Traffic Impact Assessment

Inghams Tahmoor
Residential Subdivision – Planning Proposal

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1. Introduction

TRAFFIX has been commissioned by Ingham Property Development Pty Ltd to undertake a traffic impact assessment in support of the proposed 'Inghams Tahmoor' rezoning. The site is located within the Wollondilly Council LGA and is to be assessed under the relevant Council controls. The purpose of the proposed rezoning is to accommodate residential growth in the region. This report documents the findings of our investigations and should be read in the context of the Planning Proposal, prepared separately on behalf of Urbis.

The report is structured as follows:

- Section 2: Describes the site and its location
- Section 3: Documents existing traffic conditions
- Section 4: Describes the proposed development
- Section 5: Discusses the parking requirements
- Section 6: Assesses traffic impacts
- Section 7: Discusses access and internal design aspects
- Section 8: Presents the overall study conclusions.

2. Location and Site

The site is located on the periphery of Tahmoor town centre, approximately 100km south-west of Sydney. It is located to the east of the Tahmoor Town Centre, approximately 1km from the intersection of Remembrance Drive and Progress Street. The site is irregular in configuration and currently comprises rural farmland. Vehicular access is provided to the site via the existing external road network specifically via Progress Street, Tahmoor Road, Myrtle Creek Avenue and River Road. The aforementioned roads provide access to Remembrance Drive with linkages to Picton (6km to the north of Tahmoor), Bargo, Thirlmere and the Hume Highway.

A Location Plan is presented in **Figure 1**, with a Site Plan presented in **Figure 2**. Reference should also be made to the Photographic Record presented in **Appendix A**, which provides an appreciation of the general character of roads and other key attributes in proximity to the site.

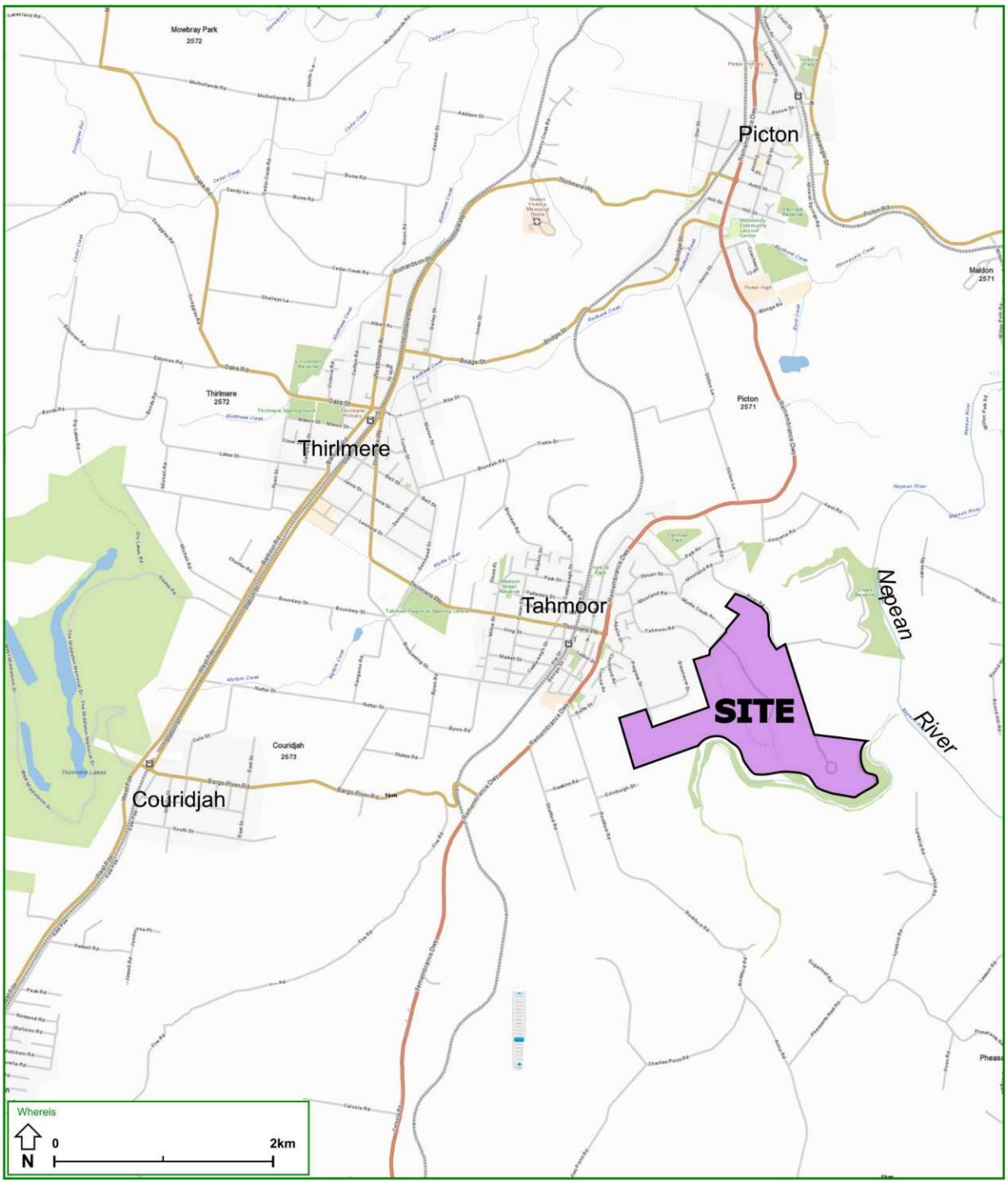

Figure 1: Location Plan

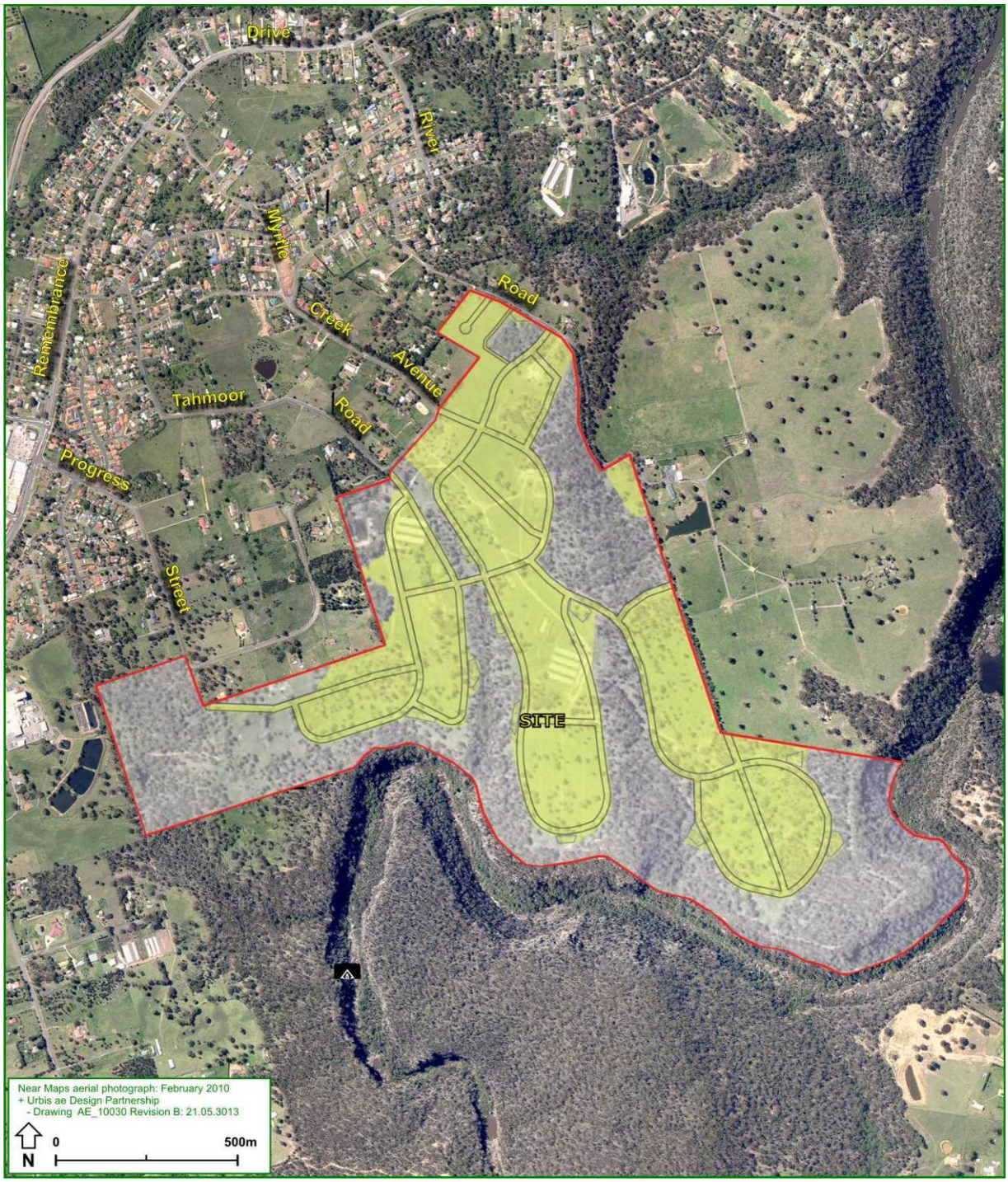

Figure 2 : Site Plan

3. Existing Traffic Conditions

3.1 Road Hierarchy

The road hierarchy in the locality is shown in **Figure 3** with the following roads of particular interest:

- Hume Highway: an RMS state road (State Highway No 2) that generally runs in a north-south direction between the M5 motorway in the north and Remembrance Drive in the south. It carries two lanes of traffic in either direction within a divided carriageway.

- Picton Road: a sub arterial road that generally runs in an east-west direction from Menangle Street in the west to Mount Ousley Road (Wollongong) in the east. It generally carries two lanes of traffic in either direction and is subject to variable speed limits with a maximum limit of 100km/hr. It is noted that Picton Road is a primary corridor that is used to access the Hume Highway and provides the most direct access to the Sydney metropolitan area.

- Remembrance Drive: an RMS State Road (MR 620) that generally runs in a north-south direction between Camden in the north and Hume Highway in the south. Remembrance Drive is generally subject to a 100km/hr, however this is reduced to 60km/hr on approach to Tahmoor.

- Progress Street a local road that generally runs in an east-west direction from Remembrance Drive in the west and providing direct access to the site in the east. It carries a single lane of traffic in either direction and is subject to a 50km/hr speed zoning in the vicinity of the site. Progress Street forms an intersection with Remembrance Drive and permits all turning movements.

- River Road: a local road that generally runs in a north-south direction from the Remembrance Drive in the north and providing direct access to the site in the south. It carries a single lane of traffic in either direction to

the north however the carriageway narrows to provide only one-way flow to the south. River Road is subject to an 50km/hr speed zoning in the vicinity of the site and there is a 8 tonne load limit restriction south of its intersection with Remembrance Drive.

- Struan Street: a local road that generally runs in an east-west direction from the Remembrance Drive in the west to Myrtle Creek Avenue in the east. It carries a single lane of traffic in either direction and is subject to an 50km/hr speed zoning in the vicinity of the site.

- Tahmoor Road: a local road that generally runs in a north-south direction from the Struan Street in the north to Cross Street in the south.

- Myrtle Creek Avenue: a local road that runs in an north-south direction from the Remembrance Drive in the north to Cross Street and the northern site boundary in the south.

It can be seen from **Figure 3** that the site is conveniently located with respect to the arterial and local road systems serving the region. It is therefore able to effectively distribute traffic onto the wider road network, minimising traffic impacts.

