Lismore Strategic Road Network Review (2023)

We acknowledge the Widjabal/Wia-bal people of the Bundjalung nation, Traditional Owners of the lands and waters on which we operate our business.

We honour their unique cultural and spiritual relationship to the land and waters and their continuing and rich contribution to Lismore City Council and the community.

We pay our respects to them and their culture, their Elders and community leaders both past and present. Additionally, we acknowledge the vibrant contribution that young Aboriginal people make as emerging leaders of the community.

For Widjabal/Wia-bal people, their country takes in everything within the physical, cultural and spiritual landscape - landforms, waters, air, trees, rocks, plants, animals, foods, medicines, minerals, stories and special places. It includes cultural practice, kinship, knowledge, songs, stories and art, as well as spiritual beings, and people: past, present and future.

Contents

1. EXECUTIVE SUMMARY

This Review of Lismore Strategic Road Network (2023) updates the previous findings of the *Lismore Strategic Road Review* 2013 (TTM ref: 34494Rep2) using the more recent traffic model as commissioned by Transport for NSW, being the *Lismore City Town Area Model (TfNSW 2019).*

A key element in this review has been that the 2013 growth rate (2.5% pa) assigned for modelling within the local government area has not occurred, with ABS information showing less the 1% population growth over the 2013 to 2021 period. This has thereby impacted upon Lismore City Council's ability to fund works other than the local road network. It is in this context that it is proposed this review does not include listing or funding of state highway works (ie Bruxner Highway / Ballina Road).

This review has considered impacts of not funding Invercauld Road / Ballina Road intersection upgrades and found that Simons Avenue line (from Invercauld Road to Rous Road) would require upgrading in lieu.

Assessment of the Elizabeth Avenue link (Rous Road to Invercauld Road) has found it would be an attractive route for local traffic that would of otherwise been using Ballina Road, increasing an extra +2000vpd using Cynthia Wilson Drive and Dalley Street. With existing steep gradients of Cynthia Wilson and as the new Elizabeth Avenue link would also be at 20% gradients, road management considerations (ie safety) as to the desirability of putting such vehicle loadings onto less than desirable road geometry need to be had. A consequential impact would be to address the additional traffic / pedestrian / parking impacts on the Dalley Street precinct. It is proposed not to proceed with the Elizabeth Drive link at this point in time, however retention of the corridor is supported.

The northern bypass link (Pineapple Road to Bangalow Road) has previously been within Council's contribution road network but was removed in the 2013 review. This has been revisited and the demand found to redirect 10% of the traffic load off Ballina Road. A clearer benefit was a substantial reduction upwards of 40% of traffic found to be removed from Richmond Hill Road. The level of demand for the northern bypass link (between 325vph to 470vph) was found to be able to be accommodated within the existing roundabout configuration at Pineapple Rd / Holland Street.

Additional development upon lands east of Holland Street (being planning proposal at 1055 Bruxner Highway) would include an additional 565vph accessing the Pineapple / Ballina Road roundabout. This demand, in conjunction with the northern bypass link, would result in upgrade of this intersection being required. Such upgrade would be subject to Transport for NSW control, particularly given the upgrade of SH16 Bruxner Highway from Wollongbar to Goonellbah. Dalley Street traffic flows were modelled without the Elizabeth Avenue link and was found that the ultimate traffic growth is upwards of 12% but gradually occurring over time. Pending undertaking a road safety audit and speed limit review, this Dalley Street precinct would benefit from local area traffic management to improve pedestrian / parking / traffic matters.

Local area investigations of Elliot Street / Wilson Street intersection and a possible link from Invercauld Road to Skyline Road were modelled and no strategic network upgrade requirements where found. Further consideration of the Skyline Road link and extension of Military Drive should be undertaken when there is a better understanding of the future uses of the Southern Cross University land at Crawford Road and other developments of the East Lismore Precinct.

Previous linkages adopted in 2013 strategic road plans which are proposed to be carried forward include:

- Upgrading of Cynthia Wilson Drive / Invercauld Road intersection to a roundabout
- Upgrading of the temporary Oliver Avenue / Rous Road roundabout
- A new northern bridge link from Orion Street to Terania Street (long term project)
- Associated roadworks for the northern bridge link connecting Orion Street to Terania Street (long term project)

Further study is required to confirm the transport timing / needs into the longer term delivery for the northern bridge link.

2. INTRODUCTION

This Review of *Lismore Strategic Road Network (2023)* is based upon updating of previous traffic network modelling and reporting as prepared in May 2013, being the *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)*. The May 2013 report and its associated network traffic model were the cornerstone of the current urban and rural road traffic management facilities as relied upon within the *Lismore City Section 94 Contributions Plan (2014)*. Similarly, this review will inform the need for future transport infrastructure and provide the basis on which funding contributions maybe levied.

The May 2013 report worked on a ultimate development horizon network to the year 2033 to which a key element was assignment of traffic generation due to growth in population and jobs. This was estimated to be at per annum traffic growth rate ranging upwards of 2.5%. This has not been the case and the Australian Bureau of Statistics average residential population for Lismore LGA shows very much a nil population growth rate between 2013 (44,408 people) to 2021 (44,344 people).

Since the May 2013 studies, Transport for NSW (TfNSW) commissioned a *Lismore City Town Area Model (TfNSW 2019)* traffic model to assist in assessing state government corridor transport requirements in the local region and in particular the Bruxner Highway, known as state highway SH16. This study used a AIMSUN microsimulation traffic model working to a ultimate horizon year of 2038. Traffic data was collected in the year 2018 including intersection counts and origin-destination surveys and Lismore City Council provided residential subdivision land release development details as current at that time.

In understanding that there has been little change in net overall population or change in land release precinct locations, it was considered that the expense in re-collection of new traffic counts / origin-destination surveys was not warranted for this *Review of Lismore Strategic Road Network (2023)*. Particularly on the basis that Lismore City Council could access the more recent TfNSW *Lismore City Town Area Model* to test traffic impacts for new / proposed network linkages. In accessing this traffic model data set, it was logical to maintain the ultimate network horizon year to 2038 as per TfNSW model parameters.

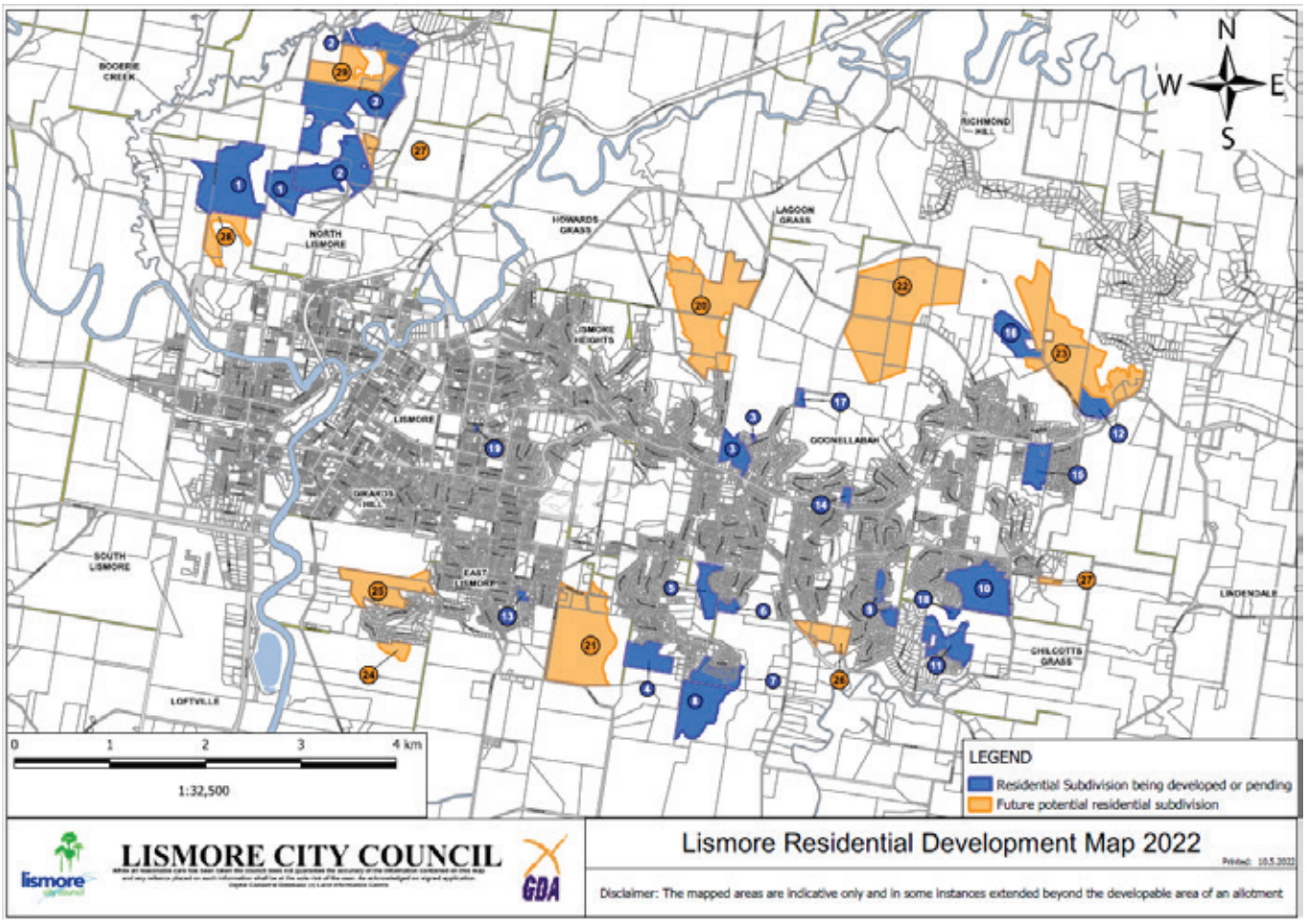
It is noted that since the creation of the TfNSW Lismore City Town Area Model, the Lismore Floods 2022 have occurred. Traffic modelling assumptions made for CBD and industrial land uses have been modified to be based upon retaining the 2018 count data (ie initial status quo) but with no continuing growth at these floodplain locations into the future. Such assumptions can be revisited once more certainty as to business / shopping / industrial development locations are known in future land release updates.

For ease of referencing and to distinguish between Lismore City Council's updates and the initial TfNSW model, this summary report shall refer to the updated model as undertaken by Bitzios Consulting for this report as the LCC Lismore City Town Area Model 2022.

3. KEY MODELLING DATA PARAMETERS

3.1 Lismore Residential Development Details

Possible land release precincts included within the *LCC Lismore City Town Area Model 2022* are shown below as per Lismore Residential Development Map 2022 (as at May 2022).



During the late stages of finalising the *LCC Lismore City Town Area Model 2022*, a substantial planning proposal being 23ha of industrial land, 2.76ha mixed business, 0.5ha local centre and 364 allotments of flood free land has been received by Lismore City Council for lands adjacent to Oliver Avenue (1055 Bruxner Highway). Notwithstanding that planning assessment of such proposal was yet to be finalised, 1055 Bruxner Highway development has been incorporated into the ultimate 2038 scenario so as to gauge impacts upon road network links.

Refer to Figure 3.1 on following page of the proposal footprint.

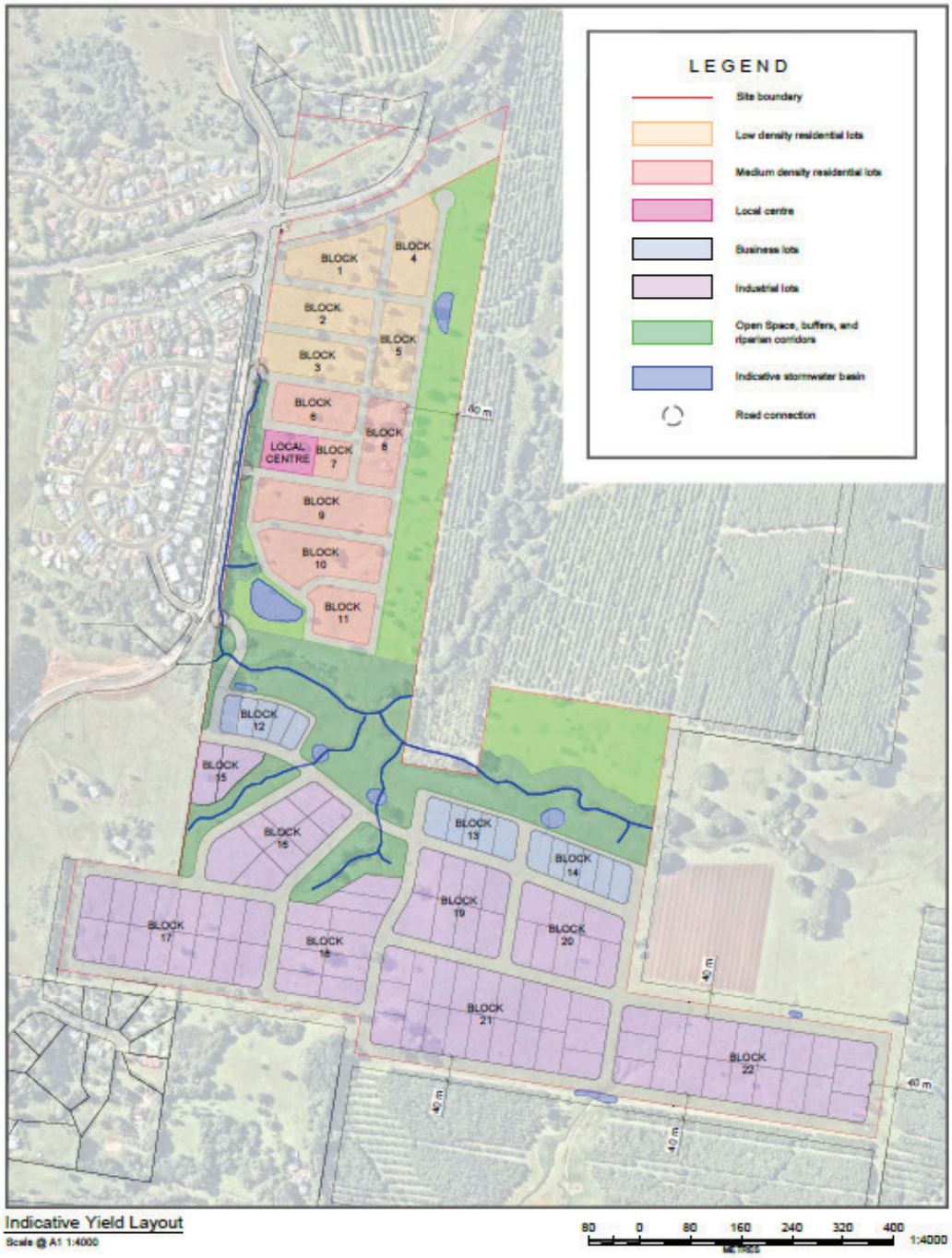


Figure 3.1 - Planning Proposal : Master Plan of 1055 Bruxner Highway

3.2 Future Planning Horizons

To determine the impact of growth and likely timing of works, the *LCC Lismore City Town Area Model 2022* were run with a year 2028 and 2038 base case scenarios.

The 2038 base case represents the 'ultimate' scenario as per current planning and land release precincts, whereby all land releases including long term projects are considered as being developed and their traffic generation demands are loaded onto the network.

The 2028 base case represents the 'short/medium' term scenario and provides guidance as to any intermediate network issues as projects come online.

4. NETWORK OPTIONS AND IMPACTS

4.1 Ballina Road / Bruxner Highway Funding Management

The management function and infrastructure upgrading of State Highway SH16 (Ballina Road / Bruxner Highway) rests with Transport for NSW. There is management overlap in that adjoining land development approvals by Lismore City Council require access points to the highway network, thereby the intersection form can be triggered by the change in traffic demand of such development.

The previous *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* identified many existing SH16 Ballina Road intersections (ie Molesworth St / Dawson St / Wyrallah Rd / Union St) and SH16 Ballina Road/Bruxner Highway duplications (ie Hollingsworth Bridge / Bruxner duplication south of Three Chain Road) which would provide improvement to the network if upgraded. The *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2) – Figure 9.1* put forward the proposition that Lismore City Council could assist to fund such works based upon sustained and consist growth (ie 2.5% per annum), hence road contribution monies could be levied and collected for such use. The reality has been a nil to negligible growth in Lismore City Council population and thereby an inability to fund these SH16 highway works. It is thereby proposed that typically SH16 Ballina Road / Bruxner Highway infrastructure works be left within the funding management of Transport for NSW, excepting the most significant of works that are undoubtably necessary for the broader benefit of Lismore local road network (ie Oliver Avenue / Pineapple Road intersection). Simply put, the existing SH16 Ballina Road / Bruxner Highway deficiencies as identified in previous studies typically remain and have not been revisited by this review.

4.1.1 Bruxner Highway Upgrade – Wollongbar to Goonellabah

A planning announcement was made 29th September 2022 by TfNSW as to the scoping of the duplication and realignment of the Bruxner Highway between Wollongbar to Goonellabah. Funding for this planning investigation was $6.81M (Australian Government) and $1.7M (NSW Government) and no construction timeframe or construction budget has yet been set.

It is anticipated that such planning investigations will lead to an opportunity for input via public consultation once preliminary findings / constraints evolve into infrastructure options to improve road safety, increase in traffic efficiency and intersection capacity.

4.2 Invercauld Road Intersection and Simons Avenue Link

Invercauld Road intersection with Ballina Road had been nominated for a $3.6M roundabout upgrade within the *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2).* Further investigations via the more recent TfNSW *Lismore City Town Area Model* has considered that this intersection is better suited to being signalised in tandem with the nearby Jubilee Avenue intersection. As the Invercauld Road intersection upgrade is identified as being within the LCC Section 94 Contribution Plan (2014), some development monies have already been collected for these works. Full project funding commitments including the detail design and construction has not yet been made.

Invercauld Road intersection at Ballina Road currently has 'No Right Turn' restrictions and controlled via a Stop sign. Local traffic is known to use Simons Avenue as an alternative connection between Rous Road and Invercauld Road. Pending the timing of future funding and upgrade of Invercauld Road / Ballina Road to signals, investigation as to management of Simons Avenue have been reviewed to:

1. Ascertain traffic impacts if no signal works on Invercauld Road were to occur in the medium term.
2. Ascertain the local area traffic improvement provided once signals are installed on Invercauld Road in the medium term.

An unexpected finding was that the *LCC Lismore City Town Area Model 2022* (Section 4.2 of report) identified that even once signalisation of Invercauld Road / Ballina Road intersection occurred, there still remains a similar demand in the morning peak hour for traffic heading west (ie from Rous Rd to Invercauld Road) to use Simons Avenue. However, the afternoon peak hour demand heading east (ie reverse to the morning peak, now being from Invercauld Road to Rous Road) significantly reduces to less than 30% of existing flows. This was found to be due to the demand created by the land uses accessing Dalley Street area (ie hospital precinct / school / university).

Road management options for Simons Avenue link (refer Figure 4.2 for works extent) are to:

a. In the medium term, await TfNSW to fund Invercauld Road / Ballina Road intersection. In the interim, Lismore City Council to upgrade Simons Avenue & Norwood Avenue to a two-way minor collector road standard (ie provide off-street parking to remove conflict with through vehicles / improve or provide pedestrian pathways / improve intersection radius for larger vehicles).

b. Or, in the medium term, await TfNSW to fund Invercauld Road / Ballina Road intersection. Once built, Lismore City Council then implement local area traffic management scheme to Simons Avenue & Norwood Avenue to discourage through traffic so as to return the roadway to a local street use (ie encourage road users to use Ballina Road). In the interim, would be desirable to provide off-street parking to remove conflict with through vehicles.

Figure 4.2 - Simons Avenue Link Extent of Works

4.3 Elizabeth Avenue Link

The Elizabeth Avenue link is a proposed 1.2km connection between Rous Road to Invercauld Road / Cynthia Wilson intersection and was identified as a $6.6M project within the LCC Section 94 Contribution Plan (2014). Preliminary concept designs undertaken since 2014 show that the road needs to be built to steep 20% gradients to utilise the existing road reserve corridor. Current design standards for major collector roads recommend a gradient at 12% to maximum of 16%. The existing corridor is unable to achieve a compliant outcome, particularly for heavy vehicles.

As identified by the Simons Avenue link investigations, there is a strong desire for a local travel corridor for people wishing to access the Dalley Street area from Goonellabah area. Both the *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* and the *LCC Lismore City Town Area Model 2022* confirm this demand would be of a major collector road level in the order of 6000vpd.

Detail assessment of the Elizabeth Avenue link within the *LCC Lismore City Town Area Model 2022* (refer Table 4.1 of report) showed that this linkage would provide a reduction in the order of 850vph using Ballina Road. This is a significant 30% benefit to Ballina Road traffic volumes (by having local traffic use the new link), however this traffic flow would now be transferred onto steep gradient roads including the existing Cynthia Wilson Drive (>20%) and funnel the extra traffic into Dalley Street.

Road management options for Elizabeth Avenue link are to:

a. Retain the existing Elizabeth Avenue road reserve corridor until a safe design solution / traffic management outcome that addresses steep gradients can be resolved.

b. In the medium to long term, pending satisfactory resolution of (a), seek TfNSW to substantially fund the works given the level of benefit provided to Ballina Road (ie State Highway SH16).

Figure 4.3 – Elizabeth Avenue Link Road Concept Design

4.4 Northern Bypass (Pineapple Road) Link

The Northern Bypass link (4km) has previously been considered within Council's strategic road planning and was listed within the Lismore Contributions Plan (2004) which connected Oliver Avenue to Bangalow Road. The *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* had removed this link but substituted the Trinity Drive / Bangalow Road link as the preferred connection to the north.

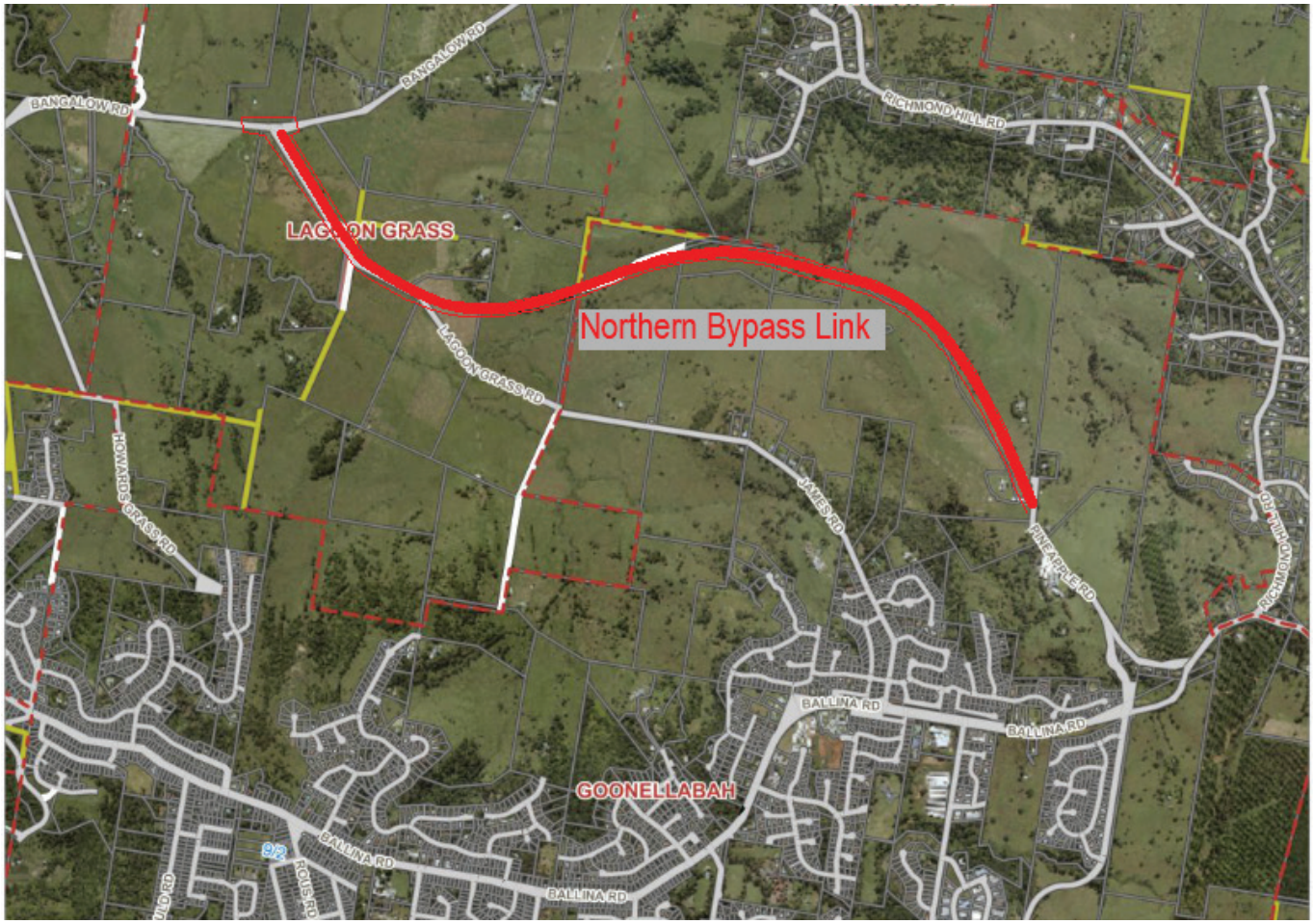


Figure 4.4 – Northern Bypass Link (Pineapple Rd to Bangalow Rd)

The *LCC Lismore City Town Area Model* has revisited this Northern Bypass link, particularly given the significant traffic generated by the 1055 Bruxner Highway planning proposal matter. This additional development traffic is separately considered in Section 4.4.1 so as to provide traffic data impacts for a 'with' and 'without' scenario.

