Our Reference: **PT22005**

A Gilbert, G Gilbert and S Zilko
C/O Premise Planning
3/31 Clinton Street
Goulburn NSW 2580

3 May 2023

Attention: Ms Tina Dodson

Via email: tina.dodson@premise.com.au

Planning Proposal for 171 lot residential subdivision – Lot 24 DP1119250 – 4273 Goulburn Road, CROOKWELL
Response Report

As requested, we have undertaken a review of the Traffic Impact Assessment (TIA) report prepared by Motion Traffic Engineers Pty Ltd dated March 2022 as well as the request for further information (RFI) Transport for NSW letter dated 18 January 2023 for the proposed rezoning of the above site to provide a residential subdivision. Copies of these documents are provided in **Appendix A** and **Appendix B** of this response report.

It is noted that the proposal includes only a rezoning application for residential development with the requirement for a future development application for the residential subdivision should approval be granted by Council and State authorities.

The Proposal

The proposed future subdivision would be located at the site known as No.4273 Goulburn Road, Crookwell as shown below in **Figure 1**.

Positive Traffic Pty Ltd ATF Positive Traffic Trust
PO Box 3457, Rouse Hill NSW 2155
T: 0414 462247 / E: dean@positivetraffic.com.au

Figure 1 – Site Location

© Nearmap

The site includes a single rural residential dwelling and frontages to both Goulburn Road (the main east – west road through the area) in the north and Grange Road in the west.

Access to the existing dwelling is via a single combined entry / exit driveway in Goulburn Road as shown below in **Figure 2**.

Figure 2 – Existing Site Access Driveway in Goulburn Road

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Future vehicle access to / from the site is expected to mainly occur through the intersection of Goulburn Road / Grange Road which currently includes a priority controlled intersection along with a wide gravel area which presents is a slip lane somewhat to westbound traffic in Goulburn Road although which has been closed via the installation of both removable bollards and concrete blocks as shown below in **Figure 3**.

Figure 3 – Existing Goulburn Road / Grange Road Intersection Arrangements

Motion Traffic Engineers Report Review

As stated above, we have reviewed the TIA report prepared by Motion Traffic Engineers in support of the proposed rezoning application and offer the following comments:

- Overall, the report has been prepared generally in accordance with the requirements of Austroads Guide to Traffic Management Part 12 and presents an assessment of existing and future traffic conditions on the basis the rezoning was approved for future housing.
- The report included a morning / afternoon peak hour intersection count of Goulburn Road / Grange Road along with SIDRA intersection modelling of both existing conditions and future conditions assuming *all* development generated traffic would pass through this intersection.
- The report found that the existing intersection operating conditions for both peak periods was Level of Service A.
- The report found that future intersection operating conditions at this intersection would remain at Level of Service A following *full* development of the site and *all* generated traffic passing through this particular intersection.
- Thus, the findings of the traffic report prepared by Motion Traffic Engineers indicates that intersection of Goulburn Road / Grange Road in its current form can accommodate the potential traffic generation of the future subdivision and would not require any capacity improvements to accommodate the potential demands generated by the proposal.

Responses / Additional Information to TfNSW RFI

The following presents comments / additional information in response to each item raised in the TfNSW RFI dated 18 January 2023. For ease of reference each item is repeated below verbatim with a response following.

Preliminary feedback

The Traffic and Parking Impact Assessment will need to address the following:

- *The trip distributions that are presented in the Traffic Impact and Parking Assessment need to be justified. This would include an explanation of the assumed travel patterns to access services and facilities in Crookwell and Goulburn.*

Response

It is noted from the existing intersection count that the eastbound and westbound traffic flows in Goulburn Road were tidal somewhat with a 70% westbound / 30% eastbound in the AM peak and a 40% westbound / 60% eastbound split in the PM peak period.

The trip distribution assumed in the TIA report was closer to a 50 / 50 split to the east and west of the intersection of Goulburn Road / Grange Road. Further, as recommended in the RTA Guide to Traffic Generating Developments, the TIA report assumed 80% outbound / 20% inbound in the AM peak with the reverse during the PM peak.

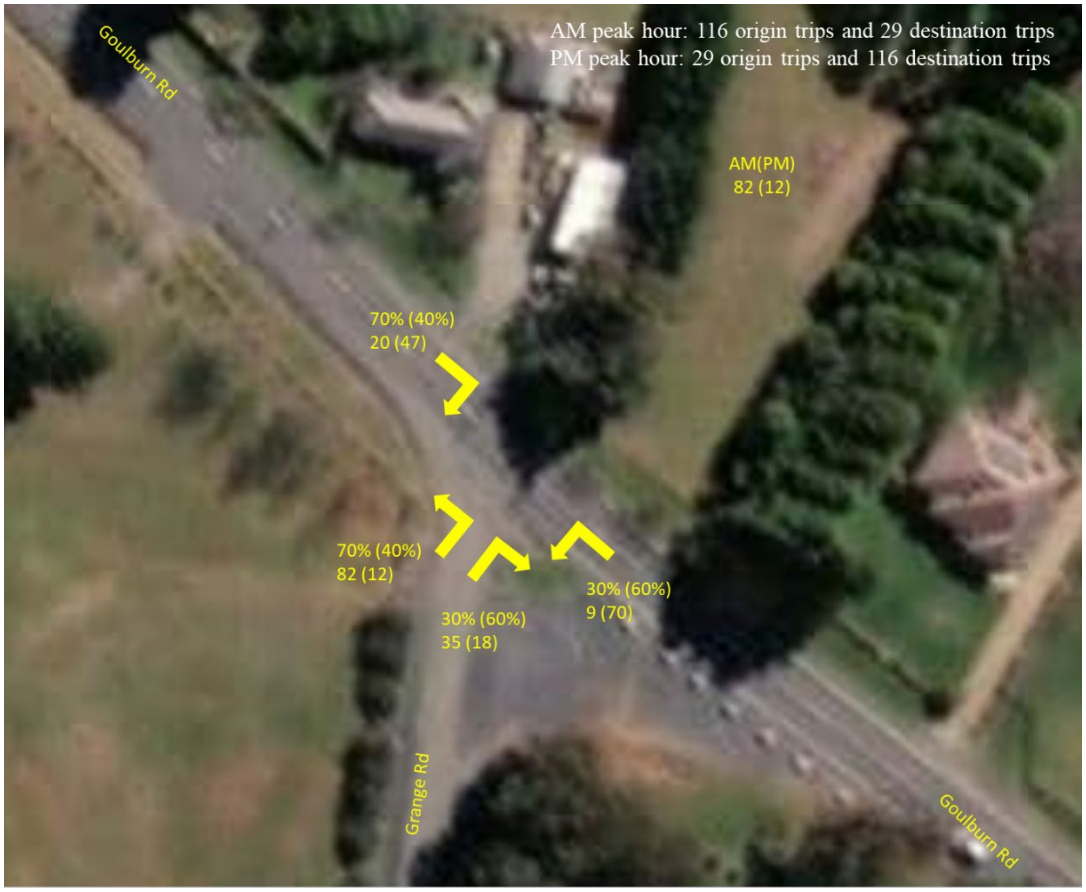
Of note, as a conservative estimate the TIA report assumed *all* traffic would pass through this intersection instead of using other routes to travel to the west such as Cullen Street / Kialla Road which would also be available to generated traffic wishing to gain access to the town centre of Crookwell.

Given the TIA report confirmed that both the existing and future intersection operating conditions at the intersection of Goulburn Road / Grange Road would remain Level of Service A in the future following full development of the site and the conservative approach of distributing all generated traffic through this intersection, any changes to the assumed trip distribution of the TIA report would have little to no impact on the resulting intersection performance findings.

Without a formal assessment of Census Journey to Work data traffic generated by a development is often distributed onto the main road network using the same distribution of mid block volumes on that network.

As a sensitivity test, the generated trips of the development (adopting the same conservative approach of *all* traffic passing through the intersection of Goulburn Road / Grange Road) have been distributed adopting the same mid block distribution of trips in Goulburn Road. This would result in the following additional trips by movement at the intersection as shown in **Figure 4**.

Figure 4 – Revised Trip Distribution of Potential Development Generated Traffic



The intersection of Goulburn Road / Grange Road has been analysed using the Sidra Intersection analysis program. Sidra Intersection determines the average delay that vehicles encounter, the degree of saturation of the intersection, and the level of service. The degree of saturation is the ratio of the arrival rate of vehicles to the capacity of the approach. Sidra Intersection provides analysis of the operating conditions which can be compared to the performance criteria set out in **Table 1**.

Table 1 – Level of Service Criteria

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

Adapted from RTA Guide to Traffic Generating Developments, 2002.

For roundabouts and priority intersections, the reported average delay is for the individual movement with the highest average delay per vehicle. At signalised intersections, the reported average delay is over all movements.

The existing weekday and weekend day intersection operating conditions are presented in **Table 2.** Average delay is expressed in seconds per vehicle. The assessment includes a 10 year future year analysis assuming a 2% per annum growth of all movements.

Table 2 – Existing Weekday AM / PM Intersection Operating Conditions

Intersection	Control	Morning Peak		Evening Peak	
		Av Delay	LOS	Av Delay	LOS
Existing					
Goulburn Rd / Grange Rd	Priority	6.2	A	6.1	A
Existing + Development					
Goulburn Rd / Grange Rd	Priority	6.5	A	6.5	A
Existing + Development + 10yrs					
Goulburn Rd / Grange Rd	Priority	6.8	A	6.8	A

Avg Delay (sec/veh) is over all movements at signals, and for worst movement at priority and roundabouts

From **Table 2** it is noted that the sensitivity test of an alternative distribution of generated trips of the development (conservatively assuming all generated traffic passes through the intersection of Goulburn Road / Grange Road) does not result in any difference in the future intersection operating conditions compared to that which was found in the Motion Traffic Engineers report.

Thus, given the generally low traffic volumes in Goulburn Road and of the potential development of the site subject to rezoning approval, the assumed distribution of trips generated by the proposal would not markedly change the forecast future intersection operating conditions of Goulburn Road / Grange Road.

Further, the existing intersection in its current form would not require any improvements on capacity grounds over and above its current form to accommodate the potential traffic generation of the proposal. This includes an assessment of future traffic conditions (10 years) with a 2% per annum compound growth of all movements)

Thus, the traffic impacts of the proposal would be considered acceptable.

SIDRA outputs are provided in **Appendix C** of this report.

- *TfNSW's preference is for access to and from the development to be via the existing local road network where it is safe and practical to do so. This is in accordance with Section 2.119 – Development with frontage to classified road of the State Environmental Planning Policy (Transport and Infrastructure) 2021.*

Response

It is noted from the Motion Traffic Engineers report that the proposed development seeks *all* vehicle access to / from the development site *only* via Grange Road along with the closure of the existing entry / exit driveway in Goulburn Road which currently serves the site. Thus, the anticipated potential arrangement of the future subdivision and its vehicle access would comply with the above requirements of Transport for NSW.

- *TfNSW highly recommends utilising Grange Road to provide access to the proposed subdivision, as per the Traffic Impact and Parking Assessment, if possible.*
  - *The proponent needs to discuss with Council on whether Grange Road is suitable for access to the subdivision. TfNSW will require that the road be suitable to allow simultaneous traffic movements, and to meet the appropriate council standards and have appropriate drainage if it is to be utilised as access from Goulburn Road.*
  - *TfNSW is open to further consultation with the proponent and Council, especially on the appropriate access to and from the proposed development.*

Response

As stated above, the anticipated development arrangement of the proposed rezoning application seeks to only provide vehicle access via two (2) new local intersection connections to Grange Road. Further, it would be expected that the final form of the Grange Road frontage of the site would be determined between the proponent and Council at the time of the development application of the subdivision.