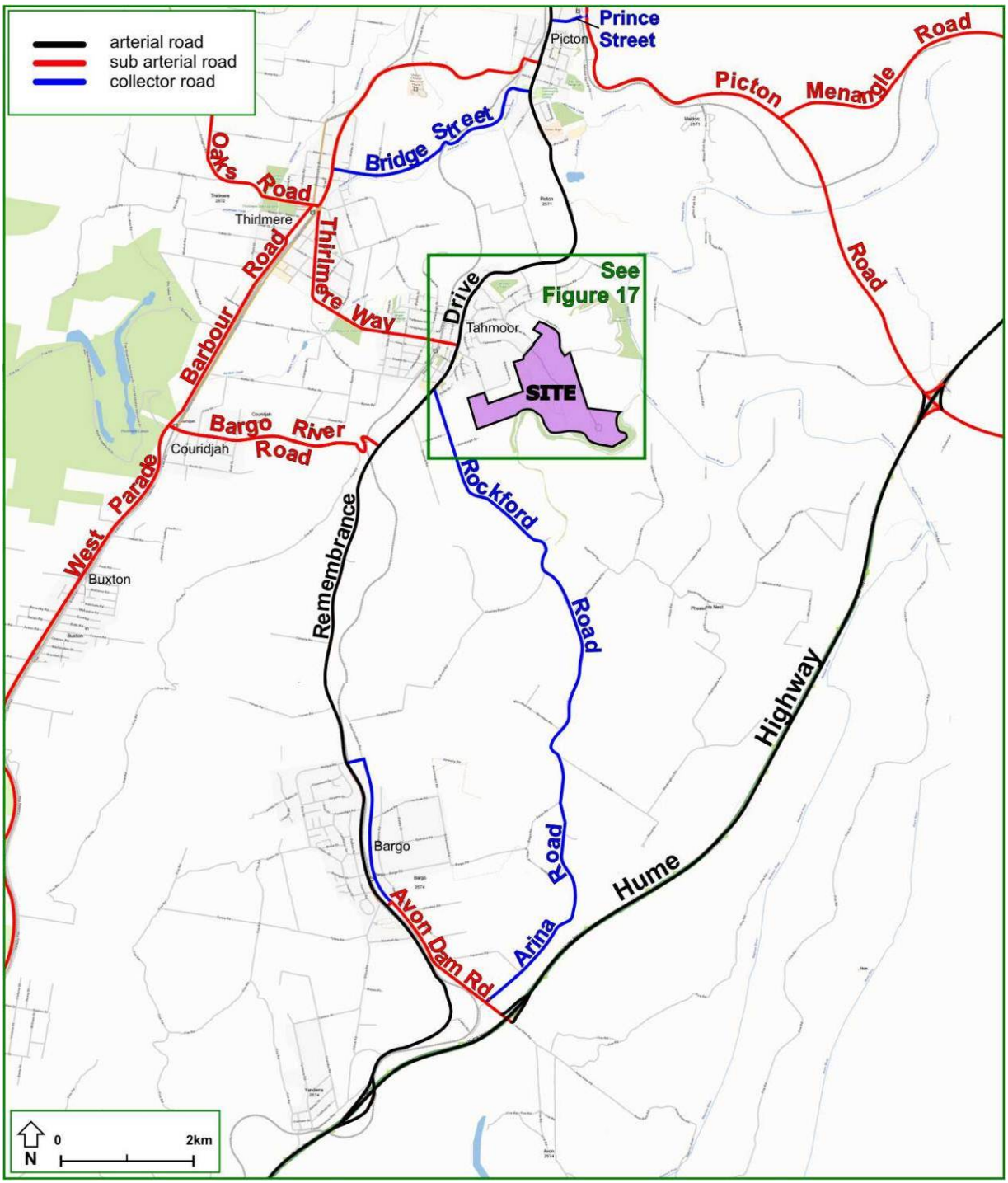

Figure 3: Surrounding Road Hierarchy

3.2 Public Transport

The existing bus services that operate in the locality are shown in **Figure 4**. The Tahmoor Railway Station is located approximately 1.5km west of the site and is located between George Street and Pitt Street. The railway station is served by CityRail's Southern Highlands Line and provides services to Campbelltown, where further railway linkages provide services to the Sydney metropolitan network.

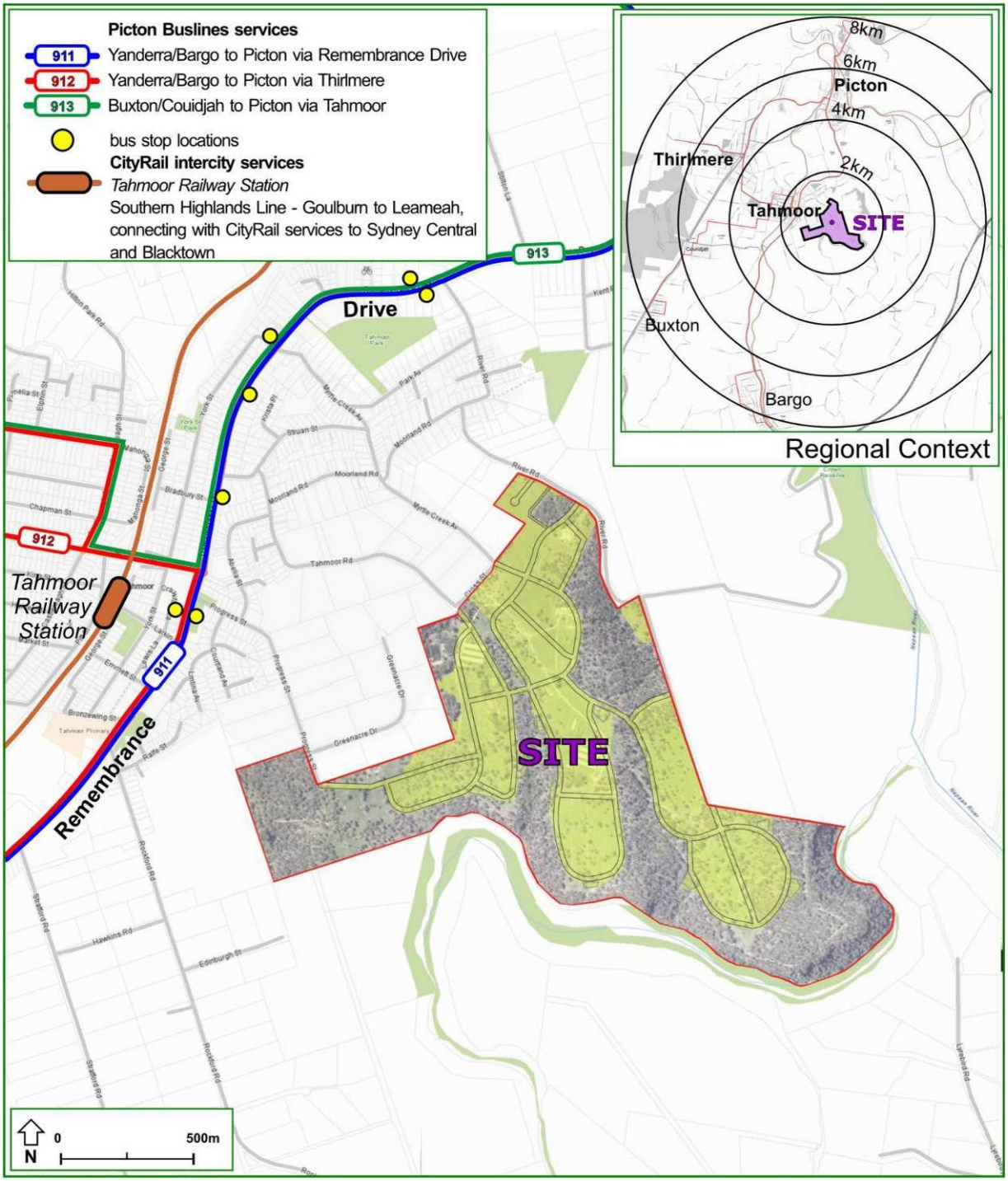

Figure 4 : Public Transport

Picton Busline provides services between Bargo and Picton which traverse Remembrance Drive via Tahmoor. There are numerous bus stops which can be accessed by residents of the proposed development and these bus stops are located adjacent the primary routes to the site, specifically near the intersections along Remembrance Drive with Progress Street, Struan Street, Myrtle Creek Avenue and River Road. Typically, the frequencies of the services vary and generally provide a service on an hourly basis on weekdays.

Taxi services are provided by Tahmoor and District Taxi's. **Figure 5** below shows the taxi rank that is provided along Remembrance Drive between Progress Street and Thirlmere Way and is located adjacent the Tahmoor Shopping Centre.

Figure 5: Taxi Rank located on Remembrance Drive

It is evident that the public transport facilities in the vicinity of the site are limited. It is expected that the increased residential densities on the subject site would not warrant the diversion of existing routes. This will be reviewed over time and will ultimately be a commercial decision by operators in response to a demonstrated demand.

3.3 Walking and Cycling

Footpaths are provided along Remembrance Drive with pedestrian facilities to cross at Remembrance Drive and Progress Street shown in **Figure 6** below.

Figure 6: Pedestrian Facilities in Tahmoor Town Centre

Bicycle facilities are provided along Remembrance Drive as illustrated in **Figure 7** below which shows the bicycle lane located to the west of the River Road with Remembrance Drive intersection. The existing bicycle routes within the vicinity of the site and Tahmoor town centre are shown on the bike plan included in **Figure 8** below. Council's Shire-wide Cycleway is also provided in **Figure 9** which demonstrates the extent of the existing cycle infrastructure.

Figure 7: Example of bicycle lane provided on Remembrance Drive

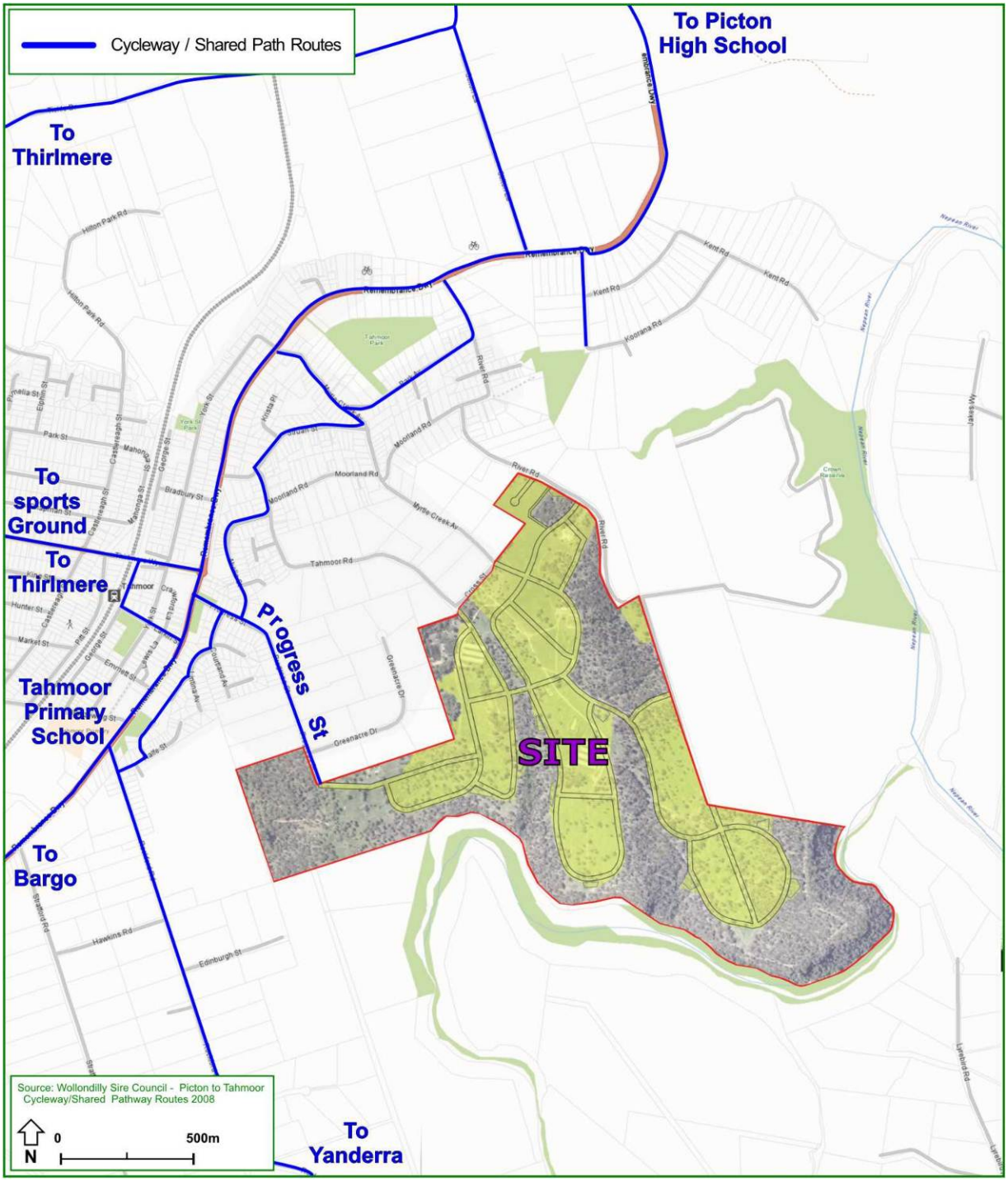

Figure 8 : Council's Bike Map (nearest the proposed site)