The Northern Bypass link ('without' scenario) carries ultimate peak hour (year 2038) demands between 325vph to 470vph and was found that the existing Pineapple Road / Ballina Road roundabout would function satisfactorily. The Northern Bypass link would reduce traffic volumes on Ballina Road (west of Pineapple Road) by 10% and Richmond Hill Road traffic by 40%. The traffic volumes using the Northern Bypass link would be significant but it would have spare capacity for future use in facilitating development of the Lagoons Grass residential growth area and additional traffic such as the 1055 Bruxner Highway planning proposal. For a local comparison, the Northern Bypass link traffic volumes would be in the order of 40% of the Bangalow Road volumes.

Road management options for the North Bypass link (on the basis of 'without' the 1055 Bruxner Highway planning proposal) are to:

a. In the short term, secure 5% funding (approx $800k of the $16M build) to undertake a concept design to develop a functional layout design for the road corridor and intersections, to provide a basis for estimating costs and to determine further investigations needed for detailed design and planning approval. Once costs are known, assess business case for implementing project given this transport link would have spare capacity once built.

b. In the medium term, acquisition of road corridor and undertake construction.

4.4.1 Planning Proposal at 1055 Bruxner Highway

The planning proposal at 1055 Bruxner Highway includes 23ha of industrial land, 2.76ha mixed business, 0.5ha local centre and 364 residential allotments and ultimately generates a peak hour demand of 940vph. Refer below extract of Table 6.1 from *Barker Ryan Stewart Traffic and Transport Study (Nov 2022)*. With approximately 60% (565vph) of this traffic accessing the Pineapple / Ballina Road roundabout, the *LCC Lismore City Town Area Model 2022* (refer Section 4.3.5 of report) advises that, when inclusive of the Northern Bypass, signalisation or grade separation of Pineapple / Ballina Road intersection would be required.

Table 6.1: Proposed uses – trip generation

Use	Yield	AM		PM	
		Trip Generation Rate	Total Trip Generation	Trip Generation Rate	Total Trip Generation
Residential	364 lots	0.71 trips per dwelling	258 trips	0.78 trips per dwelling	284 trips
Industrial	23.27 Ha	18 trips per Ha	419 trips	18 trips per Ha	419 trips
Business	2.76 Ha	18 trips per Ha	50 trips	18 trips per Ha	50 trips
Local centre	2,500 m² GLFA (1/2 of the site area)	7.48per 100m² GLFA	187 trips	7.48per 100m² GLFA	187 trips
Total	-	-	**914 trips**	-	**940 trips**

The additional trips that could be generated by the proposed rezoning are therefore:

- AM trips = 914 trips
- PM trips = 940 trips

Road management options for the Pineapple Road / Bruxner Highway intersection are to:

a. In the short term, investigate grade separation for incorporating planning proposal at 1055 Bruxner Highway traffic demands and TfNSW duplication of Bruxner Highway corridor.

b. In the short term, secure road corridor for the grade separated intersection as per (a) above or other TfNSW approved intersection form.

c. In the medium term, undertaken construction of intersection upgrade in (b) above based upon 1055 Bruxner Highway development being approved.

4.5 Trinity Drive / Bruxner Crescent Link

The Trinity Drive link to Lagoons Grass Road ($6.2M) and associated upgrade of Bruxner Crescent intersection to signals with Ballina Road ($1.5m) were identified within the *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2) and* the LCC Section 94 Contribution Plan (2014).

The *LCC Lismore City Town Area Model 2022* shows the Trinity Drive link has a usage level at less than 50% that of the Northern Bypass link. On this basis, the Trinity Drive link is not supported and is recommended that the Trinity development would thereby provide its own local connection to the proposed Northern Bypass.

There is significant intersection delay at Bruxner Crescent / Ballina Road under current day conditions and is clear that improvement to this intersection is desirable. However, in noting that it is an existing situation within the Ballina Road (ie State Highway SH16) corridor, the funding management for its upgrade should predominately rest with TfNSW.

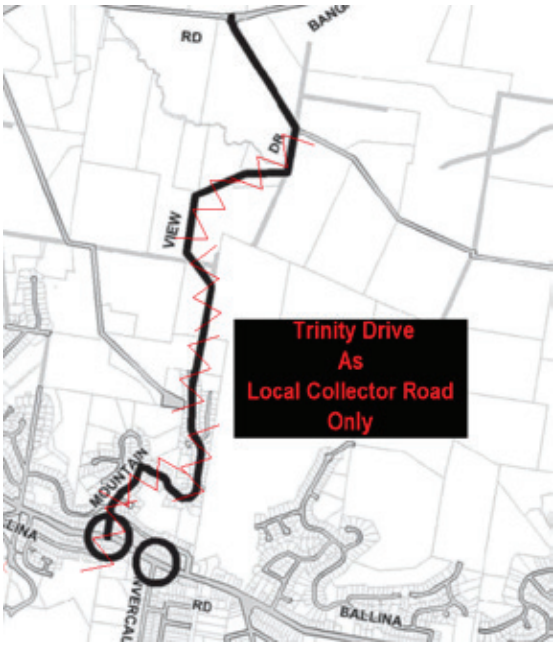


Figure 4.5 – Trinity Drive as Local Collector Road

Development potential does exist for Trinity Drive precinct (approx 250 lots) and it would be expected that, given the Bruxner Crescent intersection is at capacity, any land development of the Trinity Drive precinct would be responsible for implementing signalised intersection upgrade. Lismore City Council could assist with making funding submissions / representations to TfNSW, however given the direct nexus of the future Trinity Drive development traffic demands upon this intersection it is reasonable to not include this intersection as a high priority within Council's strategic road network.

Road management options for the Bruxner Crescent / Ballina Road intersection are to:

a. No longer include this intersection within Lismore City Council strategic funding program.

b. When a planning proposal is lodged for the Trinity Drive land Council will make submission to TfNSW seeking them to assist/consider with the design and construction of a signalised intersection at Bruxner Crescent / Ballina Road in conjunction with the planning proposal.

4.6 Elliot Road / Wilson Street Intersection

Wilson Street was upgraded (2019) with a new bridge crossing of Hollingsworth Creek which now has provided an alternative road connection through to Casino Street. The additional traffic due to growth and change to the road network was investigated to ascertain if significant intersection upgrade (ie roundabout) was required into the future at Elliot Road / Wilson Street.

Using the *LCC Lismore City Town Area Model 2022* and specific SIDRA modelling, the findings were that no significant intersection upgrade (ie roundabout) due to capacity or change in dominate travel directions were required.

Figure 4.6 – Elliot Road / Wilson Street

4.7 Dalley Street Upgrades

The *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* proposes that installing the Elizabeth Avenue link (Rous Road to Cynthia Wilson Drive) will result in significant traffic that would otherwise have used the Bruxner Highway, will now head down to Dalley Street via Cynthia Wilson Drive. Refer extract Fig 8.5, which shows traffic volumes would increase by 33% to 7,698vpd (from 5,726vpd) if this link is installed.

The *LCC Lismore City Town Area Model 2022* assessed the likely impact if this Elizabeth Avenue link was not installed and found that the future 2038 peak hour demand (refer Table 4.5) incrementally increased by 12%. This modest increase would be able to be managed within the existing road widths, however consideration as to introducing Local Area Traffic Management (LATM) to promote lower vehicle speeds and provide a safer road environment for pedestrian users within the Dalley Street precinct need to be further investigated.

The 2022 floods have resulted in multiple schools and other services from the Lismore urban area relocating to the Southern Cross University precinct for the foreseeable future (next 3 – 5 year period). These relocations have resulted in increased traffic volumes along Dalley Street and further substantiate that investigation in the form of a Road Safety Audit and Speed Limit Review is required.

Road management options for the Dalley Street precinct are to:

a. In the short term, collaborate with Southern Cross University on their masterplan to determine the additional pressures that will be placed on Dalley Street into the future.

b. In the short term, undertake a Road Safety Audit and Speed Limit Review of Dalley Street.

c. In the medium term, pending findings of (b), design and implement a LATM scheme.

4.8 Skyline Road (South) / Invercauld Road Link

An alternative link from Invercauld Road to Skyline Road (then to Wyrallah Road) was modelled within the *LCC Lismore City Town Area Model 2022* to assess likely demand. Based upon an urban speed zone (50kph), usage was very low at 81 vehicles over a 3hr period.

Further consideration of the Skyline Road (South) link should be undertaken when there is a better understanding of the future use of Southern Cross University land at Crawford Road and other development of this East Lismore precinct. Such a transport corridor / link has not been identified as essential, however given limited road alignment options (due to topography), consideration as to incorporating a local road connection (or unformed road reserve) within future subdivisional road networks would be desirable.

Road management options for the Skyline Road (South) to Invercauld Road link are:

a. That based upon current known residential land release areas, such a connection would not provide broader strategic road benefits.

b. That to improve traffic permeability through the Invercauld Road development precinct, local street access would be desirable.

5. REMOVAL OF FUNDING OF PREVIOUS SH16 NETWORK INTERSECTIONS

The *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* proposed funding towards numerous works on State Highway SH16 (Ballina Road or Bruxner Highway). Refer to extract of Table 9.1 of all works identified for upgrading, both local road and SH16 works. The reasonings why Lismore City Council could not support its funding for such SH16 works was previously noted within Section 4.1. This is not to say that such SH16 upgrades would be of clear benefit to the network overall, but simply the financial ability of Council to be responsible for funding past performance shortfalls on the state highway corridors is financially unsound when limited growth is present. Lismore City Council will continue its advocacy role in fostering road network improvements and seek funding from various Federal or State programs, particularly those works as nominated in Table 9.1.

Table 9.1 Estimated Network Stage Costs and Cost Distributions

									Cost ($M)		
2018	Ref (Fig 5.1)	Item	Type	Upgrade	Length (m)	Width (m)	Area m2	m2 rate	Council	State	Total
	B	Bruxner Highway - (Across Hollinsworth Creek)	Road	Duplication of Bridge						$ 6.00	$ 6.00
	1	Richmond Hill/Bruxner Highway	Intersection	Upgrade					$ 0.38	$ 0.38	$ 0.75
	2	Invercauld Road/Bruxner Highway	Intersection	Roundabout					$ 1.60	$ 1.60	$ 3.20
								5 Year Cost	$ 1.98	$ 7.98	$ 9.95
								Increased Trips Per Day vs 2013	17,566		
								Cost/Trip	$ 112.43	$ 454.00	$ 566.44

									Cost ($M)		
2023	Ref (Fig 5.1)	Item	Type	Upgrade	Length (m)	Width (m)	Area m2	m2 rate	Council	State	Total
	A	Bruxner Highway - (South of Three Chain Road)	Road	Duplication of Road	2000	13	26000	160		$ 4.16	$ 4.16
	C	Cynthia Wilson Drive to Rous Road	Road	New Road with Kerbs	1200	13	15600	180	$ 6.60		$ 6.60
	3	Oliver Avenue/Pineapple Road	Intersection	Upgrade					$ 1.00		$ 1.00
	7	Rous Road and Oliver Avenue Intersection	Intersection	Roundabout					$ 0.80		$ 0.80
	8	Cynthia Wilson and Invercauld Road Intersection	Intersection	Mini Roundabout					$ 0.20		$ 0.20
	9	Elizabeth Ave and Rous Road Intersection	Intersection	Mini Roundabout					$ 0.20		$ 0.20
								5 Year Cost	$ 8.80	$ 4.16	$ 12.96
								Increased Trips Per Day vs 2018	13,684		
								Cost/Trip	$ 643.09	$ 304.00	$ 947.09
								10 Year Cost	$ 10.78	$ 12.14	$ 22.91
								Increased Trips Per Day vs 2013	31,250		
								Cost/Trip	$ 344.80	$ 388.32	$ 733.12

									Cost ($M)		
2028	Ref (Fig 5.1)	Item	Type	Upgrade	Length (m)	Width (m)	Area m2	m2 rate	Council	State	Total
	D	Eastern ByPass (Oliver Avenue)	Road	Resurfacing	500	13	6500	160	$ 1.04		$ 1.04
	D	Eastern ByPass (Oliver Avenue - Bridge)	Road	New Road with Kerbs	600	13	7800	180	$ 6.01		$ 6.01
	E	Oliver Avenue / Holland Road intersection	Intersection	Roundabout					$ 1.00		
	E	Bruxner Highway (Rotary Drive to Diadem Street)	Road	Duplication of Road	2200	12	26400	180		$ 4.75	$ 4.75
	S	River Crossing (Brunswick Street to Lake Street)	Bridge	New Bridge					$ 5.50	$ 5.50	$ 11.00
	S	Northern Bypass (Terania Street to Brunswick Street)	Road	Resurfacing	1500	13	19500	160	$ 1.56	$ 1.56	$ 3.12
	S	Northern Bypass (Terania Street to Brunswick Street)	Road	New Road with Kerbs	500	13	6500	180	$ 0.59	$ 0.59	$ 1.17
	4	Pindari Crescant/Bruxner Highway	Intersection	Upgrade					$ 0.38	$ 0.38	$ 0.75
	10	Bruxner Highway and Mountainview Drive	Intersection	Traffic Signals					$ 0.75	$ 0.75	$ 1.50
								5 Year Cost	$ 16.82	$ 13.52	$ 29.34
								Increased Trips Per Day vs 2023	13,307		
								Cost/Trip	$ 1,263.62	$ 1,016.16	$ 2,204.63
								15 Year Cost	$ 27.59	$ 25.66	$ 52.25
								Increased Trips Per Day vs 2013	44,557		
								Cost/Trip	$ 619.21	$ 575.82	$ 1,172.59

									Cost ($M)		
2033	Ref (Fig 5.1)	Item	Type	Upgrade	Length (m)	Width (m)	Area m2	m2 rate	Council	State	Total
	F	Trinity Drive (Bruxner Highway to Lagoons Grass Road)	Road	Resurfacing	1300	11	14300	160	$ 2.29		$ 2.29
	F	Trinity Drive (Bruxner Highway to Lagoons Grass Road)	Road	New Road with Kerbs	1700	13	22100	180	$ 3.98		$ 3.98
	5	Molesworth Street/Bruxner Highway	Intersection	Traffic Signals					$ 0.75	$ 0.75	$ 1.50
	6	Union Street / Elliott Street	Intersection	Traffic Signals						$ 1.50	$ 1.50
								5 Year Cost	$ 7.02	$ 2.25	$ 9.27
								Increased Trips Per Day vs 2028	13,151		
								Cost/Trip	$ 533.50	$ 171.09	$ 704.59
								20 Year Cost	$ 34.61	$ 27.91	$ 61.51
								Increased Trips Per Day vs 2013	57,708		
								Cost/Trip	$ 599.67	$ 483.59	$ 1,065.94

Extract Table 9.1 - *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)*

5.1 List of SH16 Works Recommended To Be No Longer Partly Funded by Council

The following SH16 works have been removed from contributing funding by Lismore City Council (Council's contribution in brackets) from the previous *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2).* Refer to **Appendix 1** for locations of works.

Item 2	Bruxner Highway / Invercauld Road Intersection	(50% = $1.6M)
Item 4	Bruxner Highway / Pindari Crescent Intersection	(50% = $0.38M)
Item 5	Bruxner Highway / Molesworth Street Intersection	(50% = $0.75M)
Item 10	Bruxner Highway / Mountainview Drive Intersection	(50% = $0.75M)

6. WORKS CARRIED FORWARD FROM STRATEGIC ROAD REVIEW 2013

6.1 Cynthia Wilson / Invercauld Road Roundabout

The intersection is currently a T configuration and the *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* had foreshadowed the Elizabeth Avenue link, thereby becoming a four-way intersection. This intersection was included within the *Lismore City Section 94 Contributions Plan 2014* (refer Table 27) and a concept design has already been prepared. Refer Figure 6.1. These works have been carried forward and proposed to be built within the medium term timeframe.

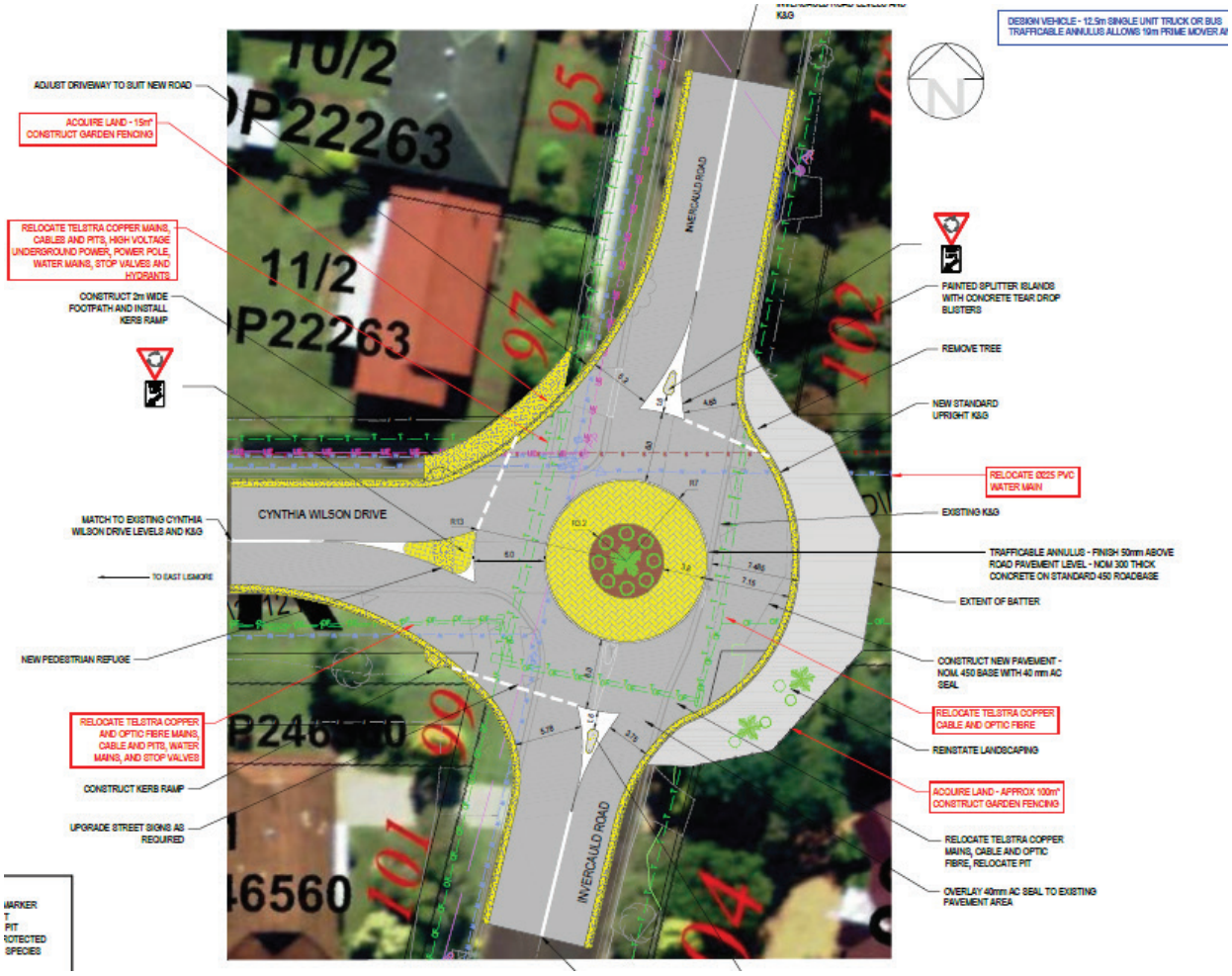


Figure 6.1 – Cynthia Wilson Drive / Invercauld Road Roundabout

6.2 Rous Road / Oliver Avenue Roundabout Upgrade

The intersection is currently a drive-over roundabout of temporary construction (ie nil central kerbing, limited lane approaches, limited lighting) and had been included within the *Lismore City Section 94 Contributions Plan 2014* (refer Table 27) and concept design has already been prepared. Refer to Figure 6.2. These works have been carried forward and proposed to be built within the short term timeframe.

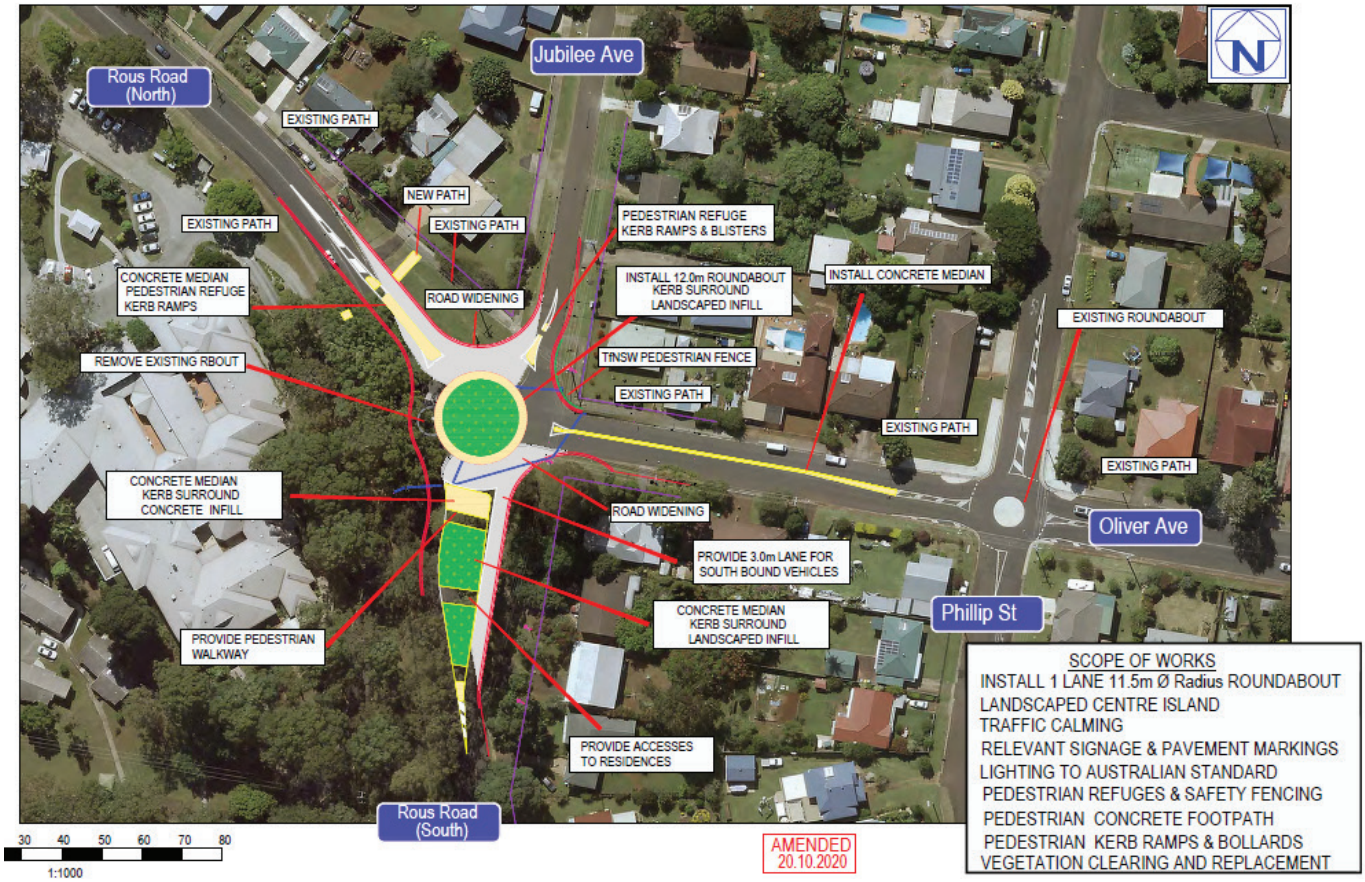


Figure 6.2 – Rous Road / Oliver Avenue Roundabout Upgrade

6.3 Northern River Crossing New Bridge (Orion Street to Terania Street)

A fourth bridge crossing (northern crossing) was included within the *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* and was included within the *Lismore City Section 94 Contributions Plan 2014* (refer Table 27). A further briefing update (4th Wilson River Bridge Crossing Briefing) was prepared for Council in 2017 and identified that further study required to confirm the location and timing and need for the bridge. Such further study has not been completed and not been seen as a priority for Council. Given the scale of the infrastructure, it is proposed to carry forward the land acquisitions component of this project to ensure the link is secured as a long-term bridge crossing option. Given the changing landscape of Lismore post the 2022 flood future studies on the bridge will determine the need for any design or construction costs. Refer to Figure 6.3 for concept location of the northern bridge.

