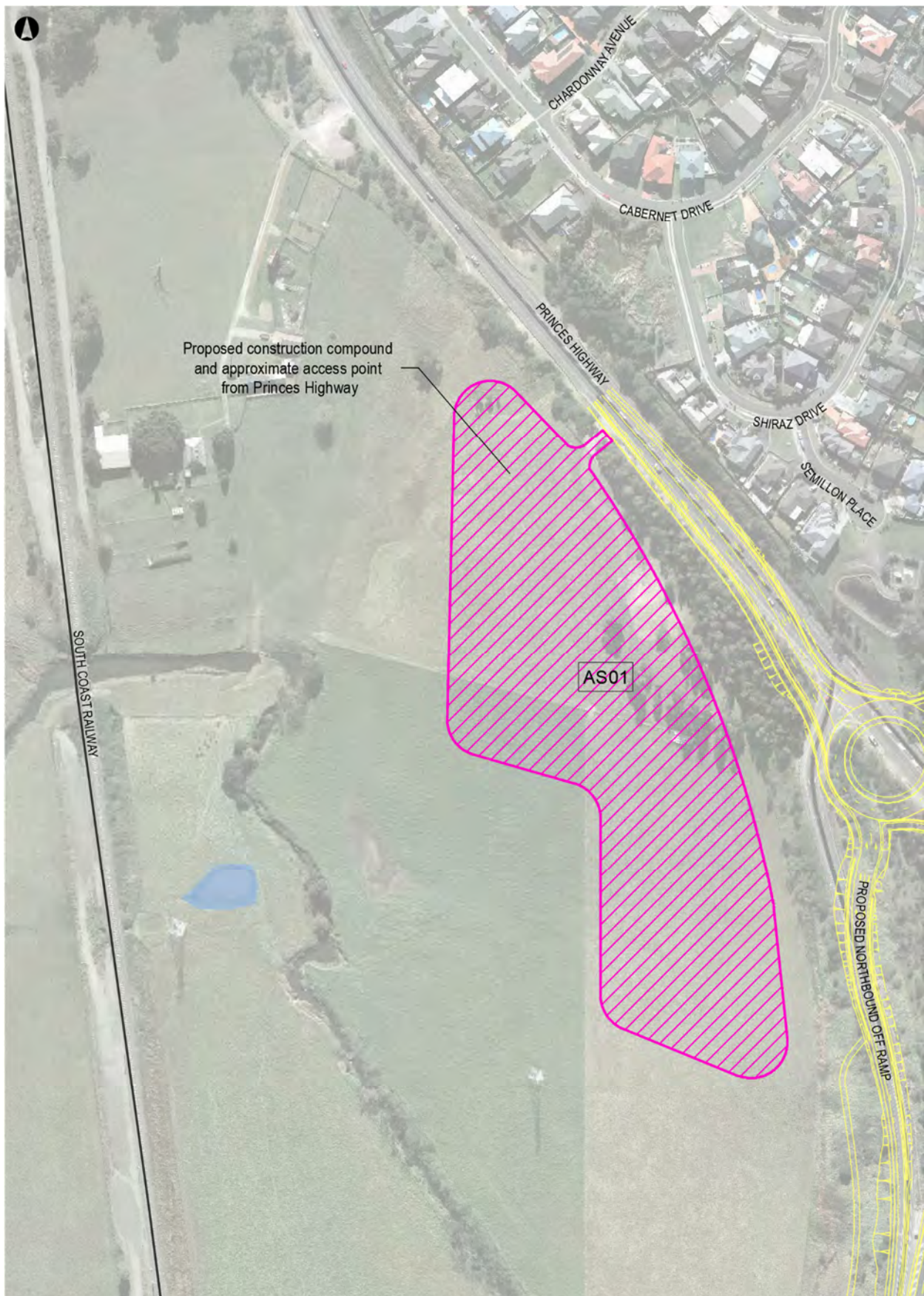


Figure 7-2 Proposed Temporary Ancillary Site AS01 west of Yallah Interchange

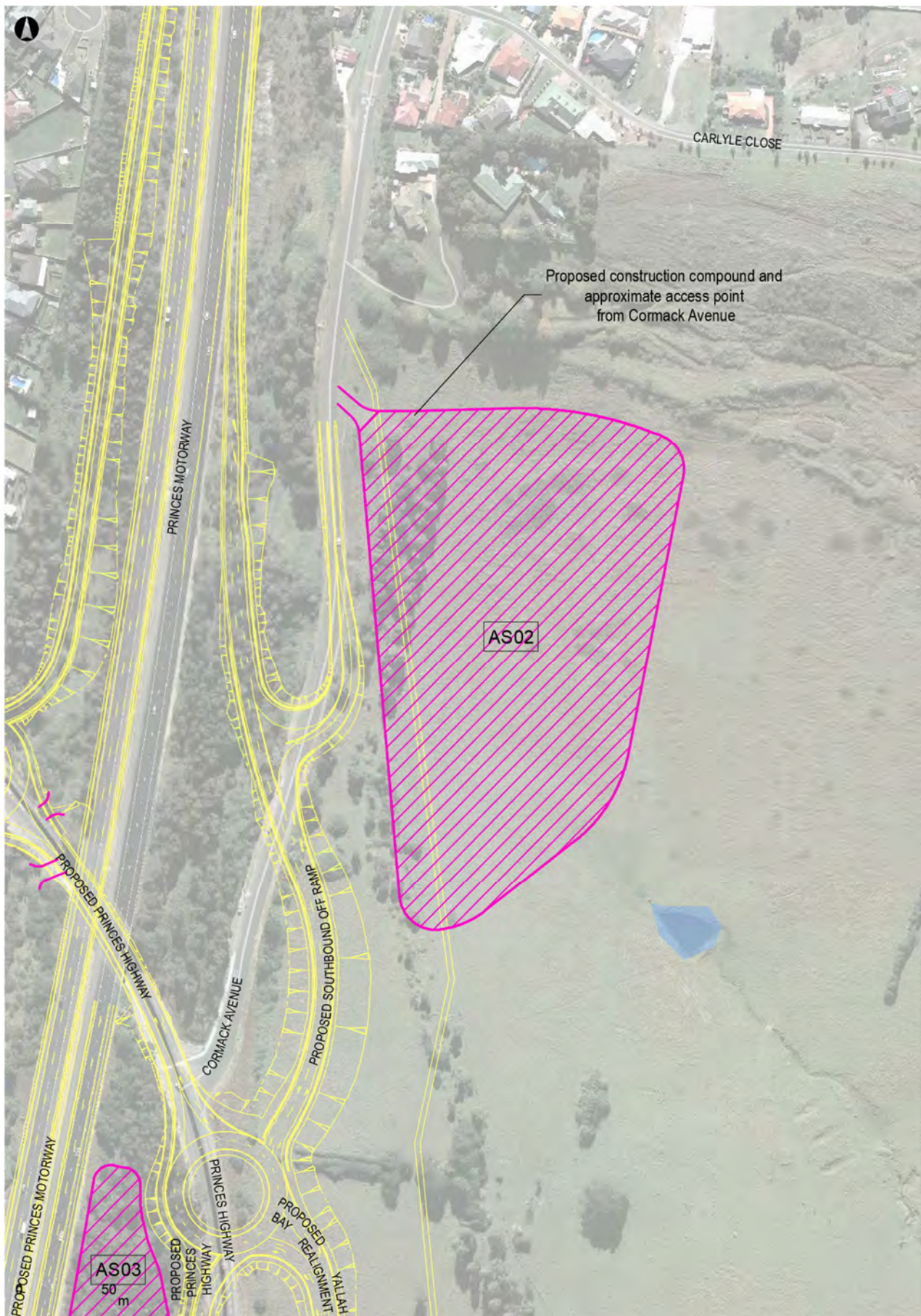


Figure 7-3 Proposed Temporary Ancillary Site AS02 east of Yallah Interchange