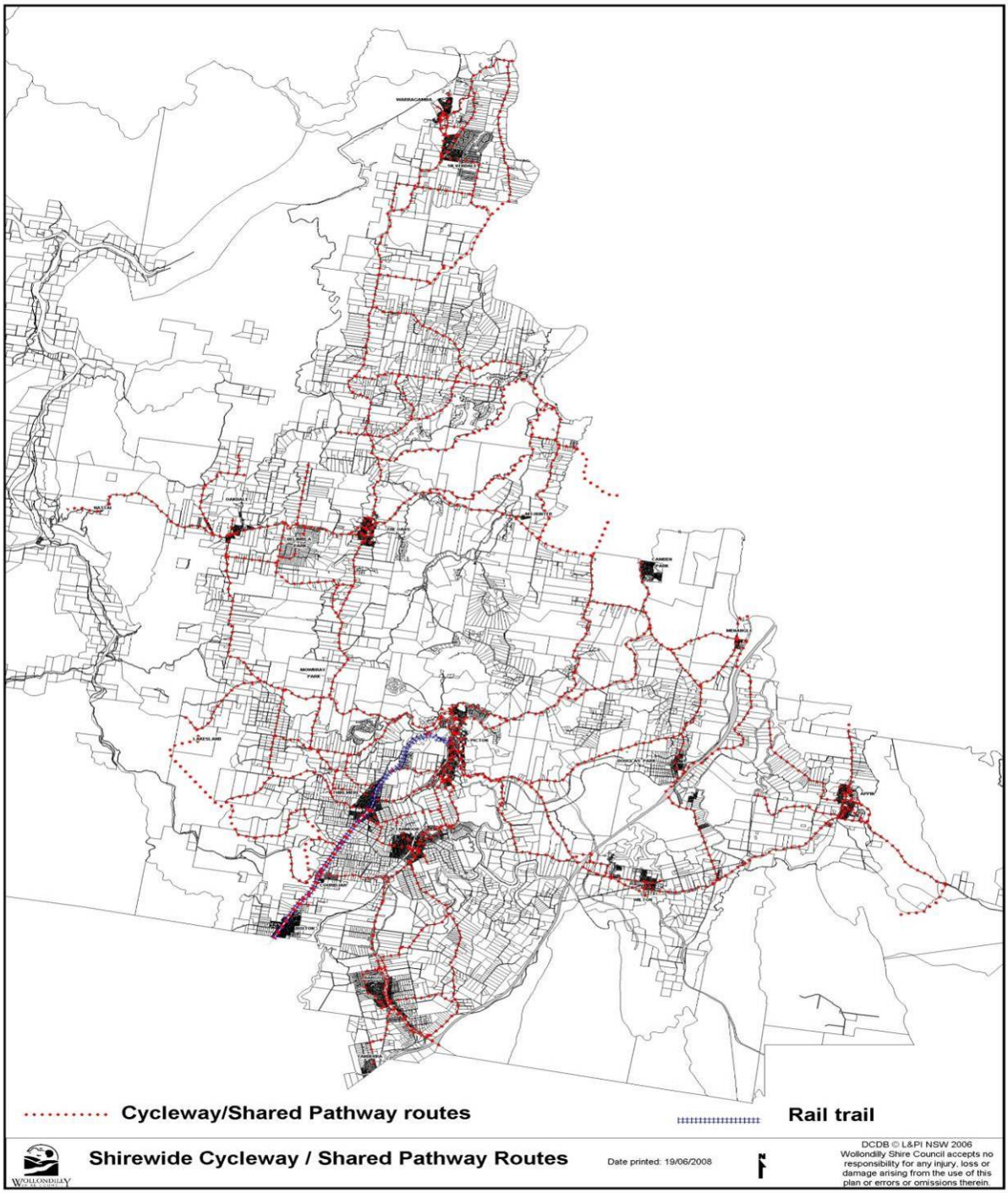

Figure 9 : Council's Shire-wide Cycleway

3.4 Existing Travel Mode

The Wollondilly Shire Council "Growth Management Strategy 2011" reports on the existing modes of travel utilised by residents within the Wollondilly LGA. The key findings are summarised below and are relevant to the proposed development:

- 66% of residents use private vehicles in their journey to work. A further 3.3% used private vehicles as 'car-as-passenger'.

- 4.2% of residents used public transport with 3.8% using rail services and 0.4% using bus services.

It is evident from the above statistics that there is a high reliance upon private vehicle usage. This is to be expected as a result of the fact at least 60% of residents work outside Wollondilly Shire. It is therefore clear that the low frequency of bus/train services within the locality is not expected to achieve high levels of patronage (in relative terms) as they are not a viable alternative to private passenger vehicles for the majority of trip purposes, certainly in the short to medium term. Thus, the traffic assessment discussed below takes a conservative (car dependent) approach in order to assess a worst case scenario, whereby traffic impacts are overstated.

3.5 Existing Site Generation

The site currently accommodates rural farmland and generates no significant traffic volumes. Accordingly, the traffic generation for the proposed development has been assessed as a net increase over and above existing conditions, to assess a worst case scenario.

3.6 Key Intersections

The key intersections in the vicinity of the site are shown below and provide an understanding of the existing road geometry and alignment:

Figure 10 : Intersection of Remembrance Drive & River Road

It can be seen from **Figure 10** that Remembrance Drive generally carries one lane of traffic in either direction in the vicinity of the site. River Road forms a 'T' intersection with Remembrance Drive and provides adequate sightlines in both directions.

Figure 11 : Intersection of Remembrance Drive & Myrtle Creek Avenue

The intersection of the Remembrance Drive, Myrtle Creek Avenue and York Street will provide an alternative route to the site. It is evident that a bicycle lane is provided on both sides of the carriageway as shown in **Figure 11**.

Figure 12 : Intersection of Remembrance Drive & Struan Street

Figure 12 shows the intersection of Remembrance Drive and Struan Street which provides direct access to both Tahmoor Road and Myrtle Creek Avenue providing linkages to the site. This is a priority controlled 'T' junction with good visibility on both approaches

Figure 13 : Intersection of Remembrance Drive & Progress Street

It can be seen from **Figure 13** that Remembrance Drive provides a left turn slip lane on the northern approach to Progress Street. This intersection is located adjacent the Tahmoor Shopping Centre and provides pedestrian and public transport facilities in the form of bus and taxi services nearby.

The four key intersections discussed will each accommodate some entry and exit movements associated with the site and have been identified for analysis as part of this Planning Proposal.

3.7 Existing Intersection Performances

For the purposes of the assessment of traffic impacts of the proposed rezoning, traffic surveys were undertaken and survey data has been utilised for the following intersections during typical morning and evening peak periods:

- Progress Street & Remembrance Drive.
- Thirlmere Way & Remembrance Drive.
- Struan Street & Remembrance Drive.
- Myrtle Creek Avenue & Remembrance Drive
- River Road & Remembrance Drive.

A summary of these surveys is provided in **Figures 14 & 15** below.

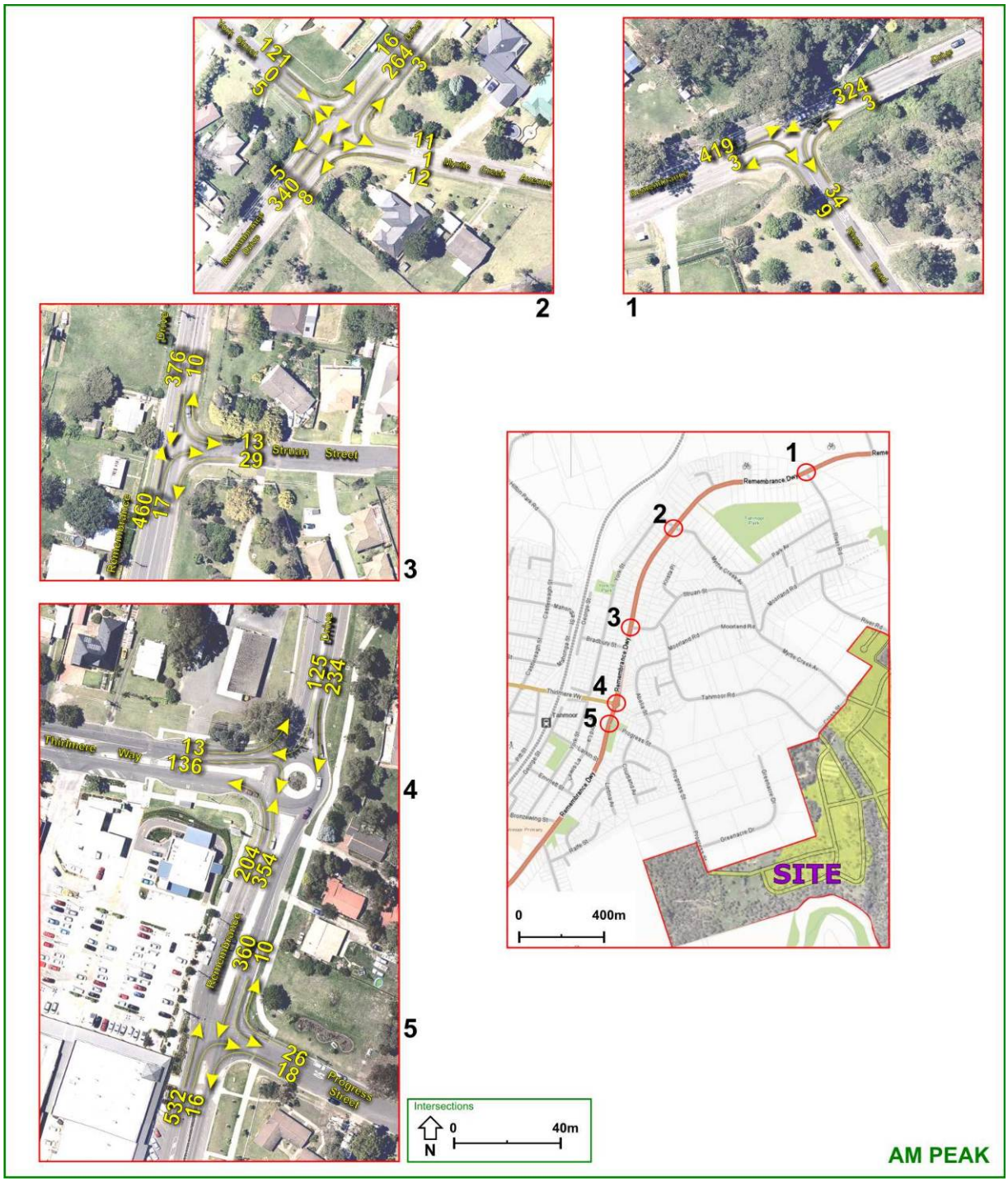

Figure 14 : Existing AM Peak Turning Counts

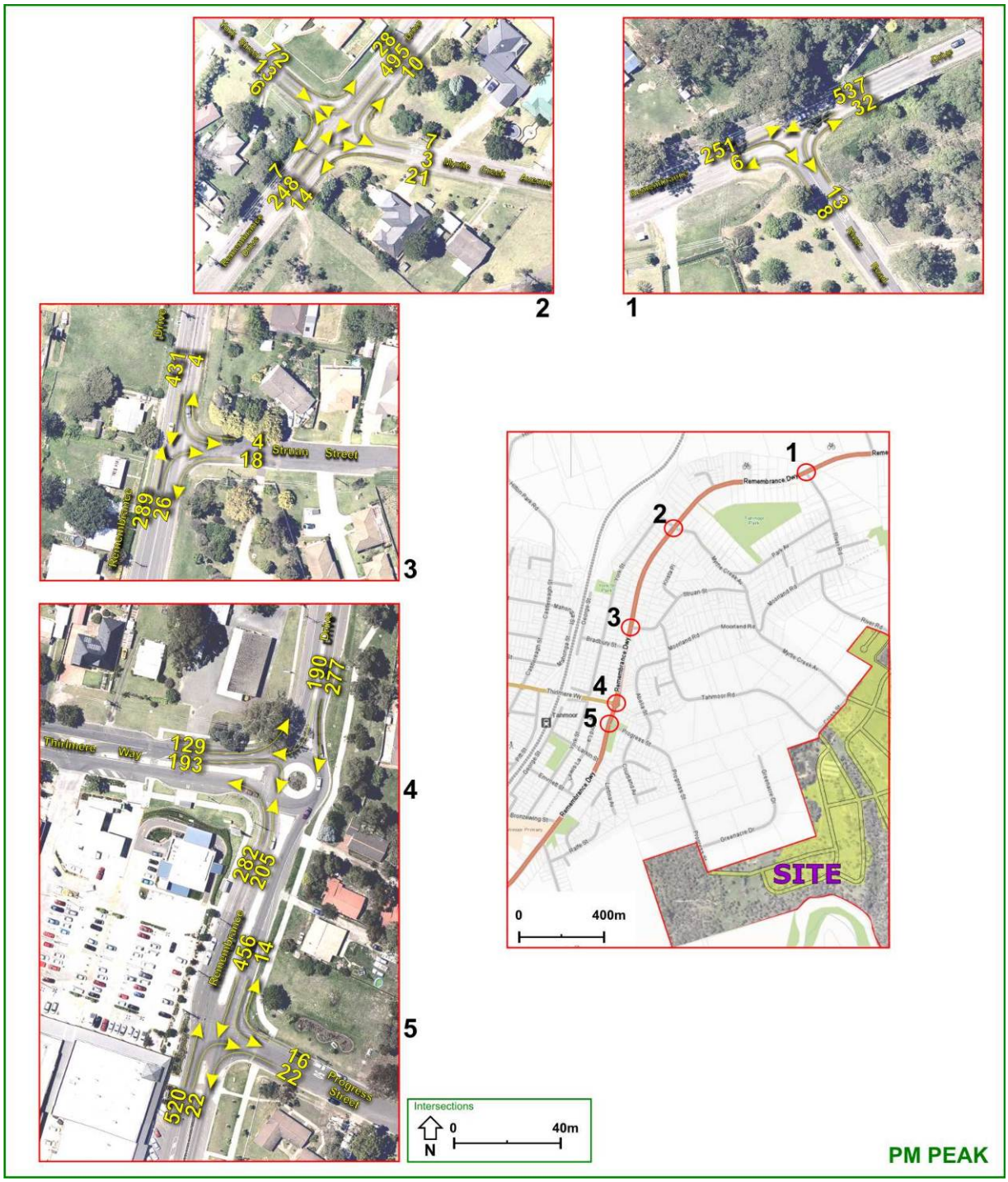

Figure 15 : Existing PM Peak Turning Counts

The results of these surveys were analysed using the SIDRA computer program to determine their performance characteristics under existing traffic conditions. The SIDRA model produces a range of outputs, the most useful of which are the Degree of Saturation (DOS) and Average Vehicle Delay per vehicle (AVD). The AVD is in turn related to a level of service (LOS) criteria. These performance measures can be interpreted using the following explanations:

DOS - the DOS is a measure of the operational performance of individual intersections. As both queue length and delay increase rapidly as DOS approaches 1, it is usual to attempt to keep DOS to less than 0.9. When DOS exceeds 0.9 residual queues can be anticipated, as occurs at many major intersections throughout the metropolitan area during peak periods. In this regard, a practical limit at 1.1 can be assumed. For intersections controlled by roundabout or give way/stop control, satisfactory intersection operation is generally indicated by a DOS of 0.8 or less.