Figure 6.3 – Northern Bridge Crossing (Orion St to Terania St)

7. SUMMARY OF STRATEGIC NETWORK LINKS AND INTERSECTIONS

The following table lists those recommended works for Lismore City Council funding as identified via the *LCC Lismore City Town Area Model 2022* and including key works carried forward from the previous *Lismore Strategic Road Review 2013 (TTM ref: 34494Rep2)* where not otherwise adjusted as identified per this report (ie non-funding SH16 works). These works are shown on layout map within **Appendix 1**

Table 7.1 Local Strategic Network Links and Intersections

Item	Description	Total Cost	Model Origin*	Timing
A22	Simons Avenue Link (Invercauld Road to Rous Road)	$1.9M	LCTAM 2022	Medium Term
B22	Northern Bypass Link (Pineapple Road to Bangalow Road)	$16.3M	LCTAM 2022	Short to Medium Term
C22	Cynthia Wilson and Invercauld Road Intersection (Mini Roundabout)	$1.1M	LSRR 2013	Medium Term
D22	Rous Road and Oliver Avenue Intersection (Roundabout)	$0.9M	LSRR 2013	Short Term
E22	Dalley Street LATM Upgrade (Military Road to Wyrallah Road)	$2.6M	LCTAM 2022	Short to Medium Term
F22	Northern River Crossing New Bridge (Orion Street to Terania Street) Land Acquisition	$1.26M	LSRR 2013 4th Bridge Briefing 2017	Long Term

LSRR 2013 – Lismore Strategic Road Review
LCTAM 2022 - LCC Lismore City Town Area Model 2022

APPENDICES

Appendix 1 Maps of Local Strategic Network Links and Intersections (2022)

Appendix 2 Lismore Strategic Road Network Review (Dec 2022 - Bitzios Consulting)

BOOERIE CREEK
WOODLAWN
BEXHILL
BOAT HARBOUR
RICHMOND HILL
LAGOON GRASS
HOWARDS GRASS
NORTH LISMORE
LISMORE HEIGHTS
LISMORE
GOONELLABAH
GIRARDS HILL
SOUTH LISMORE
EAST LISMORE
LINDENDALE
CHILCOTTS GRASS
LOFTVILLE
MONALTRIE

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1:35,000

LEGEND

Road Review Plan

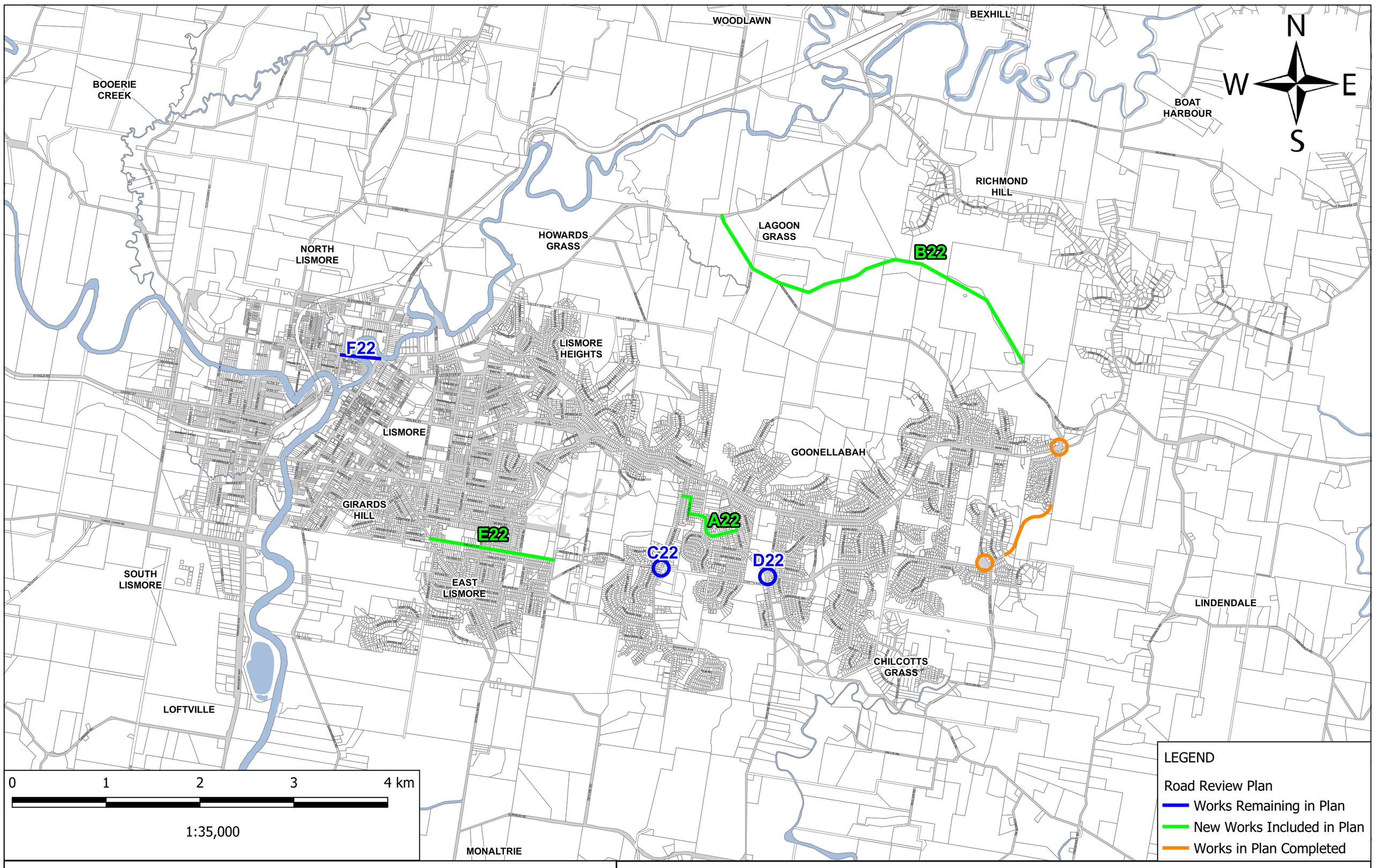
Works Removed from Plan (not being funded)

LISMORE CITY COUNCIL

Works Removed from 2013 Strategic Road Review

Printed: 14.7.2023

Disclaimer: The mapped areas are indicative only and in some instances extended beyond the developable area of an allotment



LISMORE CITY COUNCIL

Strategic Road Review 2023 Works Schedule

Printed: 14.7.2023

Disclaimer: The mapped areas are indicative only and in some instances extended beyond the developable area of an allotment

Lismore Strategic Road Network Review

Final Report

Lismore City Council

20th December 2022

Gold Coast
Suite 26, 58 Riverwalk Avenue
Robina QLD 4226
P: (07) 5562 5377

Brisbane
Level 2, 428 Upper Edward Street
Spring Hill QLD 4000
P: (07) 3831 4442

Sydney
Studio 203, 3 Gladstone Street
Newtown NSW 2042
P: (02) 9557 6202

W: www.bitziosconsulting.com.au

E: admin@bitziosconsulting.com.au

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CONTENTS

Tables

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1. INTRODUCTION

1.1 Background

Bitzios Consulting (Bitzios) was commissioned by Lismore City Council (Council) to undertake a traffic modelling assessment and review of the strategic road network in Lismore. It is understood Council is reviewing traffic matters regarding their future strategic road network, specifically, the need for future local road links as well as local road and intersection upgrades. Using the Lismore City Town Area model, Council would like to assess and understand the needs and potential consequences of not proceeding with previously proposed new links / upgrades on the local network.

1.2 Scope of Work

The scope of work has been divided into four (4) stages as shown in Figure 1.1 below.

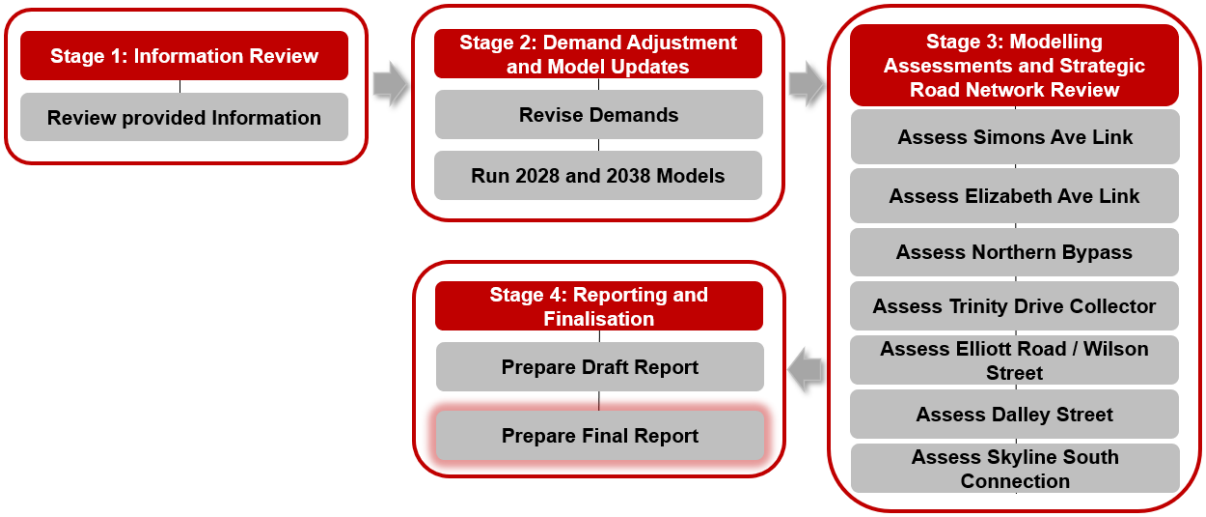
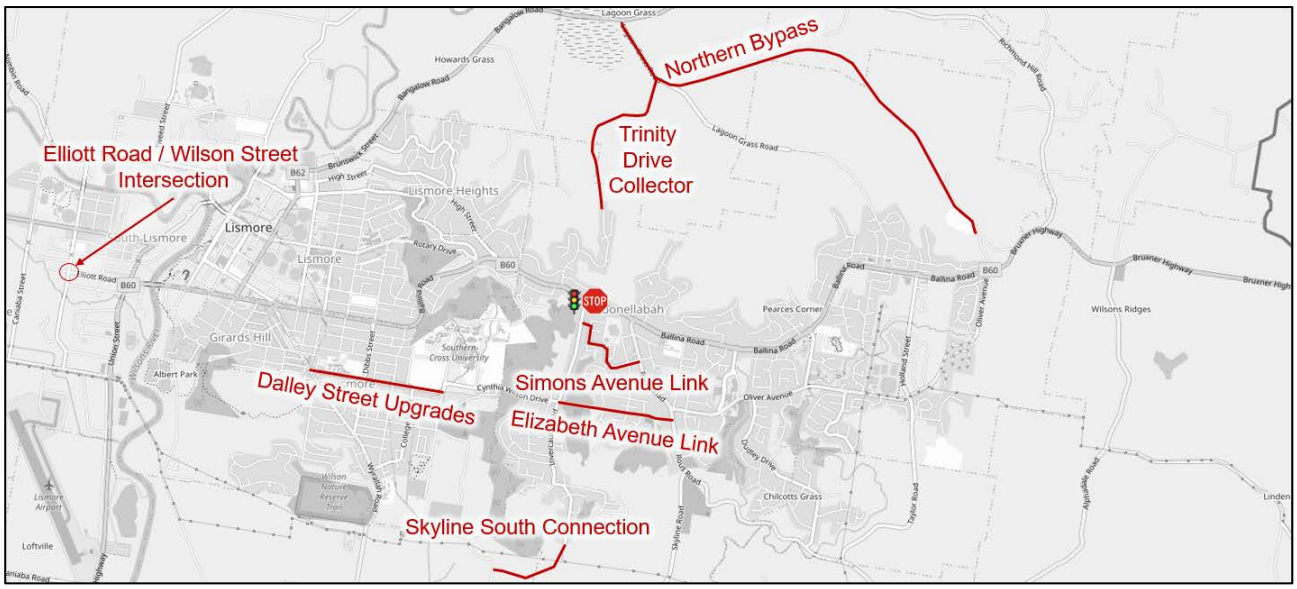


Figure 1.1: Scope of Works

1.3 Modelling Assessment Locations

The previously proposed new links or upgrades that were assessed are shown in Figure 1.2.



SOURCE: Background image taken from Open Street Map

Figure 1.2: Modelling Assessment Locations

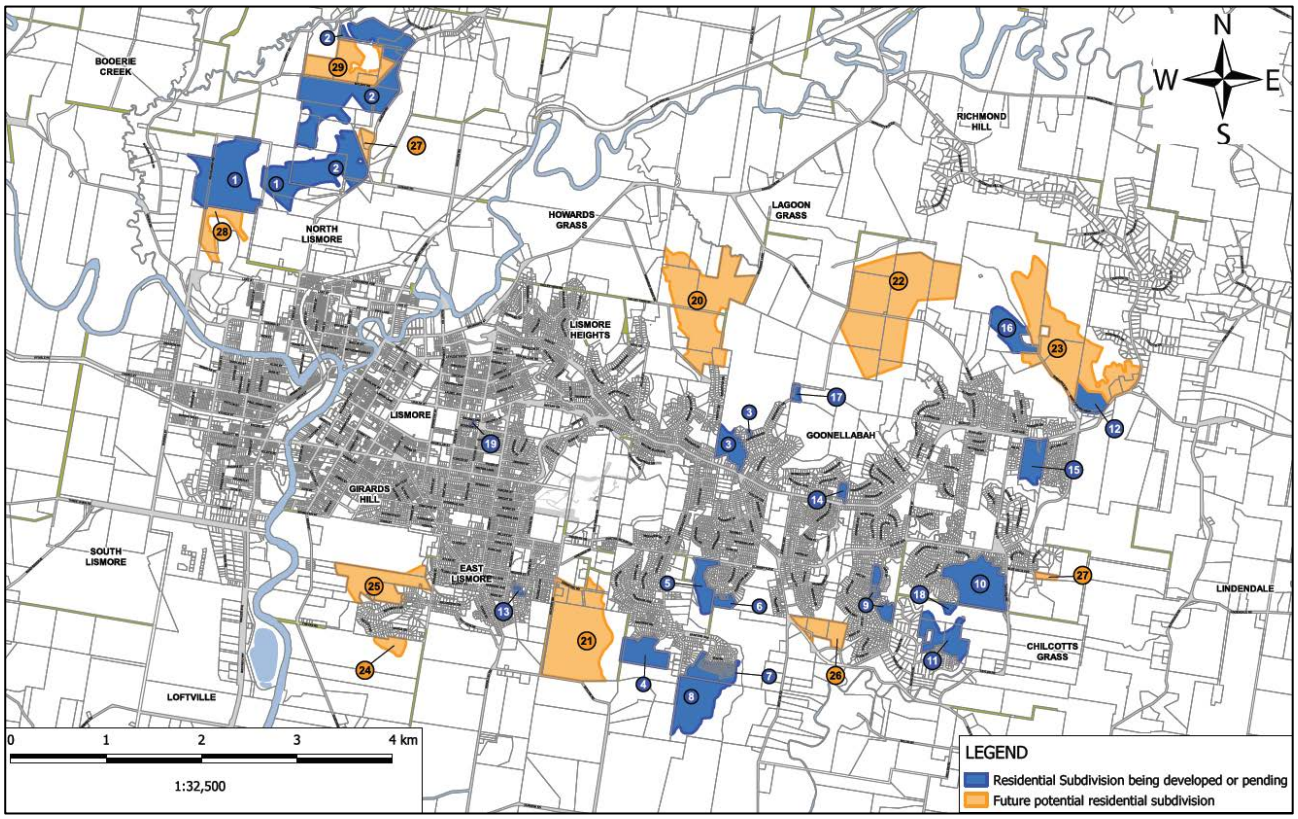
2. DEMAND ADJUSTMENTS

2.1 Lismore Town Area Model Demand Overview

Bitzios has a standing agreement with Council to undertake traffic modelling and analysis projects on an 'as needed' basis using the Lismore City Town Area Traffic Model developed by Bitzios for Transport for New South Wales (TfNSW). The Town Area Traffic Model developed in 2018 assumed a number of lots and developments based on the status and scale of land releases in the area according to the residential development map. An updated residential development map based on 2022 projections has been provided which was utilised as part of this assessment.

2.2 Lismore Residential Developments

A summary table was provided summarising the proposed developments in Lismore in the short, medium and long term. Figure 2.1 shows the location of each proposed residential development.



SOURCE: Lismore City Council – Lismore_Residential_Development_Map_2022

Figure 2.1: Lismore Residential Development Map 2022

Table 2.1 summarises the proposed lots for each residential development noting its assumed timing and if it was modelled in the 2028 or 2038 model.

Table 2.1: Lismore Residential Development

Model Year	Map No.	Location	Assumed Timing	Lots
2028	2	Allura Parklands North Lismore Plateau (PG)	Medium Term	742
	3	554 Ballina Road Goonellabah (Points North Estate)	Short Term	72
	4	Sanctuary Hills (Evergreen Drive Goonellabah)	Short Term	68
	5	Fisher Street Goonellabah	Short term	222
	6	Forestoak Way Goonellabah	Short term	11
	7	Eastwood Precinct 1 Goonellabah	Short term	135
	8	Eastwood Precinct 2 Goonellabah	Short term	203
	9	Just Street Goonellabah	Short term	108

	10	Waterford Park Goonellabah	Short term	400
	11	Hidden Valley Circuit Chilcotts Grass	Short to Medium Term	135
	12	Valley View (part Pineapple Road Precinct)	Short to Medium Term	82
	14	658 Ballina Road Goonellabah	Short to Medium term	16
	15	Platypus Park (805 Ballina Rd Goonellabah)	Short to Medium term	92
	16	97 Pineapple Road Goonellabah	Medium term	60
	17	1A & 1B Northcott Drive Goonellabah	Short to Medium term	16
	18	123 Taylor Rd Chilcotts Grass	Short to Medium term	6
	19	42 McKenzie St Lismore	Short term	30
	27	30 Blue Hills Road	Short to Medium term	4
2038	1	Fig Tree Estate North Lismore Plateau (Winten)	Long Term	85
	13	College Street East Lismore	Medium to Long Term	24
	20	Trinity Drive Precinct Goonellabah	Long term	250
	21	Southern Cross University – Crawford Road East Lismore	Long term	150
	22	Lagoon Grass	Long term	175
	23	Pineapple Road Precinct Goonellabah	Long term	390
	24	389 Keen Street East Lismore	Medium to Long Term	30
	25	King George Drive & Barham Street East Lismore	Long term	60
	26	Rous Road Goonellabah	Long term	35
	28	North Lismore Plateau	Medium to Long Term	50
	29	North Lismore Plateau - other 1/623619, 1/570029 2/570029, 2/596437, 2/537418 & 1/537418	Long term	200
	138	1055 Bruxner Highway Lands	Long term	346

SOURCE: Lismore City Council – Lismore Residential Development 2022 – Table A3

2.2.1 Trip Generation / Distribution

The trip generation and splits used in the 226 Invercauld Road Traffic Impact Assessment (TIA) that was prepared by Rytenskild in 2021, was used as part of this assessment as detailed in Table 2.2.

Table 2.2: Trip Generation

Peak	Trips per Dwelling / Lot
AM Peak	0.78
PM Peak	0.71
Daily	7.4

SOURCE: Lismore City Council – 226 Invercauld Road, Goonellabah TIA, Rytenskild Traffic Engineering, 2021

Additionally, the trip distribution used for the AM and PM peak periods are detailed in Table 2.3.

Table 2.3: Peak Hour Distribution

	IN	OUT
AM	20%	80%
PM	60%	40%
Daily	50%	50%

SOURCE: Lismore City Council – 226 Invercauld Road, Goonellabah TIA, Rytenskild Traffic Engineering, 2021

2.3 Demand Development

The trip generation above was applied to the proposed lots identified in Table 2.1 and included in their corresponding zones in 2028 and 2038. The 2028 and 2038 Aimsun models were then run to develop the 2028 and 2038 Base Case Scenarios.

3. MODELLING OVERVIEW

3.1 Assessment Years and Time Periods

The 2028 and 2038 Lismore City Town Area models were used, and outputs were taken from the following time periods:

- AM Peak: 0800-0900
- PM Peak: 1500-1600.

Appropriate “warm-up” and “cool-down” periods were incorporated in the model.

3.2 Aimsun Modelling Outputs

3.2.1 Volume Plots

Volume plot figures have been produced to demonstrate the number of vehicles using the road link. Table 3.1 summarises the link colours used for the volume plot figures.

Table 3.1: Volume Plots

Link Colour	Interval Volumes (veh/h)
	0 - 250
	250 - 500
	500 – 750
	750 – 1,000
	1,000 – 1,250
	>1,250

3.2.2 Link Delay

Average road section delay figures have been produced to demonstrate Level of Service (LOS). The LOS is based on average control delay for all intersection types based on TfNSW Modelling Guidelines. Table 3.2 summarises the link colours used for the delay figures based on the TfNSW LOS criteria.

Table 3.2: Level of Service Criteria

Level of Service	Control Delay per Vehicle in seconds (d)
	All intersection types
A	d ≤ 14.5
B	14.5 < d ≤ 28.5
C	28.5 < d ≤ 42.5
D	42.5 < d ≤ 56.5
E	56.5< d ≤ 70.5
F	70.5 < d

SOURCE: Table 5.14.3 Delay RTA NSW, SIDRA Intersection 9 User Guide

3.3 SIDRA Modelling Outputs

The following sections discuss the key output statistics and performance criteria used by TfNSW when interpreting results.

3.3.1 Degree of Saturation

The Degree of Saturation (DOS) has been used as an assessment parameter for the SIDRA results. DOS is a ratio of demand (arrival) flow to capacity, also known as the volume/capacity (v/c) ratio. A DOS above 1 (i.e. 100%) represents oversaturated conditions where the demand exceeds capacity. TfNSW Modelling Guidelines also specify a practical degree of saturation for different intersection types, as summarised in Table 3.3

Table 3.3: Maximum Practical Degree of Saturation

Intersection Type	Maximum Practical Degree of Saturation
Signals	0.90
Roundabout	0.85
Sign-controlled	0.80
Continuous Lanes	0.98

Source: Table 14.2 Maximum practical degree of saturation, Traffic Modelling Guidelines, Roads and Maritime Services, 2013

The Modelling Guidelines state that if a practical degree of saturation for any lane is greater than the corresponding value provided in Table 3.3, then the intersection requires appropriate treatment to maintain an acceptable DOS.

3.3.2 Delay / Level of Service

LOS based on average vehicle delay has also been used to assess intersection performance. Table 3.4 details the LOS thresholds used in SIDRA which are based on the TfNSW Modelling Guidelines.

Table 3.4: Level of Service Criteria

Level of Service	Control Delay per Vehicle in seconds (d)
	All intersection types
A	d ≤ 14.5
B	14.5 < d ≤ 28.5
C	28.5 < d ≤ 42.5
D	42.5 < d ≤ 56.5
E	56.5< d ≤ 70.5
F	70.5 < d

SOURCE: Table 5.14.3 Delay RTA NSW, SIDRA Intersection 9 User Guide

The Modelling Guidelines specify a LOS target of C or better for all intersection types. For traffic signals, the average movement delay and level of service over all movements should be taken, while for roundabouts and sign-controlled intersections, the level of service assessment should be based on the critical movement which corresponds to the worst movement delay.