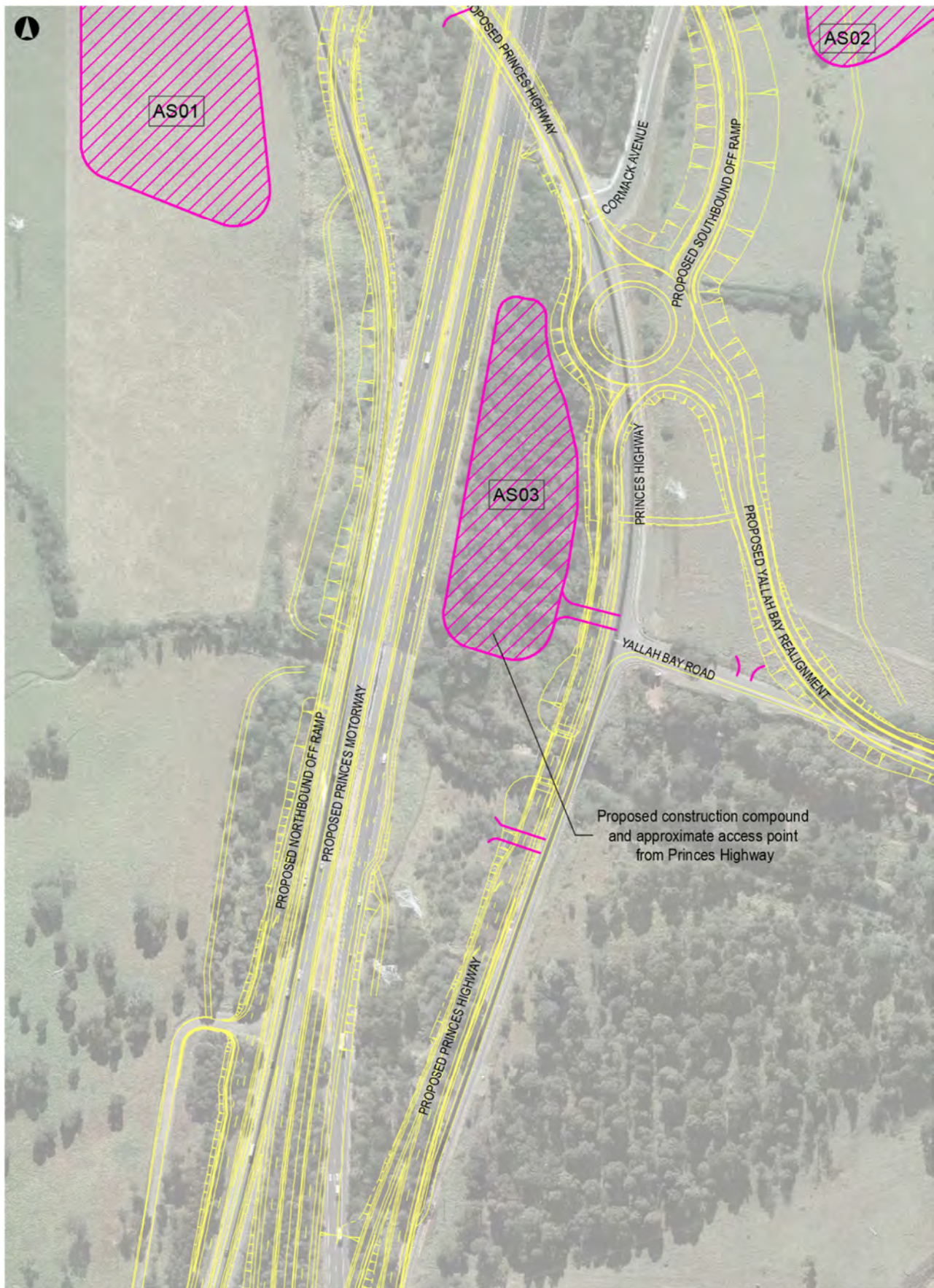


Figure 7-4 Proposed Temporary Ancillary Site AS03 near Yallah Bay Road

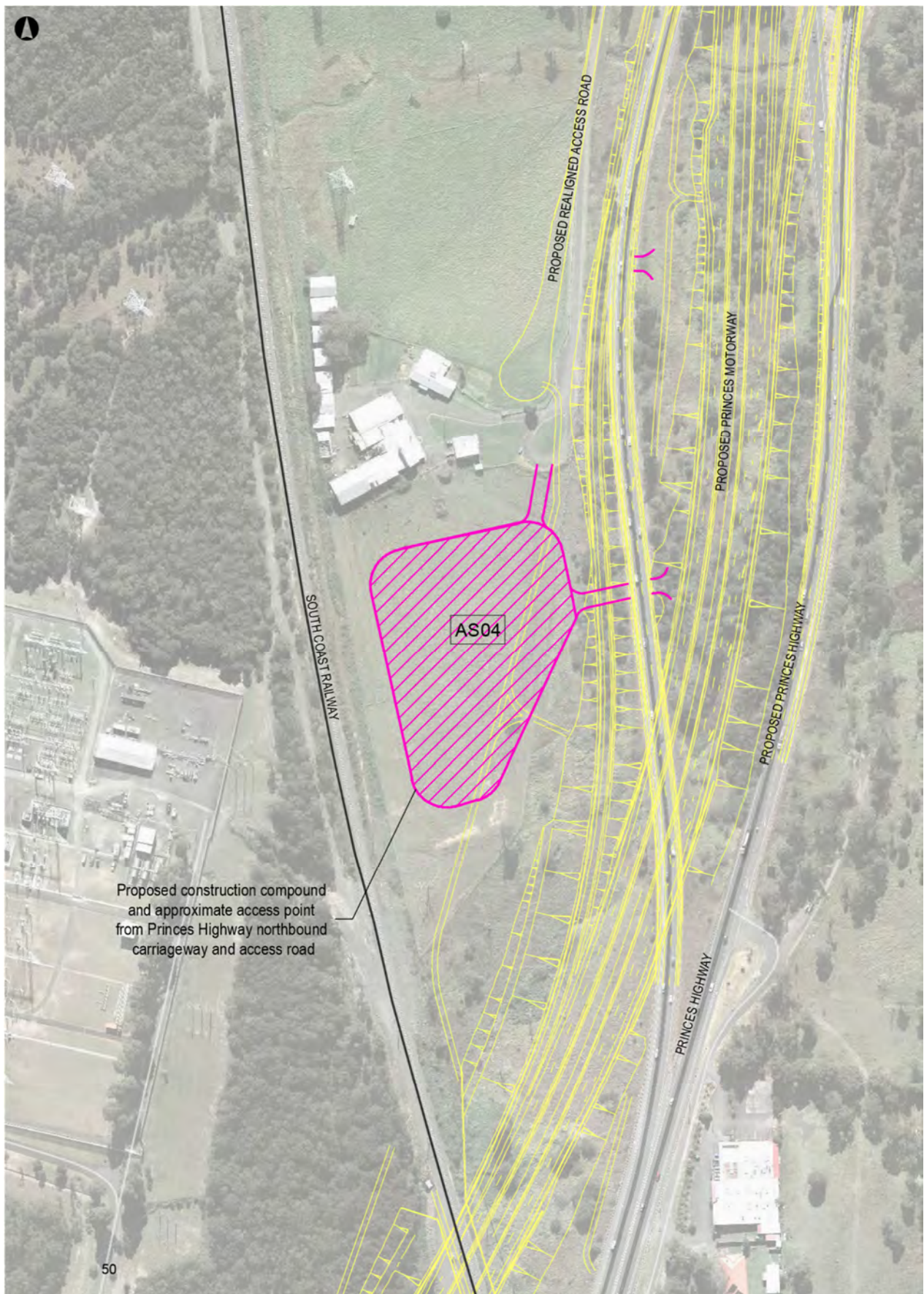


Figure 7-5 Proposed Temporary Ancillary Site AS04 near Princes Highway and South Coast Rail Line