AVD - the AVD for individual intersections provides a measure of the operational performance of an intersection. In general, levels of acceptability of AVD for individual intersections depend on the time of day (motorists generally accept higher delays during peak commuter periods) and the road system being modelled (motorists are more likely to accept longer delays on side streets than on the main road system).

LOS - this is a comparative measure which provides an indication of the operating performance of an intersection as shown below:

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way and Stop Signs
A	less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause excessive delays. Roundabouts require other control mode	At capacity and requires other control mode
F	More than 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires other control mode or major treatment.

A summary of the modelled results are provided in **Table 1** below. Reference should also be made to the SIDRA outputs provided in **Appendix B** which provide detailed results of all approaches.

Table 1: Intersection Performance - Existing

Intersection Description	Control Type	Period	Degree of Saturation	Critical Movement Delay	Level of Service
River Road & Remembrance Drive.	Priority 'Give Way'	AM	0.089	12.8	A
		PM	0.048	13.4	A
Myrtle Creek Avenue & York Street & Remembrance Drive	Priority 'Give Way'	AM	0.064	14.7	B
		PM	0.091	16	B
Struan Street & Remembrance Drive.	Priority 'Give Way'	AM	0.120	15.6	A
		PM	0.046	12.5	A
Thirlmere Way & Remembrance Drive.	Roundabout	AM	0.159	12.6	A
		PM	0.473	12.5	A
Progress Street & Remembrance Drive.	Priority 'Give Way'	AM	0.182	19.7	B
		PM	0.152	19.1	B

It can be seen from Table 1 that all intersections currently operate satisfactorily with moderate delays under the existing 'base case' scenario, with a level of service A or B during both peak periods. Nevertheless, it is emphasised that the most relevant use of this analysis is to compare the relative change in the performance parameters as a result of the proposed development. This is discussed further in Section 6.

4. Description of Proposed Development

Approval from Wollondilly Council is sought for the rezoning of the 'Inghams Tahmoor' precinct from rural to residential zoning. The application will require an amendment to Wollondilly LEP 2011. A detailed description of the proposal is provided in the Planning Proposal prepared by URBIS and the key aspects are summarised below:

- To rezone the land from rural farmland through to the establishment of an appropriate residential land-use zone.
- To allow a variety of lot sizes, ranging from 1,500m^2 to 4,000 m^2 and a proposed Lot yield of circa 240 Lots, in order to facilitate the creation of a sustainable integrated community.
- To establish a planning framework that sets a benchmark for high-quality residential development.

The overall site is shown in **Figure 16**. The parking requirements and traffic impacts arising from the development including the proposed access and internal road design aspects are discussed in Sections 5, 6 and 7.

Figure 16 : Proposed Development

5. Parking Requirements

All car parking is to be provided in accordance with Council's Development Control Plan. The proposed car parking requirements for future residential dwellings will be provided in accordance with Council's DCP and these guidelines are as follows:

Single dwelling housing

- At least 2 vehicle spaces must be provided behind the front building line for dwelling houses

Dual Occupancy and Semi-detached dwellings

The following parking requirements are specified in Councils DCP Volume 3:

- 1 space per studio per dwelling up to 125m^2 in gross floor area.
- 2 spaces per dwelling 125m^2 or greater in gross floor area.
- Within Rural (R) zones, both dwellings must have the same vehicular access from a public road

Large residential flat buildings are not proposed. The future parking requirements of the site are expected to be consistent with the above requirements. It is noted that any departure from these rates (if required) will be subject to review by Council during the Development Application process.

6. Traffic Impacts

6.1 Trip Generation

The Roads & Maritime Services publication entitled the *Guide to Traffic Generating Developments* recommends the following peak hourly traffic generation rates for residential uses:

- 0.85 trips per hour per standard residential dwelling (9 daily trips / dwelling)
- 0.4 trips per studio or one (1) bedroom medium density unit (4 daily trips / dwelling)
- 0.5 trips per two (2) bedroom medium density unit (5 daily trips / dwelling)
- 0.65 trips per three (3) or more bedroom unit (6.5 daily trips / dwelling)

The majority of the proposed 240 dwellings are expected to be standard format residential dwellings. As such, the subject site could be expected to generate a maximum in the order of 204 vehicles per hour, or 2,160 vehicle trips per day. In terms of the assessment of traffic impacts, the former peak hour flows are most relevant.

6.2 Traffic Distribution

The following assumptions have been adopted for the purposes of this assessment in relation to the distribution of traffic onto the external road network:

- Directional splits of 20% in, 80% out during the morning peak and reversed for the evening peak period based on RMS Guideline.
- 70% of total trips will be directed toward north and east which provides the most convenient and presently utilised route to the Hume Highway. This assumption is reinforced by research undertaken and discussed in the Wollondilly Shire Council Growth Management Strategy 2011. This report states that only 29.5% of residents of Wollondilly LGA work within the local area with a

high proportion of residents traveling north to Sydney Suburbs such as Campbelltown, Camden, Liverpool, Penrith etc.

- Up to 60% of trips from the site will occur via River Road.

Having regard for the above, a distribution of traffic associated with the development has been superimposed upon the base model (section 3.7) and analysed below in section 6.3.

6.3 Peak Period Intersection Performances (with Development)

The proposal seeks to provide additional residential land releases to accommodate growth within the region. The impacts of the proposed development on the external road network have been assessed having regard for the indicative yield (circa 240 dwellings). This assessment has been undertaken in accordance with the requirements of the RMS Guideline and as such, the traffic generation rates published in the RMS Guide have been adopted. Having regard for the above distributions and assumptions, the critical intersections identified in Section 3.6 will operate as summarised in **Table 2** below.

Table 2: Intersection Performance – Existing plus Development

Intersection Description	Control Type	Period	Degree of Saturation	Critical Movement Delay	Level of Service
River Road & Remembrance Drive.	Priority 'Give Way'	AM	0.314	15.0	B
		PM	0.051	14.3	A
Myrtle Creek Avenue & York Street & Remembrance Drive	Priority 'Give Way'	AM	0.209	17.3	B
		PM	0.149	18.6	B
Struan Street & Remembrance Drive.	Priority 'Give Way'	AM	0.217	19.8	B
		PM	0.067	14.5	B
Thirlmere Way & Remembrance Drive.	Roundabout	AM	0.161	12.7	A
		PM	0.485	12.5	A
Progress Street & Remembrance Drive.	Priority 'Give Way'	AM	0.246	23.5	B
		PM	0.176	20.6	B

It can be seen from the Table 2 that all intersections will continue to operate with acceptable Levels of Service and moderate delays. The intersection that is assumed to accommodate a high proportion of trips (up to 60%) is the intersection of River Road and Remembrance Drive. Nevertheless, this intersection continues to operate at an acceptable Level of Service B with minor increases in delay (2.2 seconds) and similar queue lengths.

It is noted that all other intersections analysed also remain at the same Level of Service with similar delays consistent with the existing intersection analysis. Accordingly, the impacts of the application are considered moderate and the rezoning is therefore supportable.

6.4 Cumulative Development Impacts

In addition to the subject rezoning, a neighbouring site is also proposing a similar rezoning of the land to the east of the site known as 'JR Stud'. This site is expected to yield up to 100 new residential dwellings and has been submitted to Wollondilly Council for review. In this regard, the cumulative impacts upon River Road/Remembrance Drive intersection and Myrtle Creek Avenue/Remembrance Drive intersection has been assessed, recognising that these will form the main access point to the site as stated in the ARUP traffic impact assessment undertaken in July 2012. **Table 3** below, provides a summary of the intersection performance based on this additional traffic generation of 100 vehicle trips per hour associated with Tahmoor Recreation Precinct.

Table 3: Intersection Performance – Existing plus Development plus 'Tahmoor Recreation Precinct'

Intersection Description	Control Type	Period	Degree of Saturation	Critical Movement Delay	Level of Service
River Road & Remembrance Drive.	Priority 'Give Way'	AM	0.408	16.0	B
		PM	0.181	16.0	B
Myrtle Creek Avenue & York Street & Remembrance Drive	Priority 'Give Way'	AM	0.239	15.6	B
		PM	0.169	17.7	B

It can be seen that the key intersections modelled as part of the 'Tahmoor Recreation Precinct' will continue to operate with acceptable Levels of Service and delays. Accordingly, the future operation of the intersections are generally consistent with the existing network operation noting that the largest increase in delay is 3.2 seconds at the River Road and Remembrance Drive intersection, which is negligible. The cumulative impacts of both developments are therefore supportable on traffic planning grounds.

Nevertheless, the opportunity should be undertaken (under any development application made in response to this rezoning) to improve the existing geometry of River Road which is narrow on its southern section. This intersection provides access to the northern part of the site and currently only permits one-way traffic flow. This requires widening and possibly reconstruction to provide two-way flow and it is noted that volumes on this road segment would generally be equally split between the subject site (with 60% of traffic relying on this route) and the adjacent Tahmoor Recreation Precinct (with 100% of its traffic relying on this route).

There are no other capacity issues at the analysed intersections that require upgrades and this is based on the future development of the subject site and adjacent Tahmoor Recreation site.

6.5 Wollondilly Local Environmental Study

Further to the above cumulative impact assessment in Section 6.4, Council has requested that The Wollondilly Local Environmental Study (WLES) undertaken by Cardno (2011) be considered as part of the subject planning proposal. The study undertaken identified a number of new urban residential developments located at Picton, Thamoor and Thirlmere. The study was prepared to consider the traffic impacts upon the road network for new residential development. Of particular note, the following intersections were assessed, the impacts and recommendations of which are significant to the subject planning proposal.

- Progress Street & Remembrance Drive.
- Thirlmere Way & Remembrance Drive.
- Struan Street & Remembrance Drive.
- Myrtle Creek Avenue & Remembrance Drive
- River Road & Remembrance Drive.

The WLES provided an assessment of two future road network scenarios:

- 2036 Base Case Assessment: An assessment of the 2036 future road network performance excluding the proposed residential developments within the study.
- 2036 With Development Intersection Analysis

Table 4 below provides a summary of the intersection operation with development identified in the Cardno report.

Table 4: 2036 Base Case With Development Intersection Performance - Cardno Analysis

Intersection Description	Control Type	Period	Degree of Saturation	Critical Movement Delay	Level of Service
River Road & Remembrance Drive.	Priority 'Give Way'	AM	0.871	>120	F
		PM	0.476	117.8	F
Myrtle Creek Avenue & York Street & Remembrance Drive	Priority 'Give Way'	AM	1.00	>120	F
		PM	>1.00	>120	F
Struan Street & Remembrance Drive.	Priority 'Give Way'	AM	>1.00	>120	F
		PM	>1.00	>120	F
Thirlmere Way & Remembrance Drive.	Roundabout	AM	0.534	20.0	B
		PM	0.910	29.3	C
Progress Street & Remembrance Drive.	Priority 'Give Way'	AM	>1.00	>120	F
		PM	>1.00	>120	F

Table 4 demonstrates the results of the relevant intersections for 2036 plus total development as assumed in the region. It is clear that the intersections will operate at capacity with Level of Service F should full development and growth targets be achieved. The upgrades identified by Cardno which are relevant to the Ingham planning proposal are as follows:

- Remembrance Drive/Progress Street to be converted to a one lane circulating roundabout
- Remembrance Drive / Struan Street to be converted from the current give-way priority controlled intersection to a two lane roundabout.
- Remembrance Drive/Myrtle Creek Avenue to be converted from the current give-way priority controlled intersection to a two lane roundabout.

It is assumed that the above recommendations are supported and adopted by Wollondilly Shire Council, and it is emphasised that these upgrades are also supported by TRAFFIX for the purpose of this cumulative impact assessment. In this regard, the following assessment has been undertaken demonstrating the proposed increase in traffic for the subject proposal compared to the future intersection volumes based on the 2036 plus development Cardno report.