Although a target LOS C is specified, typically LOS D is acceptable in constrained locations.

A full copy of relevant SIDRA modelling results are attached in **Appendix A**.

4. STRATEGIC ROAD NETWORK REVIEW

4.1 Overview

Area-wide traffic modelling has been used as the primary tool in assessing the requested strategic road network items. Aimsun microsimulation traffic models have been developed for 2028 and 2038 which have been updated and then utilised as part of this assessment. Model volumes were extracted and analysed from the Aimsun microsimulation traffic models for the following test scenarios:

- Item 1: Invercauld Road and Simons Avenue Link
  - Item 1a: Simons Avenue Link
  - Item 1b: Elizabeth Avenue Link.
- Item 2: Northern Bypass
- Item 3: Trinity Drive Collector
- Item 4: Elliott Road / Wilson Street intersection
- Item 5: Dalley Street Upgrades
- Item 6: Skyline South Connection.

Select link analysis was also undertaken to understand the distribution for certain test scenarios and its outputs are based on the full AM (0700-1000) or PM (1500-1800) period.

4.2 Item 1: Invercauld Road and Simons Avenue Link

4.2.1 Item 1a: Simons Avenue Link

Figure 4.1 shows the Simons Avenue Link that was coded in the Aimsun model. This was to understand if there were any impacts to this local 'rat run' if the Ballina Road / Invercauld Road intersection was not upgraded from priority controlled to signals.

SOURCE: Nearmap Imagery (left) & Aimsun Model (right)

Figure 4.1: Simons Avenue Link

It is important to note that the right turn movement is currently banned out of Invercauld Road during peak periods (0730-0930 and 1600-1800) with the existing priority controlled arrangement. This turn ban was removed in the upgrade to signals.

4.2.1.1 Volumes

Figure 4.2 shows the AM peak volume plots comparing the Simons Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

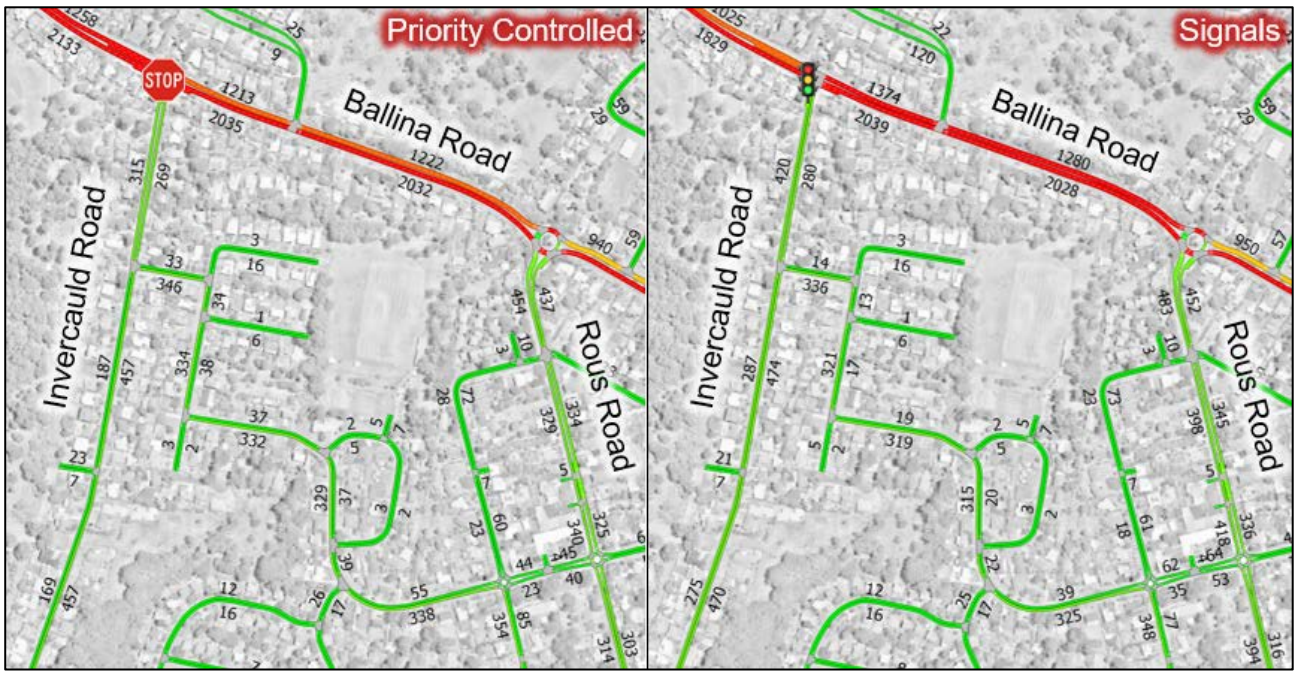


Figure 4.2: Simons Avenue Link – 2028 0800-0900 AM Peak Volumes Plot

Figure 4.3 shows the PM peak volume plots comparing the Simons Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.3: Simons Avenue Link – 2028 1500-1600 PM Peak Volumes Plot

The volume plots show that in the AM peak, the upgrade to signals of the Ballina Road / Invercauld Road intersection had minimal influence on the Simons Avenue Link. However, the PM peak shows a reduction of volumes on the Simons Avenue Link when the Ballina Road / Invercauld Road intersection is signalised. To further understand this, a select link analysis was undertaken as detailed in the next section.

4.2.1.2 Select Link Analysis

Figure 4.4 shows the eastbound and westbound select link analysis during the full AM model period (0700-1000) along the Simons Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.4: Simons Avenue Link – 2028 AM (0700-1000) Select Link

As expected in the AM peak, the select link analysis shows the upgrade to signals of the Ballina Road / Invercauld Road intersection had minimal influence on the eastbound and westbound volumes along the Simons Avenue Link.

Figure 4.5 shows the eastbound and westbound select link analysis during the full PM model period (1500-1800) along the Simons Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.5: Simons Avenue Link – 2028 PM (1500-1800) Select Link

When the Ballina Road / Invercauld Road intersection is priority-controlled, 679 vehicles (3hr period) used Simons Avenue Link headed east with the majority of traffic coming from Cynthia Wilson Drive. However, the upgrade to signals significantly decreased the eastbound traffic along Simons Avenue Link with only 171 vehicles (3hr period), a reduction of 508 vehicles (3hr period). This is highly due to the removal of the right turn ban when upgraded to signals as it has a high influence given the high eastbound movements in the PM peak. As a result, vehicles are utilising Ballina Road to head east instead of the Simons Avenue Link in the PM peak due to the removal of the right turn ban.

4.2.2 Item 1b: Elizabeth Avenue Link

Figure 4.6 shows the Elizbeth Avenue Link that was coded in the Aimsun model. It is understood that the Elizabeth Avenue Link is not so critical once the Ballina Road / Invercauld Road intersection has been upgraded to signals. Provided it is currently within the contribution plan for construction, this assessment was to understand the importance of Elizabeth Avenue Link and its likely traffic volumes if the Ballina Road / Invercauld Road intersection was not upgraded from priority controlled to signals.

SOURCE: Nearmap Imagery (left) & Aimsun Model (right)

Figure 4.6: Elizabeth Avenue Link

It is important to note that the right turn movement is currently banned out of Invercauld Road during peak periods (0730-0930 and 1600-1800) with the existing priority controlled arrangement. This turn ban was removed in the upgrade to signals as part of this assessment.

4.2.2.1 Volumes

Figure 4.7 shows the AM peak volume plots comparing the Elizabeth Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.7: Elizabeth Avenue Link – 2028 0800-0900 AM Peak Volumes Plot

Figure 4.8 shows the PM peak volume plots comparing the Elizabeth Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.8: Elizabeth Avenue Link – 2028 1500-1600 PM Peak Volumes Plot

The volume plots show that in the AM and PM peaks, the Elizabeth Avenue Link has minimal influence when the Ballina Road / Invercauld Road intersection is upgraded to signals. To further justify this, a select link analysis was undertaken.

4.2.2.2 Select Link Analysis

Figure 4.9 shows the eastbound and westbound select link analysis during the full AM model period (0700-1000) along the Elizabeth Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.9: Elizabeth Avenue Link – 2028 AM (0700-1000) Select Link

The distribution from the select link analysis shows the upgrade to signals of the Ballina Road / Invercauld Road intersection diverted approximately 50 vehicles (3hr period) eastbound and approximately 120 vehicles (3hr period) westbound off Ballina Road or Simons Avenue and onto the Elizabeth Avenue Link.

Figure 4.10 shows the eastbound and westbound select link analysis during the full PM model period (1500-1800) along the Elizabeth Avenue Link with and without the upgrade to signals at the Ballina Road / Invercauld Road intersection.

Figure 4.10: Elizabeth Avenue Link – 2028 PM (1500-1800) Select Link

The distribution from the select link analysis shows the upgrade to signals of the Ballina Road / Invercauld Road intersection diverted approximately 90 vehicles (3hr period) eastbound and approximately 80 vehicles (3hr period) westbound off Ballina Road or Simons Avenue and onto the Elizabeth Avenue Link.

4.2.3 Screenline Comparison

To further understand the influence of the Elizabeth Avenue Link and Simons Avenue Link, Table 4.1 shows a screenline comparison in the 2028 AM and PM peak comparing Ballina Road, the Simons Avenue Link and the Elizabeth Avenue Link both with and without the Elizabeth Avenue Link.

Table 4.1: Screenline Comparison – 2028 0800-0900 AM Peak and 1500-1600 PM Peak

Ballina Road / Invercauld	Elizabeth Avenue Link	Road Section	Direction	0800-0900 AM (veh/h)	1500-1600 PM (veh/h)
Priority-Controlled	**Without** Elizabeth Avenue Link	Ballina Road	Eastbound	1,222	1,579
			Westbound	2,032	1,487
		Simons Avenue Link	Eastbound	37	232
			Westbound	332	123
	With Elizabeth Avenue Link	Ballina Road	Eastbound	745	1,118
			Westbound	1,780	1,177
		Simons Avenue Link	Eastbound	24	27
			Westbound	55	9
		Elizabeth Avenue Link	Eastbound	534	754
			Westbound	571	452
Signalised	**Without** Elizabeth Avenue Link	Ballina Road	Eastbound	1,280	1,791
			Westbound	2,028	1,411
		Simons Avenue Link	Eastbound	19	57
			Westbound	319	161
	With Elizabeth Avenue Link	Ballina Road	Eastbound	764	1,083
			Westbound	1,689	1,103
		Simons Avenue Link	Eastbound	6	29
			Westbound	54	33
		Elizabeth Avenue Link	Eastbound	531	789
			Westbound	741	492

As shown in the table above, the Elizabeth Avenue Link plays a significant role taking a considerate percentage of traffic off from Ballina Road as an alternate east-west connection.

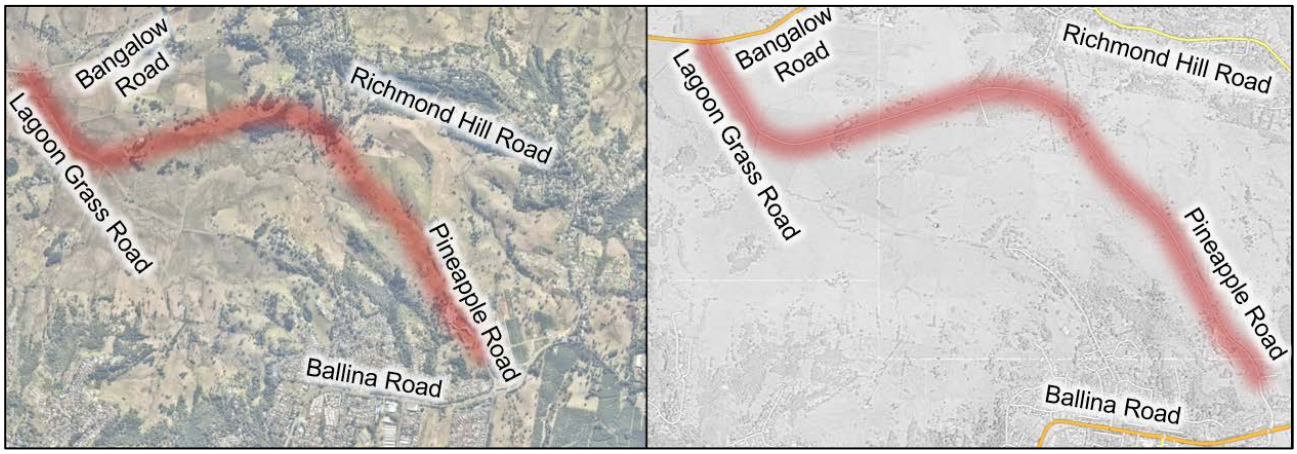
In the eastbound direction, the Elizabeth Avenue Link takes approximately 41% of vehicles in the AM peak and 40% of vehicles in the PM peak from Ballina Road when there are no upgrades to the Ballina Road / Invercauld Road intersection (i.e. existing). When the Ballina Road / Invercauld Road intersection is upgraded to signals, the Elizabeth Avenue Link also takes approximately 41% of vehicles in the AM peak and 42% of vehicles in the PM peak from Ballina Road.

As for the westbound direction, the Elizabeth Avenue takes approximately 24% of vehicles in the AM peak and 28% of vehicles in the PM peak from Ballina Road when there are no upgrades to the Ballina Road / Invercauld Road intersection (i.e. existing). When the Ballina Road / Invercauld Road intersection is upgraded to signals, the Elizabeth Avenue Link takes approximately 30% of vehicles in the AM peak and 30% of vehicles in the PM peak from Ballina Road.

This shows that when the Elizabeth Avenue Link is implemented, the upgrade of the Ballina Road / Invercauld Road intersection to signals makes little to no difference. It also shows the Simons Avenue Link has low utilisation when the Elizabeth Avenue Link is implemented.

4.3 Item 2: Northern Bypass

Figure 4.11 shows the Northern Bypass that was coded in the Aimsun model. This was to understand the likely demand for this link and its impact to the surrounding network.



SOURCE: Nearmap Imagery (left) & Aimsun Model (right)

Figure 4.11: Northern Bypass

4.3.1 Volumes

Figure 4.12 shows the AM peak volume plots comparing the impact to the network at the northern and southern ends both with and without the Northern Bypass.

Figure 4.12: Northern Bypass – 2038 0800-0900 AM Peak Volumes Plot

Figure 4.13 shows the PM peak volume plots comparing the impact to the network at the northern and southern ends both with and without the Northern Bypass.

Figure 4.13: Northern Bypass – 2038 1500-1600 PM Peak Volumes Plot

The volume plots show that in both the AM and PM peak, eastbound traffic along Bangalow Road heavily utilise the Northern Bypass and travel south to exit left and continue along Ballina Road. Similarly, westbound traffic along Ballina road turn right into the Northern Bypass and turn left onto Bangalow Road. Due to this, the modelling results show a reduction in vehicles along Richmond Hill Road during the AM and PM peaks.

During the AM peak, the Northern Bypass carries approximately 234 southbound veh/h and 91 northbound veh/h. As for the PM peak, it carries approximately 249 southbound veh/h and 221 northbound veh/h.

To further explain this, a select link analysis was undertaken as detailed in the next section.

4.3.2 Select Link Analysis

Figure 4.14 shows the northbound and southbound select link analysis of the Northern Bypass during the full AM model period (0700-1000) and full PM model period (1500-1800).

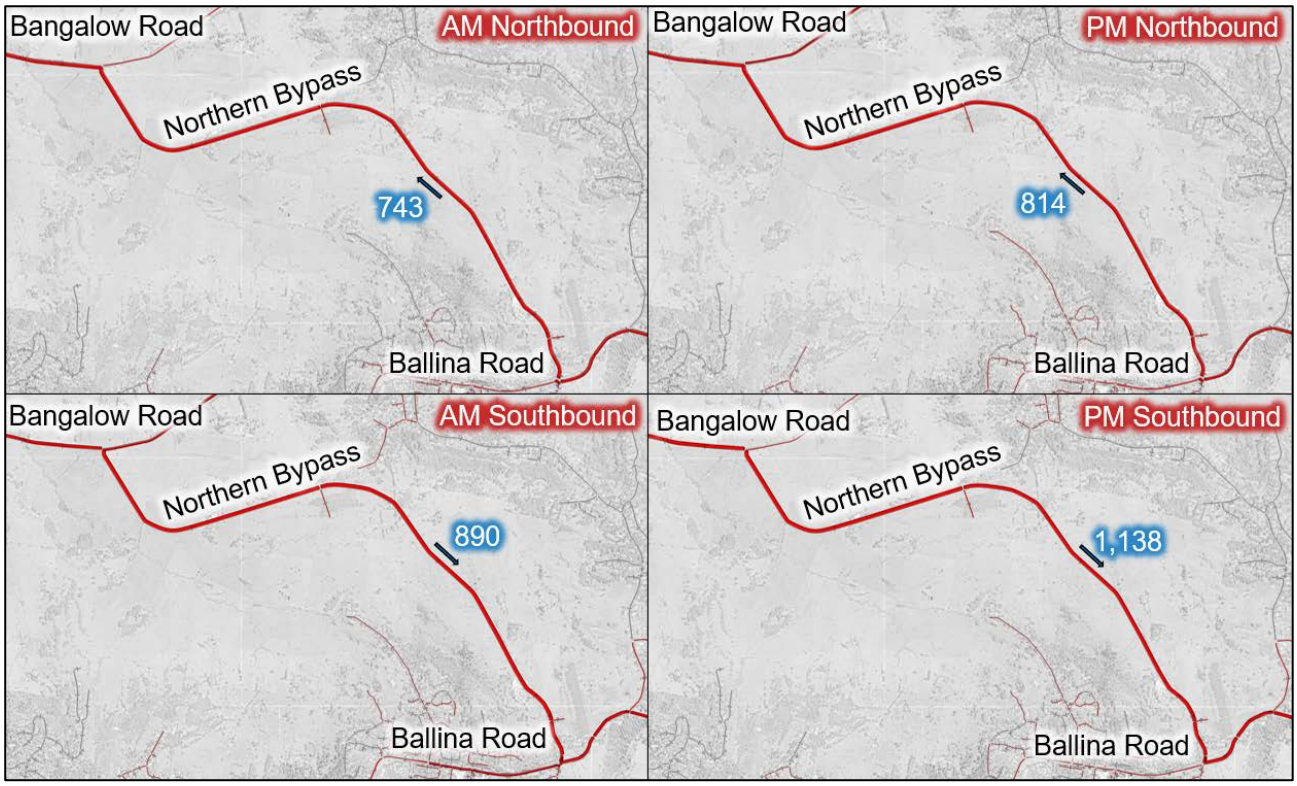


Figure 4.14: Northern Bypass – 2038 AM (0700-1000) & PM (1500-1800) Select Link

As shown in the above 2038 AM and PM select link figures, eastbound traffic along Bangalow Road travel south along the Northern Bypass to connect to Ballina Road and westbound traffic along Ballina Road travel north along the Northern Bypass to connect to Bangalow Road.

4.3.3 Link Delay

Figure 4.15 compares the delays of the Ballina Road / Pineapple Road / Oliver Avenue roundabout in the 0800-0900 AM peak with and without the Northern Bypass.

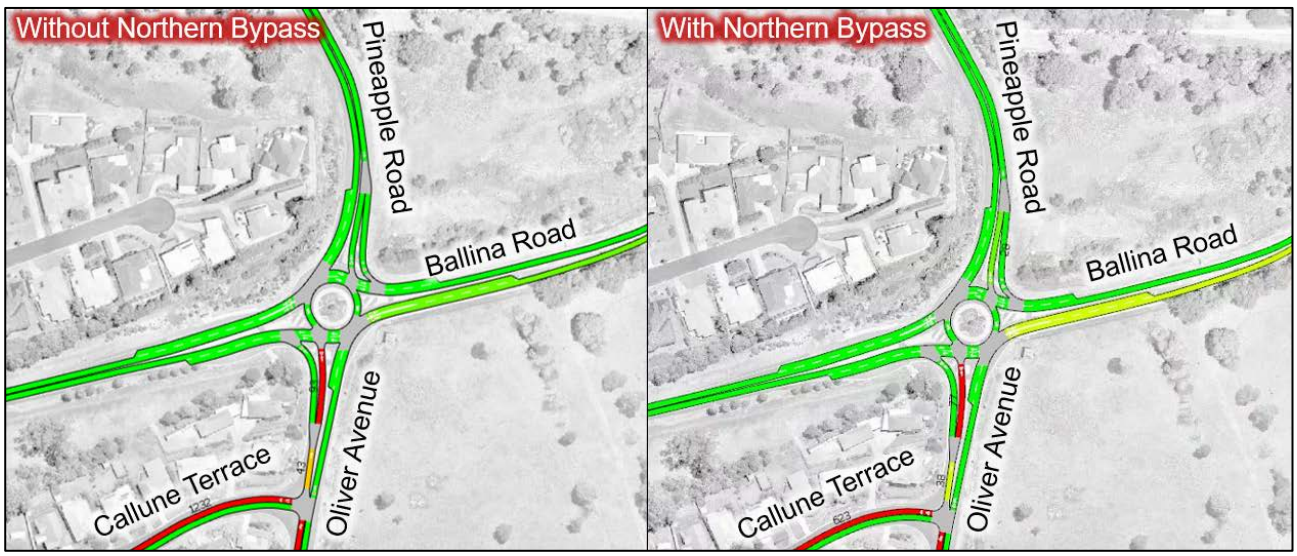


Figure 4.15: Ballina Rd / Pineapple Rd / Oliver Ave 2038 0800-0900 AM Peak Link Delays

Without the Northern Bypass, Callune Terrace and Oliver Avenue experiences significant delays due to the heavy conflicting flow of westbound traffic along Ballina Road in the AM peak. With the introduction of the Northern Bypass, the westbound traffic now has a conflicting flow from the northern approach which as a result, provides gaps to the Oliver Avenue approach which is evident due to the reduction in delays.

Figure 4.16 compares the delays of the Ballina Road / Pineapple Road / Oliver Avenue roundabout in the 1500-1600 PM peak with and without the Northern Bypass.

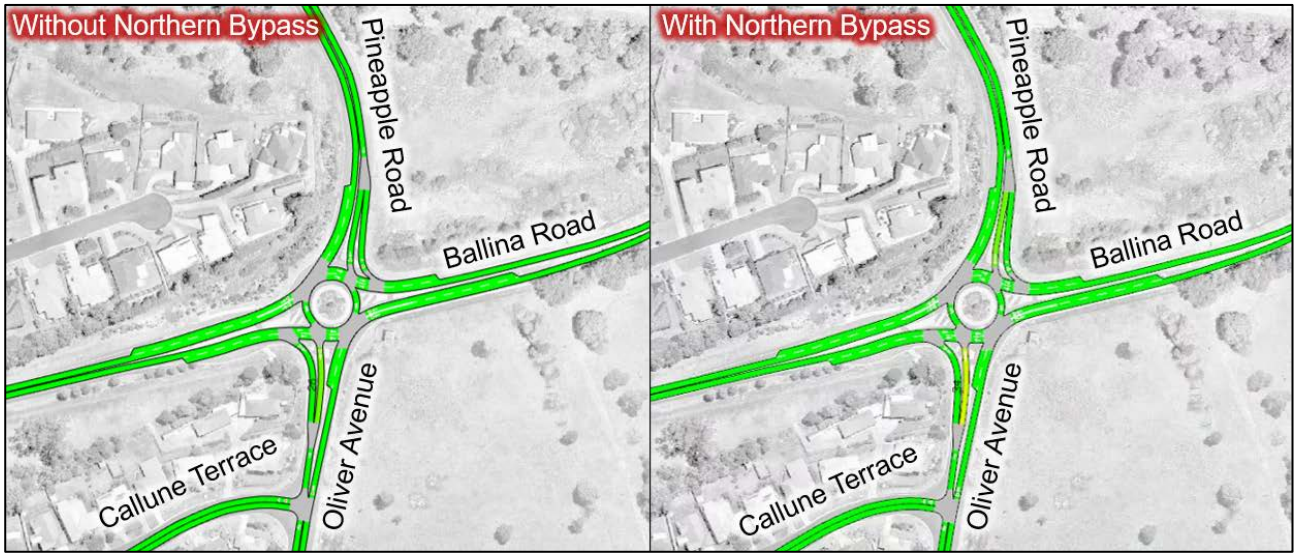


Figure 4.16: Ballina Rd / Pineapple Rd / Oliver Ave 2038 1500-1600 PM Peak Link Delays

Provided eastbound traffic is heavy in the PM peak, little to no delay is shown at the Ballina Road / Pineapple Road roundabout in the PM peak both with and without the Northern Bypass. This is due to Oliver Avenue being the conflicting flow to the eastbound traffic which provided gaps to the Pineapple Road approach.