On the matter of what would be considered an appropriate pavement width for Grange Road, the Australian Model Code For Residential Development (AMCORD) suggests the following carriageway widths for local streets which allow for 300 – 2,000 vehicles per day:

Table 1
Characteristics of street types

Street type	Indicative maximum traffic volume range (vpd) (1)	Target speed & design speed (km/h) (2)	Street reserve width minimum (m) (3)	Carriageway width (m) (4)	Verge width minimum (m) each side (5)	Parking provision within street reserve	Kerb type (20)	Entrance kerb return minimum (m)	Property access	Street longitu-dinal gradient maximum s%	Footpath	Cycles
ACCESS STREETS												
Access lane	100	15	varies	See note (6)	Not specified	No	Not required	NA	Rear	NA	No	Share with vehicles
Access place (7)	0–300	15	10.0	Single-lane 3.5–3.7(8)	See note (9)	1 Hard standing verge space per 2 dw. with scope for extra space	Layout flush	5 (10)	Access to all sites (21)	17 (11)	No	Share with vehicles
Access street	0-300 (1)	40	12.0	5.0 only	3.5	Carriageway	Layback	4	Access to all sites (21)	15 (11)	No (12)	Share with vehicles
Access street	300–1000	40	13.0	5.0–5.5 only (14)	4.0	Carriageway	Layback	5	Access to all sites (21)	12	No	Share with vehicles
Access street	1000–2000	40	13.5	5.5or7.0	4.0	Carriageway	Layback	5	Access to all sites (21)	10	1.2m wide one side (13)	Share with vehicles
COLLECTOR STREET												
Minor collector	1000–3000	50(20 at desig-nated ped-cyc. crossing)	16.50	7.0–7.5 or 6.0–6.5 plus indented parking	4.5	Carriageway or indented	Layback (15)	6	Access to all sites (17)	8 (16)	1.2m wide both sides located away from kerb	Provide within street pavement (22)
Major collector	3000–6000	Design using the performance criteria									Provide located away from kerb (18)	1.2m wide within street pavement (22)

Therefore, a pavement width of 5.5m would be considered appropriate in Grange Road to serve the subject site in the future along with considerations at intersections which allow for kerb returns which accommodate waste vehicles.

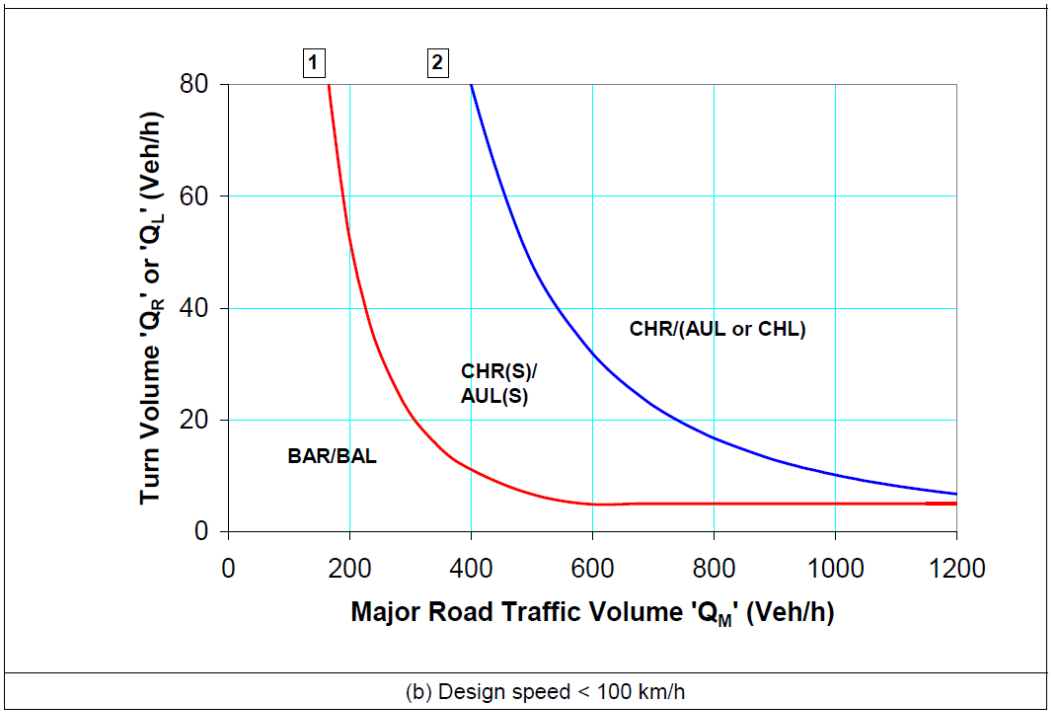
- *An analysis of the intersection of the intersection of the site access road and Goulburn Road. The treatment type is to be determined based on the warrants for basic (BA), auxiliary lane (AU) and channelised (CH) Turn Treatments outlined in Appendix A, and Figure A 10 of 8.21 Austroads Guide to Road Design – Part 4A: Intersections and Crossings – General. The analysis provided needs to:*
  - *Be supported with current traffic count data, with turn movement diagrams at the intersection for a hypothetical situation where a funeral is held during the AM and PM peak hours, and separating light and heavy vehicles;*
  - *Provide details on the assumptions used for traffic generation, noting that these should be in accordance with RTA Guide to Traffic Generating Developments and associated updated surveys or appropriately justified;*
  - *Justify the distributions (e.g. north and south to and from the development; and*
  - *Provide volume plots on Figure A 10 (of Appendix A.8) to identify the appropriate turn treatments*

Response

The above comment indicates that Transport for NSW is seeking an upgrade of the intersection of Goulburn Road / Grange Road despite confirmation in the Motion Engineers TIA report that the existing intersection capacity is more than sufficient to accommodate both the existing and potential traffic generation of development which could be achieved in the rezoning proposal.

Count data, information on the assumed trip distribution and modelling of existing versus future intersection operating conditions at the intersection of Goulburn Road / Grange Road was all presented in the original TIA report. Further, sensitivity analysis presented above of an alternative distribution of generated trips confirms that no capacity upgrades of the intersection of Goulburn Road / Grange Road is necessary to accommodate the potential development of a rezoning site at the location.

The requirements for a BAR / BAL or similar type treatment where separate turn bays are provided can be determined using Figure 4.9 of Austroads Part 4A – Unsignalised and Signalised intersections as shown below:



(b) Design speed < 100 km/h

Source: Arndt and Troutbeck (2006).

Figure 4.9: Warrants for turn treatments on the major road at unsignalised intersections

As the above graph starts at 0,0, *a single vehicle* in Grange Road exiting onto Goulburn Road would trigger the requirement for as a minimum of BAR / BAL intersection treatment which is not currently present to accommodate existing traffic flows.

Thus, strict application of the above would indicate the existing intersection would require a BAR / BAL treatment. The additional potential traffic of the development would *not* require anything beyond the existing requirement of a BAR / BAL arrangement.

The intersection is located within a 50km/hr residential zone with direct access by adjacent residential developments. Within such residential low speed environments in practice formal BAR / BAL intersection treatments are generally avoided with traffic slowing / stopping as required when queued vehicles are waiting to turn. This mirrors the principles of AMCORD where vehicle friction creates low speed safer environments in place of formal traffic control facilities such as raised thresholds etc.

The difficulty of the location is the development proposal does not have *any frontage* to the intersection of Goulburn Road / Grange Road and as such is not able to dedicate any land which could accommodate such an arrangement. Of note, Transport for NSW could impose road widening on the adjacent private properties as part of their charter and this could be considered as part of this development proposal where the proponent of this development provides works within a widened road corridor arranged by Transport for NSW.

It would present extreme difficulty imposing a requirement for intersection widening on the proponent of the development where adjacent private / public landowners surrounding the intersection could simply refuse to allocate any additional land for such widening.

It is our view that if Transport for NSW is seeking an intersection improvement of Goulburn Road / Grange Road as part of this rezoning proposal, despite the fact that such improvements are not required on capacity grounds, a BAR / BAL design is agreed to at the time of development application when at such time Transport for NSW can assist in obtaining the necessary land holdings to provide such an arrangement.

- *A SIDRA analysis needs to be provided. TfNSW notes that a SIDRA analysis was included in the initial scoping application. The SIDRA analysis must account for background growth that occurs during the development period. The background growth needs to be added to the baseline volumes and volumes resulting from the proposed subdivision for a more accurate calculation of future volumes. TfNSW recommends a growth rate of 2.0% in line with modelling guidelines.*

Response

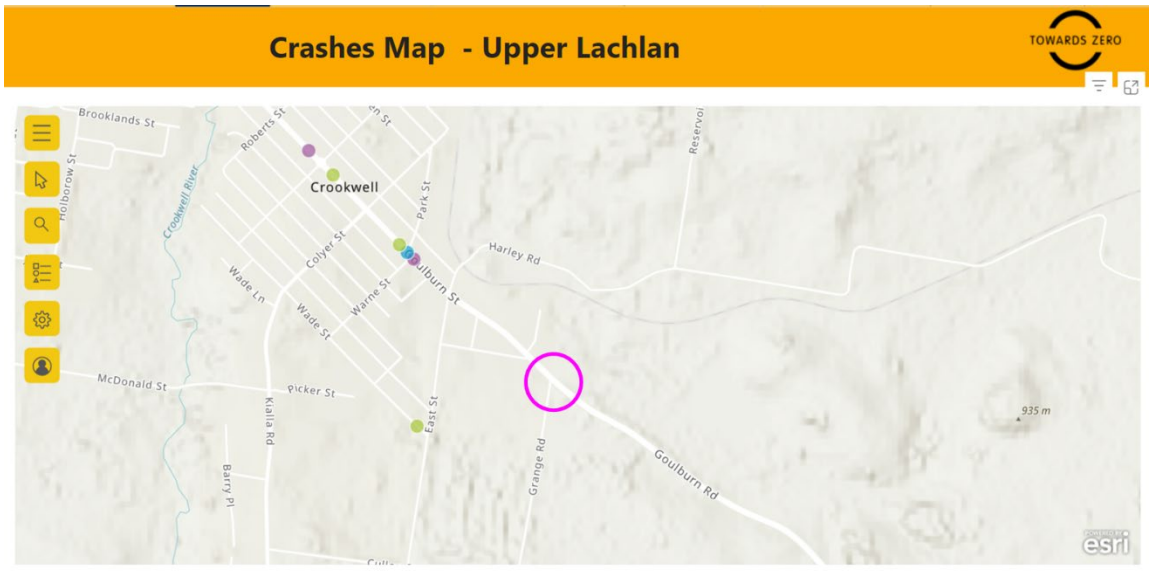
The SIDRA intersection assessment provided above and in **Appendix C** of this report includes both existing, future and a 10 year future year assessment assuming a 2% per annum growth of all movements at the intersection. In all instances, the intersection of Goulburn Road / Grange Road operates at Level of Service A.

- *Road safety assessment including details on crash history and a sight distance assessment at the local road connections with a classified road. In this instance, there will need to be an assessment of the Goulburn Road/Grange Road intersection. To demonstrate that appropriate sight distances are available, TfNSW will require a scaled concept plan showing the sight distances available and what is required at the access as well as the identification of appropriate mitigation measures to address any concerns;*

Response

The five (5) year crash data in the vicinity of the intersection of Goulburn Road / Grange Road is shown below in **Figure 5**. This confirms that *no* accidents have occurred at the intersection in the last five years.

Figure 5 – Five (5) Year Crash Data Near Goulburn Rd / Grange Rd



Reporting year	Crash Id	Degree of crash	RUM - code	RUM - description	Type of location	Natural lighting	Longitude	Latitude	Number killed	Number injured
2017	1138329	Serious Injury	47	Emerging from drive	2-way undivided	Daylight	149.473344	-34.460667		2
2018	1187249	Moderate Injury	71	Off rd left => obj	T-junction	Daylight	149.473649	-34.460924		1
2019	1203950	Serious Injury	2	Ped far side	2-way undivided	Darkness	149.470744	-34.458461		1
2020	1229270	Minor/Other Injury	64	Perm obstruction	T-junction	Daylight	149.473884	-34.461123		2
2021	1262354	Serious Injury	74	On road-out of cont.	2-way undivided	Daylight	149.474020	-34.466470		1
2021	1264686	Minor/Other Injury	0	Ped nearside	2-way undivided	Daylight	149.469820	-34.457668		1

On the matter of the sight distance assessment, traffic exiting Grange Road is afforded an available sight distance to traffic in Goulburn Road in both directions of some **230m** which far exceeds the minimum sight distance requirements for a local intersection within a 50km/hr posted speed limit.