Table 5: Inghams Tahmoor: 2036 Traffic Increase (%)

Intersection Description	Period	Subject Development Traffic Veh/hr	2036 Cardno Intersection Volume	% Increase
River Road & Remembrance Drive.	AM	122	1826	6.4
	PM		1953	6.2
Myrtle Creek Avenue & York Street & Remembrance Drive	AM	51	1920	2.6
	PM		2072	2.4
Struan Street & Remembrance Drive.	AM	20	1860	1.1
	PM		2031	1
Progress Street & Remembrance Drive.	AM	10	2298	0.43
	PM		2772	0.35

Table 5 above demonstrates the percentage increase in traffic that will arise from the subject planning proposal at the key intersections along Remembrance Drive. As mentioned above, the upgrade of the Remembrance Drive intersections with Myrtle Creek, Struan Street and Progress Street will be upgraded to roundabout intersections resulting in a Level of Service (LoS) A intersection performance. The increase in traffic generated by the subject proposal is demonstrated in Table 5 and will have a negligible effect on the operation of these intersections.

The Cardno report identified the intersection of River Road and Remembrance Drive operating at LoS F for the year 2036. The report does specify that the midblock capacity assessment undertaken will require an additional southbound and northbound lane along Remembrance Drive near the intersection with River Road. Notwithstanding, in the absence of further improvement, this intersection will continue to operate at LoS F. TRAFFIX has reviewed potential upgrade options for Remembrance Drive/Rover Road as it will form a key intersection that will accommodate a high proportion of entry and exit movements to the subject site. In this regard, the future 2036 Cardno traffic flows have been superimposed along with the subject site. The concept modelling results for the provision of an assumed two lane roundabout intersection as demonstrated in Table 6 below.

Table 6: Intersection Performance –

Existing plus Development plus 2036 Cardno Development

Intersection Description	Control Type	Period	Degree of Saturation	Critical Movement Delay	Level of Service
Potential Intersection Upgrade: River Road & Remembrance Drive.	Roundabout	AM	0.200	13.0	A
		PM	0.090	16.0	B

The River Road/Remembrance Drive intersection has been modelled as a 2 lane roundabout with 2 lanes on the eastern and western approach. The intersection operation improves significantly to LoS A during the AM peak and Los B during the PM peak (from LoS F 2036). The provision of a two lane roundabout will require potential road widening and land allocation however it is clear that there are alternative options available to improve the 2036 intersection operation.

It is evident that the tested scenario in Table 6 assumes full development identified within the Tahmoor precinct (1330 dwellings as documented in the Cardno report for east, west and south Tahmoor) and also includes the subject site (circa 240 dwellings) and the JR Stud (100 dwellings). The delivery timeframe for these residential developments is unknown and as such the above provides a worst case assessment. In this regard, it is unclear at what stage the above intersection improvements will be required and therefore this can be monitored at future DA stages. In addition to the above roundabout proposal, there are other intersection upgrades available for assessment including a Seagull Intersection or even signalisation. The preferred option would however be a 2 lane circulating roundabout with staging options available subject to review of future development applications in the locality.

In summary, having considered the Wollondilly Local Environmental Study, it is evident that the potential residential growth within the Tahmoor Region can be accommodated including the subject application. That is, it has been demonstrated that on traffic planning grounds, there is no impediment to the subject Inghams Tahmoor Planning Proposal.

6.6 Recommendations

The only recommended significant improvement in support of the Inghams Tahmoor Planning Proposal relates to the widening of River Road to permit two-way flow, as discussed in Section 6.4. There are other opportunities for further improvements which can be assessed during subsequent development application stages, having regard for the uncertainty of the final development yields across East Tahmoor, the trip rates that will be generated in practice and uncertainties relating to the staged release of lands. This is likely to include improved line marking and signage as well as an audit of road conditions generally.

Beyond the Inghams Tahmoor Planning Proposal and in a more strategic planning context (in 2036), the improvements identified by Cardno will be required and are supported by TRAFFIX. In addition, it is expected that the Remembrance Drive/River Road intersection will need to be upgraded as discussed in Section 6.5, with several options likely to be available, subject to further detailed assessment. The preferred option however would be for the intersection to be converted to a two lane circulating roundabout, subject to full development as identified by Cardno for 2036; as well as the subject Planning Proposal.

7. Access & Internal Design

7.1 Access

The primary accesses to the subject site are proposed via the main intersections that can be utilised to access the proposed site is provided in **Figure 17** below. It is noted that all access points to the site will form extensions of the existing road network. Residents can access the site via Remembrance Drive intersections with Progress Street, Struan Street, Myrtle Creek Avenue and River Road.

7.2 Internal Design

The internal road network seeks to provide a high level of connectivity and limits the number of cul-de-sac roads provided. A summary of the road hierarchy proposed is also provided in **Figure 17** below. The internal design will aim to provide a road system within the subdivision in accordance with the aims and objectives of Council's Geometric Road Design Guidelines.

- Provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists
- Provide appropriate access for buses, emergency and service vehicles.
- Provide a convenient way for public utilities.
- Provide an opportunity for street landscaping.
- Provide convenient parking for visitors.

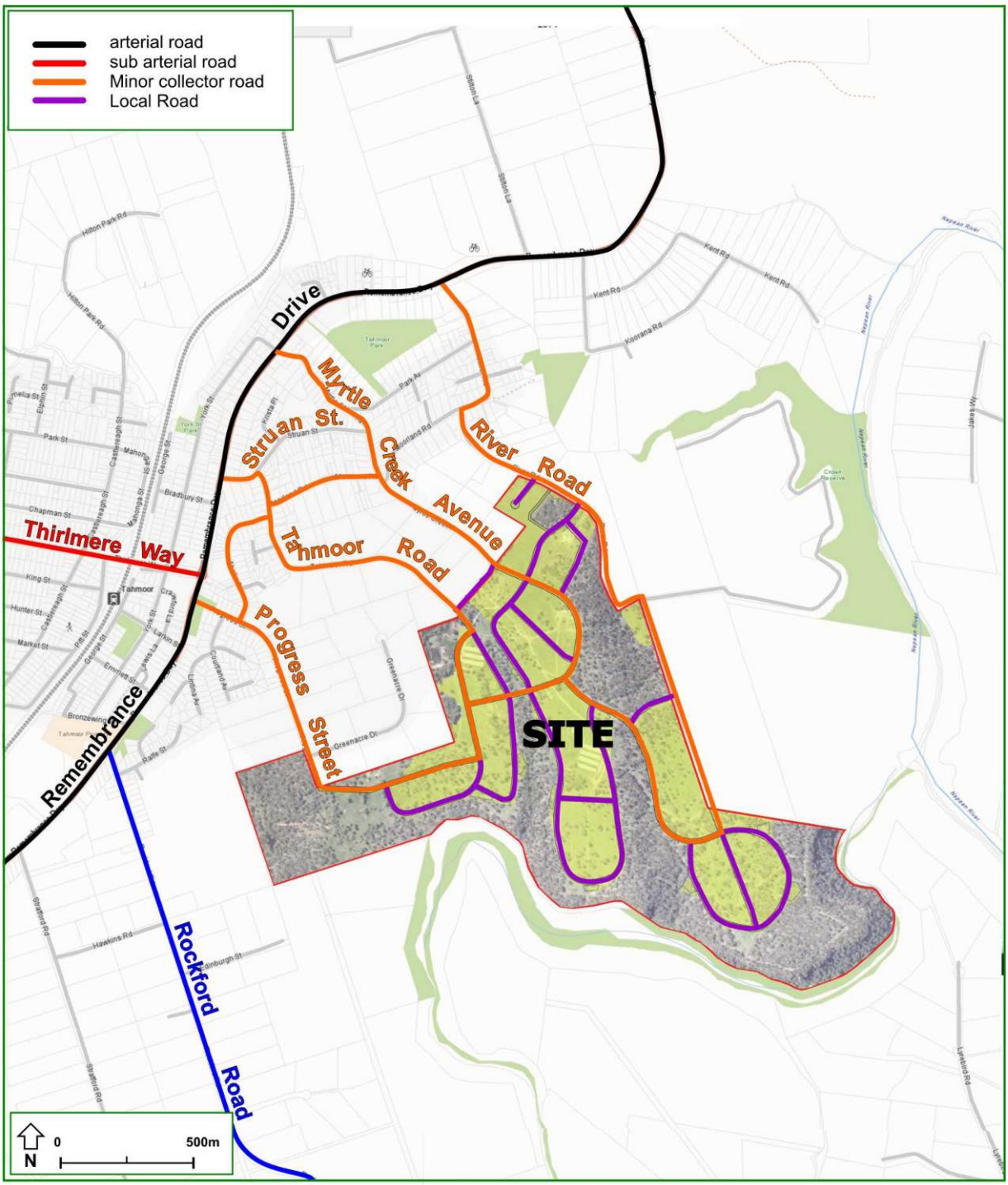

Figure 17 : Proposed Road Hierarchy within Ingham Site.

The proposed hierarchy will be a combination of minor collector roads and local access streets and will comply with the relevant Wollondilly Shire Council urban design guidelines and this can be further detailed at future DA stages.

The proposed road cross sections will take account of Council requirements as specified in Appendix B. The road provisions will allow for garbage collection to be undertaken within the precinct. The minimum carriageway width provided for all roads is 6 metres as defined by that for a minor access street. It is emphasised that AMCORD specifically states that a "5.5m carriageway allows a moving car to pass a truck". Therefore, the minimum carriageway width of 6 metres is acceptable. In summary, the proposed road hierarchy and cross sections will designed in accordance with Wollondilly Shire Council requirements and will also have some regard for AMCORD guidance (the national resource document for residential development) as well as Austroads.

8. Conclusions

The following conclusions are noteworthy:

- The proposed rezoning of the Inghams Thamoor site, based on an indicative yield of circa 240 dwellings, is considered supportable from a traffic planning perspective and does not require any intersection upgrades. SIDRA intersection analysis undertaken for existing plus development scenario demonstrates that that there will be negligible impacts upon the key intersections within the vicinity of the site.

- The cumulative impacts of the JR Stud Planning Proposal located to the east of the subject site has also been considered. In this regard, SIDRA intersection analysis has been undertaken to the nearby intersections and the results demonstrate that the current intersection layout can facilitate both developments with similar delays and queues experienced for the future scenario. It is recommended that Council monitor and review the analysed intersections during subsequent development application stages.

- Based on this cumulative assessment, the southern section of River Road that will adjoin a future access road to the Inghams site is required to be upgraded to permit two-way flow, to accommodate either of the development sites; or these sites cumulatively.

- In addition, a review of the Wollondilly Local Environmental Study (WLES) prepared by Cardno in September 2011 has also been undertaken as requested by Council. The report identifies a number of upgrades that affect intersections assessed in the subject report. The upgrades recommend conversion of priority controlled intersections to roundabouts which improve the intersection of Struan Street/Remembrance Drive, Myrtle Creek Avenue/Remembrance Drive, and Progress Street/Remembrance Drive to LoS A for the year 2036. These recommendations are supported by TRAFFIX and there is no impediment to development occurring as envisaged under the WLES.

- The WLES recommends an additional northbound and southbound lane along Remembrance Drive near the intersection of River Road/Remembrance Drive. However, this intersection will operate at LoS F in 2036. Further modelling as discussed above demonstrates that the provision of a 2 lane circulating roundabout at this location will provide a Level of Service to A during the AM peak and B during the PM peak for the year 2036. It is therefore recommended that this

intersection be monitored during any future DA stages. It is however emphasised that this upgrade is not relied upon for the subject application.

- The proposed development will provide parking in accordance with the Wollondilly DCP requirements and this will be detailed at future DA stages; and
- The proposed internal road network layout is supported. The road network will be designed in accordance with Council's DCP and the key geometric considerations are to be satisfied and detailed during future DA applications.

The assessment satisfactorily demonstrates that the traffic generated by the assumed development yield under the rezoning is supportable and further refinement will be possible at development application stage/s. There is therefore no traffic planning impediment and the subject site is capable of rezoning.

Appendix A

Photographic Record

View looking south along Progress Street towards its termination with the north western site boundary.

View looking north along Progress Street at its intersection with Greenacre Drive which runs parallel to the north western site boundary.

View looking north along Remembrance Drive at its intersection with Progress Street.

View looking west along Progress Street, on approach to its intersection with Remembrance Drive. .

View looking north along Remembrance Drive towards its intersection with Thirlmere Way.

View looking south along Remembrance Drive towards its intersection with Progress Street.

View looking south along Remembrance Drive illustrating the on-street parking provision within the town centre.

View looking east along Tahmoor Road which will form a local road within the site.

View looking west along Struan Street at its intersection with Remembrance Drive.

View looking north along Remembrance Drive at its intersection with Struan Street.

View looking south along Remembrance Drive at its intersection with Myrtle Creek Avenue (left) and York Street (right).

View looking east from York Street across Remembrance Drive to Myrtle Creek Avenue.

View looking north along River Road along its southern section demonstrating that only one-way flow is available.

View looking north along River Road towards its intersection with Remembrance Drive.

View looking east from River Road along Remembrance Drive.

View looking west from River Road along Remembrance Drive.