4.3.4 Richmond Hill Road

Richmond Hill Road is located east of the Northern Bypass and is an existing north-south connection. Figure 4.17 shows the northbound and southbound select link analysis along Richmond Hill Road during the full AM model period (0700-1000) with and without the Northern Bypass.

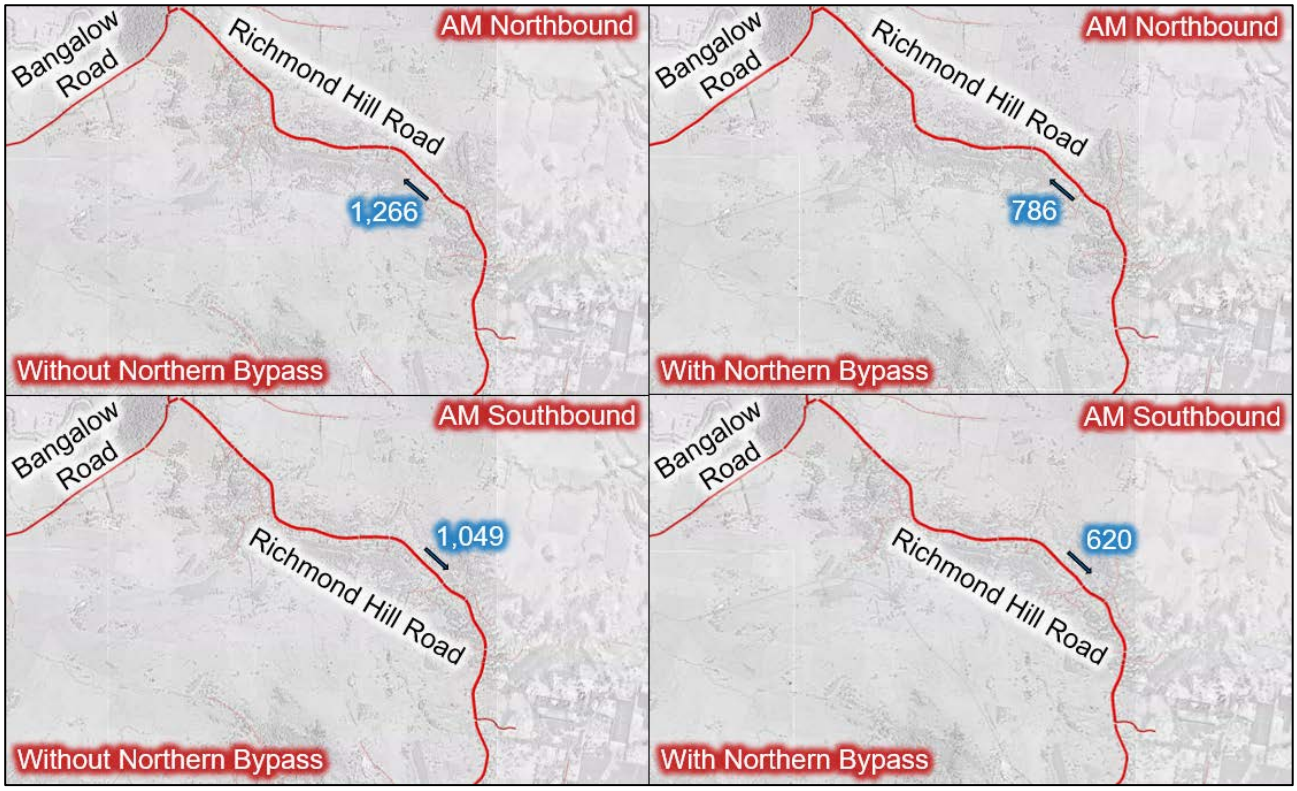


Figure 4.17: Richmond Hill Road – 2038 AM (0700-1000) | With & Without Northern Bypass

The figures show that with the inclusion of the Northern Bypass, it significantly reduces the northbound and southbound volumes along Richmond Hill Road. Approximately 480 northbound vehicles (38% reduction) and 429 southbound vehicles (40% reduction) in the AM peak.

Figure 4.18 shows the northbound and southbound select link analysis along Richmond Hill Road during the full PM model period (1500-1800) with and without the Northern Bypass.

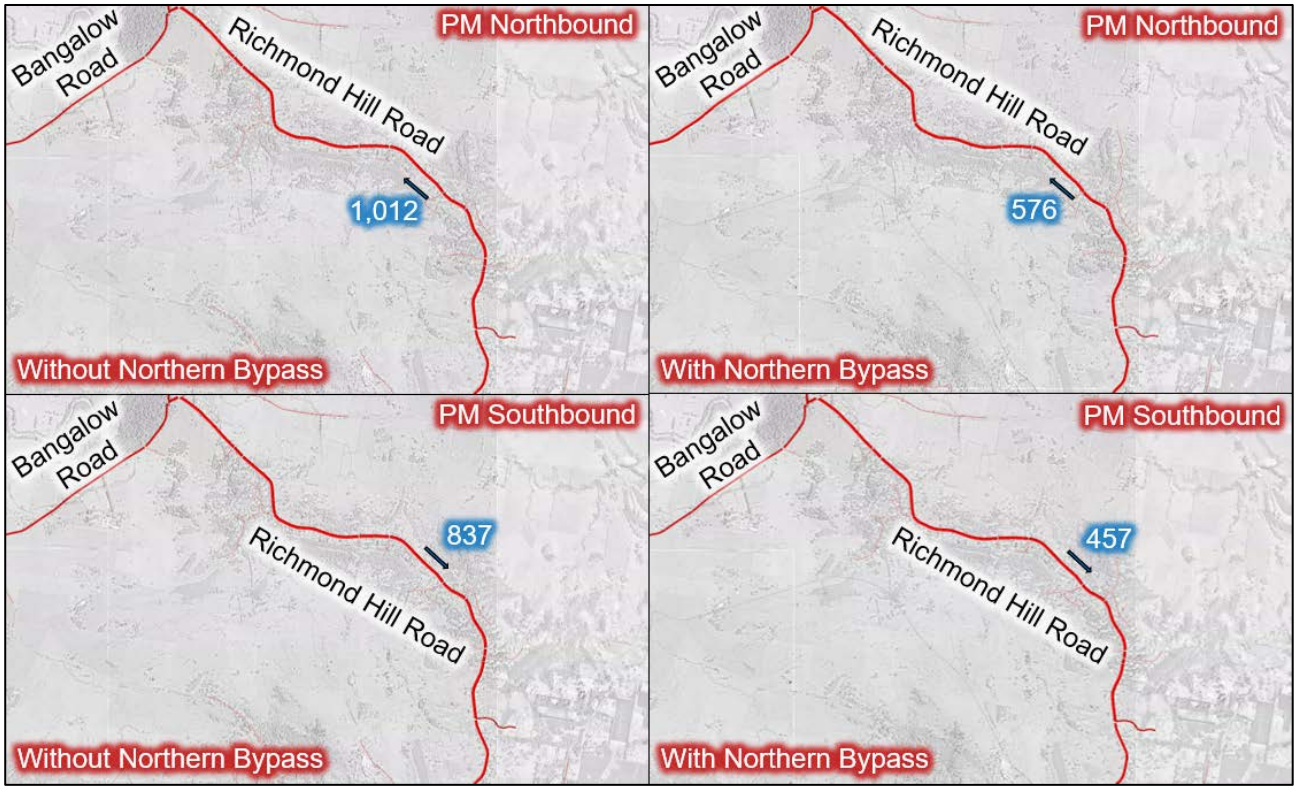


Figure 4.18: Richmond Hill Road – 2038 PM (1500-1800) | With & Without Northern Bypass

Similarly with the AM, it significantly reduces the northbound and southbound volumes along Richmond Hill Road. Approximately 436 northbound vehicles (43% reduction) and 380 southbound vehicles (45% reduction) in the PM peak.

4.3.5 1055 Bruxner Highway Lands

A development is proposed at 1055 Bruxner Highway with an approximate area of 76 hectares that will rezone the existing land use from Primary Production (RU1) into several land use zones:

- General Residential (R1)
- Mixed Use (B4)
- Public Recreation (RE1)
- General Industrial (IN1).

The proposed development will feed onto Oliver Avenue and directly to the existing roundabout with Ballina Road / Pineapple Road. It will comprise of 23.27 hectares of industrial zoned land, 2.76 hectares of mixed business zoned land, 5,000m² of local centre zoned land and proposed to facilitate 346 allotments. Based on this, Council would like to understand the impacts of the proposed development, particularly at the Ballina Road / Pineapple Road / Oliver Avenue roundabout, and if the Northern Bypass has any influence when the proposed development is complete. The Traffic and Transport Study undertaken by Barker Ryan Stewart in November 2022 was used to determine the proposed trips from the development in the AM and PM peaks of 2038. It was then applied to the appropriate zone of 138 as shown in Figure 4.19.

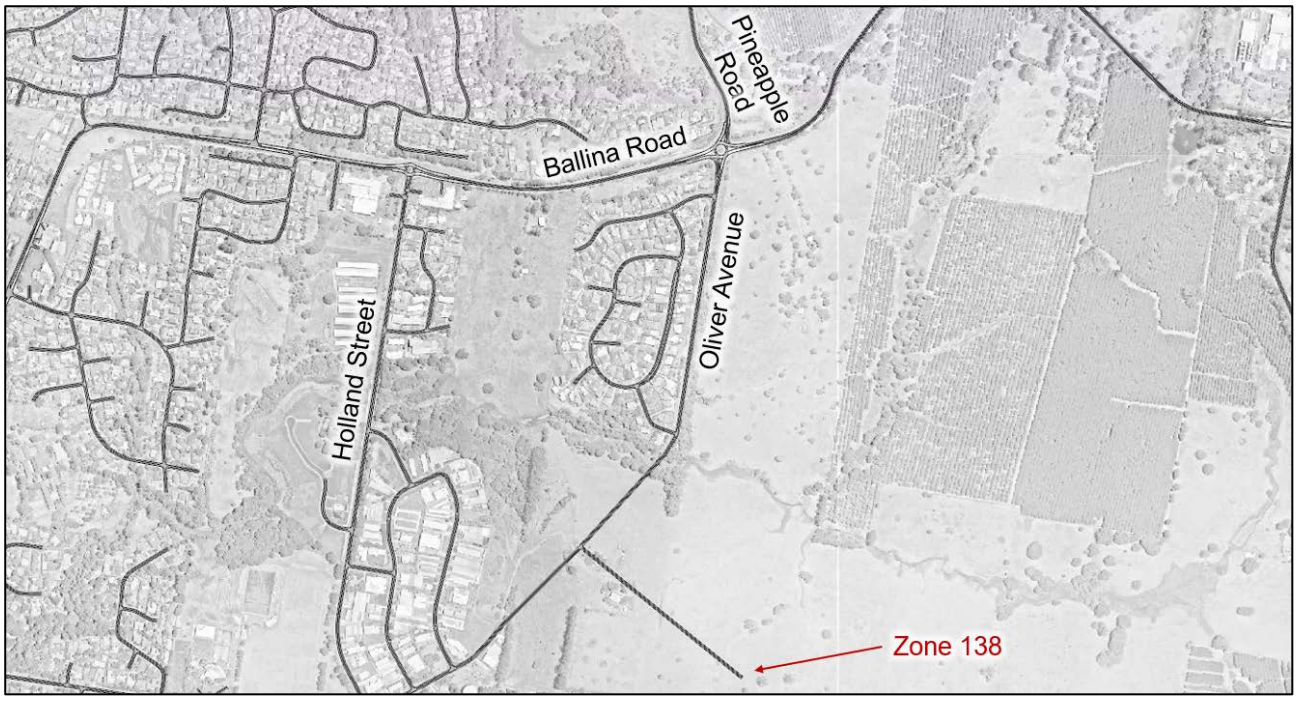


Figure 4.19: 1055 Bruxner Highway Lands – Aimsun Network

It is noted the proposed development was only assessed in the Northern Bypass scenario in 2038 as it is directly connected to the Ballina Road / Pineapple Road / Oliver Avenue roundabout.

4.3.5.1 Ballina Road / Pineapple Road / Oliver Avenue

Figure 4.20 compares the delays of the Ballina Road / Pineapple Road / Oliver Avenue roundabout in the 0800-0900 AM peak with and without the proposed development.

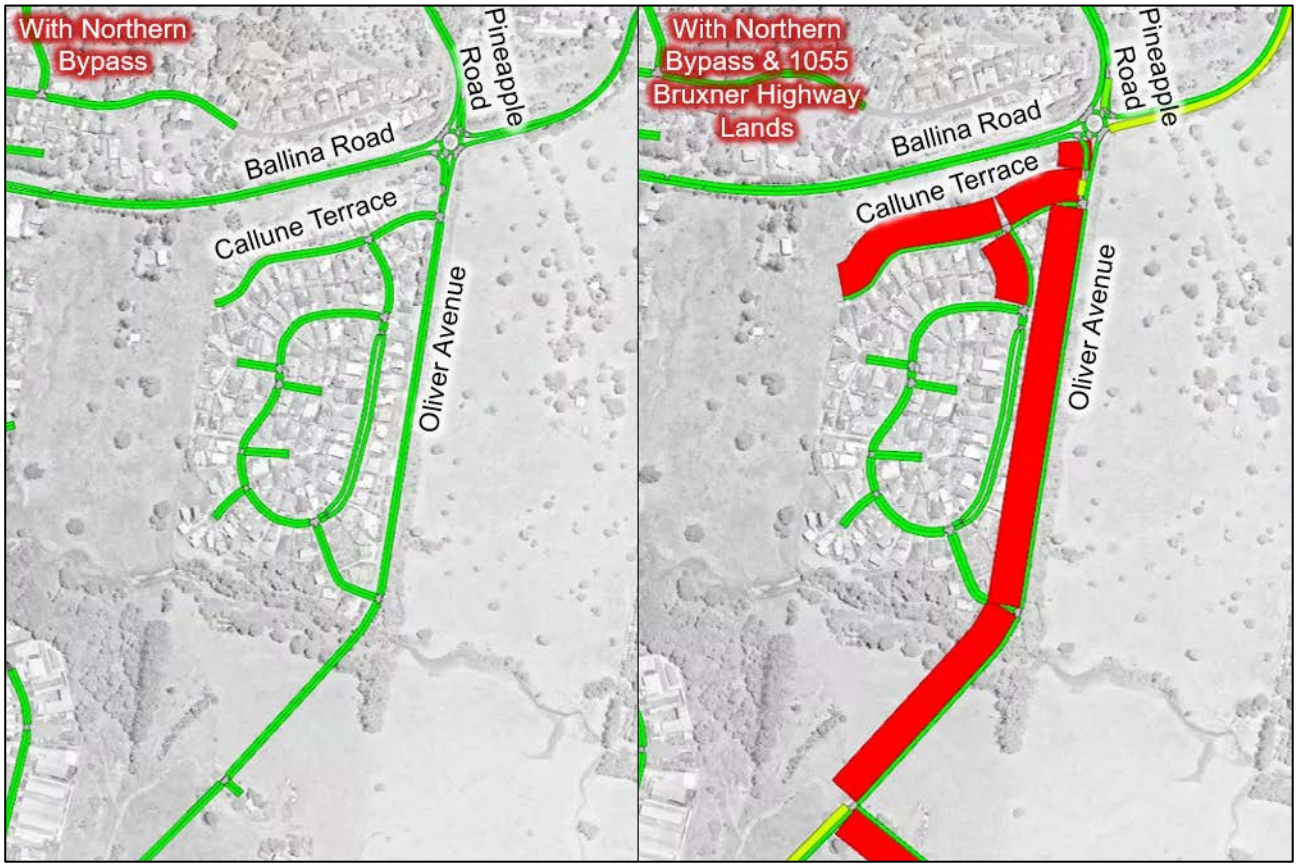


Figure 4.20: Ballina Rd / Pineapple Rd / Oliver Ave 2038 0800-0900 AM Peak Link Delays

The figures show that the proposed development significantly increases the delays along Oliver Avenue and Callune Terrace in the AM peak on approach to the Ballina Road / Pineapple Road roundabout. Based on this, an upgrade to the roundabout would be required if the development is to be proposed by 2038, inclusive of the Northern Bypass.

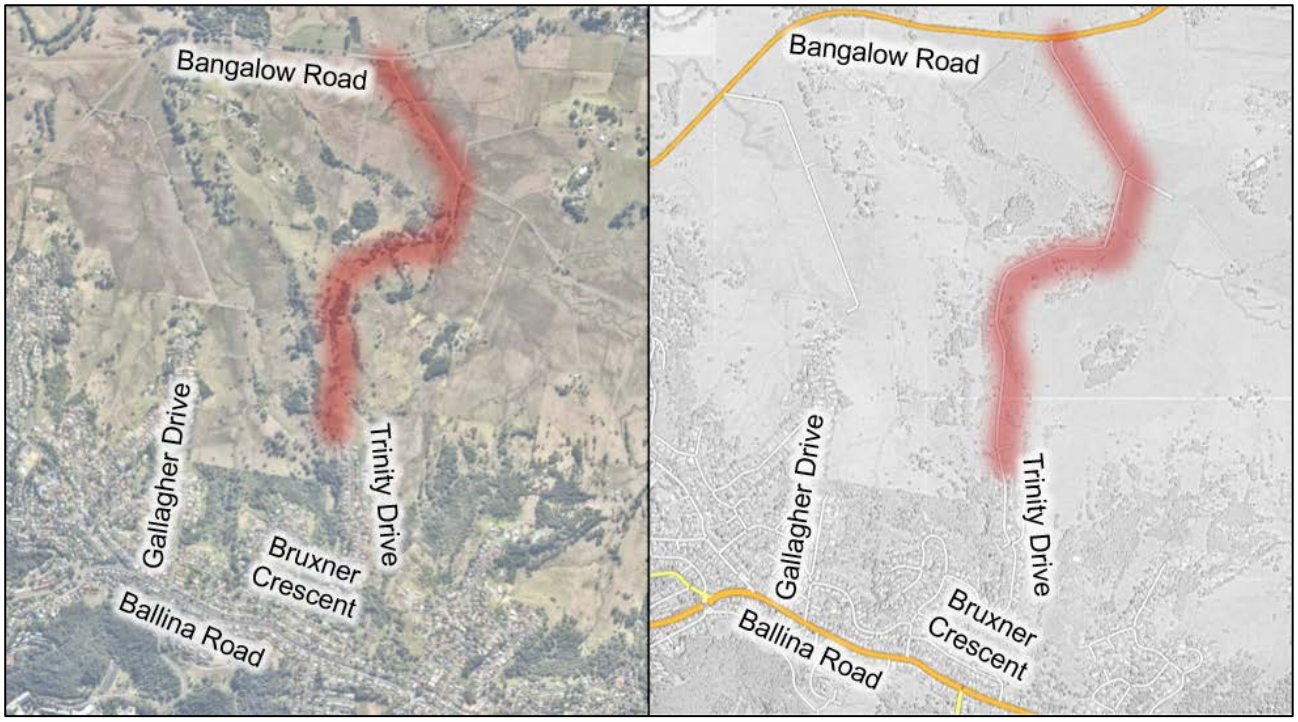
Figure 4.21 compares the delays of the Ballina Road / Pineapple Road / Oliver Avenue roundabout in the 1500-1600 PM peak with and without the proposed development.

Figure 4.21: Ballina Rd / Pineapple Rd / Oliver Ave 2038 1500-1600 PM Peak Link Delays

Similarly, long delays are shown along Oliver Avenue in the PM peak on approach to the Ballina Road roundabout with the proposed development in 2038, inclusive of the Northern Bypass. An upgrade to increase capacity is required potentially signalising or grade separating the intersection to accommodate the high influx of traffic movements.

4.4 Item 3: Trinity Drive Collector

Figure 4.22 shows the Trinity Drive Collector extension from Bangalow Road to Ballina Road. This potential link was modelled to understand the attractiveness of the link and its impacts to the intersections where it connects to Ballina Road.



SOURCE: Nearmap Imagery (left) & Aimsun Model (right)

Figure 4.22: Trinity Drive Collector

4.4.1 Volumes

Figure 4.23 shows the AM peak volume plots comparing the impact to the network with and without the Trinity Drive Collector.

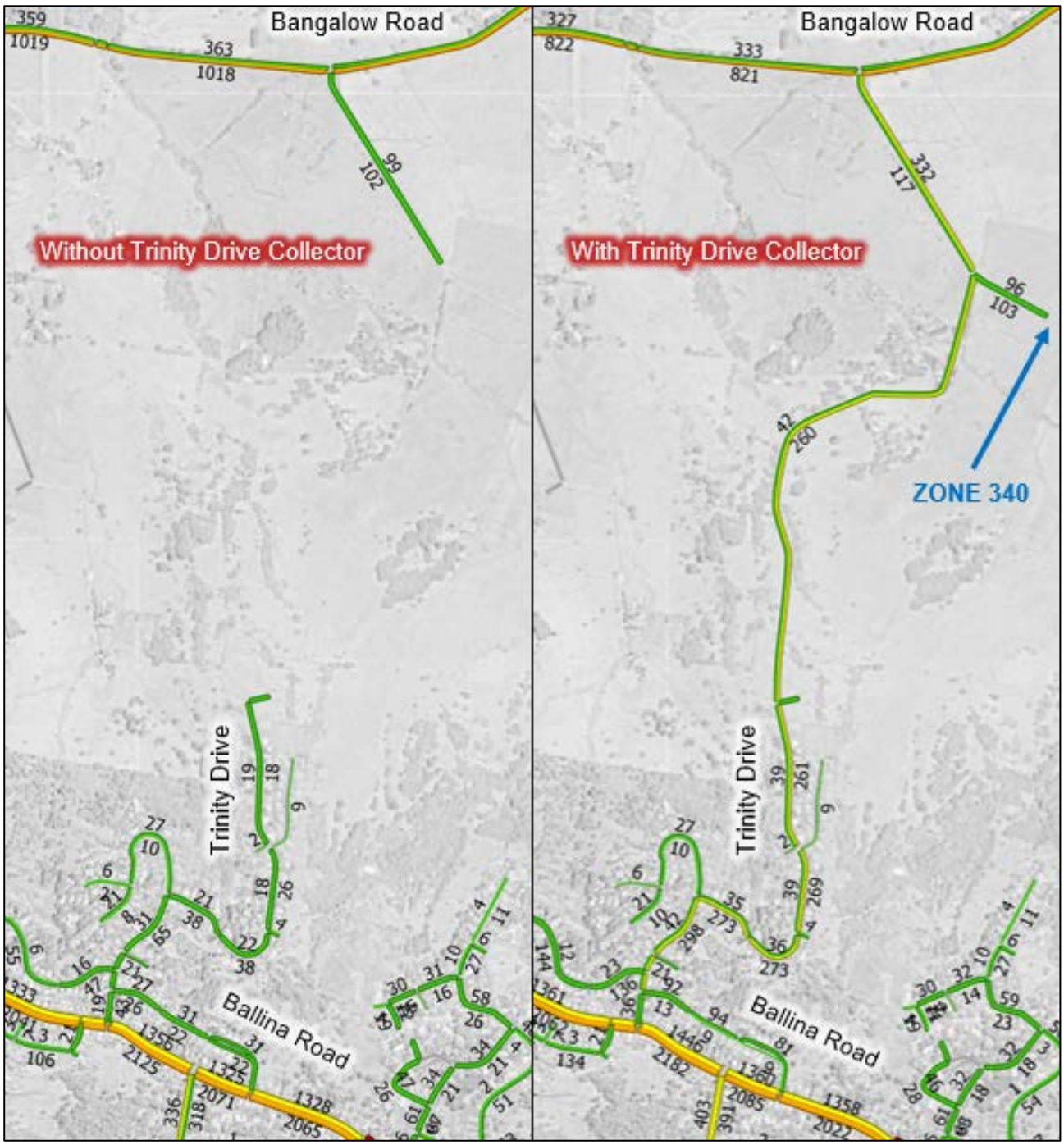


Figure 4.23: Trinity Drive Collector – 2038 0800-0900 AM Peak Volumes Plot

Figure 4.24 shows the PM peak volume plots comparing the impact to the network with and without the Trinity Drive Collector.