Figure 7-6 Proposed Temporary Ancillary Sites AS05 and AS06 near Yallah Road

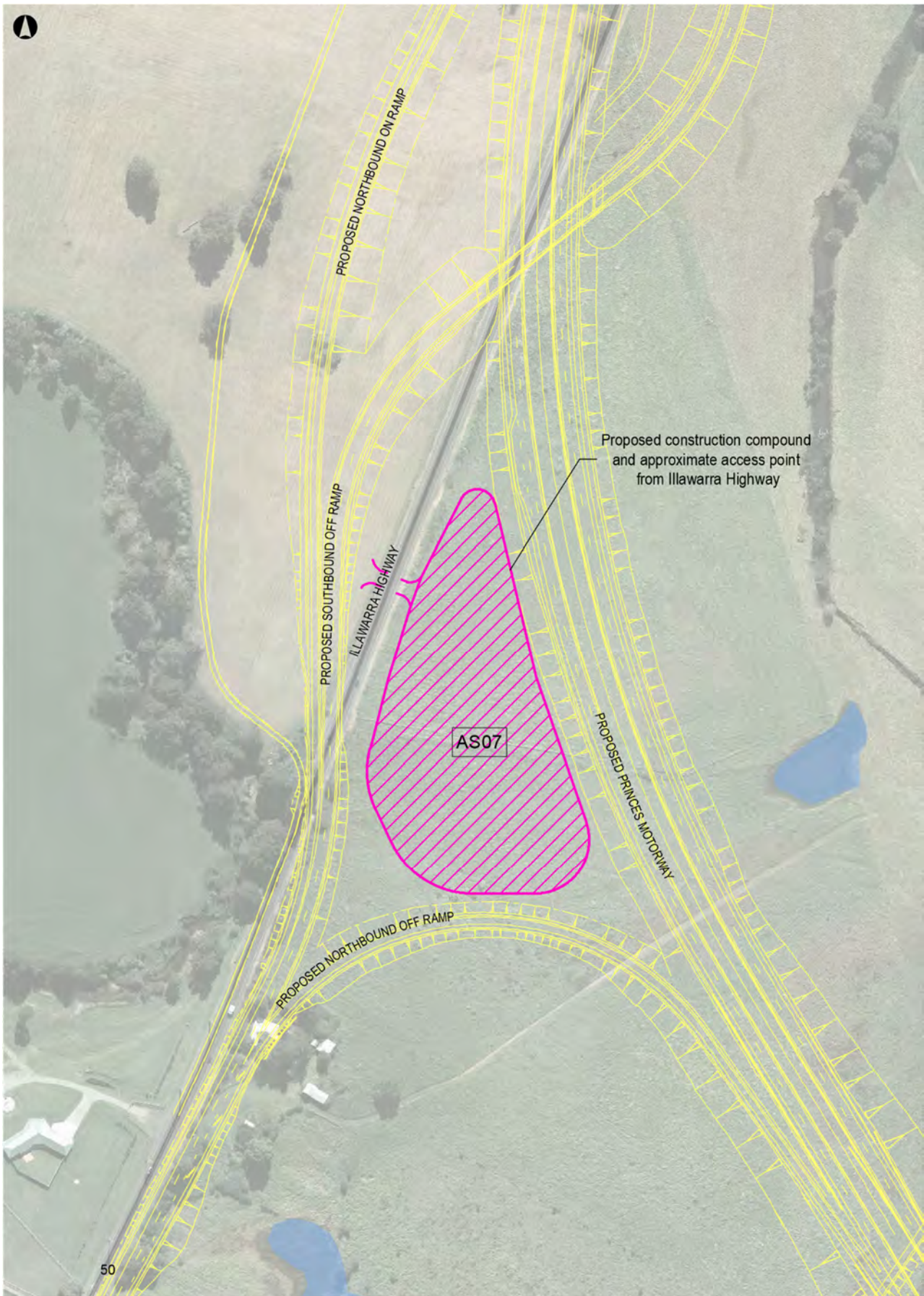


Figure 7-7 Proposed Temporary Ancillary AS07 near Illawarra Highway Intersection

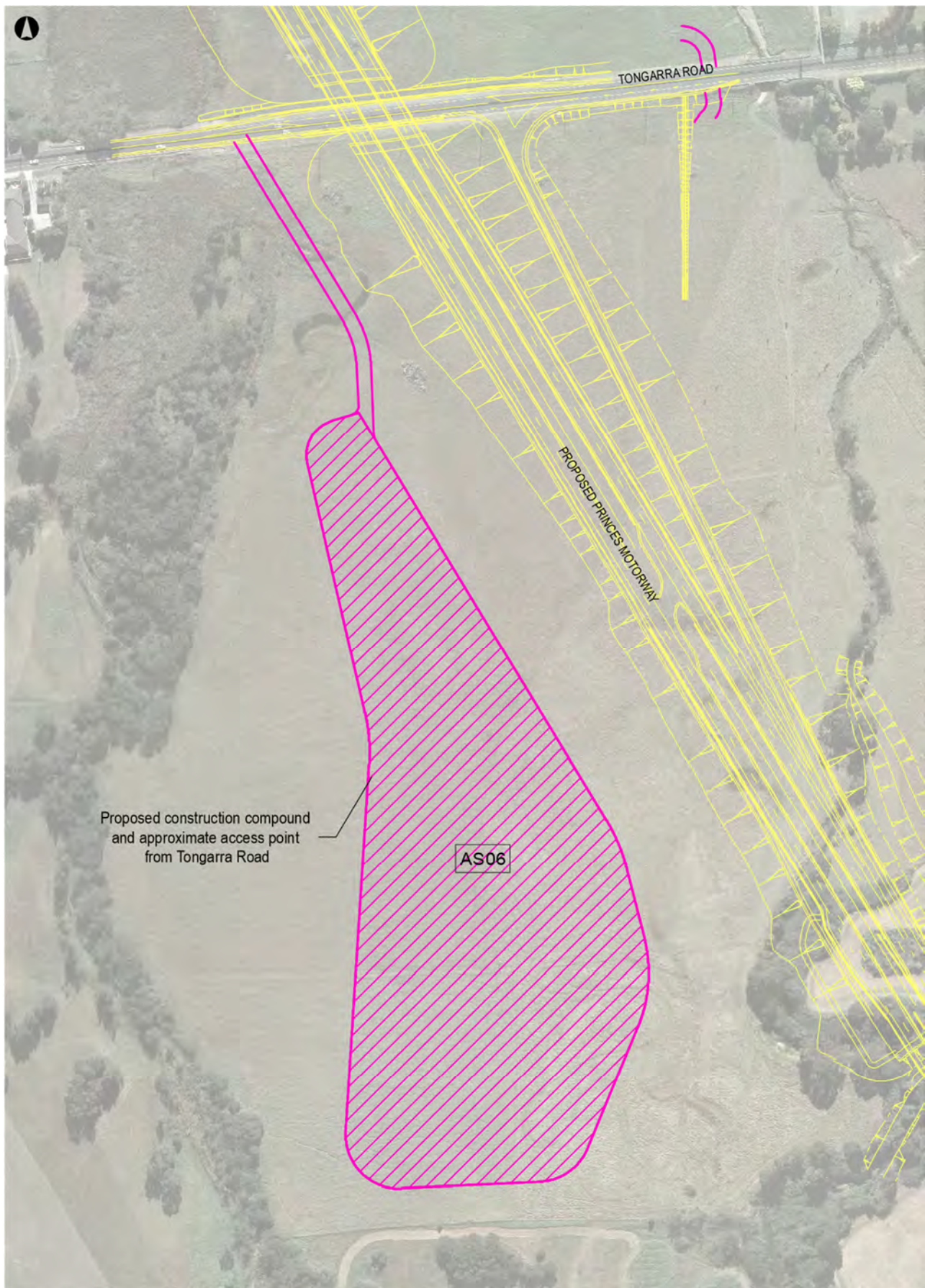


Figure 7-8 Proposed Temporary Ancillary Site AS08 area near the Albion Park Interchange



Figure 7-9 Proposed Temporary Ancillary Site AS09 near Tongarra Road Bridge



Figure 7-10 Proposed Temporary Ancillary Site AS10 at Croome Regional Sporting Complex