Appendix B

SIDRA Outputs

Appendix B-1

Existing Conditions

MOVEMENT SUMMARY

Site: Myrtle Creek & Remem Dr AM Ex

Intersection: Remembrance Drive & Myrtle Creek Avenue
Period: AM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Myrtle Creek Avenue											
1	L	13	3.0	0.064	14.4	LOS A	0.2	1.6	0.55	0.67	38.2
2	T	1	3.0	0.064	11.5	LOS A	0.2	1.6	0.55	0.73	37.8
3	R	12	3.0	0.064	14.7	LOS B	0.2	1.6	0.55	0.86	38.1
Approach		25	3.0	0.064	14.5	LOS A	0.2	1.6	0.55	0.76	38.2
East: Remembrance Drive (East)											
4	L	3	3.0	0.164	9.2	LOS A	1.3	9.3	0.52	0.52	32.0
5	T	278	3.0	0.164	2.0	LOS A	1.3	9.3	0.52	0.00	38.6
6	R	17	3.0	0.164	9.6	LOS A	1.3	9.3	0.52	1.02	48.9
Approach		298	3.0	0.164	2.5	NA	1.3	9.3	0.52	0.06	39.7
North: York Street											
7	L	127	3.0	0.181	8.6	LOS A	0.7	4.9	0.48	0.71	36.0
8	T	1	3.0	0.181	6.7	LOS A	0.7	4.9	0.48	0.69	35.8
9	R	5	3.0	0.181	8.9	LOS A	0.7	4.9	0.48	0.82	35.8
Approach		134	3.0	0.181	8.6	LOS A	0.7	4.9	0.48	0.72	35.9
West: Remembrance Drive (West)											
10	L	5	3.0	0.198	8.8	LOS A	1.5	11.1	0.47	0.58	49.0
11	T	358	3.0	0.198	1.5	LOS A	1.5	11.1	0.47	0.00	43.5
12	R	8	3.0	0.198	9.3	LOS A	1.5	11.1	0.47	1.04	38.3
Approach		372	3.0	0.198	1.8	NA	1.5	11.1	0.47	0.03	43.6
All Vehicles		828	3.0	0.198	3.5	NA	1.5	11.1	0.49	0.18	39.6

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Myrtle Creek & Remem Dr PM Ex

Intersection: Remembrance Drive & Myrtle Creek Avenue
Period: PM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Myrtle Creek Avenue											
1	L	22	3.0	0.091	15.7	LOS B	0.3	2.2	0.65	0.83	37.4
2	T	3	3.0	0.091	12.8	LOS A	0.3	2.2	0.65	0.80	36.9
3	R	7	3.0	0.091	16.0	LOS B	0.3	2.2	0.65	0.90	37.4
Approach		33	3.0	0.091	15.5	LOS B	0.3	2.2	0.65	0.84	37.4
East: Remembrance Drive (East)											
4	L	11	3.0	0.306	9.5	LOS A	2.7	19.5	0.56	0.49	33.8
5	T	521	3.0	0.306	2.0	LOS A	2.7	19.5	0.56	0.00	37.6
6	R	29	3.0	0.306	9.6	LOS A	2.7	19.5	0.56	1.00	49.1
Approach		561	3.0	0.306	2.5	NA	2.7	19.5	0.56	0.06	38.8
North: York Street											
7	L	76	3.0	0.180	10.9	LOS A	0.7	4.7	0.52	0.70	34.6
8	T	14	3.0	0.180	9.1	LOS A	0.7	4.7	0.52	0.72	34.5
9	R	6	3.0	0.180	11.2	LOS A	0.7	4.7	0.52	0.84	34.5
Approach		96	3.0	0.180	10.7	LOS A	0.7	4.7	0.52	0.71	34.6
West: Remembrance Drive (West)											
10	L	7	3.0	0.181	10.8	LOS A	1.8	12.6	0.65	0.38	47.8
11	T	303	3.0	0.181	3.5	LOS A	1.8	12.6	0.65	0.00	39.3
12	R	15	3.0	0.181	11.4	LOS A	1.8	12.6	0.65	1.06	36.4
Approach		325	3.0	0.181	4.0	NA	1.8	12.6	0.65	0.06	39.5
All Vehicles		1015	3.0	0.306	4.2	NA	2.7	19.5	0.59	0.15	38.0

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Progress St & Remem Dr AM Ex

Intersection: Remembrance Drive & Progress Street
Period: AM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Progress Street											
1	L	19	5.0	0.182	19.8	LOS B	0.6	4.5	0.71	0.79	34.0
3	R	27	5.0	0.182	19.7	LOS B	0.6	4.5	0.71	0.88	34.0
Approach		46	5.0	0.182	19.7	LOS B	0.6	4.5	0.71	0.84	34.0
East: Remembrance Drive (East)											
4	L	11	5.0	0.006	6.5	LOS A	0.0	0.0	0.00	0.61	31.8
5	T	379	5.0	0.201	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		389	5.0	0.201	0.2	NA	0.0	0.0	0.00	0.02	49.2
West: Remembrance Drive (West)											
11	T	560	5.0	0.157	1.0	LOS A	1.3	9.2	0.25	0.00	42.9
12	R	17	5.0	0.157	8.8	LOS A	1.3	9.2	0.52	0.88	34.9
Approach		577	5.0	0.157	1.2	NA	1.3	9.2	0.25	0.03	42.6
All Vehicles		1013	5.0	0.201	1.7	NA	1.3	9.2	0.18	0.06	42.8

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Progress St & Remem Dr PM Ex

Intersection: Remembrance Drive & Progress Street
Period: PM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Progress Street											
1	L	23	5.0	0.152	19.1	LOS B	0.5	3.6	0.71	0.83	34.3
3	R	17	5.0	0.152	19.0	LOS B	0.5	3.6	0.71	0.88	34.4
Approach		40	5.0	0.152	19.0	LOS B	0.5	3.6	0.71	0.85	34.4
East: Remembrance Drive (East)											
4	L	15	5.0	0.008	6.5	LOS A	0.0	0.0	0.00	0.61	31.8
5	T	480	5.0	0.254	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		495	5.0	0.254	0.2	NA	0.0	0.0	0.00	0.02	49.1
West: Remembrance Drive (West)											
11	T	547	5.0	0.158	1.3	LOS A	1.4	9.9	0.26	0.00	42.3
12	R	23	5.0	0.158	9.6	LOS A	1.4	9.9	0.58	0.91	34.0
Approach		571	5.0	0.158	1.6	NA	1.4	9.9	0.28	0.04	41.9
All Vehicles		1105	5.0	0.254	1.6	NA	1.4	9.9	0.17	0.06	43.1

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Intersection: Remembrance Drive & River Road
Period: AM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	9	3.0	0.089	12.5	LOS A	0.3	2.2	0.57	0.71	39.5
3	R	36	3.0	0.089	12.8	LOS A	0.3	2.2	0.57	0.86	39.4
Approach		45	3.0	0.089	12.8	LOS A	0.3	2.2	0.57	0.83	39.4
East: Remembrance Drive (East)											
4	L	3	3.0	0.180	10.1	LOS A	0.0	0.0	0.00	1.34	57.1
5	T	341	3.0	0.180	2.6	LOS A	0.0	0.0	0.00	0.23	71.0
Approach		344	3.0	0.180	2.7	NA	0.0	0.0	0.00	0.24	70.8
West: Remembrance Drive (West)											
11	T	441	3.0	0.234	2.0	LOS A	2.0	14.6	0.55	0.00	51.8
12	R	3	3.0	0.234	9.8	LOS A	2.0	14.6	0.55	1.05	49.3
Approach		444	3.0	0.234	2.1	NA	2.0	14.6	0.55	0.01	51.8
All Vehicles		834	3.0	0.234	2.9	NA	2.0	14.6	0.32	0.15	56.8

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Intersection: Remembrance Drive & River Road
Period: PM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	8	3.0	0.048	13.1	LOS A	0.2	1.1	0.62	0.80	39.1
3	R	14	3.0	0.048	13.4	LOS A	0.2	1.1	0.62	0.88	39.0
Approach		22	3.0	0.048	13.3	LOS A	0.2	1.1	0.62	0.85	39.1
East: Remembrance Drive (East)											
4	L	34	3.0	0.314	10.2	LOS A	0.0	0.0	0.00	1.35	57.1
5	T	565	3.0	0.314	2.6	LOS A	0.0	0.0	0.00	0.22	71.0
Approach		599	3.0	0.314	3.0	NA	0.0	0.0	0.00	0.28	70.1
West: Remembrance Drive (West)											
11	T	264	3.0	0.147	4.1	LOS A	1.5	11.0	0.67	0.00	49.8
12	R	6	3.0	0.147	11.9	LOS A	1.5	11.0	0.67	1.09	47.6
Approach		271	3.0	0.147	4.2	NA	1.5	11.0	0.67	0.03	49.8
All Vehicles		892	3.0	0.314	3.6	NA	1.5	11.0	0.22	0.22	60.7

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Struan St & Remem Dr AM Ex

Intersection: Remembrance Drive & Struan Street
Period: AM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Struan Street											
1	L	31	3.0	0.120	15.3	LOS B	0.4	2.9	0.61	0.77	37.6
3	R	14	3.0	0.120	15.6	LOS B	0.4	2.9	0.61	0.88	37.5
Approach		44	3.0	0.120	15.4	LOS B	0.4	2.9	0.61	0.80	37.6
East: Remembrance Drive (East)											
4	L	11	3.0	0.213	10.2	LOS A	0.0	0.0	0.00	1.35	57.1
5	T	396	3.0	0.213	2.6	LOS A	0.0	0.0	0.00	0.22	71.0
Approach		406	3.0	0.213	2.8	NA	0.0	0.0	0.00	0.25	70.6
West: Remembrance Drive (West)											
11	T	484	3.0	0.272	2.7	LOS A	2.6	18.5	0.62	0.00	50.5
12	R	18	3.0	0.272	10.6	LOS A	2.6	18.5	0.62	1.04	48.8
Approach		502	3.0	0.272	3.0	NA	2.6	18.5	0.62	0.04	50.5
All Vehicles		953	3.0	0.272	3.5	NA	2.6	18.5	0.35	0.16	56.0

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Struan St & Remem Dr PM Ex

Intersection: Remembrance Drive & Struan Street
Period: PM
Scenario: Existing
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Struan Street											
1	L	19	3.0	0.046	12.2	LOS A	0.2	1.1	0.55	0.74	39.8
3	R	4	3.0	0.046	12.5	LOS A	0.2	1.1	0.55	0.86	39.7
Approach		23	3.0	0.046	12.3	LOS A	0.2	1.1	0.55	0.76	39.8
East: Remembrance Drive (East)											
4	L	4	3.0	0.240	7.5	LOS A	0.0	0.0	0.00	1.19	48.6
5	T	454	3.0	0.240	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		458	3.0	0.240	0.1	NA	0.0	0.0	0.00	0.01	59.9
West: Remembrance Drive (West)											
11	T	304	3.0	0.190	2.8	LOS A	1.7	11.9	0.59	0.00	49.8
12	R	27	3.0	0.190	10.7	LOS A	1.7	11.9	0.59	1.03	48.3
Approach		332	3.0	0.190	3.5	NA	1.7	11.9	0.59	0.09	49.7
All Vehicles		813	3.0	0.240	1.8	NA	1.7	11.9	0.26	0.06	54.5

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Intersection: Thirlmere Way & Remembrance Drive
Period: AM
Scenario: Existing
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Remembrance Drive											
5	T	246	3.0	0.345	7.1	LOS A	1.9	13.9	0.36	0.54	48.9
6	R	132	3.0	0.345	11.9	LOS A	1.9	13.9	0.36	0.77	45.8
Approach		378	3.0	0.345	8.7	LOS A	1.9	13.9	0.36	0.62	47.7
North: Thirlmere Drive											
7	L	139	3.0	0.140	9.1	LOS A	0.7	4.7	0.46	0.68	47.6
9	R	143	3.0	0.159	12.6	LOS A	0.7	4.8	0.46	0.73	44.8
Approach		282	3.0	0.159	10.9	LOS A	0.7	4.8	0.46	0.70	46.1
West: Remembrance Drive											
10	L	215	3.0	0.184	8.3	LOS A	1.0	7.4	0.33	0.60	48.2
11	T	373	3.0	0.262	6.8	LOS A	1.6	11.6	0.33	0.53	49.3
Approach		587	3.0	0.262	7.3	LOS A	1.6	11.6	0.33	0.55	48.9
All Vehicles		1247	3.0	0.345	8.6	LOS A	1.9	13.9	0.37	0.61	47.9

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Intersection: Thirlmere Way & Remembrance Drive
Period: PM
Scenario: Existing
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Remembrance Drive											
5	T	292	3.0	0.473	7.6	LOS A	3.0	21.3	0.48	0.60	48.0
6	R	200	3.0	0.473	12.5	LOS A	3.0	21.3	0.48	0.78	45.5
Approach		492	3.0	0.473	9.6	LOS A	3.0	21.3	0.48	0.67	47.0
North: Thirlmere Drive											
7	L	136	3.0	0.133	8.5	LOS A	0.6	4.3	0.36	0.63	48.0
9	R	203	3.0	0.219	11.9	LOS A	0.9	6.2	0.36	0.70	45.1
Approach		339	3.0	0.219	10.6	LOS A	0.9	6.2	0.36	0.67	46.2
West: Remembrance Drive											
10	L	297	3.0	0.227	8.4	LOS A	1.4	9.9	0.41	0.62	47.8
11	T	216	3.0	0.190	7.3	LOS A	1.1	7.9	0.41	0.57	48.8
Approach		513	3.0	0.227	7.9	LOS A	1.4	9.9	0.41	0.60	48.2
All Vehicles		1343	3.0	0.473	9.2	LOS A	3.0	21.3	0.43	0.64	47.2