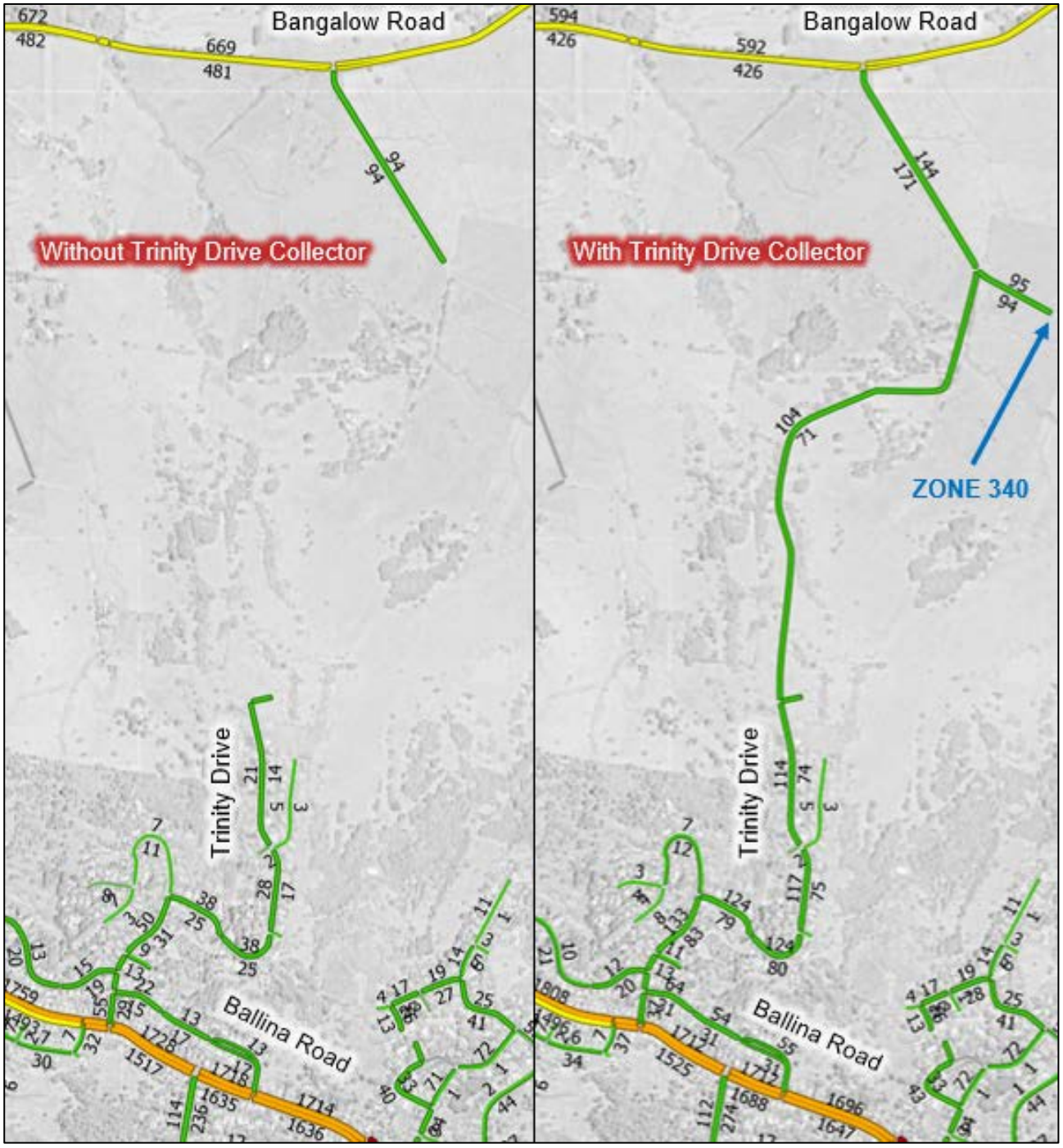


Figure 4.24: Trinity Drive Collector – 2038 1500-1600 PM Peak Volumes Plot

The volume plots show that both in the AM and PM peak, westbound traffic along Bangalow Road travel south along the Trinity Drive Collector and filter out to Ballina Road, while a small portion of eastbound traffic travel north along the Trinity Drive Collector and turn onto Bangalow Road. Due to this, the modelling results show a reduction in vehicles along Bangalow Road during the AM and PM peaks west of the link.

During the AM peak, the Trinity Drive Collector carries approximately 233 southbound veh/h and 15 northbound veh/h (excluding the trips from zone 340). As for the PM peak, it carries approximately 20 southbound veh/h and 77 northbound veh/h (excluding the trips from zone 340). The projected traffic volumes using this proposed new link are considered low, with the major traffic changes only

increasing the volume of traffic utilising Ballina Road in the morning period and potentially exacerbating capacity issues along the corridor. To further understand these impacts, a select link analysis was undertaken as detailed below.

4.4.2 Select Link Analysis

A northbound and southbound select link analysis was undertaken along the Trinity Drive Collector during the full AM model period (0700-1000) as shown in Figure 4.25.

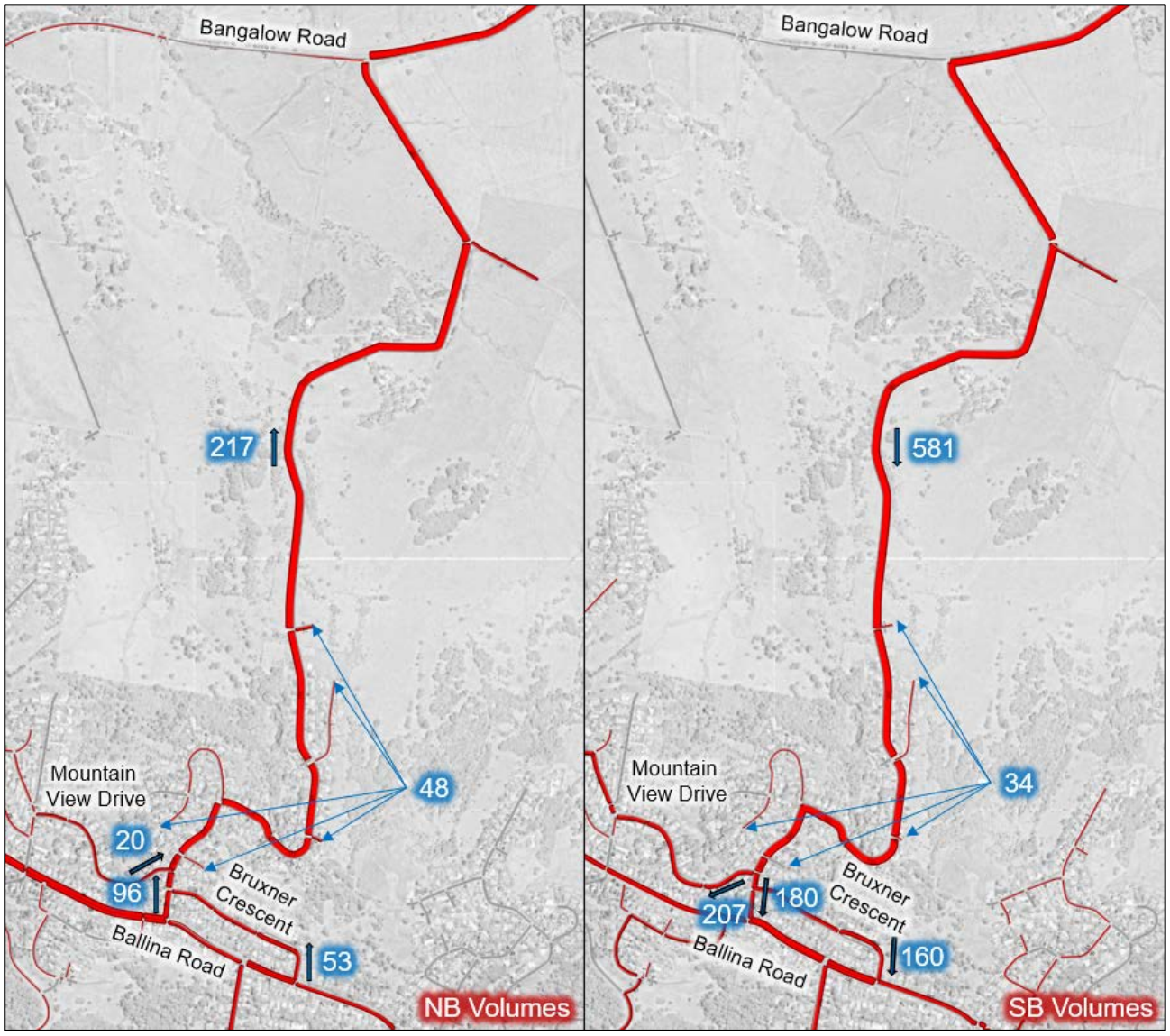


Figure 4.25: Trinity Drive Collector – 2038 AM (0700-1000) Select Link Analysis

The above AM select link analysis plots show that approximately 217 vehicles (3hr period) northbound and 581 vehicles (3hr period) southbound utilise the Trinity Drive Collector to travel to / from Ballina Road and Bangalow Road.

A portion of those vehicles, particularly southbound volumes, utilise Mountain View Drive that eventually connect onto Ballina Road. This may be due to queues at the Bruxner Crescent approaches to Ballina Road where a total of 340 vehicles (3hr period) are connecting to Ballina Road.

A northbound and southbound select link analysis was undertaken along the Trinity Drive Collector during the full PM model period (1500-1800) as shown in Figure 4.26.

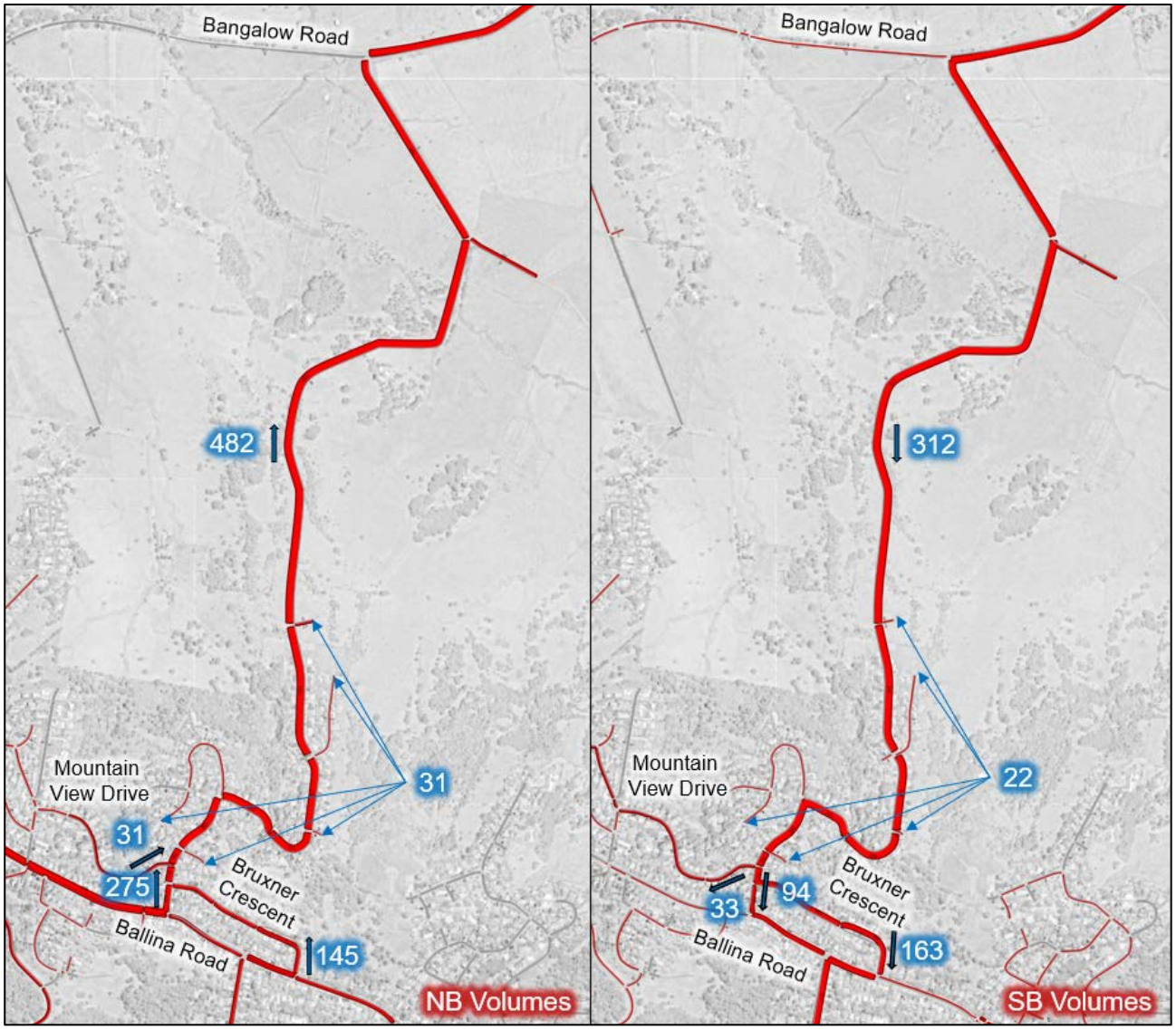


Figure 4.26: Trinity Drive Collector – 2038 PM (1500-1800) Select Link Analysis

The above PM select link analysis plots show that approximately 482 vehicles (3hr period) northbound and 312 vehicles (3hr period) southbound travel to / from Ballina Road and Bangalow Road.

Around only 30 vehicles (3hr period) in the PM peak utilise Mountain View Drive showing that 257 vehicles (3hr period) would join Ballina Road via the two (2) Bruxner Crescent approaches. It is noted that the western Bruxner Crescent intersection is left-in / left-out only with the eastern Bruxner Crescent intersection allowing all movements.

4.4.3 SIDRA Intersection Analysis

To understand the impacts of the approaches onto Ballina Road, SIDRA intersection analysis was undertaken for intersections on approach to Ballina Road that allow right turns out. Based on this, Figure 4.27 shows the intersection layout for the Ballina Road / Bruxner Crescent intersection to the east.

SOURCE: Nearmap Imagery (left) & SIDRA Model (right)

Figure 4.27: Ballina Road / Bruxner Crescent (East) Existing SIDRA Layout

Table 4.2 compares the SIDRA results of the existing priority-controlled Ballina Road / Bruxner Crescent intersection to the east with and with the Trinity Drive Collector.

Table 4.2: Ballina Road / Bruxner Crescent (East) SIDRA Results – Priority-Controlled

Year	App	Turn	AM Peak (0800-0900)					PM Peak (1500-1600)				
			Vol[1]	DoS[2]	Delay[3]	LoS[4]	Queue[5]	Vol[1]	DoS[2]	Delay[3]	LoS[4]	Queue[5]
PRIORITY-CONTROLLED (EXISTING) – WITHOUT TRINITY DRIVE COLLECTOR												
2038	E	T	2,044	0.63	2.5	LOS A	16	1,621	0.56	7.9	LOS A	25
		R	22	0.63	44.3	LOS D	16	16	0.56	81.6	LOS F	25
	N	L	8	4.05	2,903.4	LOS F	23	1	2.11	1,288.9	LOS F	9
		R	23	4.05	3,004.7	LOS F	23	12	2.11	1,488.1	LOS F	9
	W	L	1	0.37	4.7	LOS A	0	1	0.49	4.8	LOS A	0
		T	1,326	0.37	0.1	LOS A	0	1,718	0.49	0.2	LOS A	0
All Vehicles			**3,424**	**4.05**	**28.8**	**NA**	**23**	**3,369**	**2.11**	**10.0**	**NA**	**25**
PRIORITY-CONTROLLED (EXISTING) – WITH TRINITY DRIVE COLLECTOR												
2038	E	T	2,014	0.59	1.2	LOS A	2	1,630	0.56	7.9	LOS A	24
		R	8	0.59	48.5	LOS D	2	17	0.56	79.6	LOS F	24
	N	L	9	12.48	10,430.4	LOS F	72	1	9.65	7,912.3	LOS F	52
		R	71	12.48	10,463.7	LOS F	72	55	9.65	7,955.5	LOS F	52
	W	L	1	0.38	4.7	LOS A	0	14	0.48	4.8	LOS A	0
		T	1,359	0.38	0.2	LOS A	0	1,697	0.48	0.2	LOS A	0
All Vehicles			**3,462**	**12.48**	**242.6**	**NA**	**72**	**3,414**	**9.65**	**134.8**	**NA**	**52**

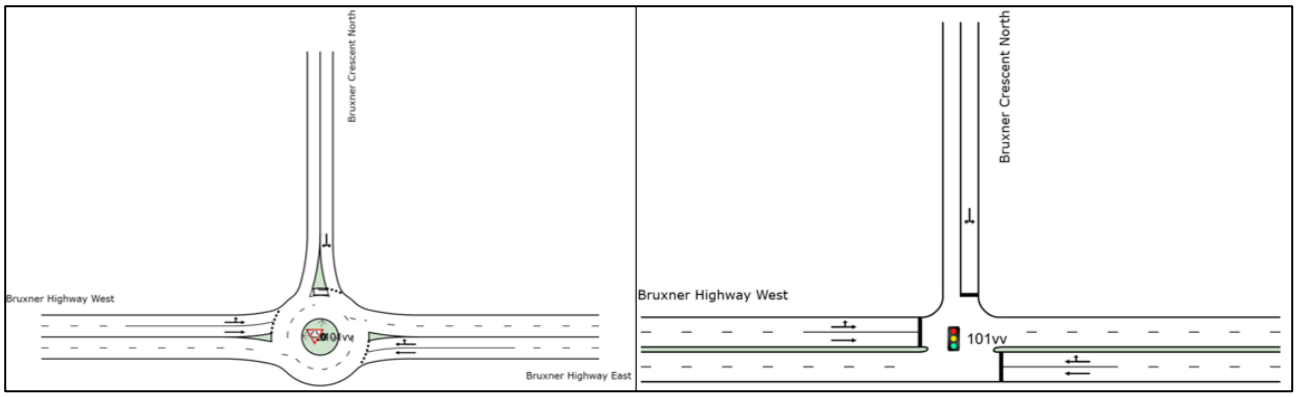
[1] Vol = Volume (veh/h) / [2] Del = Average Delay (sec) / [3] Average Delay (sec) / [4] Level of Service / [5] 95% Back of Queue (m)

As shown above, the northern approach experiences excessive delay resulting in LOS F in the AM and PM peaks, regardless of the Trinity Drive Collector. Noting this intersection is state-controlled, it is understood not to be a priority to upgrade.

As expected, the delays are increased on the northern approaches when the Trinity Drive Collector is implemented, resulting in LOS F both in the AM and PM peaks.

Based on the above, this intersection will require an upgraded before the Trinity Drive Collector is implemented.

Intersection upgrades for this intersection were therefore tested as either a roundabout or as a signalised intersection. Figure 4.28 shows the SIDRA intersection layouts of the Ballina Road / Bruxner Crescent intersection to the east, as an upgraded roundabout and as a signalised intersection.



Upgraded SIDRA Model Layouts | Roundabout (left) and Signals (right)

Figure 4.28: Ballina Road / Bruxner Crescent (East) Upgraded SIDRA Layouts

Table 4.3 shows the SIDRA results of the Ballina Road / Bruxner Crescent intersection to the east, upgraded as a roundabout and as a signalised intersection. The results show that the northern approach still experiences excessive delay in the PM peak when the intersection is upgraded as a roundabout. When the intersection is upgraded to signals, the intersection operates at LOS A both in the AM and PM peaks, noting the average movement delay and level of service over all movements should be taken.

Table 4.3: Ballina Road / Bruxner Crescent (East) SIDRA Results – Upgrades

Year	App	Turn	AM Peak (0800-0900)					PM Peak (1500-1600)				
			Vol[1]	DoS[2]	Delay[3]	LoS[4]	Queue[5]	Vol[1]	DoS[2]	Delay[3]	LoS[4]	Queue[5]
UPGRADE TO ROUNDABOUT												
2038	E	T	2,014	0.80	4.9	LOS A	15	1,630	0.64	4.3	LOS A	8
		R	8	0.80	8.2	LOS A	15	17	0.64	7.6	LOS A	8
	N	L	9	0.38	41.1	LOS C	3	1	1.00	1,511.1	LOS F	5
		R	71	0.38	46.8	LOS D	3	55	1.00	200.5	LOS F	5
	W	L	1	0.47	3.8	LOS A	5	14	0.60	3.9	LOS A	7
		T	1,359	0.47	3.7	LOS A	5	1,697	0.60	3.8	LOS A	7
All Vehicles			**3,462**	**0.80**	**5.4**	**LOS A**	**15**	**3,414**	**1.00**	**7.7**	**LOS A**	**8**
UPGRADE TO SIGNALS												
2038	E	T	2,014	0.74	5.7	LOS A	25	1,630	0.68	8.3	LOS A	22
		R	8	0.74	11.5	LOS A	25	17	0.68	18.7	LOS B	22
	N	L	9	0.70	53.3	LOS D	4	1	0.49	51.0	LOS D	3
		R	71	0.70	53.4	LOS D	4	55	0.49	51.1	LOS D	3
	W	L	1	0.77	24.2	LOS B	26	14	0.76	16.5	LOS B	27
		T	1,359	0.77	19.9	LOS B	26	1,697	0.76	12.2	LOS A	28
All Vehicles			**3,462**	**0.77**	**12.4**	**LOS A**	**26**	**3,414**	**0.76**	**11.0**	**LOS A**	**28**

[1] Vol = Volume (veh/h) / [2] Del = Average Delay (sec) / [3] Average Delay (sec) / [4] Level of Service / [5] 95% Back of Queue (m)

Based on the above, with or without the Trinity Drive Collector, the Ballina Road / Bruxner Crescent intersection to the east will be required to be upgraded.

4.5 Item 4: Elliott Road / Wilson Street Intersection

Figure 4.29 shows the Elliott Road / Wilson Street intersection that was coded in the Aimsun model. Wilson Street was then upgraded to include with a small bridge crossing within the 2038 forecast scenario.

SOURCE: Nearmap Imagery (left) & Aimsun Model (right)

Figure 4.29: Elliott Road / Wilson Street Intersection

4.5.1 SIDRA Intersection Analysis

Intersection turning volumes were extracted from the Aimsun model and used in the SIDRA intersection model. Figure 4.30 shows the SIDRA intersection layout for the Elliott Road / Wilson Street intersection.

SOURCE: Nearmap Imagery (left) & SIDRA Model (right)

Figure 4.30: Elliott Road / Wilson Street Intersection SIDRA Intersection Layout

Table 4.4 shows the SIDRA results of the existing Elliott Road / Wilson Street intersection in 2038.

Table 4.4: Elliott Road / Wilson Street Intersection – SIDRA Results

Year	App	Turn	AM Peak (0800-0900)					PM Peak (1500-1600)				
			Vol[1]	DoS[2]	Delay[3]	LoS[4]	Queue[5]	Vol[1]	DoS[2]	Delay[3]	LoS[4]	Queue[5]
2038	S	L	5	0.13	4.8	LOS A	1	5	0.08	4.6	LOS A	0
		T	73	0.13	4.5	LOS A	1	28	0.08	4.2	LOS A	0
		R	29	0.13	7.4	LOS A	1	40	0.08	6.1	LOS A	0
	E	L	19	0.13	4.7	LOS A	1	17	0.09	4.7	LOS A	0
		T	28	0.13	0	LOS A	1	17	0.09	0.1	LOS A	0
		R	161	0.13	4.7	LOS A	1	111	0.09	4.7	LOS A	0
	N	L	74	0.16	4.6	LOS A	1	59	0.08	4.7	LOS A	0
		T	87	0.16	4.6	LOS A	1	36	0.08	4.1	LOS A	0
		R	10	0.16	6.4	LOS A	1	1	0.08	5.6	LOS A	0
	W	L	1	0.01	4.7	LOS A	0	20	0.02	4.6	LOS A	0
		T	6	0.01	0.1	LOS A	0	14	0.02	0	LOS A	0
		R	9	0.01	4.9	LOS A	0	4	0.02	4.7	LOS A	0
All Vehicles			**502**	**0.16**	**4.5**	**NA**	**1**	**352**	**0.09**	**4.3**	**NA**	**0**

[1] Vol = Volume (veh/h) / [2] Del = Average Delay (sec) / [3] Average Delay (sec) / [4] Level of Service / [5] 95% Back of Queue (m)

As shown above, the existing intersection is operating at LOS A both in the AM and PM peaks of 2038, therefore, no intersection upgrades are required. It is also noted this intersection was calibrated to counts from 2018 in which the intersection may be operating differently now.

Based on aerial imagery, there are wide swept paths cutting the corner and potentially conflicting with opposing movements. Based on this, Figure 4.31 shows additional line marking which may assist slowing vehicle movements through the intersection and help delineate turn paths to prevent cutting of the corner.