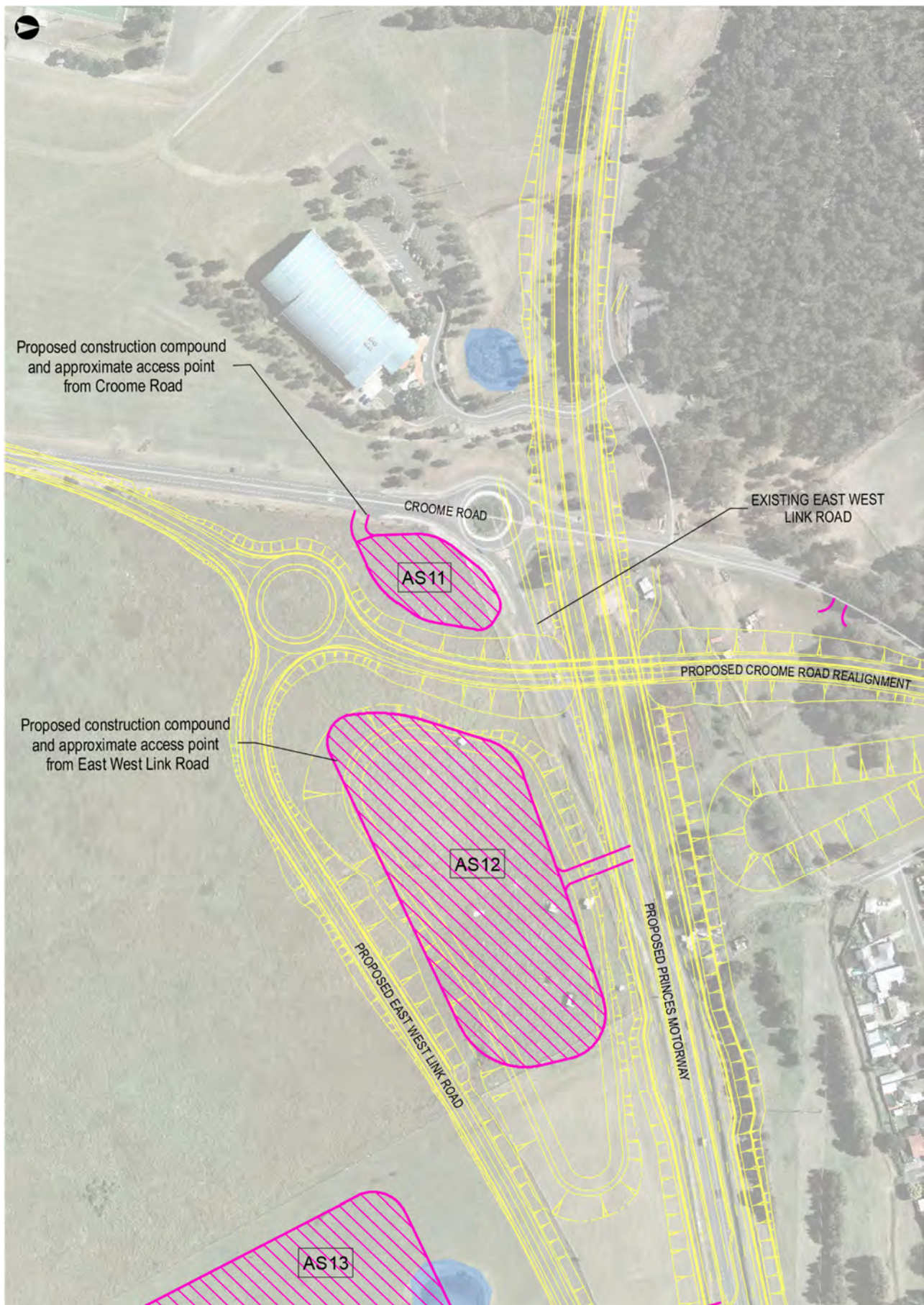


Figure 7-11 Proposed Temporary Ancillary Sites AS11 and AS12 near Croome Regional Sporting Complex

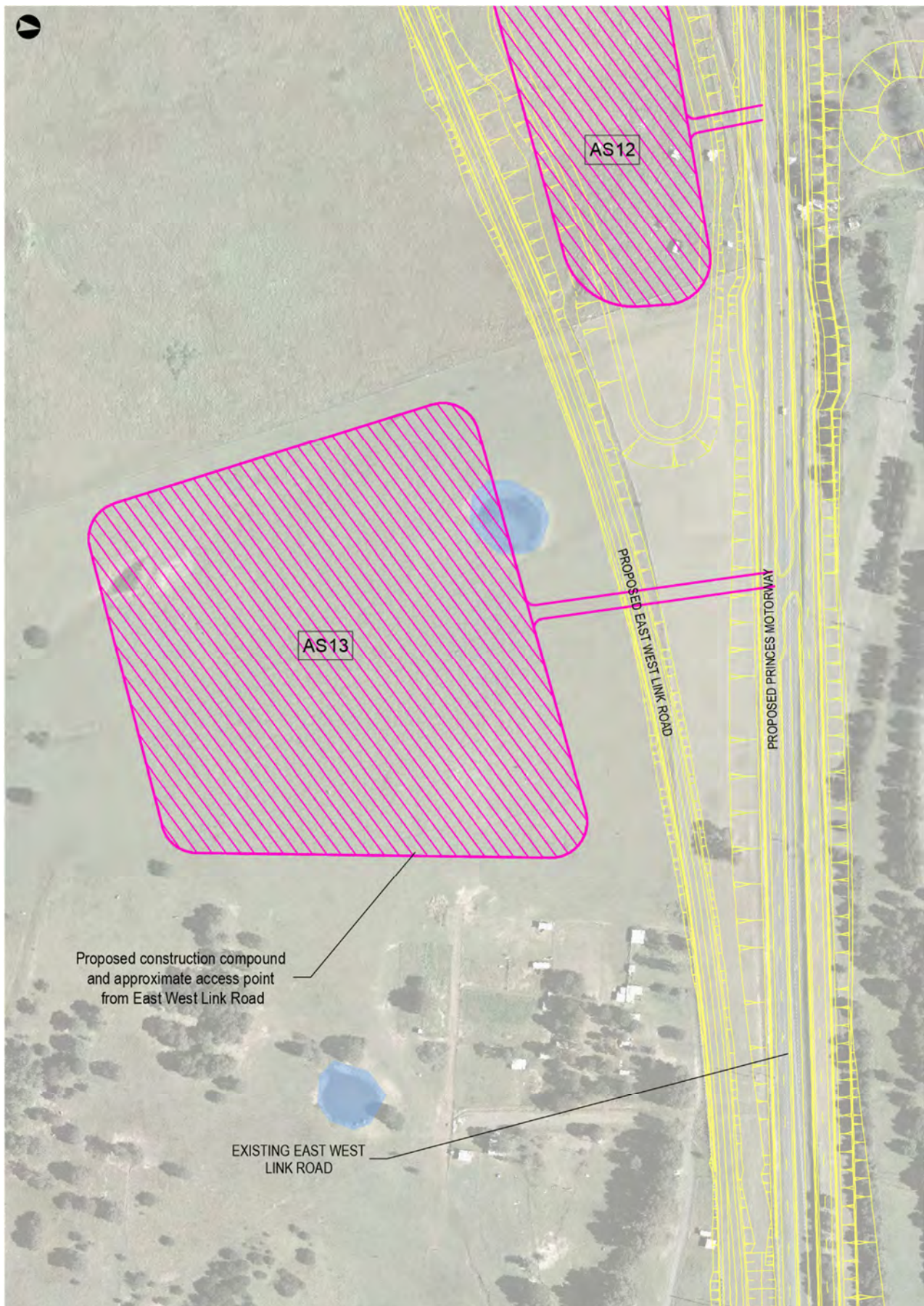


Figure 7-12 Proposed Temporary Ancillary Sites AS12 & AS13 near East West Link Road

7.7 HAULAGE OF EARTHWORK MATERIAL UTILISING EXISTING ROADS

A number of assumptions have been made in order to determine the total number of trucks required for bulk earthworks material haulage, the frequency of travel and the routes used. The approximate bulk earthwork quantities used to determine truck movements are shown in Table 7-47. Refer to Figure 7-13 for breakdown of work areas over project.