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

Appendix B-2

Existing plus Development Scenario

MOVEMENT SUMMARY

Site: Myrtle Creek & Remem Dr
AM Ex + Dev

Intersection: Remembrance Drive & Myrtle Creek Avenue
Period: AM
Scenario: Existing + Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Myrtle Creek Avenue											
1	L	25	3.0	0.209	17.3	LOS B	0.7	5.4	0.64	0.73	36.4
2	T	1	3.0	0.209	14.4	LOS A	0.7	5.4	0.64	0.79	35.8
3	R	42	3.0	0.209	17.6	LOS B	0.7	5.4	0.64	0.89	36.3
Approach		68	3.0	0.209	17.4	LOS B	0.7	5.4	0.64	0.83	36.3
East: Remembrance Drive (East)											
4	L	11	3.0	0.171	9.3	LOS A	1.4	9.8	0.53	0.51	32.0
5	T	282	3.0	0.171	2.1	LOS A	1.4	9.8	0.53	0.00	38.1
6	R	17	3.0	0.171	9.7	LOS A	1.4	9.8	0.53	1.01	48.9
Approach		309	3.0	0.171	2.7	NA	1.4	9.8	0.53	0.07	39.1
North: York Street											
7	L	127	3.0	0.183	8.7	LOS A	0.7	4.9	0.48	0.72	35.9
8	T	1	3.0	0.183	6.8	LOS A	0.7	4.9	0.48	0.69	35.8
9	R	5	3.0	0.183	9.0	LOS A	0.7	4.9	0.48	0.83	35.7
Approach		134	3.0	0.183	8.7	LOS A	0.7	4.9	0.48	0.72	35.9
West: Remembrance Drive (West)											
10	L	5	3.0	0.205	8.8	LOS A	1.6	11.6	0.49	0.56	49.0
11	T	365	3.0	0.205	1.6	LOS A	1.6	11.6	0.49	0.00	43.2
12	R	12	3.0	0.205	9.4	LOS A	1.6	11.6	0.49	1.03	38.3
Approach		382	3.0	0.205	1.9	NA	1.6	11.6	0.49	0.04	43.2
All Vehicles		894	3.0	0.209	4.4	NA	1.6	11.6	0.51	0.21	39.0

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Intersection: Remembrance Drive & Myrtle Creek Avenue
Period: PM
Scenario: Existing + Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Myrtle Creek Avenue											
1	L	25	3.0	0.149	18.6	LOS B	0.5	3.6	0.72	0.90	35.7
2	T	3	3.0	0.149	15.6	LOS B	0.5	3.6	0.72	0.84	35.0
3	R	15	3.0	0.149	18.9	LOS B	0.5	3.6	0.72	0.92	35.6
Approach		43	3.0	0.149	18.4	LOS B	0.5	3.6	0.72	0.90	35.6
East: Remembrance Drive (East)											
4	L	41	3.0	0.334	9.9	LOS A	3.1	22.6	0.62	0.41	33.5
5	T	539	3.0	0.334	2.4	LOS A	3.1	22.6	0.62	0.00	35.9
6	R	29	3.0	0.334	10.0	LOS A	3.1	22.6	0.62	0.99	49.1
Approach		609	3.0	0.334	3.2	NA	3.1	22.6	0.62	0.08	37.0
North: York Street											
7	L	76	3.0	0.193	11.5	LOS A	0.7	5.0	0.55	0.72	34.3
8	T	14	3.0	0.193	9.7	LOS A	0.7	5.0	0.55	0.73	34.1
9	R	6	3.0	0.193	11.9	LOS A	0.7	5.0	0.55	0.85	34.2
Approach		96	3.0	0.193	11.3	LOS A	0.7	5.0	0.55	0.73	34.3
West: Remembrance Drive (West)											
10	L	38	3.0	0.202	11.4	LOS A	2.1	15.0	0.71	0.31	47.4
11	T	303	3.0	0.202	4.2	LOS A	2.1	15.0	0.71	0.00	37.6
12	R	17	3.0	0.202	12.0	LOS A	2.1	15.0	0.71	1.04	35.3
Approach		358	3.0	0.202	5.3	NA	2.1	15.0	0.71	0.08	39.1
All Vehicles		1106	3.0	0.334	5.2	NA	3.1	22.6	0.65	0.17	37.0

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Progress St & Remem Dr AM Ex +Dev

Intersection: Remembrance Drive & Progress Street
Period: AM
Scenario: Existing+Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Progress Street											
1	L	21	5.0	0.246	23.5	LOS B	0.9	6.4	0.76	0.88	32.0
3	R	34	5.0	0.246	23.4	LOS B	0.9	6.4	0.76	0.93	32.0
Approach		55	5.0	0.246	23.4	LOS B	0.9	6.4	0.76	0.91	32.0
East: Remembrance Drive (East)											
4	L	12	5.0	0.006	6.5	LOS A	0.0	0.0	0.00	0.61	31.8
5	T	423	5.0	0.224	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		435	5.0	0.224	0.2	NA	0.0	0.0	0.00	0.02	49.2
West: Remembrance Drive (West)											
11	T	571	5.0	0.161	1.1	LOS A	1.3	9.8	0.26	0.00	42.5
12	R	18	5.0	0.161	9.2	LOS A	1.3	9.8	0.55	0.90	34.6
Approach		588	5.0	0.161	1.4	NA	1.3	9.8	0.27	0.03	42.2
All Vehicles		1078	5.0	0.246	2.0	NA	1.3	9.8	0.18	0.07	42.1

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Progress St & Remem Dr PM Ex + Dev

Intersection: Remembrance Drive & Progress Street
Period: PM
Scenario: Existing+ Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Progress Street											
1	L	24	5.0	0.176	20.6	LOS B	0.6	4.2	0.73	0.85	33.5
3	R	18	5.0	0.176	20.6	LOS B	0.6	4.2	0.73	0.89	33.5
Approach		42	5.0	0.176	20.6	LOS B	0.6	4.2	0.73	0.87	33.5
East: Remembrance Drive (East)											
4	L	6	5.0	0.004	6.5	LOS A	0.0	0.0	0.00	0.61	31.8
5	T	491	5.0	0.260	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		497	5.0	0.260	0.1	NA	0.0	0.0	0.00	0.01	49.6
West: Remembrance Drive (West)											
11	T	592	5.0	0.171	1.3	LOS A	1.5	10.9	0.27	0.00	42.3
12	R	25	5.0	0.171	9.7	LOS A	1.5	10.9	0.59	0.91	33.9
Approach		617	5.0	0.171	1.7	NA	1.5	10.9	0.28	0.04	41.8
All Vehicles		1156	5.0	0.260	1.7	NA	1.5	10.9	0.18	0.05	42.9

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: River Rd & Remem Dr AM Ex + Dev

Intersection: Remembrance Drive & River Road
Period: AM
Scenario: Existing + Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	40	3.0	0.314	14.7	LOS B	1.3	9.4	0.65	0.87	37.9
3	R	108	3.0	0.314	15.0	LOS B	1.3	9.4	0.65	0.93	37.9
Approach		148	3.0	0.314	15.0	LOS B	1.3	9.4	0.65	0.92	37.9
East: Remembrance Drive (East)											
4	L	21	3.0	0.196	10.2	LOS A	0.0	0.0	0.00	1.35	57.1
5	T	353	3.0	0.196	2.6	LOS A	0.0	0.0	0.00	0.22	71.0
Approach		374	3.0	0.196	3.0	NA	0.0	0.0	0.00	0.28	70.1
West: Remembrance Drive (West)											
11	T	489	3.0	0.267	2.4	LOS A	2.5	17.6	0.59	0.00	51.1
12	R	11	3.0	0.267	10.2	LOS A	2.5	17.6	0.59	1.05	49.1
Approach		500	3.0	0.267	2.6	NA	2.5	17.6	0.59	0.02	51.0
All Vehicles		1022	3.0	0.314	4.5	NA	2.5	17.6	0.38	0.25	53.5

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: River Rd & Remem Dr PM Ex + Dev

Intersection: Remembrance Drive & River Road
Period: PM
Scenario: Existing+Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	8	3.0	0.051	14.1	LOS A	0.2	1.2	0.66	0.83	38.4
3	R	13	0.0	0.051	14.3	LOS A	0.2	1.2	0.66	0.89	38.3
Approach		21	1.1	0.051	14.2	LOS A	0.2	1.2	0.66	0.87	38.3
East: Remembrance Drive (East)											
4	L	101	0.0	0.359	10.1	LOS A	0.0	0.0	0.00	1.33	57.1
5	T	583	3.0	0.359	2.6	LOS A	0.0	0.0	0.00	0.20	71.0
Approach		684	2.6	0.359	3.7	NA	0.0	0.0	0.00	0.37	68.6
West: Remembrance Drive (West)											
11	T	262	3.0	0.193	5.5	LOS A	2.0	14.3	0.71	0.00	48.9
12	R	35	0.0	0.193	13.3	LOS A	2.0	14.3	0.71	1.06	45.9
Approach		297	2.6	0.193	6.4	NA	2.0	14.3	0.71	0.12	48.5
All Vehicles		1002	2.6	0.359	4.7	NA	2.0	14.3	0.22	0.31	59.7

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Struan St & Remem Dr AM Ex +Dev

Intersection: Remembrance Drive & Struan Street
Period: AM
Scenario: Existing+Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Struan Street											
1	L	36	3.0	0.217	19.5	LOS B	0.7	5.4	0.71	0.87	35.1
3	R	25	3.0	0.217	19.8	LOS B	0.7	5.4	0.71	0.92	35.0
Approach		61	3.0	0.217	19.7	LOS B	0.7	5.4	0.71	0.89	35.0
East: Remembrance Drive (East)											
4	L	14	3.0	0.237	10.2	LOS A	0.0	0.0	0.00	1.35	57.1
5	T	439	3.0	0.237	2.6	LOS A	0.0	0.0	0.00	0.22	71.0
Approach		453	3.0	0.237	2.8	NA	0.0	0.0	0.00	0.26	70.5
West: Remembrance Drive (West)											
11	T	495	3.0	0.280	3.2	LOS A	2.8	20.1	0.66	0.00	49.9
12	R	19	3.0	0.280	11.0	LOS A	2.8	20.1	0.66	1.05	48.5
Approach		514	3.0	0.280	3.5	NA	2.8	20.1	0.66	0.04	49.8
All Vehicles		1027	3.0	0.280	4.2	NA	2.8	20.1	0.37	0.18	55.2

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Struan St & Remem Dr PM Ex +Dev

Intersection: Remembrance Drive & Struan Street
Period: PM
Scenario: Existing+Development
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Struan Street											
1	L	20	3.0	0.067	14.2	LOS A	0.2	1.6	0.59	0.77	38.4
3	R	7	3.0	0.067	14.5	LOS B	0.2	1.6	0.59	0.88	38.3
Approach		27	3.0	0.067	14.3	LOS A	0.2	1.6	0.59	0.80	38.4
East: Remembrance Drive (East)											
4	L	16	3.0	0.251	7.5	LOS A	0.0	0.0	0.00	1.16	48.6
5	T	464	3.0	0.251	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		480	3.0	0.251	0.2	NA	0.0	0.0	0.00	0.04	59.6
West: Remembrance Drive (West)											
11	T	349	3.0	0.221	3.2	LOS A	2.0	14.5	0.63	0.00	49.3
12	R	33	3.0	0.221	11.0	LOS A	2.0	14.5	0.63	1.04	48.0
Approach		382	3.0	0.221	3.9	NA	2.0	14.5	0.63	0.09	49.2
All Vehicles		889	3.0	0.251	2.2	NA	2.0	14.5	0.29	0.08	53.8

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Thirlmere Way & Remem Dr
AM Ex+ Dev

Intersection: Thirlmere Way & Remembrance Drive
Period: AM
Scenario: Existing + Development
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Remembrance Drive											
5	T	291	3.0	0.387	7.1	LOS A	2.3	16.4	0.38	0.55	48.8
6	R	137	3.0	0.387	11.9	LOS A	2.3	16.4	0.38	0.77	45.8
Approach		427	3.0	0.387	8.6	LOS A	2.3	16.4	0.38	0.62	47.8
North: Thirlmere Drive											
7	L	140	3.0	0.142	9.2	LOS A	0.7	4.9	0.47	0.68	47.5
9	R	143	3.0	0.161	12.7	LOS A	0.7	4.9	0.47	0.74	44.7
Approach		283	3.0	0.161	11.0	LOS A	0.7	4.9	0.47	0.71	46.0
West: Remembrance Drive											
10	L	215	3.0	0.187	8.3	LOS A	1.0	7.5	0.34	0.60	48.1
11	T	389	3.0	0.275	6.8	LOS A	1.7	12.4	0.34	0.53	49.2
Approach		604	3.0	0.275	7.4	LOS A	1.7	12.4	0.34	0.56	48.8
All Vehicles		1315	3.0	0.387	8.6	LOS A	2.3	16.4	0.38	0.61	47.8