- *Internal road network details need to be provided;*

Response

The development is seeking *only* a rezoning of the site for future residential subdivision development. It is not possible to provide details of internal road network arrangements until such time as the final engineering design of the site is completed at the time of the submission of the development application.

- *A swept path analysis in accordance with Austroads turning templates to demonstrate that the largest vehicle likely to utilise an access/connection with a classified road can safely enter and exit;*

Response

The development does not propose anything which would require a vehicle larger than what would currently utilises the intersection of Goulburn Road / Grange Road, that is, a Council waste service vehicle.

It is unclear why a private development rezoning proposal is required to provide a turn path assessment of an existing vehicle using a local intersection where the proposal does not result in the usage of a vehicle which would be any larger.

The provision of such information is more appropriate at the time of any future development application where the final arrangements of Grange Avenue are agreed to with Council.

- *The analysis also needs to consider the impacts to traffic accessing key recreational facilities and Crookwell Showground.*

Response

The RTA Guide to Traffic Generating Developments does not publish any traffic generation information for the varying use of a local showground. Further, the peak use of such a facility would not coincide with the peak traffic generation periods of any future residential development proposal of the subject site which occur during weekday AM and PM road network peak periods.

The development would be located within a convenient walking distance to the showground where access could be gained via a number of non private vehicle mode methods such as walking and cycling.

Given the SIDRA analysis above, which includes a 10 year compound growth rate applied to all movements at the intersection of Goulburn Road / Grange Road, plus the development generated traffic, confirms the intersection would continue to operate at Level of Service A, it is not expected that proposed development would have any material impact on operations of the showground. Further, it would be expected that any large events which could occur at the showground would be subject to their own plan of management approved by Council and Transport for NSW.

- *The TIA needs to address public transport provision and active transport links. Active transport infrastructure including pedestrian and cycling links to the town centre needs to be considered in order to incentivise walking and cycling. This, in turn would reduce the amount of vehicle traffic on the state road network.*
  - *TfNSW notes that Crookwell currently has a thrice daily return bus service to Goulburn, and that a future stop could be added on Goulburn Road near Grange Road if required.*

Response

The nature of the development is such that upon completion it would provide potential additional patronage of existing bus services operating along Goulburn Road. Further, it would also provide the opportunity for buses to circulate the subdivision as part of expansion of existing services to accommodate future demands and such arrangements can form future conditions of consent at the time of any development application.

An all weather pedestrian path is located along the southern side of Goulburn Road a short distance from Grange Road providing direct access to the Crookwell town centre. Expansion of bus services and provision of bus stops are matters for Transport for NSW.

- *The subdivision layout needs to identify and provide cross-section details on collector roads through the subdivision that are capable of accommodating buses. The Guidelines for Public Transport Capable Infrastructure in Greenfield Sites (July 2018, see Attachment 2) provides details on road infrastructure and road network requirements for consideration.*

Response

As stated above the proposal *only* includes a rezoning application for provision of a future residential subdivision of which would be subject to its own separate development application. It is not possible to provide internal subdivision / road network configurations at this time until such time as the finer grain engineering design of any future subdivision is completed.

It would be expected that any design of a residential subdivision for the site on the basis the rezoning application is approved would give consideration to existing published policy to inform such designs.

- TfNSW highlights that Priority 2.3(a) in Table 1 of the Upper Lachlan Shire Local Strategic Planning Statement 2040 states that towns should be designed for walking and cycling and to promote active transport.

Response

Noted and any future development application for the design of a residential subdivision at the site subject to approval of this rezoning application should include promotion of active transport modes.

- *The TIA needs to highlight the significance of Goulburn Road as a major transport route between Goulburn and Bathurst and also a tourist route that is subject to seasonal variation. Therefore, it is an arterial road and not a collector road as stated in the TIA. The commentary should also highlight the importance of Goulburn Street (Goulburn Road where it passes through Crookwell town centre) and its significance as the main street and for placemaking as the centre for Crookwell's economic, social and cultural activities.*

Response

The designation of Goulburn Road as an arterial road is noted. However, the intersection in question is located within a residential environment, a 50km/hr speed limit and single residential dwellings having direct access to Goulburn Road. Thus, whilst it remains a key corridor through the area due to limited alternative route choices available for regional trips, the environment in the vicinity of the development site is one of a local residential nature.

As confirmed in the original TIA report[1] and presented above, the traffic impacts of the rezoning proposal are considered acceptable and not intersection / road upgrades are necessary on capacity grounds (other than Grange Road frontage works) to accommodate the traffic generation of a potential future residential subdivision.

- *Details on any oversize and/or over mass vehicle (OSOM) movements associated with the proposal as well as any changes to the road network required to cater for OSOM movements must be provided.*

Response

As stated above, the proposed development which would be achieved upon approval of the rezoning proposal would not generate any vehicle greater in size than currently uses Grange Avenue or passes through the intersection of Goulburn Road / Grange Road. That is, a Council waste service vehicle.

Overall, the potential traffic impacts of the proposed residential subdivision are considered acceptable.

We trust the additional information assists you in your planning for the subdivision. Should you require any further information please do not hesitate to contact myself on 0414 462247.

Yours sincerely

DEAN BRODIE
Managing Director
B.Eng (Civil) MIEAust NER
RMS Accredited Level 3 (Lead) Road Safety Auditor
RPEQ 27423
Expert Traffic Engineering & Road Safety Witness at NSW Land & Environment & NSW Supreme Court

[1] 4273 Goulburn Road, Crookwell NSW TIA Report – Motion Traffic Engineers March 2022

Appendix A – Motion Traffic Engineers Pty Ltd Report Dated March 2022

TRAFFIC AND PARKING IMPACT ASSESSMENT

Proposed Residential Rezoning

4273 Goulburn Road, Crookwell NSW

Prepared for: A Gilbert, G Gilbert and S Zilko

N22742A (version 1a)

March 2022

Motion Traffic Engineers Pty Ltd
Telephone:
940 33588
sydney@motiontraffic.com.au

ACN 600201583

Contents

1. Introduction

Motion Traffic Engineers was commissioned by Client to undertake a traffic and parking impact assessment of proposed residential rezoning at 4273 Goulburn Road, Crookwell.

Application is now being sought for a proposed residential rezoning. The site is currently farmland.

This traffic report presents an assessment of the anticipated transport implications of the proposed residential rezoning , with the following considerations:

- Background and existing traffic and parking conditions of the proposed residential rezoning site
- Assessment of the public transport network within the vicinity of the site
- Adequacy of car and parking provision
- The projected traffic generation residential rezoning
- The transport impact of the residential rezoning on the surrounding road network

In the course of preparing this assessment, the proposed site and its environs have been inspected, plans of the development examined, and all relevant traffic and parking data collected and analysed.

2.Background and Existing Conditions of the Proposed Residential Rezoning

2.1. Location and Land Use

The proposed residential rezoning site is located at 4273 Goulburn Road, Crookwell. Currently is farmland.

This site is located within a *Primary Production, RU1* zone, South-East of Crookwell Town Centre. The immediate surrounding area of the proposed site are rural landscapes, residential and commercial development is located north west of the site within Crookwell Town Centre.

Figures 1 and 2 shows the location of the residential rezoning site from the aerial and street map perspective respectively. Figure 2 also shows the location of the surveyed intersection in relation to the site.

Figure 3 shows a photograph of the site taken at Goulburn Road.