Table 7-47 Project Bulk Earthwork Quantities by Sections

Work area no.	Work area	Cut (m ³)	General Fill (m ³)	Pavement (m ³)
1	Croome Road and the Oak Flats Interchange	660,000	260,000	80,000
2	Tongarra Road and Croome Road	10,000	175,000	20,000
3	Illawarra Highway and Tongarra Road	5,000	270,000	30,000
4	Frazers Creek and Illawarra Highway	2,000	200,000	40,000
5	Macquarie Rivulet and Frazers Creek	5,000	40,000	10,000
6	South Coast Railway line to Macquarie Rivulet	220,000	195,000	15,000
7	Princes Highway northbound carriageway to the South Coast Railway line	-	160,000	5,000
8	Duck Creek to the A1 Princes Highway northbound carriageway	20,000	140,000	40,000
9	Princes Highway to Duck Creek	125,000	-	25,000

All imported materials access the work sites using existing roads. All cutting material is deemed suitable for use as general fill either within the same section of work or within the adjacent section. The cut to fill haulage of this nature is deemed to largely use the footprint of the worksite, meaning that haulage does not contribute to traffic volumes on existing roads. This is with exception of material being moved from cuttings within work area 1 to work areas 2 and 3. This would require truck haulage along East-West link, Princes Highway and Tongarra Road. An equipment and productivity profile has been selected that would result in the overall project being completed within approximately 30 months (bulk earthworks completed in approximately 350 working days, refer to Table 7-48).

Table 7-48 Equipment and Productivity Profile – Bulk Earthworks

Haulage type	Vehicle type	No. crews	Vehicles per crew	Productivity per crew	Average cycles per working day
Material hauled using existing roads – imported materials and cut to fill between workfronts 1 and 2	B double / semi-side tippers or similar (20m ³ capacity)	3	6	1,600m ³ /day	15 (45 min round trip)

Haulage type	Vehicle type	No. crews	Vehicles per crew	Productivity per crew	Average cycles per working day
Material hauled within the project footprint (no use of local roads) – cut to fill	Articulated dump trucks / scrapers (11m3 capacity)	Up to 2	5	2,000m3/day	44 (15 min round trip)

Based on equipment and productivity profile, haulage operations would generate around 270 cycles each day along the adjacent road network. The material import source has been assumed to originate from south of the Oak Flats Interchange using the existing Princes Highway to approach the work site. The timing in which the trucks would use the nominated routes would be dependent on the Contractor's methodology. However, it is assumed that haulage operations along any given route would be largely continuous during nominated hours of work from period of commencement until completion. The assumed haulage routes to the worksite areas are shown in Table 7-52 and Table 7-53)

The frequency of haulage is assumed to be evenly spread throughout the standard working day hours.

7.8 CONSTRUCTION IMPACTS

7.8.1 TEMPORARY TRAFFIC MANAGEMENT

All construction activities would be completed whilst maintaining through traffic either on existing roads or detour routes. Access to properties would be maintained for the full duration of the works. However, temporary traffic management measures would be implemented at various stages of the project in accordance with the Traffic Control at Worksites (Roads and Maritime, 2010) document. This includes:

- Modification to lane widths to facilitate the safe entry, exit and movement of plant and materials and allow for construction staging of proposed works in close proximity to existing roads
- Placement of separation barriers to protect live traffic from the worksites
- Reducing speed zones where existing road conditions are adversely modified by the construction effort
- Reducing shoulder widths to allow for tie in works to be completed
- Traffic detours and switches such as required for the existing Illawarra Highway onto the proposed northbound carriageway of the new motorway.

Table 7-49 identifies likely temporary traffic management required on each of the interfacing local roads.

Table 7-49 Temporary Traffic Managements at Each Road

Road	Location details	Temporary traffic management required					
		Traffic switches	Detours	Lane width adjustments & relocation	Shoulders reduced	Reduced speed zones	Separation barriers
Princes Highway	Various discrete areas throughout project	✓	✓	✓	✓	✓	✓
Illawarra Highway	Discrete areas between intersections with Princes Highway and Terry Street	✓	✓	✓	✓	✓	✓
Yallah Bay Road	Intersection and approach with Princes Highway	✓				✓	✓
Cormack Avenue	Intersection and approach with Princes Highway	✓	✓			✓	✓
Yallah Road	Intersection with Princes Highway and where proposed realignment ties in	✓	✓			✓	✓
Tongarra Road	Eastern approach to Terry Street intersection	✓		✓	✓	✓	✓
Croome Road	Near intersection with East West Link	✓		✓	✓	✓	✓
Oak Flats Interchange	Junction of Princes Highway and East West Link Road					✓	✓

The use of temporary directional and advisory signage as well as Variable Message Signs would be used throughout the projects extent where necessary. Kerbside parking restrictions for designed zones would not be required however loss of space associated with shoulder reduction or tie-in works may impact some areas.

A concentration of temporary traffic control would be required at junctions where the project ties into the existing roads. Table 7-50 shows these tie-in locations. In all cases it is envisaged that the Contractors would maintain the current level of serviceability with minor disruptions during final surfacing and line-marking.

Table 7-50 Roadwork Tie-ins to Existing Locations

Location	Length m (approx.)	Lane Configuration
Princes Highway north of northern interchange	350	Existing with reduced lane width and staging
Princes Motorway northbound carriageway at limit of works	200	Existing with traffic management
Princes Motorway southbound carriageway at limit of works	200	Existing with traffic management
Yallah Bay Road	50	Existing with traffic management
Princes Highway northbound south of western roundabout	150	Existing with reduced lane width and staging
Princes Highway southbound south of Yallah Bay Road	400	Existing with reduced lane width and staging
Yallah Road	50	Existing with traffic management
Yallah Road with Princes Highway	20	Existing with traffic management
Temporary tie-in: Illawarra Highway with temporary diversion road	100	Existing with traffic management
Temporary tie-in: Illawarra Highway with Princes Motorway northbound on ramp	50	Existing with traffic management
Illawarra Highway southern end	150	Existing with traffic management
Tongarra Road	450	Existing with reduced lane width and staging
Croome Road south end	100	Existing with traffic management
Croome Road north end	50	Existing with traffic management
Croome Road with Croom Regional Sporting Complex	100	Existing with traffic management
Proposed East West Link with Oak Flats Roundabout	80	Existing with traffic management
Princes Highway southbound south of Oak Flats Roundabout	800	Existing with reduced lane width and staging
Princes Highway northbound south of Oak Flats Roundabout	550	Existing with reduced lane width and staging
Princes Highway southbound through Oak Flats Roundabout	350	Existing with reduced lane width and staging

7.8.2 TEMPORARY ROAD CLOSURES

There will be no long term temporary closures of existing roads. All existing roads other than those closed permanently as result of the project, will be maintained operational through localised diversions or in the case of the Illawarra Highway, through a substantial traffic switch.

- 6 However the construction may require a number of short term traffic management measures that effectively close sections of local roads for short periods. These include:
- Temporary stoppage of traffic through traffic control for construction vehicle crossings of existing roads.
 - Temporary local traffic diversions through traffic switches
 - All of the above will be undertaken outside of peak hours or where traffic impacts resulting from diverted traffic are manageable and following the approval of the construction contractor's traffic management plan and relevant traffic control plans and road occupancy licenses.

7.8.3 PERMANENT ROAD CLOSURES

Intersections of Colden Drive and Woollybutt Drive with the East West Link Road would be removed. This would occur once traffic has been switched onto the new Service Road at completion of Stage 1 works. The Illawarra Highway will be closed between Tongarra Road and the A1 Princes Highway. This will not occur until the opening of the new motorway.

A number of driveway accesses would be closed but not before their relocation to new access arrangements. This includes accesses into the Croom Regional Sporting Complex.