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Intersection: Thirlmere Way & Remembrance Drive
Period: PM
Scenario: Existing+Development
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Remembrance Drive											
5	T	302	3.0	0.485	7.7	LOS A	3.1	22.3	0.49	0.60	48.0
6	R	201	3.0	0.485	12.5	LOS A	3.1	22.3	0.49	0.78	45.5
Approach		503	3.0	0.485	9.6	LOS A	3.1	22.3	0.49	0.67	46.9
North: Thirlmere Drive											
7	L	141	3.0	0.142	8.7	LOS A	0.7	4.7	0.40	0.65	47.9
9	R	203	3.0	0.221	12.2	LOS A	0.9	6.5	0.40	0.71	45.0
Approach		344	3.0	0.221	10.8	LOS A	0.9	6.5	0.40	0.68	46.1
West: Remembrance Drive											
10	L	297	3.0	0.227	8.4	LOS A	1.4	10.0	0.41	0.62	47.8
11	T	261	3.0	0.223	7.3	LOS A	1.3	9.5	0.42	0.57	48.7
Approach		558	3.0	0.227	7.9	LOS A	1.4	10.0	0.42	0.59	48.2
All Vehicles		1405	3.0	0.485	9.2	LOS A	3.1	22.3	0.44	0.65	47.2

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

Appendix B-3

Existing plus Development plus Tahmoor Recreation Precinct

MOVEMENT SUMMARY

Site: Myrtle Creek & Remem Dr
AM Ex + Dev+JR Stud Site

Intersection: Remembrance Drive & Myrtle Creek Avenue
Period: AM
Scenario: Existing + Development+ JR Stud Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Myrtle Creek Avenue											
1	L	49	3.0	0.239	15.6	LOS B	0.9	6.4	0.59	0.74	37.5
2	T	1	3.0	0.239	12.7	LOS A	0.9	6.4	0.59	0.77	36.9
3	R	42	3.0	0.239	15.9	LOS B	0.9	6.4	0.59	0.88	37.4
Approach		93	3.0	0.239	15.7	LOS B	0.9	6.4	0.59	0.81	37.4
East: Remembrance Drive (East)											
4	L	11	3.0	0.171	9.3	LOS A	1.4	9.8	0.53	0.51	32.0
5	T	282	3.0	0.171	2.1	LOS A	1.4	9.8	0.53	0.00	38.1
6	R	17	3.0	0.171	9.7	LOS A	1.4	9.8	0.53	1.01	48.9
Approach		309	3.0	0.171	2.7	NA	1.4	9.8	0.53	0.07	39.1
North: York Street											
7	L	127	3.0	0.184	8.7	LOS A	0.7	5.0	0.48	0.72	35.9
8	T	1	3.0	0.184	6.8	LOS A	0.7	5.0	0.48	0.70	35.8
9	R	5	3.0	0.184	9.0	LOS A	0.7	5.0	0.48	0.83	35.7
Approach		134	3.0	0.184	8.7	LOS A	0.7	5.0	0.48	0.72	35.9
West: Remembrance Drive (West)											
10	L	5	3.0	0.211	8.9	LOS A	1.7	11.9	0.49	0.56	49.0
11	T	365	3.0	0.211	1.6	LOS A	1.7	11.9	0.49	0.00	43.1
12	R	18	3.0	0.211	9.5	LOS A	1.7	11.9	0.49	1.02	38.2
Approach		388	3.0	0.211	2.1	NA	1.7	11.9	0.49	0.05	43.0
All Vehicles		924	3.0	0.239	4.6	NA	1.7	11.9	0.51	0.23	39.0

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Intersection: Remembrance Drive & Myrtle Creek Avenue
Period: PM
Scenario: Existing + Development +JR Stud Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Myrtle Creek Avenue											
1	L	35	3.0	0.169	17.7	LOS B	0.6	4.1	0.71	0.89	36.2
2	T	3	3.0	0.169	14.8	LOS B	0.6	4.1	0.71	0.83	35.5
3	R	15	3.0	0.169	18.1	LOS B	0.6	4.1	0.71	0.91	36.1
Approach		53	3.0	0.169	17.7	LOS B	0.6	4.1	0.71	0.90	36.1
East: Remembrance Drive (East)											
4	L	41	3.0	0.334	9.9	LOS A	3.1	22.6	0.62	0.41	33.5
5	T	539	3.0	0.334	2.4	LOS A	3.1	22.6	0.62	0.00	35.9
6	R	29	3.0	0.334	10.0	LOS A	3.1	22.6	0.62	0.99	49.1
Approach		609	3.0	0.334	3.2	NA	3.1	22.6	0.62	0.08	37.0
North: York Street											
7	L	76	3.0	0.199	11.8	LOS A	0.7	5.1	0.55	0.72	34.2
8	T	14	3.0	0.199	10.0	LOS A	0.7	5.1	0.55	0.74	33.9
9	R	6	3.0	0.199	12.1	LOS A	0.7	5.1	0.55	0.85	34.0
Approach		96	3.0	0.199	11.6	LOS A	0.7	5.1	0.55	0.73	34.1
West: Remembrance Drive (West)											
10	L	38	3.0	0.231	11.6	LOS A	2.3	16.5	0.71	0.31	47.2
11	T	303	3.0	0.231	4.4	LOS A	2.3	16.5	0.71	0.00	37.3
12	R	38	3.0	0.231	12.2	LOS A	2.3	16.5	0.71	1.03	34.7
Approach		379	3.0	0.231	5.9	NA	2.3	16.5	0.71	0.13	38.6
All Vehicles		1137	3.0	0.334	5.5	NA	3.1	22.6	0.65	0.19	36.9

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: River Rd & Remem Dr AM Ex + Dev +JR Stud Site

Intersection: Remembrance Drive & River Road
Period: AM
Scenario: Existing + Development +JR Stud Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	38	3.0	0.408	15.7	LOS B	1.9	13.8	0.68	0.93	37.3
3	R	157	3.0	0.408	16.0	LOS B	1.9	13.8	0.68	0.98	37.2
Approach		195	3.0	0.408	15.9	LOS B	1.9	13.8	0.68	0.97	37.3
East: Remembrance Drive (East)											
4	L	33	3.0	0.193	10.2	LOS A	0.0	0.0	0.00	1.35	57.1
5	T	335	3.0	0.193	2.6	LOS A	0.0	0.0	0.00	0.21	71.0
Approach		368	3.0	0.193	3.3	NA	0.0	0.0	0.00	0.31	69.5
West: Remembrance Drive (West)											
11	T	465	3.0	0.253	2.3	LOS A	2.3	16.4	0.58	0.00	51.3
12	R	10	3.0	0.253	10.1	LOS A	2.3	16.4	0.58	1.05	49.1
Approach		475	3.0	0.253	2.5	NA	2.3	16.4	0.58	0.02	51.2
All Vehicles		1038	3.0	0.408	5.3	NA	2.3	16.4	0.39	0.30	52.4

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: River Rd & Remem Dr PM Ex + Dev +JR Stud Site

Intersection: Remembrance Drive & River Road
Period: PM
Scenario: Existing+Development +JR Stud Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	15	3.0	0.181	16.1	LOS B	0.6	4.3	0.73	0.90	37.1
3	R	51	3.0	0.181	16.4	LOS B	0.6	4.3	0.73	0.92	37.0
Approach		66	3.0	0.181	16.3	LOS B	0.6	4.3	0.73	0.91	37.0
East: Remembrance Drive (East)											
4	L	195	3.0	0.412	10.2	LOS A	0.0	0.0	0.00	1.34	57.1
5	T	583	3.0	0.412	2.6	LOS A	0.0	0.0	0.00	0.19	71.0
Approach		778	3.0	0.412	4.5	NA	0.0	0.0	0.00	0.48	67.0
West: Remembrance Drive (West)											
11	T	262	3.0	0.204	7.2	LOS A	2.4	17.0	0.80	0.00	47.4
12	R	35	3.0	0.204	15.1	LOS B	2.4	17.0	0.80	1.05	44.5
Approach		297	3.0	0.204	8.2	NA	2.4	17.0	0.80	0.12	47.1
All Vehicles		1141	3.0	0.412	6.1	NA	2.4	17.0	0.25	0.41	57.5

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

Appendix B-4

Existing plus Development plus Wollondilly Local Environmental Plan

River Road/Remembrance Drive Intersection Upgrade

MOVEMENT SUMMARY

Site: River Rd & Remem Dr AM Ex + Dev +Cardno

Intersection Upgrade: Remembrance Drive & River Road (Roundabout)
Period: AM
Scenario: Existing + Development + Cardno (Wollondilly LES)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	30	5.0	0.200	9.5	LOS A	0.9	6.4	0.56	0.76	41.7
3	R	123	5.0	0.200	13.0	LOS A	0.9	6.4	0.56	0.83	39.7
Approach		153	5.0	0.200	12.3	LOS A	0.9	6.4	0.56	0.82	40.1
East: Remembrance Drive (East)											
4	L	37	5.0	0.184	10.0	LOS A	1.1	7.9	0.06	0.73	57.4
5	T	530	5.0	0.184	9.0	LOS A	1.1	7.9	0.06	0.60	58.5
Approach		567	5.0	0.184	9.1	LOS A	1.1	7.9	0.06	0.61	58.5
West: Remembrance Drive (West)											
11	T	1277	5.0	0.507	9.0	LOS A	4.2	30.7	0.45	0.59	50.0
12	R	8	5.0	0.507	11.0	LOS A	4.2	30.4	0.46	0.76	45.6
Approach		1285	5.0	0.507	9.0	LOS A	4.2	30.7	0.45	0.59	50.0
All Vehicles		2005	5.0	0.507	9.3	LOS A	4.2	30.7	0.35	0.61	51.0

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: River Rd & Remem Dr PM Ex + Dev +Cardno

Intersection Upgrade: Remembrance Drive & River Road (Roundabout)
Period: PM
Scenario: Existing + Development + Cardno (Wollondilly LES)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: River Road											
1	L	8	5.0	0.090	12.5	LOS A	0.4	2.7	0.69	0.87	39.4
3	R	37	5.0	0.090	16.0	LOS B	0.4	2.7	0.69	0.92	37.7
Approach		45	5.0	0.090	15.4	LOS B	0.4	2.7	0.69	0.91	38.0
East: Remembrance Drive (East)											
4	L	142	5.0	0.492	10.1	LOS A	3.9	28.3	0.18	0.68	56.8
5	T	1321	5.0	0.492	9.2	LOS A	3.9	28.4	0.19	0.57	57.5
Approach		1463	5.0	0.492	9.3	LOS A	3.9	28.4	0.19	0.58	57.5
West: Remembrance Drive (West)											
11	T	594	5.0	0.222	8.2	LOS A	1.4	10.3	0.18	0.55	51.5
12	R	30	5.0	0.222	10.3	LOS A	1.4	10.2	0.18	0.79	45.8
Approach		624	5.0	0.222	8.3	LOS A	1.4	10.3	0.18	0.57	51.2
All Vehicles		2132	5.0	0.492	9.1	LOS A	3.9	28.4	0.20	0.58	54.8

Level of Service (LOS) Method: Delay (RTA NSW).
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.
SIDRA Standard Delay Model used.

Appendix C

Wollondilly Shire Council Urban Road Design Requirements

Table D.1.5 Characteristics of Urban Roads in Wollondilly Shire Council Road Networks

Road Category & Type	Maximum Number of Dwellings	Maximum Speed [2] (kph)	Road Reserve Width (m	Carriageway width (m)	Verge Width (m) Left/Right	Kerb Type	1.5 m wide Concrete Footpaving/ 2.0 m Cyclepath	Specific Parking Provisions
Cat. A Accessway	7	25	10	5.0	2.5 / 2.5	Flush or Roll	No	No
Cat. B Minor Cul-de-Sac	15	30	13	6.0	3.5 / 3.5	Roll	No	No
Cat. C Cul-de-Sac	30	40	15	8.0	3.5 / 3.5 [2]	Roll	Yes [1]	No
Cat D1 Local Street	N/A	50	15	8.0	3.5 / 3.5 [2]	Roll	Yes [1]	No
Cat. D2 Local Street	N/A	50	18	10.0	4.0 / 4.0 [3]	Standard K & G	Yes [1]	No
Cat. E Collector / Bus Route	N/A	60	21	13.0	4.0 / 4.0 [3]	Standard K &	Yes [1]	No
Cat. F Commercial / Industrial	N/A	60 / 80	21	13.0	4.0 / 4.0 [3]	Standard K & G	Yes [1]	No

1 Normally required by Council unless alternative shared pathway access is available via an integrated network within the development.
2 A 2.0m shared path/ cycleway requires a verge width of 4.5m. If required, this shall be provided by increasing the road reserve and may include reducing the opposite verge to 3.0m.
3 A 2.0m shared path/ cycleway requires a verge width of 4.5m. This may be provided by increasing the road reserve or reducing the opposite verge to 3.5m.