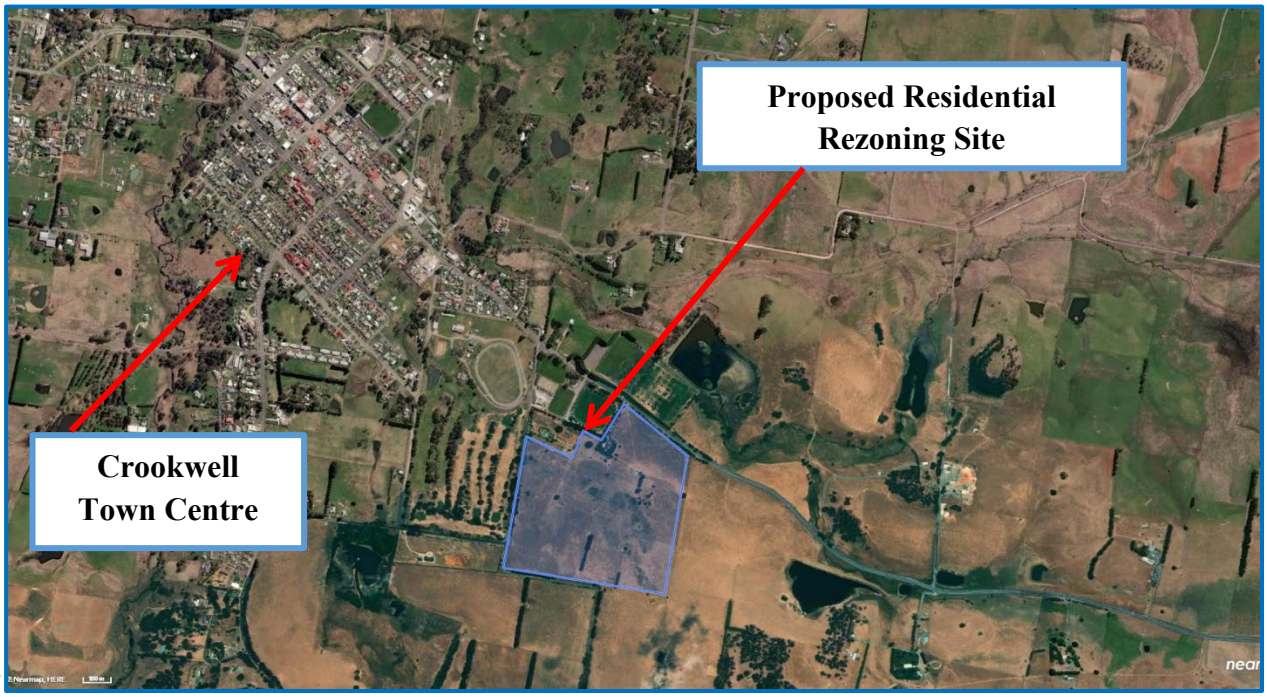


Figure 1: Location of the Subject Site on Aerial View Perspective

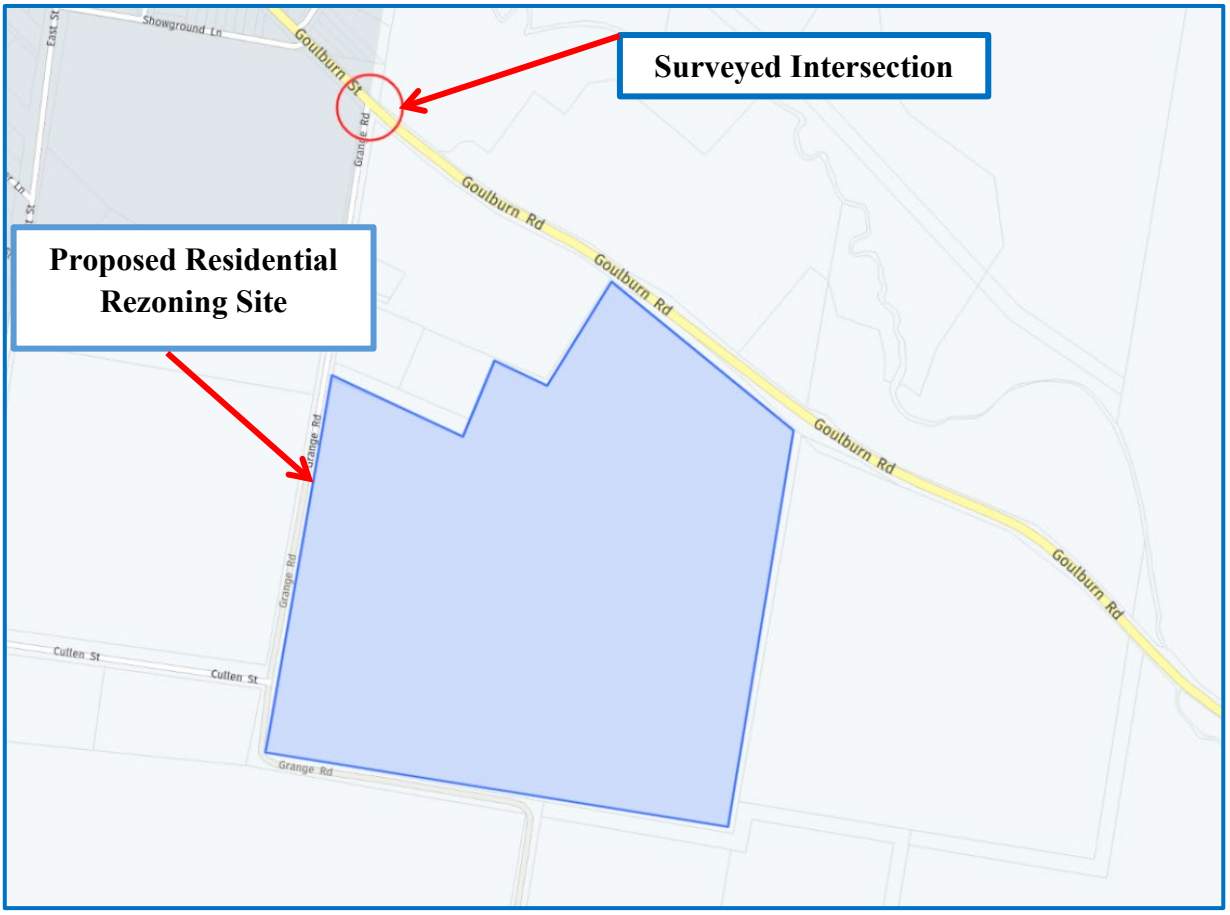


Figure 2: Location of the Site on Street Map in Relation to Surveyed Intersections

Figure 3: Photograph of Proposed residential rezoning Site from Goulburn Road

2.2. Road Network

Goulburn Road is a collector road within Crookwell Town Centre. Goulburn Road has one lane of traffic each at the midblock. Sections of Goulburn Road near the residential rezoning site have a road shoulder for emergency parking such as a car breakdown. The sign posted speed limit is 50km/hr. Figure 4a and 4b show photographs of Goulburn Road.

Grange Road is a residential road with one lane of traffic. The default speed limit is 50km/hr. Figure 4c shows a photograph of Grange Road.

Figure 4a: Goulburn Road looking east from the site

Figure 4b: Goulburn Road looking west from the site

Figure 4c: Grange Road looking north from the site

2.3. Public Parking

On street parking is not permitted on Grange Road or Goulburn Road,

2.4. Intersection Description

As part of the traffic impact assessment, the performance of the nearby intersection was surveyed and assessed:

- The priority intersection of Goulburn Road with Grange Road

External traffic to and from the proposed residential rezoning is likely to travel through at least one of the above intersections. Drivers on Grange Road need to give way to traffic on Goulburn Road.

The priority intersection of Goulburn Road with Grange Road is a three-leg intersection, with all turn movements permitted. Drivers on Grange Road need to give way to Goulburn Road traffic

Figure 6a and 6b present photographs of the intersection on Aerial and the layout of this intersection using SIDRA (9), respectively. SIDRA is an industry standard intersection software.

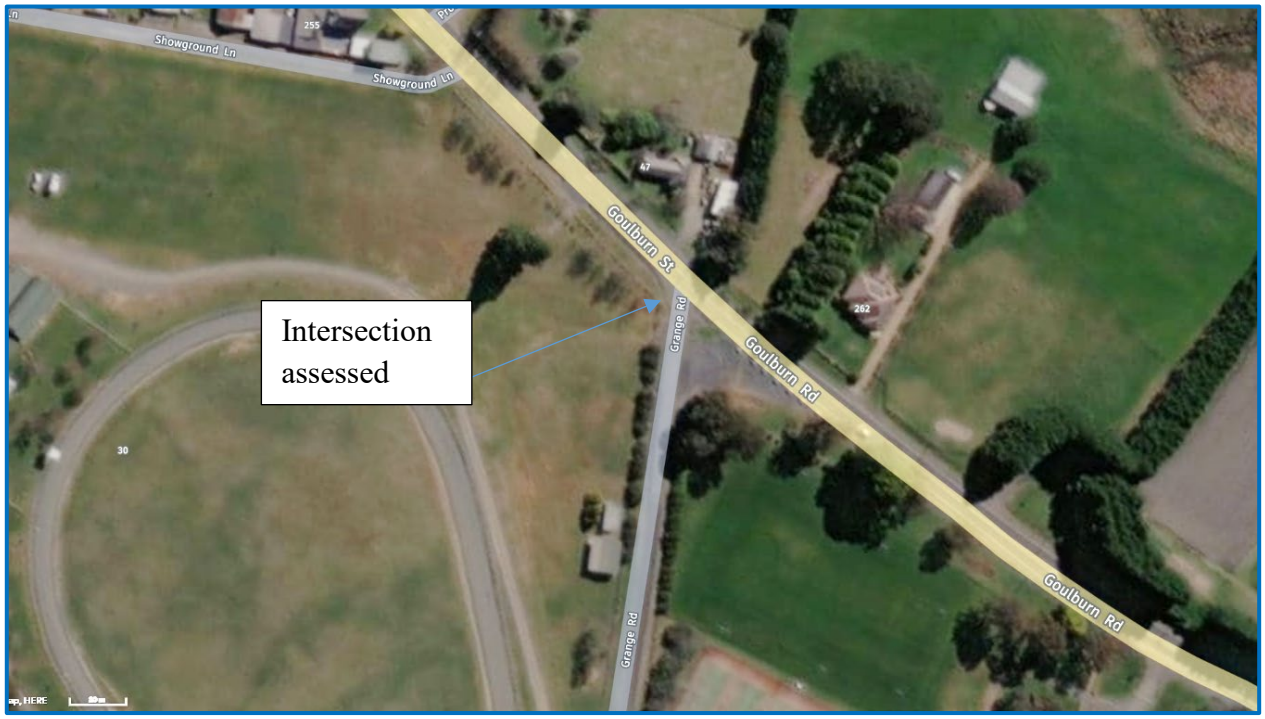


Figure 6a: The priority intersection of Goulburn Road with Grange Road

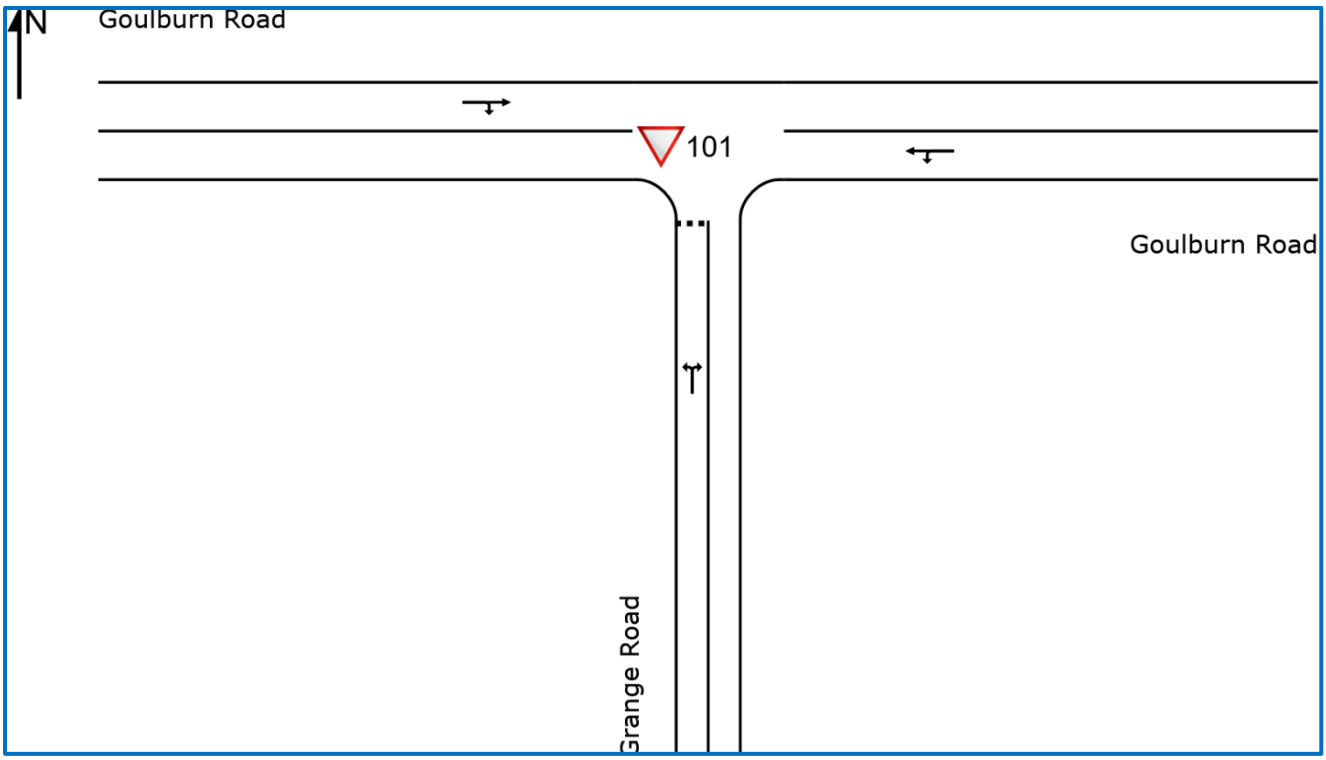


Figure 6b: The priority intersection of Goulburn Road with Grange Road (SIDRA)

2.5. Existing Traffic Volumes

As part of the traffic assessment, traffic counts have been undertaken at the above-mentioned intersections and the AM and PM peak hours are identified accordingly. The AM peak hour is 7:45am to 8:45am and the PM peak hour is 4:30pm to 5:30pm.