SOURCE: Background image taken from Nearmap Imagery

Figure 4.31: Elliott Road / Wilson Street Intersection Line Marking

4.6 Item 5: Dalley Street Upgrades

Figure 4.32 shows Dalley Street from Wyrallah Road to Military Road which passes through the St Vincent's Hospital precinct, Lismore High School, Southern Cross University and provides direct residential access.

SOURCE: Nearmap Imagery (top) & Aimsun Model (bottom)

Figure 4.32: Dalley Street Upgrades

Dalley Street is a 50km/h road with a 40km/h school zone (0800-0930AM & 1430-1600PM) from just west of College Road to Military Road. There are two (2) roundabouts with Dibbs Street and Neilson Street with a pedestrian refuge island opposite the St. Vincent's Hospital and a pedestrian crossing opposite the Lismore High School.

It is understood that previous projections indicate that traffic flow on Dalley Street will continue to incrementally increase. Table 4.5 summarises the eastbound and westbound traffic in 2028 and 2038 along Dalley Street, showing a slight increase of volumes over the years.

Table 4.5: Dalley Street Volumes

	0800-0900 AM Peak		1500-1600 PM Peak	
	2028	2038	2028	2038
Eastbound	370	371	321	347
Westbound	371	385	300	348

Potential opportunities to manage the traffic along Dalley Street may be to provide additional pedestrian refuge crossings along Dalley Street given the high pedestrian activity. In doing so may also promote lower vehicle speeds and provide a better and safer connection for cyclists and pedestrians.

It is recommended to undertake a Road Safety Audit (RSA) in accordance with Austroads *'Guide to Road Safety Part 6: Road Safety Audit (2022)* and / or a Speed Limit Review (SLR) in accordance

with the Manual for Uniform Traffic Control Devices (MUTCD) Part 4: Speed Controls, to further inform potential opportunities to manage traffic and improve safety.

Introducing Local Area Traffic Management (LATM) in accordance with Austroads *'Guide to Traffic Management Part 8: Local Street Management (2020)* can also be considered as a tool of traffic calming at a local level and to discourage through movements. Figure 4.33 shows an example of a horizontal deflection device along a local road which can also provide an opportunity to include pedestrian refuge crossings. These can be placed at pedestrian heavy locations along Dalley Street such as adjacent to the St. Vincent's Hospital and Lismore High School. These can provide shorter crossing distances for pedestrians and cyclists while reducing vehicle speeds along Dalley Street.

SOURCE: Google Streetmap – Griffith Street, Everton Park

Figure 4.33: Horizontal Deflection Example

4.7 Item 6: Skyline South Connection

Figure 4.34 shows the Skyline South Connection that was coded in the Aimsun model. This was to understand any benefits from this road extension connecting Invercauld Road to Skyline Road.

SOURCE: Nearmap Imagery (left) & Aimsun Model (right)

Figure 4.34: Skyline South Connection – Aimsun Network

A northbound and southbound select link analysis was undertaken along the Skyline South Connection during the full AM model period (0700-1000) as shown in Figure 4.35.

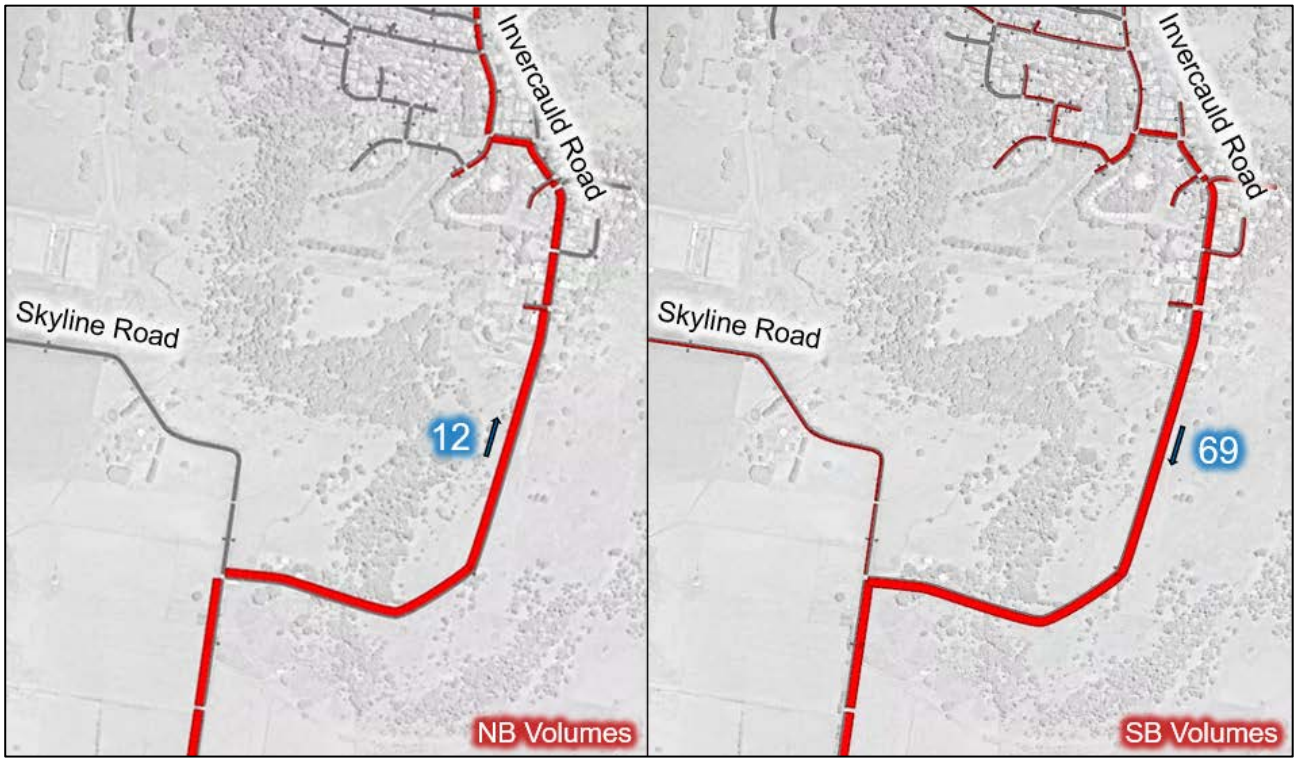


Figure 4.35: Skyline South Connection – 2038 AM (0700-1000) Select Link Analysis

The above figures show that during the full three (3) hour period in the AM, the projected traffic volumes using this proposed new link are considered very low with only 12 vehicles heading northbound and 69 vehicles heading southbound.

A northbound and southbound select link analysis was undertaken along the Skyline South Connection during the full PM model period (1500-1800) as shown in Figure 4.36.

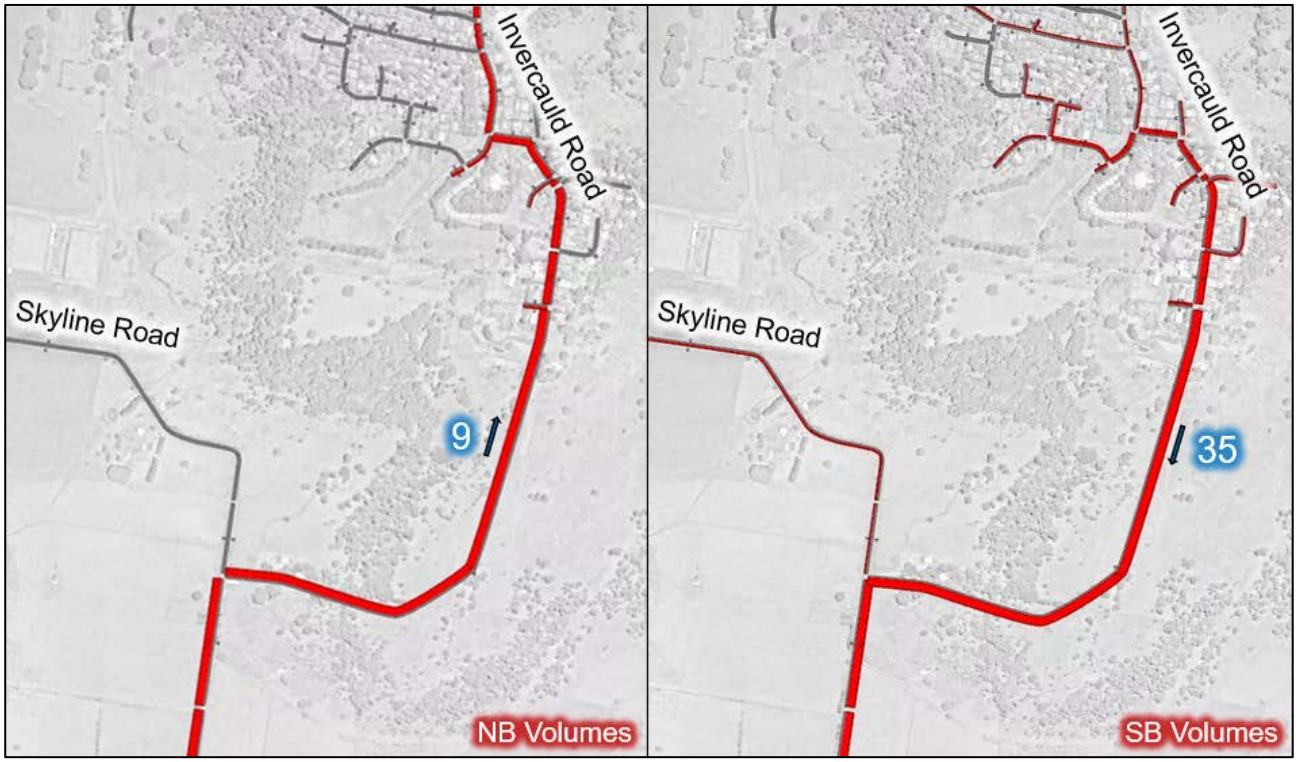


Figure 4.36: Skyline South Connection – 2038 PM (1500-1800) Select Link Analysis

Similar to the AM, the projected traffic volumes using this proposed new link during the full three (3) hour period in the PM peak are considered very low with only nine (9) veh heading northbound and 35 vehicles heading southbound.

The analysis shows that Invercauld Road is still the preferred route being the shortest path to connect to Ballina Road, compared to utilising the proposed new link and travelling along Wyrallah Road. Based on the assessment above, the benefits from this proposed new link are unlikely to outweigh the costs involved with the construction and maintenance of the new link.

5. CONCLUSIONS

The following key conclusions were drawn from this assessment:

Simons Avenue Link / Elizabeth Avenue Link

- In the AM peak, the upgrade to signals of the Ballina Road / Invercauld Road intersection had minimal influence on the Simons Avenue Link
- In the PM peak, eastbound vehicles are utilising Ballina Road more instead of the Simons Avenue Link (a reduction of 508 vehicles)
- The removal of the right turn ban when upgraded to signals has a high influence given the high eastbound movements in the PM peak
- In the AM peak, the upgrade to signals of the Ballina Road / Invercauld Road intersection diverted approximately 50 vehicles eastbound and approximately 120 vehicles westbound off Ballina Road or Simons Avenue and onto the Elizabeth Avenue Link
- In the PM peak, the upgrade to signals of the Ballina Road / Invercauld Road intersection diverted approximately 90 vehicles eastbound and approximately 80 vehicles westbound off Ballina Road or Simons Avenue and onto the Elizabeth Avenue Link
- The Elizabeth Avenue Link plays a significant role taking a considerate percentage of traffic off from Ballina Road as an alternate east-west connection
- In the eastbound direction, the Elizabeth Avenue Link takes approximately 41% of vehicles in the AM peak and 40% of vehicles in the PM peak from Ballina Road when there are no upgrades to the Ballina Road / Invercauld Road intersection (i.e. existing). The Elizabeth Avenue Link also takes approximately 41% of vehicles in the AM peak and 42% of vehicles in the PM peak from Ballina Road when the Ballina Road / Invercauld Road intersection is upgraded to signals
- In the westbound direction, the Elizabeth Avenue takes approximately 24% of vehicles in the AM peak and 28% of vehicles in the PM peak from Ballina Road when there are no upgrades to the Ballina Road / Invercauld Road intersection (i.e. existing). The Elizabeth Avenue Link takes approximately 30% of vehicles in the AM peak and 30% of vehicles in the PM peak from Ballina Road when the Ballina Road / Invercauld Road intersection is upgraded to signals
- When the Elizabeth Avenue Link is implemented, the upgrade of the Ballina Road / Invercauld Road intersection to signals makes little to no difference
- The Simons Avenue Link has low utilisation when the Elizabeth Avenue Link is implemented.

Northern Bypass

- Eastbound traffic along Bangalow Road heavily utilise the Northern Bypass and travel south to exit left and continue along Ballina Road and westbound traffic along Ballina road turn right into the Northern Bypass and turn left onto Bangalow Road
- In the AM peak, the Northern Bypass carries approximately 234 southbound veh/h and 91 northbound veh/h and in the PM peak, it carries approximately 249 southbound veh/h and 221 northbound veh/h
- Delays are increased at the Ballina Road / Pineapple Road roundabout, particularly on the northern and eastern approaches of the AM peak
- The modelling results show a significant reduction in vehicles along Richmond Hill Road with an approximate 38% reduction in northbound volumes and 40% reduction in southbound volumes for the AM peak. In the PM peak, it has an approximate 43% in northbound volumes and 45% reduction in southbound volumes
- The proposed development of 1055 Bruxner Highway Lands was modelled in the 2038 Northern Bypass scenario via zone 138 that is connected to Oliver Avenue and feeds onto the roundabout with Ballina Road and Pineapple Road

- The proposed development significantly increases the delays along Oliver Avenue on approach to the Ballina Road roundabout when the proposed development is to be proposed by 2038, inclusive of the Northern Bypass

Trinity Drive Collector

- Westbound traffic along Bangalow Road travel south along the Trinity Drive Collector and filter out to Ballina Road and eastbound traffic travel north along the Trinity Drive Collector and turn onto Bangalow Road
- The modelling results show a reduction in vehicles along Bangalow Road during the AM and PM peaks
- In AM peak, the Trinity Drive Collector carries approximately 233 southbound vehicles and 15 northbound vehicles and in the PM peak, it carries approximately 20 southbound vehicles and 77 northbound vehicles
- These volumes are considerably low showing how underutilised the Trinity Drive Collector is, particularly in the PM peak
- The benefits from the Trinity Drive Collector is unlikely to outweigh the costs and may introduce more impacts at the Ballina Road intersections
- A portion of southbound volumes utilise Mountain View Drive that eventually connect onto Ballina Road which may be due to queues at the Bruxner Crescent approaches to Ballina Road where a total of 340 vehicles in the AM peak and 257 vehicles in the PM peak are connecting to Ballina Road
- SIDRA results shows the existing priority-controlled Ballina Road / Bruxner Crescent intersection to the east experiences excessive delay at the northern approach without the Trinity Drive Collector, resulting in LOS F both in the AM and PM peaks
- Introducing the Trinity Drive Collector increases the delays at the northern approach of the priority-controlled Ballina Road / Bruxner Crescent intersection to the east, resulting in LOS F both in the AM and PM peaks
- The upgrade to a roundabout of the Ballina Road / Bruxner Crescent intersection to the east still experiences excessive delay at the northern approach in the PM peak, resulting in LOS F
- The upgrade to signals of the Ballina Road / Bruxner Crescent intersection to the east operates at LOS A both in the 2038 AM and PM peaks
- Even if the Trinity Drive Collector is implemented or not, the Ballina Road / Bruxner Crescent intersection to the east will be required to be upgraded
- Delays are introduced at the northern and eastern approaches of the Ballina Road / Pineapple Road roundabout in the AM peak due to the Northern Bypass but reduces delays on the southern approach (i.e. Oliver Avenue) due to the conflicting movement.

Elliott Road / Wilson Street Intersection

- SIDRA results shows the Elliott Road / Wilson Street intersection operating at LOS A both in the 2038 AM and PM peaks
- Aerial imagery show wide swept paths cutting the corner and potentially conflicting with opposing movements
- Additional line marking which may assist slowing vehicle movements through the intersection and help delineate turn paths to prevent cutting of the corner. These include:
  - Extending the northern median to promote slower turning speeds
  - Line marking the give-way lines
  - Providing road centrelines.

Dalley Street Upgrades

- Dalley Street shows a slight increase of volumes from 2028 to 2038

- Provide additional pedestrian refuge crossings along Dalley Street given the high pedestrian activity
- Undertake a Road Safety Audit (RSA) and / or Speed Limit Review (SLR) to further inform potential opportunities to manage traffic and improve safety
- Introduce LATM devices such as horizontal deflections to reduce vehicle speeds and discourage through movements along Dalley Street.

Skyline South Connection

- The Skyline South Connection extends Invercauld Road to connect to Skyline Road
- The modelling results show the proposed link is underutilised with only 12 northbound vehicles and 69 southbound vehicles in the AM peak. In the PM peak, there are only nine (9) northbound vehicles and 35 southbound vehicles
- Given the low volumes, Invercauld Road is still the preferred route compared to the proposed new link to connect to Ballina Road.

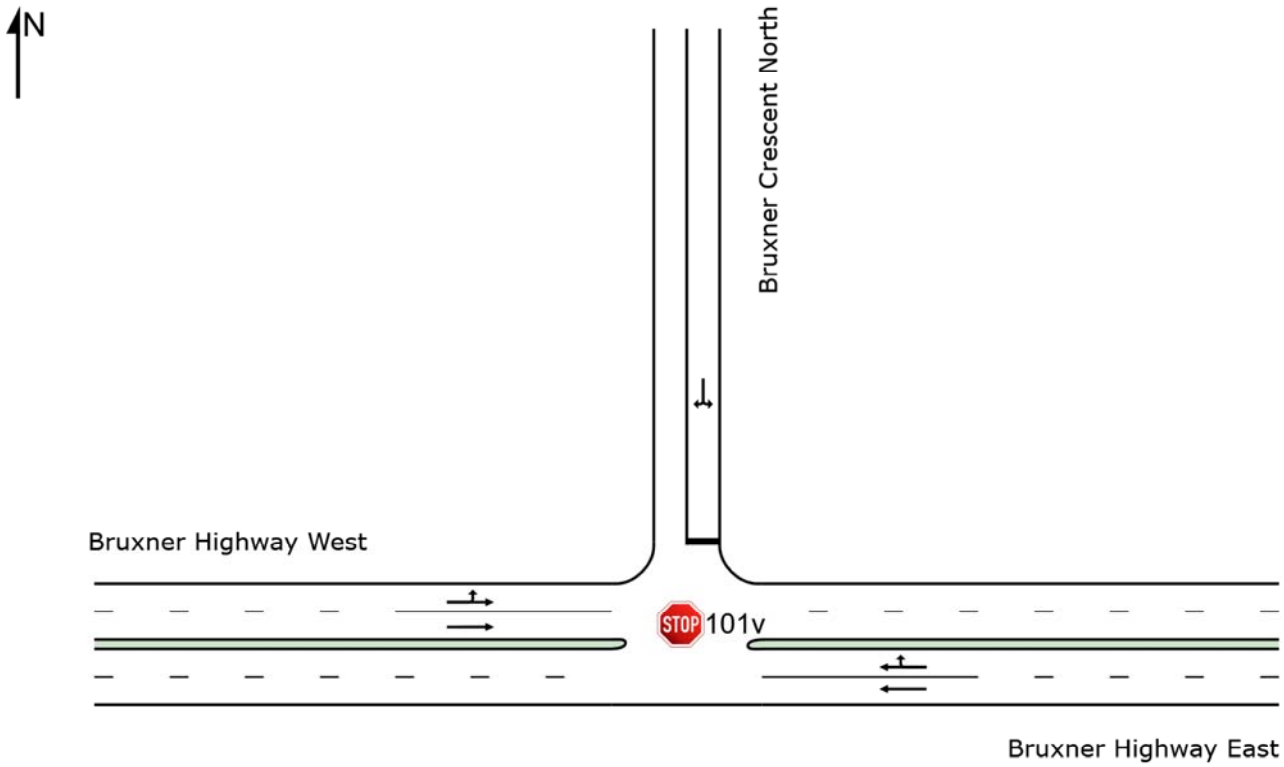
Appendix A: SIDRA Intersection Results

SITE LAYOUT

Site: 101v [2038 AM (east)_Without Trinity Dr Collector (Site Folder: General)]

New Site
Site Category: (None)
Stop (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101v [2038 AM (east)_Without Trinity Dr Collector (Site Folder: General)]

New Site
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	2044	69	2152	3.4	0.625	2.5	LOS A	15.8	113.8	0.45	0.01	0.52	48.1
6	R2	22	0	23	0.0	0.625	44.3	LOS D	15.8	113.8	1.00	0.03	1.15	45.6
Approach		2066	69	2175	3.3	0.625	2.9	NA	15.8	113.8	0.46	0.01	0.53	48.1
North: Bruxner Crescent North														
7	L2	8	0	8	0.0	4.053	2903.4	LOS F	23.0	183.4	1.00	1.65	3.45	1.1
9	R2	23	5	24	21.7	4.053	3004.7	LOS F	23.0	183.4	1.00	1.65	3.45	1.1
Approach		31	5	33	16.1	4.053	2978.6	LOS F	23.0	183.4	1.00	1.65	3.45	1.1
West: Bruxner Highway West														
10	L2	1	0	1	0.0	0.373	4.7	LOS A	0.0	0.0	0.00	0.00	0.00	49.3
11	T1	1326	52	1396	3.9	0.373	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
Approach		1327	52	1397	3.9	0.373	0.2	NA	0.0	0.0	0.00	0.00	0.00	49.8
All Vehicles		3424	126	3604	3.7	4.053	28.8	NA	23.0	183.4	0.29	0.02	0.35	35.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [2038 PM (east)_Without Trinity Dr Collector (Site Folder: General)]

New Site
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	1621	80	1706	4.9	0.555	7.9	LOS A	24.9	181.5	0.40	0.01	0.48	44.8
6	R2	16	0	17	0.0	0.555	81.6	LOS F	24.9	181.5	1.00	0.03	1.22	38.3
Approach		1637	80	1723	4.9	0.555	8.6	NA	24.9	181.5	0.40	0.01	0.49	44.7
North: Bruxner Crescent North														
7	L2	1	0	1	0.0	2.109	1288.9	LOS F	8.7	61.0	1.00	1.31	2.37	2.1
9	R2	12	0	13	0.0	2.109	1488.1	LOS F	8.7	61.0	1.00	1.31	2.37	2.1
Approach		13	0	14	0.0	2.109	1472.8	LOS F	8.7	61.0	1.00	1.31	2.37	2.1
West: Bruxner Highway West														
10	L2	1	0	1	0.0	0.486	4.8	LOS A	0.0	0.0	0.00	0.00	0.00	49.2
11	T1	1718	82	1808	4.8	0.486	0.2	LOS A	0.0	0.0	0.00	0.00	0.00	49.7
Approach		1719	82	1809	4.8	0.486	0.2	NA	0.0	0.0	0.00	0.00	0.00	49.7
All Vehicles		3369	162	3546	4.8	2.109	10.0	NA	24.9	181.5	0.20	0.01	0.25	43.5

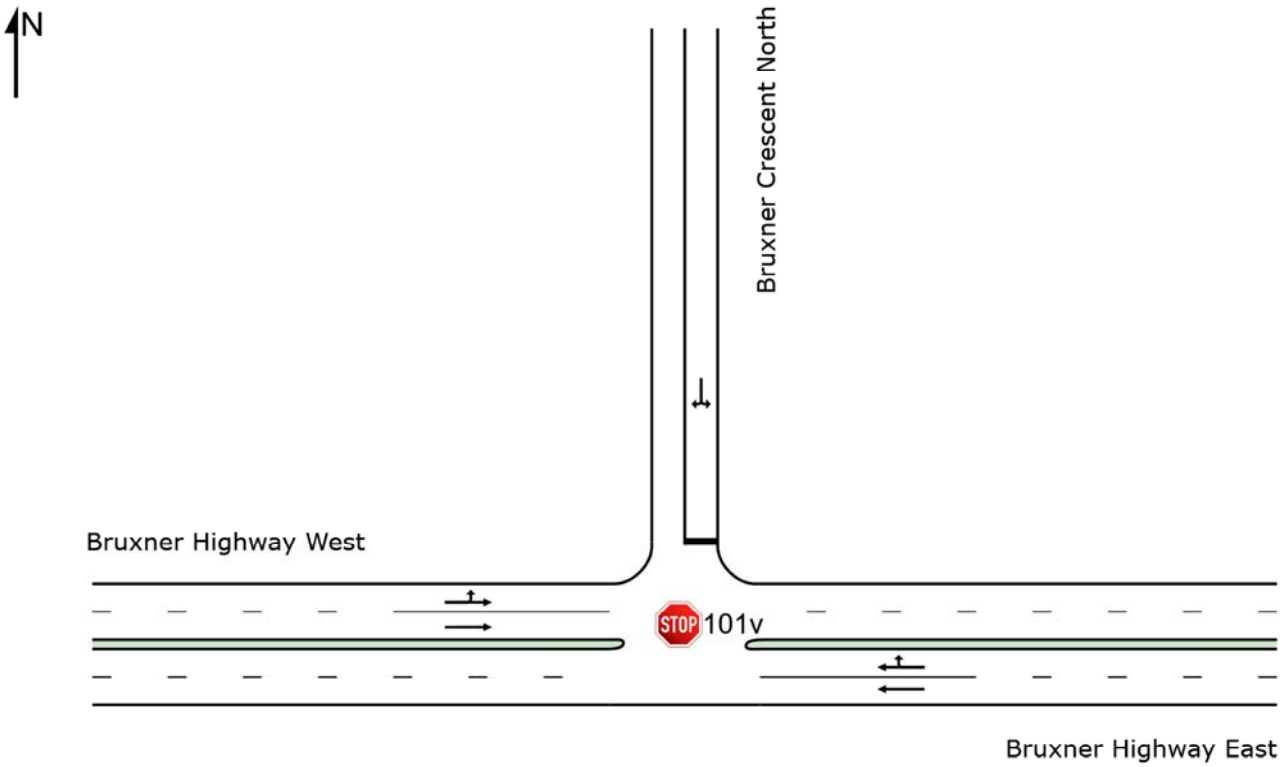
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101v [2038 AM (east) (Site Folder: General)]