7.8.4 IMPACTS TO THE EXISTING ROAD NETWORK

Construction related traffic would utilise the surrounding road network to:

- Haul material from the quarries / borrow source to work site areas
- Haul material from one section of a work sites to another (where required)
- Provide access for the delivery of all construction materials and consumables
- Provide access for the workforce to the various locations along the job footprint, in particular project laydowns and offices.

The most significant contributions to additional vehicle movements on the existing road network occur surrounding access to temporary ancillary sites and on the roads linking imported material sources to the construction access points. The existing traffic volumes at key access roads to the temporary ancillary sites are summarised in Table 7-51 below.

For access into the assumed main project site office and compound (AS06) on the corner of Princes Highway and Illawarra Highway, it can reasonably be expected that approximately 300 movements in and out each day for the project duration would occur. For all other laydown areas around 200 movements (or less) in and out per day could be expected onto the adjacent roads. A breakdown of the anticipated vehicle movements by time period and details on the impacted roads is shown in Table 7-51.

Table 7-51 does not cover vehicles associated with the haulage of material (if applicable) to that entry point. For haulage vehicles refer to Table 7-52 and Table 7-53)

It is generally assumed that vehicle movements operate throughout the entire project duration. However moderate fluctuation could be expected dependant on the Contractor's works programme. The additional construction traffic generated from accessing the site office and laydown areas represent only small increases to current traffic volumes. The traffic increase to access roads attributable to construction activities are estimated to be between 1 per cent and 7 per cent depending on sites. The construction traffic impact to Princes Highway, Tongarra Road, Illawarra Highway and East West Link Road will be small and unlikely to impact current operation and level of service.

Table 7-51 Access to/from Office and Laydown Areas

Site Office and Laydown Area	Access from	Estimated Daily Construction Traffic (two way)	Existing Daily Traffic (two way)	Construction Traffic Impact (%)
AS-01	Princes Highway ¹	210	58730	<1%
AS-02	Cormack Avenue ⁵	150	2694	5.6%
AS-03	Princes Highway (possible use of Yallah Bay Road) ¹	210	58730	<1%
AS-04	Princes Highway northbound carriageway and use of Haywards Bay Interchange for accessing Princes Highway northbound carriageway when approaching from north ¹	210	58730	<1%
AS-05	Existing driveway off Illawarra Highway & using roundabout with Princes Highway ²	210	15000	1.4%
AS-06	Existing driveway off Illawarra Highway & using roundabout with Princes Highway ²	300	15000	2.0%
AS-07	Illawarra Highway ²	210	15000	1.4%
AS-08	Tongarra Road ⁴	210	11630	1.8%
AS-09	Croome Road ⁵	150	4356	3.4%
AS-10	Croome Road ⁵	150	4356	3.4%
AS-11	Croome Road using East West Link Road ⁵	210	15100	1.4%
AS-12	East West Link Road ⁵	210	15100	1.4%
AS-13	Using work site footprint with access Croome Road using East West Link Road ⁵	150	15100	1.0%

¹ Existing ADT volumes for Princes Highway at Macquarie Rivulet Bridge used

² Existing ADT volumes for Illawarra Highway South of Princes Highway used

³ Existing ADT volumes for Tongarra Road East of Princes Highway used

⁴ Existing ADT volumes for Princes Highway South of Tongarra Road used

⁵ Daily traffic volumes are estimated from AM Peak and PM Peak counts.

The traffic movements shown in Table 7-51 include both:

- a** Travel of staff and workers to and from the site at the commencement and completion of each days works plus,
- b** Travel from office complexes to specific sites within the project throughout the day for work or inspection

The assumed layout has only one main site office at Site AS06 and other smaller satellite ancillary sites spread throughout the project. These smaller construction compounds would normally house crib, ablution and parking facilities for the workforce thus these would be where they would start and finish each days works. Therefore while the staff component of the project may be fully accommodated within the main compound the construction workforce would be spread throughout the various satellite compounds for the commencement of each day's works.

For the travel associated with a) above (the travel to the site for start of work) it is estimated that the majority of these travel trips (approximately 90%) would occur prior to work commencement hours i.e. normally between 6:00am – 7:00am. At the completion of works, the departure from site is likely to be a little more staggered as most of the construction workforce would be leaving just after the completion time i.e. 4:30pm – 6:00pm, but many of the office staff are likely to be back in the office finishing up paperwork and thus would be leaving progressively over the period 5:00 pm through to maybe 7:30pm.

Assumptions for traffic modelling

- At the commencement of the work day, 5% of the travel trips to the sites occur during the AM peak hour (8:00 am to 9:00 am)
- At the completion of the work day, 30% of the trips leaving the sites occur during the PM peak hour (4:00 pm to 5:00 pm). (This does not include traffic from site AS06 as office staff are expected to leave between 5:00 pm and 7:30 pm)
- All traffic accessing the sites – 50% from south of oak flats and 50% from north of Yallah interchange

For the travel associated with b) above (travel between the site office and other ancillary sites), this will generally comprise the workforce being dropped out to specific worksites (using crew cab utes or troop carriers carrying 4-8 passengers) at the commencement of the site i.e. 7:15am – 7:30am and subsequent return at end of site around 4:30- 5:00pm. There may also be additional trips for lunch around 12:30 – 1:00pm. Where possible these trips would be along the formation unless access is restricted by an uncompleted bridge structure or similar. Generally for structures work areas ancillary sites are located in close proximity to the work area and thus travel to and from the work site at start and end of the day is by foot not by vehicle.

Throughout the day supervisors and engineers will make various trips to manage and inspect certain parts of the works, again where possible these would be from within the project footprint where access is available and via local road network when access is restricted.

Assumptions for traffic modelling

- Trips between site offices during the AM peak hour will be negligible
- Of the return trips to the site office from the other ancillary sites, 20% of these movements occur during the PM peak hour.

7.8.4.1 Haulage of Material on Existing Roads

IMPORTED MATERIALS

Imported materials would be needed to fill the earthworks deficiency of the project (Refer **Table 7-47** for volumes) the total volume of material that will need to be imported is between 400,000m³ and 600,000m³ (600,000 m³ assumed for traffic assessment purposes). The number of truck movements has been calculated based on assuming a density of 2.2t/m³ and truck capacity of 30 T.

A practical imported limit per day would be in the order of 4,000 – 5000m³ per day. The contractor would setup the number of trucks required and the destination of the haulage would vary on a daily or weekly basis depending on the size of the destination fill. As one fill is completed the fleet would then be relocated to the next available fill area. While the overall number of truck trips would not change to that given, these would be spread over a duration which would then be in the order of 6- 8 months. Specific areas would be targeted by the contractor to suit critical activities for instance embankments for approach to bridges would be initially commenced to allow subsequent piling operations to commence, then the remainder of the fill in that vicinity would be delayed until after the completion of the bridge structure. In the meantime the haulage fleet would be diverted to open fills where these restrictions do not apply.

The haulage fleets would be spread evenly throughout the day starting at 7:00 am through to about 3:30 -4:00 pm allowing sufficient time to compact the last placed fill prior to the end of the work day.

Table 7-52 and Table 7-53 detail the duration in which these haulage operations would be in place for each of the assumed haulage routes. Figure 7-13 shows the possible routes and workfront areas.

Figure 7-13 below shows the total truck movements based on an addition of truck numbers in Table 7-52. However this would be an unlikely maximum if all haulage activities occurred in parallel. For traffic assessment purposes a maximum haulage volume of 5000 m³ per day (as described above) has been used.