The following Figures present the traffic volumes in vehicles for the weekday peak hours. The bracketed numbers are trucks, and un-bracketed are cars

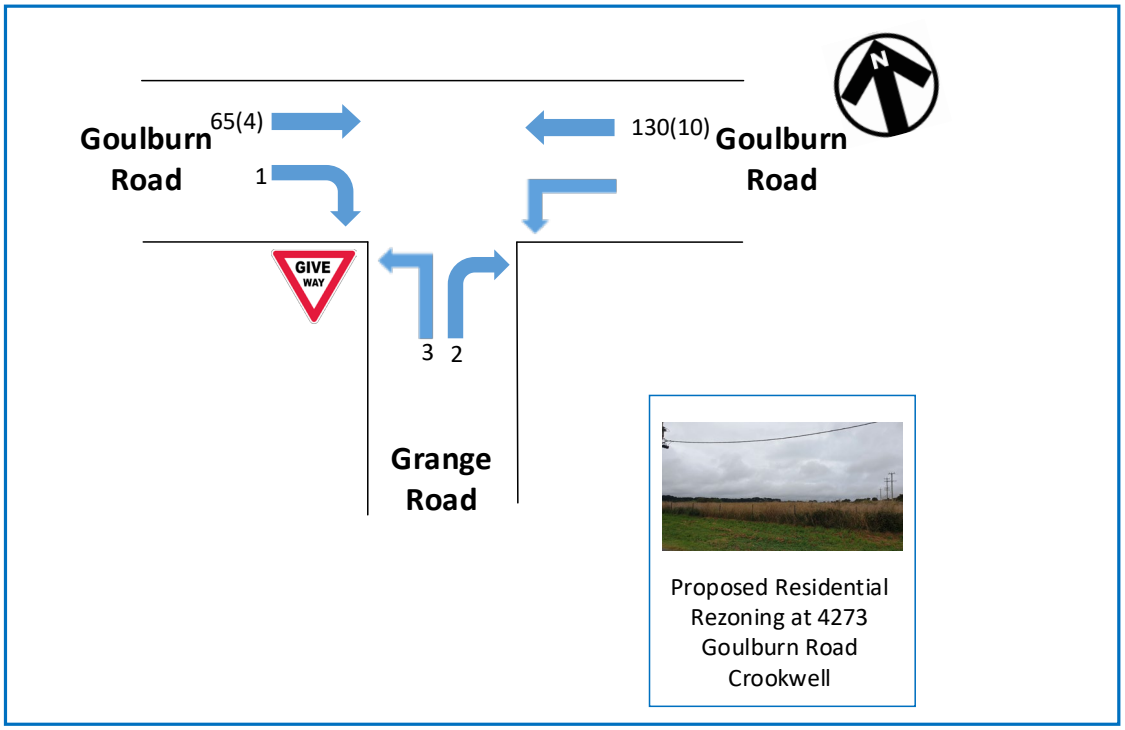


Figure 7a: Existing Weekday Traffic Volumes AM Peak Hour

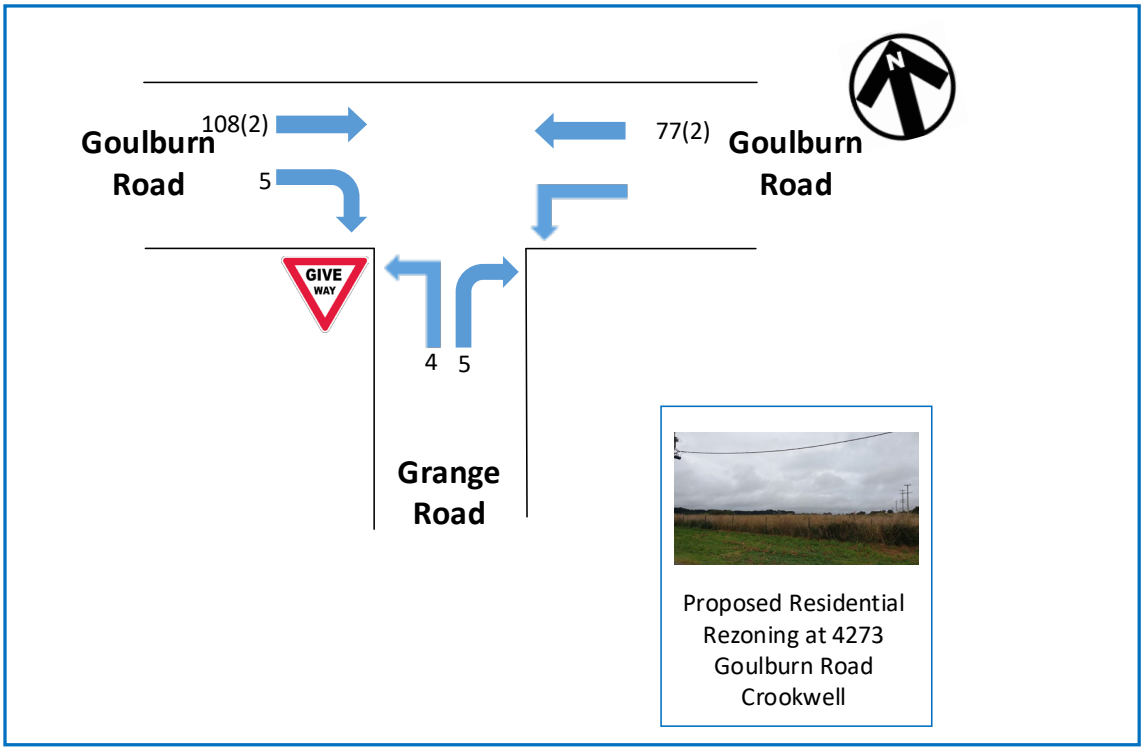


Figure 8b: Existing Weekday Traffic Volumes PM Peak Hour

2.6.Intersection Assessment with Existing Traffic

An intersection assessment has been undertaken for:

- The priority intersection of Goulburn Road with Grange Road

The existing intersection operating performance was assessed using the SIDRA software package (version 9) to determine the Degree of Saturation (DS), Average Delay (AVD in seconds) and Level of Service (LoS) at each intersection. The SIDRA program provides Level of Service Criteria Tables for various intersection types. The key indicator of intersection performance is Level of Service, where results are placed on a continuum from 'A' to 'F', as shown in Table 1.

LoS	Traffic Signal / Roundabout	Give Way / Stop Sign / T-Junction control
A	Good operation	Good operation
B	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but accident study required
D	Operating near capacity	Near capacity & accident study required
E	At capacity, at signals incidents will cause excessive delays.	At capacity, requires other control mode
F	Unsatisfactory and requires additional capacity, Roundabouts require other control mode	At capacity, requires other control mode

Table 1: Intersection Level of Service

The Average Vehicle Delay (AVD) provides a measure of the operational performance of an intersection as indicated below, which relates AVD to LOS. The AVD's should be taken as a guide only as longer delays could be tolerated in some locations (i.e., inner city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route). For traffic signals, the average delay over all movements should be taken. For roundabouts and priority control intersections (sign control) the critical movement for level of service assessment should be that movement with the highest average delay.

LoS	Average Delay per Vehicles (seconds/vehicle)
A	Less than 14
B	15 to 28
C	29 to 42
D	43 to 56
E	57 to 70
F	>70

Table 2: Intersection Average Delay (AVD)

The degree of saturation (DS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals both queue length and delay increase rapidly as DS approaches 1. It is usual to attempt to keep DS to less than 0.9. Degrees of Saturation in the order of 0.7 generally represent satisfactory intersection operation. When DS exceed 0.9 queues can be anticipated.

The results of the intersection analysis are as follows

Intersection/ Performance criteria	**AM Peak Hour Existing**	**PM Peak Hour Existing**
Goulburn Road/Grange Road *LoS* *AVD(s)* *DS*	 N/A(Worst A) 0.2 0.073	 N/A(Worst A) 0.4 0.058

Table 3: Existing intersection performances

All intersections are operating at excellent level of services with the current traffic volume. There are spare capacities at these intersections to accommodate additional traffic volume. The full intersection results are presented in Appendix A.

2.7.Conclusions on the Existing Conditions

The proposed residential rezoning is located in an area where there are no vacant on-street car spaces available.

The nearby intersection overall performs well with sufficient spare capacity to accommodate additional traffic.

3. Proposed Residential Rezoning

A description of the Proposed residential rezoning are as follows:

- Proposed rezoning with the potential for 171 lots ranging from 800m^2 to 5850m^2.
- There are two proposed roads that will run off Grange Road
- The internal roads will incorporate a 15 m road reserve width, 7m bitumen sealed carriageway, kerbing and footpath in accordance with councils Development Control Plan 2010
- The road width and geometry will accommodate Council's waste truck
- Vehicle and pedestrian sight distance at the intersections will comply with Council and Austroads requirements

A full scaled plan of the proposed residential rezoning will be provided as part of the Development Application.

4. Parking Requirements

Future of the residential lots will need to comply with the car parking requirements of Upper Lachlan Shire Council as follows:

- One car space per dwelling

There are no additional parking requirements for a residential lot. The internal road layout will be able to accommodate visitor parking.

5.Traffic Generation and Impact

5.1. Traffic Generation

The *NSW RTA Guide to Traffic Generating Developments* provides trip rates for residential rezoning as follows for the weekday peak hours

- 0.85 car trips per residential lot

Overall, the residential rezoning is a high trip generator.

Application of the above-mentioned rates to the proposed residential development results the peak hour trip generation presented in Table 5a below:

Landuse	Number of lots	Trip Generation Rate	Trips Generated
Residential	171	0.85	145

Table 5a: Trip generation by the proposed residential rezoning

5.2.Trip Distribution

The predicted trips are distributed to the road network assuming 80 percent outbound trips 20 percent inbound trips for the AM peak hour and 20 percent outbound trips 80 percent inbound trips for the PM peak hour, which results the following:

- AM peak hour: 116 origin trips and 29 destination trips
- PM peak hour: 29 origin trips and 116 destination trips

5.3. Existing with Residential Rezoning Traffic

The additional development trips are assigned onto the local traffic network. The following figures present the future traffic volume with the development trips (in red for origin trips and blue for destination trips) for the weekday AM and PM peak hours.

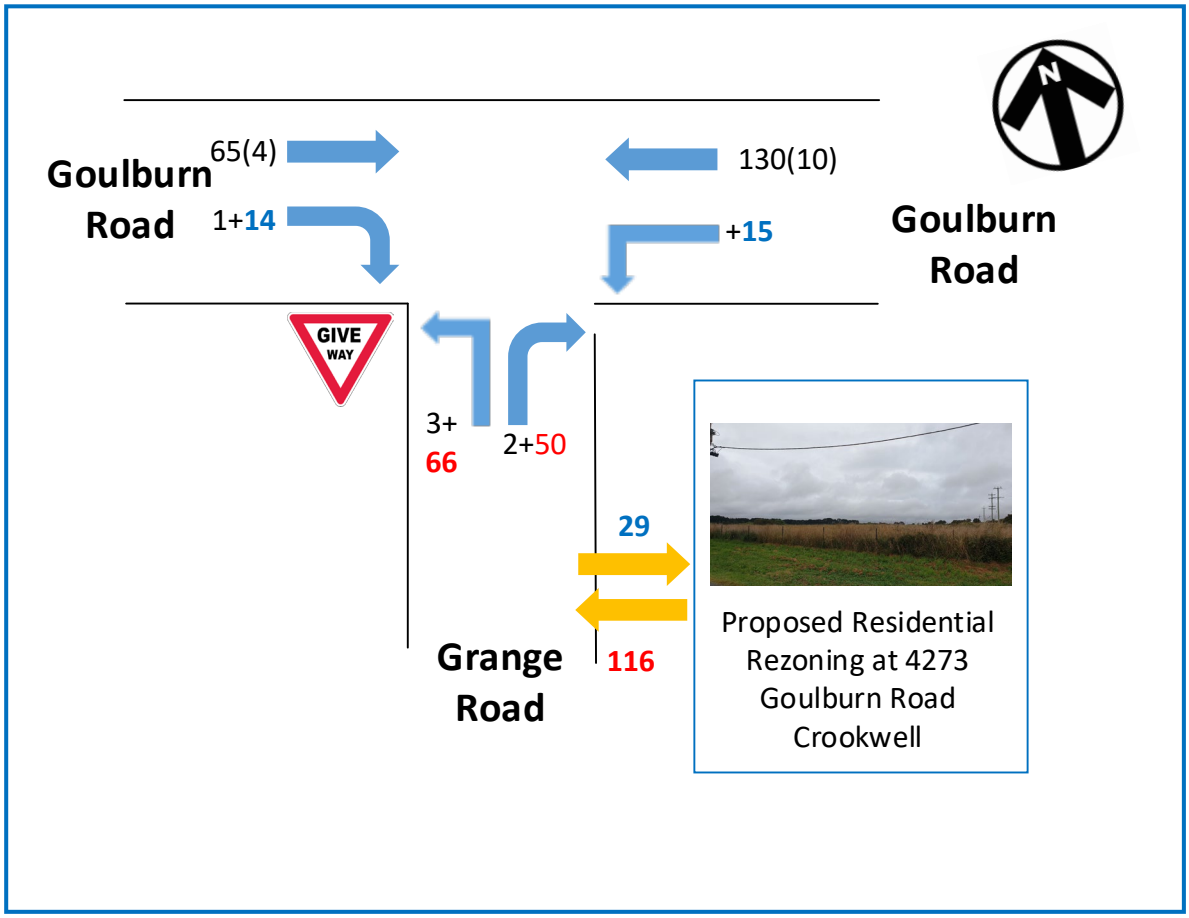


Figure 10a: Existing Weekday Traffic Volumes with Proposed residential rezoning Traffic AM Peak Hour