New Site
Site Category: (None)
Stop (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101v [2038 AM (east) (Site Folder: General)]

New Site
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	2014	65	2120	3.2	0.585	1.2	LOS A	2.0	14.0	0.05	0.00	0.07	49.1
6	R2	8	0	8	0.0	0.585	48.5	LOS D	2.0	14.0	0.10	0.01	0.15	47.7
Approach		2022	65	2128	3.2	0.585	1.4	NA	2.0	14.0	0.05	0.00	0.07	49.1
North: Bruxner Crescent North														
7	L2	9	0	9	0.0	12.477	10430.4	LOS F	71.9	552.2	1.00	1.59	3.46	0.3
9	R2	71	9	75	12.7	12.477	10463.7	LOS F	71.9	552.2	1.00	1.59	3.46	0.3
Approach		80	9	84	11.3	12.477	10459.9	LOS F	71.9	552.2	1.00	1.59	3.46	0.3
West: Bruxner Highway West														
10	L2	1	0	1	0.0	0.384	4.7	LOS A	0.0	0.0	0.00	0.00	0.00	49.3
11	T1	1359	60	1431	4.4	0.384	0.2	LOS A	0.0	0.0	0.00	0.00	0.00	49.8
Approach		1360	60	1432	4.4	0.384	0.2	NA	0.0	0.0	0.00	0.00	0.00	49.8
All Vehicles		3462	134	3644	3.9	12.477	242.6	NA	71.9	552.2	0.05	0.04	0.12	11.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [2038 PM (east) (Site Folder: General)]

New Site
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	1630	80	1716	4.9	0.560	7.9	LOS A	24.4	178.0	0.39	0.01	0.48	44.8
6	R2	17	0	18	0.0	0.560	79.6	LOS F	24.4	178.0	1.00	0.03	1.23	38.2
Approach		1647	80	1734	4.9	0.560	8.7	NA	24.4	178.0	0.40	0.01	0.49	44.7
North: Bruxner Crescent North														
7	L2	1	0	1	0.0	9.652	7912.3	LOS F	51.6	383.4	1.00	1.48	3.13	0.4
9	R2	55	4	58	7.3	9.652	7955.5	LOS F	51.6	383.4	1.00	1.48	3.13	0.4
Approach		56	4	59	7.1	9.652	7954.7	LOS F	51.6	383.4	1.00	1.48	3.13	0.4
West: Bruxner Highway West														
10	L2	14	0	15	0.0	0.483	4.8	LOS A	0.0	0.0	0.00	0.01	0.00	49.2
11	T1	1697	76	1786	4.5	0.483	0.2	LOS A	0.0	0.0	0.00	0.00	0.00	49.7
Approach		1711	76	1801	4.4	0.483	0.3	NA	0.0	0.0	0.00	0.00	0.00	49.7
All Vehicles		3414	160	3594	4.7	9.652	134.8	NA	51.6	383.4	0.21	0.03	0.29	17.0

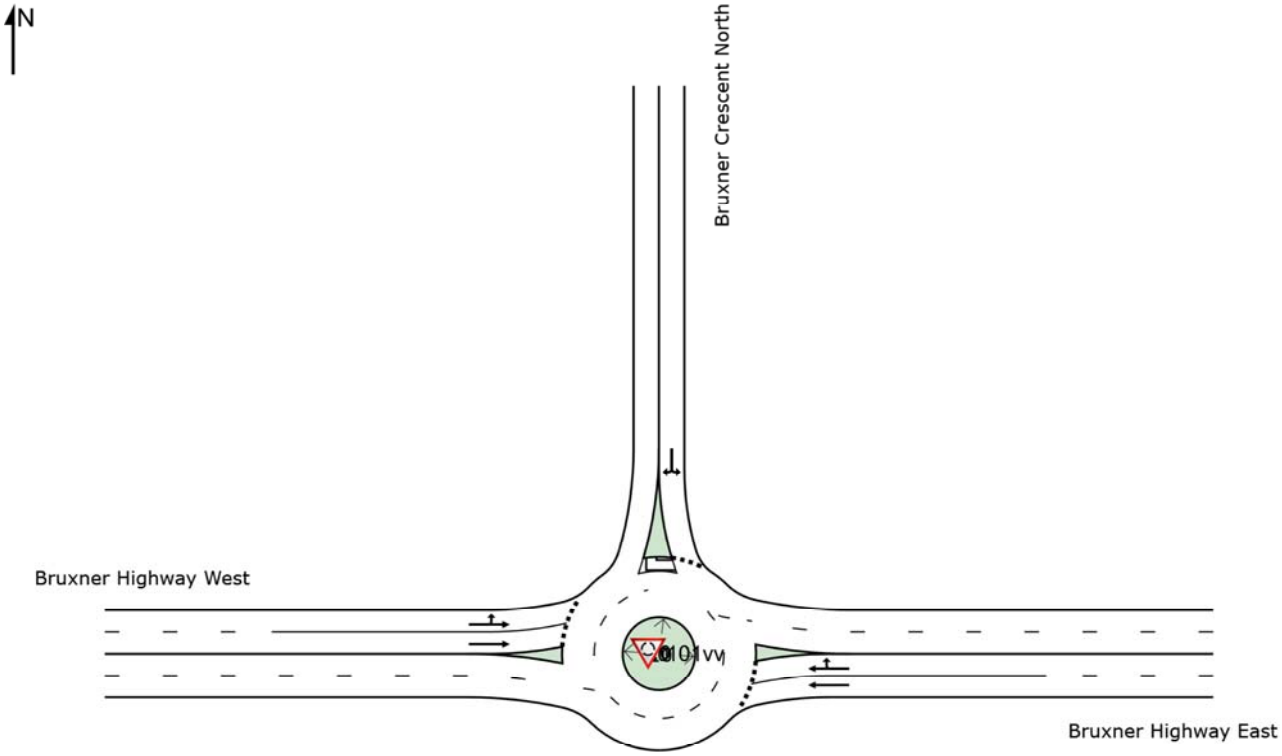
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101vv [2038 AM (east)_Roundabout (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101vv [2038 AM (east)_Roundabout (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	2014	65	2120	3.2	0.799	4.9	LOS A	14.6	105.2	0.76	0.48	0.76	45.7
6	R2	8	0	8	0.0	0.799	8.2	LOS A	14.6	104.9	0.77	0.49	0.77	45.5
Approach		2022	65	2128	3.2	0.799	4.9	LOS A	14.6	105.2	0.76	0.48	0.76	45.7
North: Bruxner Crescent North														
7	L2	9	0	9	0.0	0.375	41.1	LOS C	2.7	21.0	1.00	1.08	1.20	30.6
9	R2	71	9	75	12.7	0.375	46.8	LOS D	2.7	21.0	1.00	1.08	1.20	30.8
Approach		80	9	84	11.3	0.375	46.2	LOS D	2.7	21.0	1.00	1.08	1.20	30.8
West: Bruxner Highway West														
10	L2	1	0	1	0.0	0.466	3.8	LOS A	4.7	34.1	0.11	0.39	0.11	46.7
11	T1	1359	60	1431	4.4	0.466	3.7	LOS A	4.7	34.1	0.11	0.39	0.11	47.6
Approach		1360	60	1432	4.4	0.466	3.7	LOS A	4.7	34.1	0.11	0.39	0.11	47.6
All Vehicles		3462	134	3644	3.9	0.799	5.4	LOS A	14.6	105.2	0.51	0.46	0.51	45.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101vv [2038 PM (east)_Roundabout (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	1630	80	1716	4.9	0.637	4.3	LOS A	8.4	61.4	0.47	0.43	0.47	46.5
6	R2	17	0	18	0.0	0.637	7.6	LOS A	8.4	61.1	0.48	0.44	0.48	46.3
Approach		1647	80	1734	4.9	0.637	4.3	LOS A	8.4	61.4	0.47	0.43	0.47	46.5
North: Bruxner Crescent North														
7	L2	1	0	1	0.0	1.000	1511.1	LOS F	5.3	39.4	1.00	1.39	2.68	12.4
9	R2	55	4	58	7.3	1.000	200.5	LOS F	5.3	39.4	1.00	1.39	2.68	12.5
Approach		56	4	59	7.1	1.000	223.9	LOS F	5.3	39.4	1.00	1.39	2.68	12.5
West: Bruxner Highway West														
10	L2	14	0	15	0.0	0.599	3.9	LOS A	6.8	49.7	0.19	0.38	0.19	46.5
11	T1	1697	76	1786	4.5	0.599	3.8	LOS A	6.9	50.3	0.20	0.38	0.20	47.4
Approach		1711	76	1801	4.4	0.599	3.8	LOS A	6.9	50.3	0.20	0.38	0.20	47.4
All Vehicles		3414	160	3594	4.7	1.000	7.7	LOS A	8.4	61.4	0.34	0.42	0.37	44.9

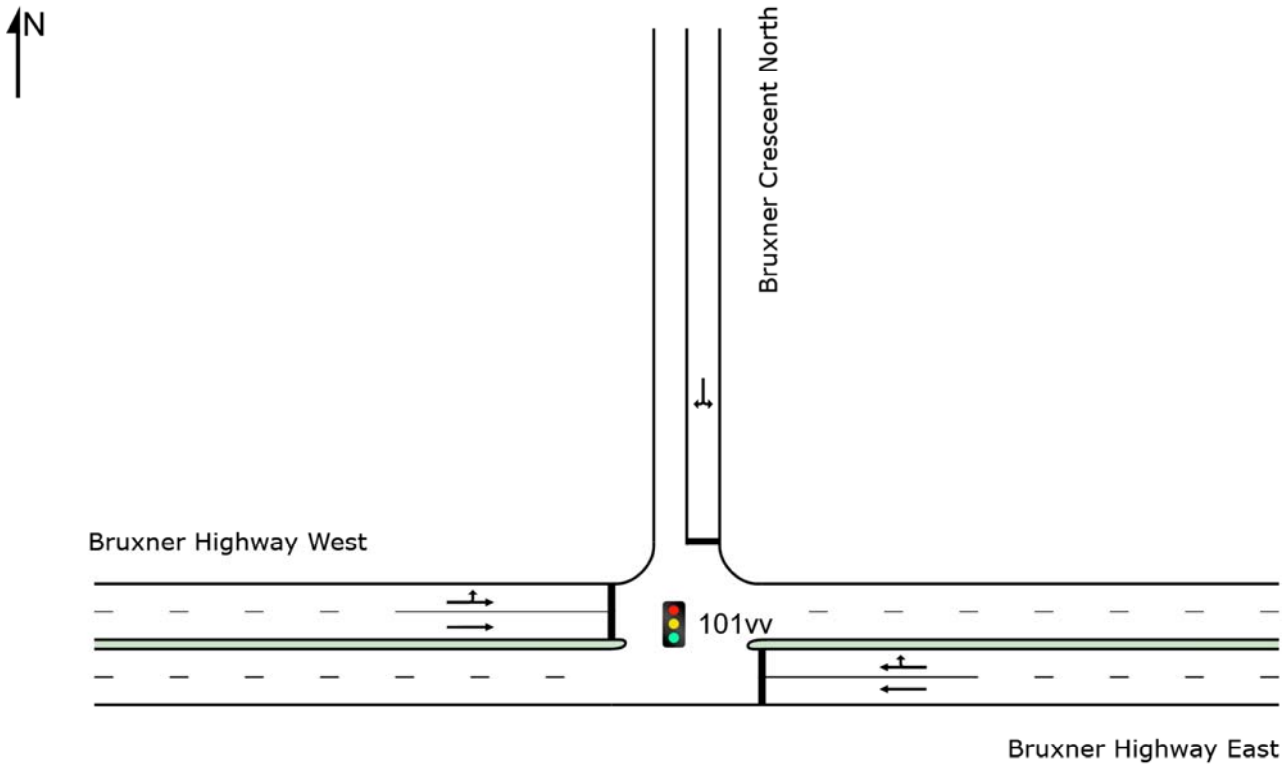
Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101vv [2038 AM (east)_Signals (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101vv [2038 AM (east)_Signals (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 90 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	2014	65	2120	3.2	0.735	5.7	LOS A	25.1	180.2	0.57	0.53	0.57	46.3
6	R2	8	0	8	0.0	* 0.735	11.5	LOS A	25.1	180.2	0.61	0.57	0.61	45.0
Approach		2022	65	2128	3.2	0.735	5.7	LOS A	25.1	180.2	0.57	0.53	0.57	46.3
North: Bruxner Crescent North														
7	L2	9	0	9	0.0	0.697	53.3	LOS D	4.0	30.8	1.00	0.86	1.19	28.7
9	R2	71	9	75	12.7	* 0.697	53.4	LOS D	4.0	30.8	1.00	0.86	1.19	28.6
Approach		80	9	84	11.3	0.697	53.4	LOS D	4.0	30.8	1.00	0.86	1.19	28.6
West: Bruxner Highway West														
10	L2	1	0	1	0.0	0.767	24.2	LOS B	25.7	186.5	0.87	0.80	0.88	39.1
11	T1	1359	60	1431	4.4	* 0.767	19.9	LOS B	25.9	188.0	0.87	0.80	0.88	39.2
Approach		1360	60	1432	4.4	0.767	19.9	LOS B	25.9	188.0	0.87	0.80	0.88	39.2
All Vehicles		3462	134	3644	3.9	0.767	12.4	LOS A	25.9	188.0	0.70	0.65	0.71	42.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

MOVEMENT SUMMARY

Site: 101vv [2038 PM (east)_Signals (Site Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 90 seconds (Site Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Bruxner Highway East														
5	T1	1630	80	1716	4.9	0.679	8.3	LOS A	21.9	159.9	0.59	0.54	0.59	44.9
6	R2	17	0	18	0.0	* 0.679	18.7	LOS B	21.9	159.9	0.75	0.69	0.75	41.3
Approach		1647	80	1734	4.9	0.679	8.4	LOS A	21.9	159.9	0.59	0.55	0.59	44.8
North: Bruxner Crescent North														
7	L2	1	0	1	0.0	0.492	51.0	LOS D	2.7	20.0	1.00	0.76	1.00	29.3
9	R2	55	4	58	7.3	* 0.492	51.1	LOS D	2.7	20.0	1.00	0.76	1.00	29.1
Approach		56	4	59	7.1	0.492	51.1	LOS D	2.7	20.0	1.00	0.76	1.00	29.1
West: Bruxner Highway West														
10	L2	14	0	15	0.0	0.762	16.5	LOS B	27.4	199.3	0.76	0.70	0.76	42.5
11	T1	1697	76	1786	4.5	* 0.762	12.2	LOS A	27.8	202.2	0.76	0.71	0.76	42.8
Approach		1711	76	1801	4.4	0.762	12.3	LOS A	27.8	202.2	0.76	0.71	0.76	42.8
All Vehicles		3414	160	3594	4.7	0.762	11.0	LOS A	27.8	202.2	0.68	0.63	0.68	43.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

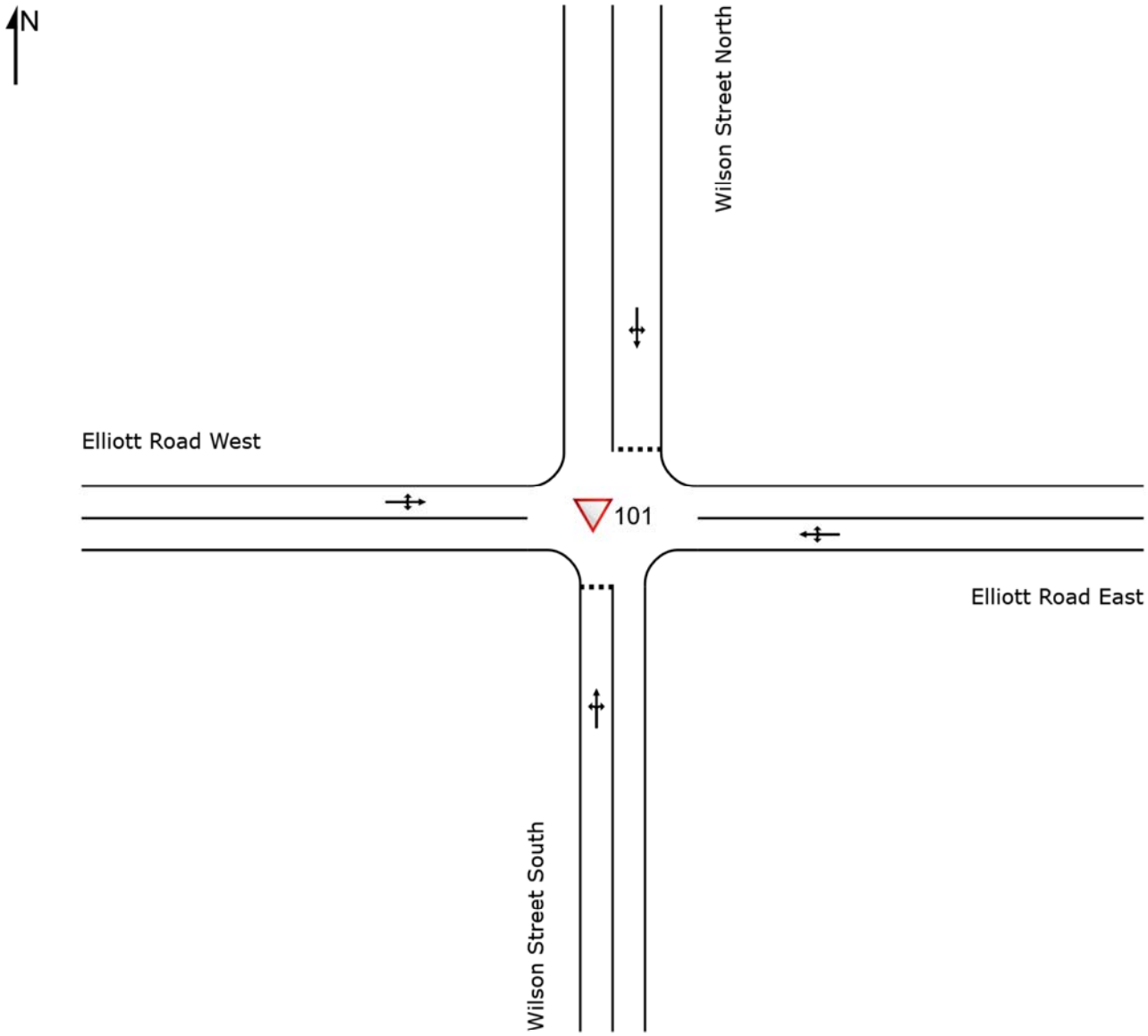
* Critical Movement (Signal Timing)

SITE LAYOUT

Site: 101 [2038 AM (Site Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [2038 AM (Site Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Wilson Street South														
1	L2	5	1	5	20.0	0.127	4.8	LOS A	0.5	3.6	0.29	0.56	0.29	45.9
2	T1	73	9	77	12.3	0.127	4.5	LOS A	0.5	3.6	0.29	0.56	0.29	46.2
3	R2	29	3	31	10.3	0.127	7.4	LOS A	0.5	3.6	0.29	0.56	0.29	45.8
Approach		107	13	113	12.1	0.127	5.3	LOS A	0.5	3.6	0.29	0.56	0.29	46.1
East: Elliott Road East														
4	L2	19	2	20	10.5	0.126	4.7	LOS A	0.6	4.8	0.05	0.44	0.05	46.7
5	T1	28	2	29	7.1	0.126	0.0	LOS A	0.6	4.8	0.05	0.44	0.05	47.3
6	R2	161	15	169	9.3	0.126	4.7	LOS A	0.6	4.8	0.05	0.44	0.05	46.8
Approach		208	19	219	9.1	0.126	4.0	NA	0.6	4.8	0.05	0.44	0.05	46.8
North: Wilson Street North														
7	L2	74	5	78	6.8	0.155	4.6	LOS A	0.6	4.7	0.03	0.49	0.03	46.5
8	T1	87	9	92	10.3	0.155	4.6	LOS A	0.6	4.7	0.03	0.49	0.03	46.6
9	R2	10	0	11	0.0	0.155	6.4	LOS A	0.6	4.7	0.03	0.49	0.03	46.6
Approach		171	14	180	8.2	0.155	4.7	LOS A	0.6	4.7	0.03	0.49	0.03	46.5
West: Elliott Road West														
10	L2	1	0	1	0.0	0.010	4.7	LOS A	0.0	0.4	0.13	0.31	0.13	47.5
11	T1	6	0	6	0.0	0.010	0.1	LOS A	0.0	0.4	0.13	0.31	0.13	47.9
12	R2	9	2	9	22.2	0.010	4.9	LOS A	0.0	0.4	0.13	0.31	0.13	46.9
Approach		16	2	17	12.5	0.010	3.1	NA	0.0	0.4	0.13	0.31	0.13	47.3
All Vehicles		502	48	528	9.6	0.155	4.5	NA	0.6	4.8	0.10	0.48	0.10	46.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [2038 PM (Site Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Wilson Street South														
1	L2	5	0	5	0.0	0.082	4.6	LOS A	0.3	2.1	0.20	0.54	0.20	46.2
2	T1	28	3	29	10.7	0.082	4.2	LOS A	0.3	2.1	0.20	0.54	0.20	46.2
3	R2	40	2	42	5.0	0.082	6.1	LOS A	0.3	2.1	0.20	0.54	0.20	45.9
Approach		73	5	77	6.8	0.082	5.3	LOS A	0.3	2.1	0.20	0.54	0.20	46.1
East: Elliott Road East														
4	L2	17	0	18	0.0	0.088	4.7	LOS A	0.4	3.1	0.12	0.44	0.12	46.7
5	T1	17	0	18	0.0	0.088	0.1	LOS A	0.4	3.1	0.12	0.44	0.12	47.1
6	R2	111	6	117	5.4	0.088	4.7	LOS A	0.4	3.1	0.12	0.44	0.12	46.6
Approach		145	6	153	4.1	0.088	4.2	NA	0.4	3.1	0.12	0.44	0.12	46.7
North: Wilson Street North														
7	L2	59	3	62	5.1	0.075	4.7	LOS A	0.3	2.2	0.05	0.50	0.05	46.6
8	T1	36	2	38	5.6	0.075	4.1	LOS A	0.3	2.2	0.05	0.50	0.05	46.8
9	R2	1	0	1	0.0	0.075	5.6	LOS A	0.3	2.2	0.05	0.50	0.05	46.7
Approach		96	5	101	5.2	0.075	4.5	LOS A	0.3	2.2	0.05	0.50	0.05	46.7
West: Elliott Road West														
10	L2	20	0	21	0.0	0.021	4.6	LOS A	0.0	0.2	0.03	0.33	0.03	47.6
11	T1	14	0	15	0.0	0.021	0.0	LOS A	0.0	0.2	0.03	0.33	0.03	48.0
12	R2	4	0	4	0.0	0.021	4.7	LOS A	0.0	0.2	0.03	0.33	0.03	47.3
Approach		38	0	40	0.0	0.021	2.9	NA	0.0	0.2	0.03	0.33	0.03	47.7
All Vehicles		352	16	371	4.5	0.088	4.3	NA	0.4	3.1	0.11	0.46	0.11	46.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.