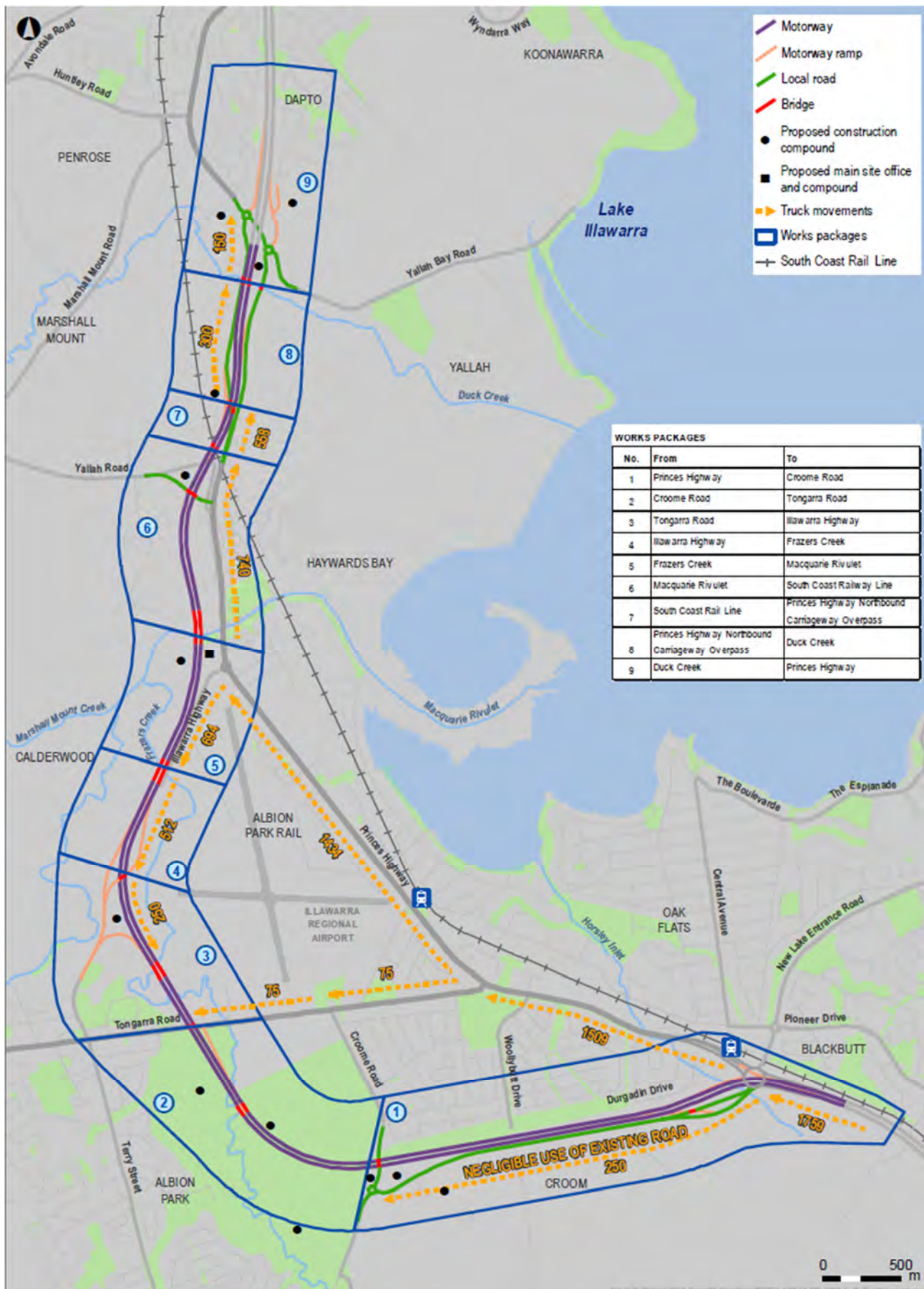


Figure 7-13 Estimated Daily Trucks Required on Existing Roads for Haulage of Material

Table 7-52 Material Hauled using Existing Roads – Imported Materials

Workfront	Assumed route(s)	Minimum duration of haulage	Average Daily Haulage Truck Movements	Average Daily Traffic Observed	Truck % to Average Daily Traffic
Croome Road to Princes Highway	Princes Highway to workfront entry via Oak Flats Interchange	1 month	250	11,630	2.1%
Tongarra Road to Croome Road	Princes Highway and entry via Tongarra Road	<1 month	75	11,630	<1%
Illawarra Highway to Tongarra Road	Route 1: Princes Highway and entry via Tongarra Road	1 month	250	15,000	1.7%
	Route 2: Princes Highway, Tongarra Road and entry via Illawarra Highway				
Frazers Creek to Illawarra Highway	Princes Highway and entry via Illawarra Highway	4 months	262	47,150	<1%
Macquarie Rivulet to Frazers Creek	Princes Highway and entry via Illawarra Highway	1 week	182	47,150	<1%
South Coast Railway line to Macquarie Rivulet	Princes Highway only	1 week	182	47,150	<1%
Princes Highway northbound carriageway to the South Coast Railway line	Princes Highway only	1.5 months	258	47,150	<1%
Duck Creek to the A1 Princes Highway northbound carriageway	Princes Highway only	<1 month	150	47,150	<1%
Princes Highway to Duck Creek	Princes Highway only	<1 month	150	47,150	<1%

Assumptions for traffic modelling

- Maximum of 5000m³ of material imported per day, resulting in 40 trucks per hour each way (over a 9 hour daily work period)
- In AM peak, haulage trucks travel both to sites (north along road network) and from sites (south along road network)
- In PM peak only return trips for the haulage trucks are assumed (i.e. traveling to south of Oak Flats interchange)

CUT TO FILL MATERIALS

Table 7-53 details the movements of general earthworks volumes from the Croome Road area cuttings, back to the various fills in the north of the project. Based on the number of movements and the durations, i.e. 4 months and 341 average daily truck movement this equates to approximately 4650m³ per day. Thus overall quantity of material being moved assuming a 20 day/month calendar of 372,000m³ of earthworks.

Table 7-53 Material Hauled using Existing Roads – Cut to Fill Movements

Workfront	Assumed route(s) for haulage of cut to fill materials	Minimum duration of haulage	Average Daily Haulage Truck Movements	Average Daily Traffic (ADT)	Truck %
Cut from: Croome Rd to Princes Highway Haul to: Illawarra Highway to Croome Road (work areas 2 & 3)	East-West Link, Princes Highway and entry via Tongarra Road	4 months	341	11,630	2.9%

As this project already includes a significant imported fill component, the contractor would plan the earthworks such that all close (within say 4-5km) accessible fills can be completed using off road (along alignment routes) haulage equipment from the available cuts. This may need to include some at grade haulage crossing of local roads as required using localised traffic controls to have short stoppages of the local traffic while the off road haulage vehicles cross – thereby reducing the impact on the existing road network.

If, however this material movement is to occur on-road, it is noted that this would happen at a different point in time than the haulage of imported material (as described in the previous section), i.e. at any one time the maximum haulage movement per day would be 5000m³.

7.8.4.2 Level of Service Impacts during Construction

Table 7-51, Table 7-52 and Table 7-53 show numbers of construction traffic and haulage trucks anticipated to use existing roads during the construction period.

For determining construction traffic impacts, the four key intersections assessed in Section 4.4 were re-assessed by incrementing peak hour traffic by the construction traffic volumes and the results are shown in Table 7-54 to

Table 7-57 below.