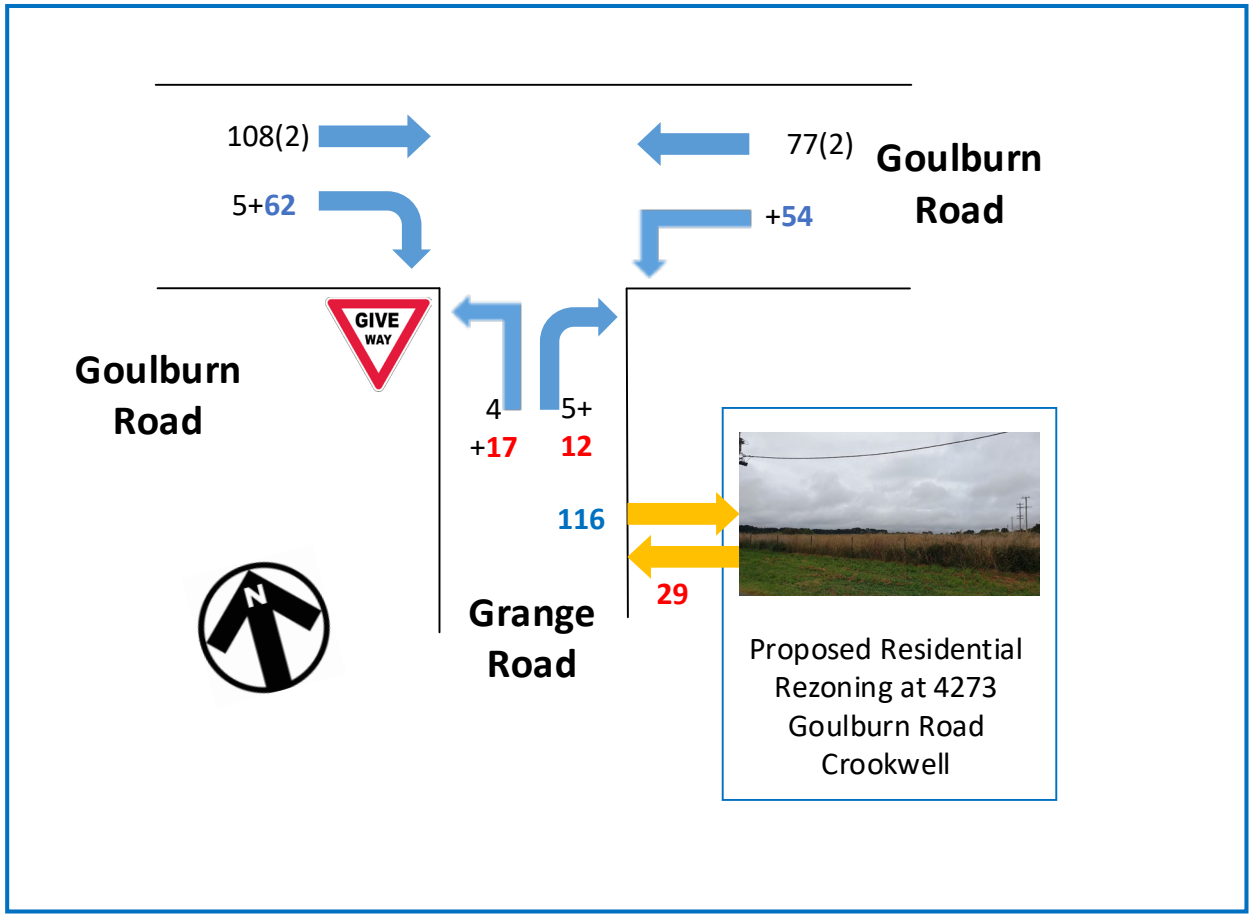


Figure 10b: Existing Weekday Traffic Volumes with Proposed residential rezoning Traffic PM Peak Hour

5.4. Traffic Impact

This section assesses the following intersections for the existing traffic with the Proposed residential rezoning Traffic. The results of the intersection assessment are as follows:

Intersection/ Performance criteria	Performance with Existing Traffic		Projected Performance with Existing and Proposed Apartment Traffic	
	AM Peak Hour Existing	PM Peak Hour Existing	AM Peak Hour Projected	PM Peak Hour Projected
Goulburn Road /Grange Road				
LoS	N/A(Worst A)	N/A(Worst A)	N/A(Worst A)	N/A(Worst A)
AVD(s)	0.2	0.4	2.2	2.4
DS	0.073	0.058	0.104	0.101

Table 6: Projected Intersection Performance with Proposed residential rezoning Traffic

As presented in Table 6 above, the additional trips generated by the proposed residential rezoning have minimum impact on the intersection performances in both AM and PM peak hours. The LoS, AVD and DS of each intersection are not significantly affected by the addition of proposed residential rezoning traffic. The traffic impact of the Proposed residential rezoning is therefore considered acceptable.

The full SIDRA results are presented in Appendix B for the future conditions with the Proposed residential rezoning traffic.

6. Conclusions

This traffic impact assessment reports relates to a Proposed residential rezoning at *4273* Goulburn Road in Crookwell. Based on the analysis and discussions presented in this report, the following conclusions are made:

- The residential rezoning site is located in a *Primary Production, RU1* zone
- The nearby intersection currently operates at good levels of service
- Each of the residential lots will be subject to council approval for minimum car park requirement
- The proposed residential rezoning is expected to generate a high number of additional trips in both AM and PM peak hours
- According to the Intersection Assessment, the additional trips can be accommodated in the nearby intersections without significantly affecting the performance of any turn movement, approach arm or the overall intersection

There are no general traffic engineering reasons why a development consent for the Proposed residential rezoning at *4273*Goulburn Road in Crookwell should not be granted.

APPENDIX A

INTERSECTION ASSESSMENT FOR EXISTING TRAFFIC

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES DEMAND FLOWS [Total veh/h	HV] veh/h	[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: Grange Road														
1	L2	3	0	3	0.0	0.004	5.0	LOS A	0.0	0.1	0.24	0.50	0.24	46.1
3	R2	2	0	2	0.0	0.004	5.3	LOS A	0.0	0.1	0.24	0.50	0.24	45.9
Approach		5	0	5	0.0	0.004	5.1	LOS A	0.0	0.1	0.24	0.50	0.24	46.0
East: Goulburn Road														
4	L2	1	0	1	0.0	0.073	4.6	LOS A	0.0	0.0	0.00	0.00	0.00	49.5
5	T1	140	10	147	7.1	0.073	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	50.0
Approach		141	10	148	7.1	0.073	0.1	NA	0.0	0.0	0.00	0.00	0.00	49.9
West: Goulburn Road														
11	T1	69	4	73	5.8	0.036	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.9
12	R2	1	0	1	0.0	0.036	5.0	LOS A	0.0	0.1	0.01	0.01	0.01	49.2
Approach		70	4	74	5.7	0.036	0.1	NA	0.0	0.1	0.01	0.01	0.01	49.9
All Vehicles		216	14	227	6.5	0.073	0.2	NA	0.0	0.1	0.01	0.02	0.01	49.8

Table A1: The priority intersection of Goulburn Road with Grange Road for the AM Peak Hour

Vehicle Movement Performance														
Mov ID	Turn	INPUT VOLUMES DEMAND FLOWS [Total veh/h	HV] veh/h	[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: Grange Road														
1	L2	4	0	4	0.0	0.008	4.8	LOS A	0.0	0.2	0.19	0.51	0.19	46.2
3	R2	5	0	5	0.0	0.008	5.2	LOS A	0.0	0.2	0.19	0.51	0.19	46.0
Approach		9	0	9	0.0	0.008	5.0	LOS A	0.0	0.2	0.19	0.51	0.19	46.1
East: Goulburn Road														
4	L2	1	0	1	0.0	0.040	4.6	LOS A	0.0	0.0	0.00	0.01	0.00	49.5
5	T1	79	2	83	2.5	0.040	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	49.9
Approach		80	2	84	2.5	0.040	0.1	NA	0.0	0.0	0.00	0.01	0.00	49.9
West: Goulburn Road														
11	T1	110	2	116	1.8	0.058	0.0	LOS A	0.0	0.2	0.02	0.02	0.02	49.8
12	R2	5	0	5	0.0	0.058	4.8	LOS A	0.0	0.2	0.02	0.02	0.02	49.1
Approach		115	2	121	1.7	0.058	0.2	NA	0.0	0.2	0.02	0.02	0.02	49.8
All Vehicles		204	4	215	2.0	0.058	0.4	NA	0.0	0.2	0.02	0.04	0.02	49.7

Table A2: The priority intersection of Goulburn Road with Grange Road for the PM Peak Hour

APPENDIX B

INTERSECTION ASSESSMENT FOR FUTURE CONDITION WITH RESIDENTIAL REZONING TRAFFIC

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: Grange Road														
1	L2	69	0	73	0.0	0.104	5.0	LOS A	0.4	2.7	0.27	0.55	0.27	46.0
3	R2	52	0	55	0.0	0.104	5.5	LOS A	0.4	2.7	0.27	0.55	0.27	45.8
Approach		121	0	127	0.0	0.104	5.3	LOS A	0.4	2.7	0.27	0.55	0.27	45.9
East: Goulburn Road														
4	L2	15	0	16	0.0	0.080	4.6	LOS A	0.0	0.0	0.00	0.05	0.00	49.2
5	T1	140	10	147	7.1	0.080	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	49.7
Approach		155	10	163	6.5	0.080	0.5	NA	0.0	0.0	0.00	0.05	0.00	49.6
West: Goulburn Road														
11	T1	69	4	73	5.8	0.046	0.1	LOS A	0.1	0.8	0.11	0.10	0.11	49.1
12	R2	15	0	16	0.0	0.046	5.1	LOS A	0.1	0.8	0.11	0.10	0.11	48.4
Approach		84	4	88	4.8	0.046	1.0	NA	0.1	0.8	0.11	0.10	0.11	49.0
All Vehicles		360	14	379	3.9	0.104	2.2	NA	0.4	2.7	0.12	0.23	0.12	48.2

Table B1: The priority intersection of Goulburn Road with Grange Road for the AM Peak Hour with residential rezoning traffic

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: Grange Road														
1	L2	21	0	22	0.0	0.033	4.8	LOS A	0.1	0.8	0.18	0.52	0.18	46.2
3	R2	17	0	18	0.0	0.033	5.7	LOS A	0.1	0.8	0.18	0.52	0.18	46.0
Approach		38	0	40	0.0	0.033	5.2	LOS A	0.1	0.8	0.18	0.52	0.18	46.1
East: Goulburn Road														
4	L2	59	0	62	0.0	0.071	4.6	LOS A	0.0	0.0	0.00	0.23	0.00	48.2
5	T1	79	2	83	2.5	0.071	0.0	LOS A	0.0	0.0	0.00	0.23	0.00	48.7
Approach		138	2	145	1.4	0.071	2.0	NA	0.0	0.0	0.00	0.23	0.00	48.5
West: Goulburn Road														
11	T1	110	2	116	1.8	0.101	0.3	LOS A	0.4	2.9	0.20	0.20	0.20	48.3
12	R2	67	0	71	0.0	0.101	5.0	LOS A	0.4	2.9	0.20	0.20	0.20	47.7
Approach		177	2	186	1.1	0.101	2.1	NA	0.4	2.9	0.20	0.20	0.20	48.1
All Vehicles		353	4	372	1.1	0.101	2.4	NA	0.4	2.9	0.12	0.25	0.12	48.0

Table B2: The priority intersection of Goulburn Road with Grange Road for the PM Peak Hour with residential rezoning traffic

Appendix B – Transport for NSW Letter Dated 18 January 2023

18 January 2023

TfNSW reference: STH22/00366/01

Upper Lachlan Shire Council
By Email: sarkinstall@upperlachlan.nsw.gov.au

Attention: Simon Arkinstall

Planning Proposal for 171 lot residential subdivision – Lot 24 DP1119250 – 4273 Goulburn Road, CROOKWELL

Dear Simon

Transport for NSW (TfNSW) is responding to the initial scoping application that was prepared by Laterals Planning and referred on 7 November 2022.

TfNSW has reviewed the information and provides feedback on the submitted documents for the applicant to consider in Attachment 1.

If you have any questions, please contact Steven Yuan, Development Services Case Officer, on 02 9983 2596 or email development.south@transport.nsw.gov.au.

Yours faithfully

Steven Yuan
Development Services Case Officer, Development Services

Attachment 1

Planning Proposal for 171 lot residential subdivision – Lot 24 DP1119250 – 4273 Goulburn Road, CROOKWELL

Context

TfNSW notes for this development:

- The key state road is Goulburn Road;
- Council is seeking initial advice from TfNSW on a future planning proposal to rezone Lot 24 DP119250 from RU1 Primary Production to R2 Low Density Residential and R5 Large Lot Residential. This will facilitate 171 residential lots. The site is 32.31ha and is located to the southeast of Crookwell town centre; and
- The site has a frontage to Goulburn Road. The proponent is proposing for the development to be accessed via Grange Road, which is a local road.

Preliminary feedback

The Traffic and Parking Impact Assessment will need to address the following:

- The trip distributions that are presented in the Traffic Impact and Parking Assessment need to be justified. This would include an explanation of the assumed travel patterns to access services and facilities in Crookwell and Goulburn.
- TfNSW's preference is for access to and from the development to be via the existing local road network where it is safe and practical to do so. This is in accordance with Section 2.119 – Development with frontage to classified road of the State Environmental Planning Policy (Transport and Infrastructure) 2021.
- TfNSW highly recommends utilising Grange Road to provide access to the proposed subdivision, as per the Traffic Impact and Parking Assessment, if possible.
    - The proponent needs to discuss with Council on whether Grange Road is suitable for access to the subdivision. TfNSW will require that the road be suitable to allow simultaneous traffic movements, and to meet the appropriate council standards and have appropriate drainage if it is to be utilised as access from Goulburn Road.
    - TfNSW is open to further consultation with the proponent and Council, especially on the appropriate access to and from the proposed development.
- An analysis of the intersection of the intersection of the site access road and Goulburn Road. The treatment type is to be determined based on the warrants for basic (BA), auxiliary lane (AU) and channelised (CH) Turn Treatments outlined in Appendix A, and Figure A 10 of 8.21 Austroads Guide to Road Design – Part 4A: Intersections and Crossings – General. The analysis provided needs to:
    - Be supported with current traffic count data, with turn movement diagrams at the intersection for a hypothetical situation where a funeral is held during the AM and PM peak hours, and separating light and heavy vehicles;

    - Provide details on the assumptions used for traffic generation, noting that these should be in accordance with RTA Guide to Traffic Generating Developments and associated updated surveys or appropriately justified;
    - Justify the distributions (e.g. north and south to and from the development; and
    - Provide volume plots on Figure A 10 (of Appendix A.8) to identify the appropriate turn treatments
- A SIDRA analysis needs to be provided. TfNSW notes that a SIDRA analysis was included in the initial scoping application. The SIDRA analysis must account for background growth that occurs during the development period. The background growth needs to be added to the baseline volumes and volumes resulting from the proposed subdivision for a more accurate calculation of future volumes. TfNSW recommends a growth rate of 2.0% in line with modelling guidelines.
- Road safety assessment including details on crash history and a sight distance assessment at the local road connections with a classified road. In this instance, there will need to be an assessment of the Goulburn Road/Grange Road intersection. To demonstrate that appropriate sight distances are available, TfNSW will require a scaled concept plan showing the sight distances available and what is required at the access as well as the identification of appropriate mitigation measures to address any concerns;
- Internal road network details need to be provided;
- A swept path analysis in accordance with Austroads turning templates to demonstrate that the largest vehicle likely to utilise an access/connection with a classified road can safely enter and exit;
- The analysis also needs to consider the impacts to traffic accessing key recreational facilities and Crookwell Showground.
- The TIA needs to address public transport provision and active transport links. Active transport infrastructure including pedestrian and cycling links to the town centre needs to be considered in order to incentivise walking and cycling. This, in turn would reduce the amount of vehicle traffic on the state road network.
    - TfNSW notes that Crookwell currently has a thrice daily return bus service to Goulburn, and that a future stop could be added on Goulburn Road near Grange Road if required.
    - The subdivision layout needs to identify and provide cross-section details on collector roads through the subdivision that are capable of accommodating buses. *The Guidelines for Public Transport Capable Infrastructure in Greenfield Sites* (July 2018, see **Attachment 2**) provides details on road infrastructure and road network requirements for consideration.
    - TfNSW highlights that Priority 2.3(a) in Table 1 of the Upper Lachlan Shire Local Strategic Planning Statement 2040 states that towns should be designed for walking and cycling and to promote active transport.
- The TIA needs to highlight the significance of Goulburn Road as a major transport route between Goulburn and Bathurst and also a tourist route that is subject to seasonal variation. Therefore, it is an arterial road and not a collector road as stated in the TIA. The commentary should also highlight the importance of Goulburn Street (Goulburn Road where it passes through Crookwell town centre) and its significance as the main street and for placemaking as the centre for Crookwell's economic, social and cultural activities.

- Details on any oversize and/or over mass vehicle (OSOM) movements associated with the proposal as well as any changes to the road network required to cater for OSOM movements must be provided.

Level 4, 90 Crown St (PO Box 477 2520) Wollongong NSW 2500
193-195 Morgan Street (PO Box 484) Wagga Wagga NSW 2650
ABN 18 804 239 602
transport.nsw.gov.au

Appendix C – SIDRA Outputs

MOVEMENT SUMMARY

Site: 101 [Goulburn_Grange_PM_Fut + 10yrs (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

New Site
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival 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	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Goulburn Rd															
1	L2	All MCs	91	0.0	91	0.0	0.102	5.6	LOS A	0.0	0.0	0.00	0.28	0.00	55.2
		LV	91		91		0.102	5.6	LOS A	0.0	0.0	NA	NA	NA	55.2
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
2	T1	All MCs	101	2.5	101	2.5	0.102	0.0	LOS A	0.0	0.0	0.00	0.28	0.00	57.4
		LV	99		99		0.102	0.0	LOS A	0.0	0.0	NA	NA	NA	57.4
		HV	3		3		0.102	0.0	LOS A	0.0	0.0	NA	NA	NA	57.4
Approach			192	1.3	192	1.3	0.102	2.6	NA	0.0	0.0	0.00	0.28	0.00	56.3
North: Goulburn Rd															
8	T1	All MCs	141	1.8	141	1.8	0.118	0.0	LOS A	0.4	3.0	0.21	0.26	0.21	57.5
		LV	139		139		0.118	0.0	LOS A	0.4	3.0	NA	NA	NA	57.5
		HV	3		3		0.118	0.0	LOS A	0.4	3.0	NA	NA	NA	57.5
9	R2	All MCs	67	0.0	67	0.0	0.118	6.8	LOS A	0.4	3.0	0.21	0.26	0.21	54.9
		LV	67		67		0.118	6.8	LOS A	0.4	3.0	NA	NA	NA	54.9
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			208	1.2	208	1.2	0.118	2.2	NA	0.4	3.0	0.21	0.26	0.21	56.6
West: Grange Rd															
10	L2	All MCs	21	0.0	21	0.0	0.045	5.8	LOS A	0.2	1.1	0.27	0.57	0.27	52.1
		LV	21		21		0.045	5.8	LOS A	0.2	1.1	NA	NA	NA	52.1
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
12	R2	All MCs	30	0.0	30	0.0	0.045	6.8	LOS A	0.2	1.1	0.27	0.57	0.27	51.9
		LV	30		30		0.045	6.8	LOS A	0.2	1.1	NA	NA	NA	51.9
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			50	0.0	50	0.0	0.045	6.4	LOS A	0.2	1.1	0.27	0.57	0.27	52.0
All Vehicles			450	1.1	450	1.1	0.118	2.8	NA	0.4	3.0	0.13	0.30	0.13	56.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options 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 (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

INTERSECTION SUMMARY

Site: 101 [Goulburn_Grange_AM_Ex (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Intersection Performance - Hourly Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Travel Speed (Average)	km/h	59.7	59.7 km/h
Travel Distance (Total)	veh-km/h	229.7	275.6 pers-km/h
Travel Time (Total)	veh-h/h	3.8	4.6 pers-h/h
Desired Speed	km/h	60.0	
Speed Efficiency		0.99	
Travel Time Index		9.94	
Congestion Coefficient		1.01	
Demand Flows (Total)	veh/h	227	273 pers/h
Arrival Flows (Total)	veh/h	227	
Percent Heavy Vehicles (Demand)	%	6.5	
Percent Heavy Vehicles (Arrivals)	%	6.5	
Degree of Saturation		0.080	
Practical Spare Capacity	%	1130.4	
Effective Intersection Capacity	veh/h	2855	
Control Delay (Total)	veh-h/h	0.01	0.02 pers-h/h
Control Delay (Average)	sec	0.2	0.2 sec
Control Delay (Worst Lane by MC)	sec	6.1	
Control Delay (Worst Movement by MC)	sec	6.2	6.2 sec
Geometric Delay (Average)	sec	0.2	
Stop-Line Delay (Average)	sec	0.0	
Idling Time (Average)	sec	0.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.0	
95% Back of Queue - Dist (Worst Lane)	m	0.1	
Ave. Que Storage Ratio (Worst Lane)		0.00	
Effective Stops (Total)	veh/h	4	5 pers/h
Effective Stop Rate		0.02	0.02
Proportion Queued		0.01	0.01
Performance Index		3.9	3.9
Cost (Total)	$/h	177.94	177.94 $/h
Fuel Consumption (Total)	L/h	16.6	
Carbon Dioxide (Total)	kg/h	39.9	
Hydrocarbons (Total)	kg/h	0.003	
Carbon Monoxide (Total)	kg/h	0.05	
NOx (Total)	kg/h	0.077	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.
In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 32.4% 0.3% 0.0%

Intersection Performance - Annual Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Demand Flows (Total)	veh/y	109,137	130,964 pers/y
Delay (Total)	veh-h/y	6	7 pers-h/y
Effective Stops (Total)	veh/y	2,006	2,407 pers/y

Travel Distance (Total)	veh-km/y	110,241	132,289	pers-km/y
Travel Time (Total)	veh-h/y	1,847	2,217	pers-h/y
Cost (Total)	$/y	85,413	85,413	$/y
Fuel Consumption (Total)	L/y	7,988		
Carbon Dioxide (Total)	kg/y	19,134		
Hydrocarbons (Total)	kg/y	1		
Carbon Monoxide (Total)	kg/y	22		
NOx (Total)	kg/y	37		