Table 7-54 Construction Traffic Impact on Operation of Princes Highway / Illawarra Highway Intersection

ID	Intersection	Control Type	Approach	AM Peak				PM Peak			
				Existing Condition		With Construction Traffic		Existing Condition		With Construction Traffic	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-1	Princes Highway and Illawarra Highway	Roundabout / Signals during peak periods	North - Princes Highway	19	B	22	B	17	B	50	D
			South - Princes Highway	51	D	52	D	28	B	39	C
			West - Illawarra Highway	60	E	65	E	19	B	17	B
			Overall Intersection	60	E	65	E	28	B	50	D

Table 7-55 Construction Traffic Impact on Operation of Terry Street / Tongarra Road Intersection

ID	Intersection	Control Type	Approach	AM Peak				PM Peak			
				Existing Condition		With Construction Traffic		Existing Condition		With Construction Traffic	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-2	Terry Street /Tongarra Road and Illawarra Highway	Signal	North - Illawarra Highway	83	F	83	F	37	C	39	C
			East - Tongarra Road	22	B	22	B	43	D	43	D
			South - Terry Street	18	B	18	B	43	D	43	D
			West - Tongarra Road	59	E	59	E	23	B	23	B
			Overall Intersection	41	C	41	C	37	C	38	C

Table 7-56 Construction Traffic Impact on Operation of Princes Highway / Tongarra Road Intersection

ID	Intersection	Control Type	Approach	AM Peak				PM Peak			
				Existing Condition		With Construction Traffic		Existing Condition		With Construction Traffic	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-3	Princes Highway and Tongarra Road	Signals	South - Princes Highway	15	B	19	B	22	B	38	C
			West - Tongarra Road	40	C	41	C	47	D	47	D
			North - Princes Highway (through)	5	A	5	A	7	A	8	A
			North - Princes Highway (right-turn)	61	E	64	E	58	E	58	E
			Overall Intersection	16	B	18	B	20	B	27	B

Table 7-57 Construction Traffic Impact on Operation of Oak Flats Interchange

ID	Intersection	Control Type	Approach	AM Peak				PM Peak			
				Existing Condition		With Construction Traffic		Existing Condition		With Construction Traffic	
				Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS	Average Delay (sec)	LoS
I-4	Princes Highway and East West Link (Oak Flats interchange)	Roundabout	North-Princes Highway southbound exit ramp	16	B	17	B	15	B	19	B
			East-New Lake Entrance Road	10	A	10	A	14	A	27	B
			South-Princes Highway northbound exit ramp	60	E	71	E	60	E	60	E
			West-East West Link	31	C	31	C	23	B	32	C
			Overall Intersection	60	E	71	E	60	E	60	E

SUMMARY OF RESULTS

Based on the assumptions made about construction traffic volumes, movements and timing, construction traffic has been assessed to have no tangible impacts on intersection levels of service except for the Illawarra Highway/Princes Highway intersection in the PM peak. This is due to the proximity of the main site compound to the intersection and the assumptions made around construction travel times.

It is considered that the assessed impact on the road network from construction is acceptable, especially when considering the substantial improvement in traffic flow that would occur in operation.

7.8.5 PEDESTRIANS

Refer to Section 6.7.3 for project impact on pedestrian facilities. There are no defined footpaths which the project would impact on except at Croom Regional Sporting Complex. Key pedestrian movements (formal and informal) would be maintained during construction.

7.8.6 CYCLING

Refer to Section 6.7.3 for project impact on cyclist facilities. All key cyclist routes (off-road and on-road) will be maintained during construction except at Croom Regional Sporting Complex.

7.8.7 PROPERTY

The property access will be maintained where required. Alternative access arrangements will be provided if required.

7.8.8 PUBLIC TRANSPORT

No bus stop locations would need to be relocated as a result of construction activities. However, some bus routes operate along existing roads which would be subject to temporary traffic control measures. These are bus routes which operate on:

- The A1 Princes Highway – routes 37, 51, 57 and 76; and
- Tongarra and Croome Roads – routes 76 and 77.

It is not envisaged that any of these routes would need to be amended once the project is commissioned.

7.9 MANAGEMENT & MITIGATION MEASURES

The impact of the project can be reduced by some of the following means:

7.9.1 ADMINISTRATION AND PLANNING

Develop a construction traffic management plan, to be prepared based on the detailed design and improved understanding of construction programming and methodology. The Traffic Management Plan will include, but not be limited to:

- Restriction of certain intersection movements should there be an overall benefit
- Review of proposed haulage routes to be adopted in the Plan based on updated truck movements.
- Scheduling construction efforts, where required under traffic, be completed outside of the peak period hours
- Early and regular community and stakeholder liaison to ensure those located nearby are well informed of the Project impacts during construction.

The type of traffic control measures that minimise impact of construction works on local traffic may include:

- Limiting the number of workfront access points
- Where practical, maximising the use of the workfront (as opposed to existing roads) for the haulage of earthwork material
- Building temporary watercourse crossings across creeks to facilitate material being moved along the workfront (as opposed to local roads and going around). This could be used for the traverse of Frazers Creek (adjacent existing Illawarra Highway) and the Macquarie Rivulet.
- Using temporary road diversions to maintain through traffic where existing roads need to be removed or realigned
- Undertaking works which have a significant impact on traffic outside of peak periods and / or at night
- Ensuring that appropriate design standards are adopted for temporary pavement constructions
- Adopting appropriate design speeds on temporary roads and through areas where construction works are in close proximity to traffic
- Ensuring construction works that impact on traffic are undertaken as swiftly as practical

8 MANAGEMENT OF TRAFFIC AND TRANSPORT IMPACTS

The contractor would be required to develop a traffic management plan in accordance with Roads and Maritime specification G10 as part of the construction environmental management plan, as required for proposed major work that would impact on existing traffic arrangements. Roads and Maritime approval of the plan is required before work begins. The traffic management plan would be submitted in stages to reflect the progress of work and would address issues such as:

- Impacts on existing traffic
- Number and width of traffic lanes
- Temporary works
- Provision of barriers between working and trafficked areas
- Pedestrian and bicycle facilities
- Signposting
- Stormwater drainage
- Methods for implementing the traffic management plan
- Access to side streets and adjoining properties
- Methods of minimising road user delays
- Road closures.

Construction methods and staging for the project would minimise temporary road closures, subject to other project constraints, and allow staged construction so that disruption to the existing traffic is minimised.

The contractor would be required to obtain Road Occupancy Licensing approval for any traffic control, including lane and shoulder closures, from the Roads and Maritime before they are implemented, to minimise any disruption to existing traffic.

Roads and Maritime will monitor traffic volumes and behaviour after the opening of the project.

8.1 PRELIMINARY OPERATION MANAGEMENT

There can be an opportunity to future proof the new motorway design by considering Intelligent Transport Systems (ITS) such as variable speed limits, breakdown/ queue detection to ensure that the motorway continues to operate efficiently. The forecast traffic volumes on the project at opening year and 20 years after opening would not trigger the need for ITS to manage the forecast traffic flows. At the detailed design stage, consideration of future proofing requirements for ITS will be undertaken with the potential to include conduits or ducting to allow a minimum of disruption to traffic operation while these upgrades are installed. This consideration will occur during the detailed design phases of the project.

Operation of the road network adjoining the bypass would be undertaken using existing traffic management techniques, principally use of the Sydney Co-ordinated Adaptive Traffic System (SCATS). Given the significant reduction in traffic volumes on the road network adjacent to the project and within the study area, further operational management would not be required.

The existing signalised roundabout operation of the intersection of Princes Highway and Illawarra Highway may become redundant as a result of the project. The project scope of work does not propose to remove the signals infrastructure from this roundabout, as it may remain useful during planned events, incident traffic conditions on the project or to cater for changing (intensification) or other adjacent land uses.

Table 8-58 summarises the proposed environmental management measures resulting from changed traffic operation as a result of the project, as well as responsibility and the timing.

Table 8-58 Proposed Operational Management Measures

Impact	Environmental Management Measure/ Mitigation	Responsibility	Timing
Closure of Woollybutt Drive at East West Link	Provide a signalised intersection upgrade at the intersection of Princes Highway and Woollybutt Drive	Roads and Maritime	Prior to closure of Woollybutt Drive at East-West Link Road
Tripoli Way	Continue to work with Council to ensure the design of Tripoli Way maximises the benefits of the project.	Roads and Maritime	Prior to construction of the project and through the design of Tripoli Way
Construction traffic/ haulage	Prepare a Traffic Management Plan (in accordance with Roads and Maritime specification G10)	Roads and Maritime and/ or Contractor	Prior to commencement of early works package
Road closures, detours or diversions associated with construction	Prepare a Traffic Management Plan	Roads and Maritime and/ or Contractor	Prior to commencement of early works package
Closure of Durgadin Drive at East West Link	Traffic to use the signalised intersection of Colden Drive/ Princes Highway to access/ egress the Colden Drive precinct	NA	NA
Reduction of traffic on existing corridors	SCATS traffic signal timing adjustments to balance delays on the basis of new traffic flows and demands	Roads and Maritime	At opening and during preliminary stages of project operation

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