1 Hours per Year: 480 (Site)

MOVEMENT SUMMARY

Site: 101 [Goulburn_Grange_AM_Ex (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival 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	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Goulburn Rd															
1	L2	All MCs	1	0.0	1	0.0	0.080	5.6	LOS A	0.0	0.0	0.00	0.00	0.00	57.4
		LV	1		1		0.080	5.6	LOS A	0.0	0.0	NA	NA	NA	57.4
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
2	T1	All MCs	147	7.1	147	7.1	0.080	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
		LV	137		137		0.080	0.0	LOS A	0.0	0.0	NA	NA	NA	59.9
		HV	11		11		0.080	0.0	LOS A	0.0	0.0	NA	NA	NA	59.9
Approach			148	7.1	148	7.1	0.080	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Goulburn Rd															
8	T1	All MCs	73	5.8	73	5.8	0.039	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	59.9
		LV	68		68		0.039	0.0	LOS A	0.0	0.1	NA	NA	NA	59.9
		HV	4		4		0.039	0.0	LOS A	0.0	0.1	NA	NA	NA	59.9
9	R2	All MCs	1	0.0	1	0.0	0.039	5.7	LOS A	0.0	0.1	0.01	0.01	0.01	57.1
		LV	1		1		0.039	5.7	LOS A	0.0	0.1	NA	NA	NA	57.1
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			74	5.7	74	5.7	0.039	0.1	NA	0.0	0.1	0.01	0.01	0.01	59.8
West: Grange Rd															
10	L2	All MCs	3	0.0	3	0.0	0.004	6.0	LOS A	0.0	0.1	0.25	0.54	0.25	52.2
		LV	3		3		0.004	6.0	LOS A	0.0	0.1	NA	NA	NA	52.2
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
12	R2	All MCs	2	0.0	2	0.0	0.004	6.2	LOS A	0.0	0.1	0.25	0.54	0.25	51.9
		LV	2		2		0.004	6.2	LOS A	0.0	0.1	NA	NA	NA	51.9
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			5	0.0	5	0.0	0.004	6.1	LOS A	0.0	0.1	0.25	0.54	0.25	52.1
All Vehicles			227	6.5	227	6.5	0.080	0.2	NA	0.0	0.1	0.01	0.02	0.01	59.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options 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 (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

INTERSECTION SUMMARY

Site: 101 [Goulburn_Grange_PM_Ex (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Intersection Performance - Hourly Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Travel Speed (Average)	km/h	59.3	59.3 km/h
Travel Distance (Total)	veh-km/h	216.9	260.3 pers-km/h
Travel Time (Total)	veh-h/h	3.7	4.4 pers-h/h
Desired Speed	km/h	60.0	
Speed Efficiency		0.99	
Travel Time Index		9.87	
Congestion Coefficient		1.01	
Demand Flows (Total)	veh/h	215	258 pers/h
Arrival Flows (Total)	veh/h	215	
Percent Heavy Vehicles (Demand)	%	2.0	
Percent Heavy Vehicles (Arrivals)	%	2.0	
Degree of Saturation		0.063	
Practical Spare Capacity	%	1447.6	
Effective Intersection Capacity	veh/h	3391	
Control Delay (Total)	veh-h/h	0.03	0.03 pers-h/h
Control Delay (Average)	sec	0.4	0.4 sec
Control Delay (Worst Lane by MC)	sec	6.0	
Control Delay (Worst Movement by MC)	sec	6.1	6.1 sec
Geometric Delay (Average)	sec	0.4	
Stop-Line Delay (Average)	sec	0.0	
Idling Time (Average)	sec	0.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.0	
95% Back of Queue - Dist (Worst Lane)	m	0.2	
Ave. Que Storage Ratio (Worst Lane)		0.00	
Effective Stops (Total)	veh/h	9	11 pers/h
Effective Stop Rate		0.04	0.04
Proportion Queued		0.02	0.02
Performance Index		3.8	3.8
Cost (Total)	$/h	163.41	163.41 $/h
Fuel Consumption (Total)	L/h	13.7	
Carbon Dioxide (Total)	kg/h	32.4	
Hydrocarbons (Total)	kg/h	0.002	
Carbon Monoxide (Total)	kg/h	0.04	
NOx (Total)	kg/h	0.027	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.
In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 33.3% 0.6% 0.0%

Intersection Performance - Annual Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Demand Flows (Total)	veh/y	103,074	123,688 pers/y
Delay (Total)	veh-h/y	12	15 pers-h/y
Effective Stops (Total)	veh/y	4,444	5,333 pers/y

Travel Distance (Total)	veh-km/y	104,121	124,945	pers-km/y
Travel Time (Total)	veh-h/y	1,756	2,107	pers-h/y
Cost (Total)	$/y	78,435	78,435	$/y
Fuel Consumption (Total)	L/y	6,578		
Carbon Dioxide (Total)	kg/y	15,560		
Hydrocarbons (Total)	kg/y	1		
Carbon Monoxide (Total)	kg/y	19		
NOx (Total)	kg/y	13		

1 Hours per Year: 480 (Site)

MOVEMENT SUMMARY

Site: 101 [Goulburn_Grange_PM_Ex (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival 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	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Goulburn Rd															
1	L2	All MCs	1	0.0	1	0.0	0.044	5.6	LOS A	0.0	0.0	0.00	0.01	0.00	57.4
		LV	1		1		0.044	5.6	LOS A	0.0	0.0	NA	NA	NA	57.4
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
2	T1	All MCs	83	2.5	83	2.5	0.044	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.9
		LV	81		81		0.044	0.0	LOS A	0.0	0.0	NA	NA	NA	59.9
		HV	2		2		0.044	0.0	LOS A	0.0	0.0	NA	NA	NA	59.9
Approach			84	2.5	84	2.5	0.044	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.9
North: Goulburn Rd															
8	T1	All MCs	116	1.8	116	1.8	0.063	0.0	LOS A	0.0	0.2	0.02	0.03	0.02	59.7
		LV	114		114		0.063	0.0	LOS A	0.0	0.2	NA	NA	NA	59.7
		HV	2		2		0.063	0.0	LOS A	0.0	0.2	NA	NA	NA	59.7
9	R2	All MCs	5	0.0	5	0.0	0.063	5.7	LOS A	0.0	0.2	0.02	0.03	0.02	56.9
		LV	5		5		0.063	5.7	LOS A	0.0	0.2	NA	NA	NA	56.9
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			121	1.7	121	1.7	0.063	0.2	NA	0.0	0.2	0.02	0.03	0.02	59.6
West: Grange Rd															
10	L2	All MCs	4	0.0	4	0.0	0.008	5.8	LOS A	0.0	0.2	0.21	0.55	0.21	52.3
		LV	4		4		0.008	5.8	LOS A	0.0	0.2	NA	NA	NA	52.3
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
12	R2	All MCs	5	0.0	5	0.0	0.008	6.1	LOS A	0.0	0.2	0.21	0.55	0.21	52.1
		LV	5		5		0.008	6.1	LOS A	0.0	0.2	NA	NA	NA	52.1
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			9	0.0	9	0.0	0.008	6.0	LOS A	0.0	0.2	0.21	0.55	0.21	52.2
All Vehicles			215	2.0	215	2.0	0.063	0.4	NA	0.0	0.2	0.02	0.04	0.02	59.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options 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 (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

INTERSECTION SUMMARY

Site: 101 [Goulburn_Grange_AM_Fut (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Intersection Performance - Hourly Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Travel Speed (Average)	km/h	56.3	56.3 km/h
Travel Distance (Total)	veh-km/h	385.5	462.6 pers-km/h
Travel Time (Total)	veh-h/h	6.9	8.2 pers-h/h
Desired Speed	km/h	60.0	
Speed Efficiency		0.94	
Travel Time Index		9.31	
Congestion Coefficient		1.07	
Demand Flows (Total)	veh/h	381	457 pers/h
Arrival Flows (Total)	veh/h	381	
Percent Heavy Vehicles (Demand)	%	3.9	
Percent Heavy Vehicles (Arrivals)	%	3.9	
Degree of Saturation		0.100	
Practical Spare Capacity	%	699.2	
Effective Intersection Capacity	veh/h	3807	
Control Delay (Total)	veh-h/h	0.28	0.33 pers-h/h
Control Delay (Average)	sec	2.6	2.6 sec
Control Delay (Worst Lane by MC)	sec	6.2	
Control Delay (Worst Movement by MC)	sec	6.5	6.5 sec
Geometric Delay (Average)	sec	2.3	
Stop-Line Delay (Average)	sec	0.3	
Idling Time (Average)	sec	0.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.4	
95% Back of Queue - Dist (Worst Lane)	m	2.7	
Ave. Que Storage Ratio (Worst Lane)		0.00	
Effective Stops (Total)	veh/h	97	117 pers/h
Effective Stop Rate		0.26	0.26
Proportion Queued		0.12	0.12
Performance Index		7.7	7.7
Cost (Total)	$/h	316.81	316.81 $/h
Fuel Consumption (Total)	L/h	29.6	
Carbon Dioxide (Total)	kg/h	70.4	
Hydrocarbons (Total)	kg/h	0.005	
Carbon Monoxide (Total)	kg/h	0.08	
NOx (Total)	kg/h	0.089	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.
In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 30.9% 4.5% 0.0%

Intersection Performance - Annual Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Demand Flows (Total)	veh/y	182,905	219,486 pers/y
Delay (Total)	veh-h/y	133	159 pers-h/y
Effective Stops (Total)	veh/y	46,682	56,018 pers/y

Travel Distance (Total)	veh-km/y	185,021	222,026	pers-km/y
Travel Time (Total)	veh-h/y	3,289	3,947	pers-h/y
Cost (Total)	$/y	152,067	152,067	$/y
Fuel Consumption (Total)	L/y	14,220		
Carbon Dioxide (Total)	kg/y	33,785		
Hydrocarbons (Total)	kg/y	3		
Carbon Monoxide (Total)	kg/y	39		
NOx (Total)	kg/y	43		

1 Hours per Year: 480 (Site)

MOVEMENT SUMMARY

Site: 101 [Goulburn_Grange_AM_Fut (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival 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	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Goulburn Rd															
1	L2	All MCs	11	0.0	11	0.0	0.085	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	57.1
		LV	11		11		0.085	5.6	LOS A	0.0	0.0	NA	NA	NA	57.1
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
2	T1	All MCs	147	7.1	147	7.1	0.085	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	59.6
		LV	137		137		0.085	0.0	LOS A	0.0	0.0	NA	NA	NA	59.6
		HV	11		11		0.085	0.0	LOS A	0.0	0.0	NA	NA	NA	59.6
Approach			158	6.7	158	6.7	0.085	0.4	NA	0.0	0.0	0.00	0.04	0.00	59.4
North: Goulburn Rd															
8	T1	All MCs	73	5.8	73	5.8	0.053	0.0	LOS A	0.1	1.0	0.14	0.18	0.14	58.2
		LV	68		68		0.053	0.0	LOS A	0.1	1.0	NA	NA	NA	58.2
		HV	4		4		0.053	0.0	LOS A	0.1	1.0	NA	NA	NA	58.2
9	R2	All MCs	22	0.0	22	0.0	0.053	6.5	LOS A	0.1	1.0	0.14	0.18	0.14	55.5
		LV	22		22		0.053	6.5	LOS A	0.1	1.0	NA	NA	NA	55.5
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			95	4.4	95	4.4	0.053	1.5	NA	0.1	1.0	0.14	0.18	0.14	57.5
West: Grange Rd															
10	L2	All MCs	89	0.0	89	0.0	0.100	6.0	LOS A	0.4	2.7	0.27	0.57	0.27	52.1
		LV	89		89		0.100	6.0	LOS A	0.4	2.7	NA	NA	NA	52.1
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
12	R2	All MCs	39	0.0	39	0.0	0.100	6.4	LOS A	0.4	2.7	0.27	0.57	0.27	51.8
		LV	39		39		0.100	6.4	LOS A	0.4	2.7	NA	NA	NA	51.8
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			128	0.0	128	0.0	0.100	6.2	LOS A	0.4	2.7	0.27	0.57	0.27	52.0
All Vehicles			381	3.9	381	3.9	0.100	2.6	NA	0.4	2.7	0.12	0.26	0.12	56.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options 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 (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

INTERSECTION SUMMARY

Site: 101 [Goulburn_Grange_PM_Fut (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles:**	**All MCs**	**Persons**	
Travel Speed (Average)	km/h	56.0	56.0	km/h
Travel Distance (Total)	veh-km/h	373.7	448.5	pers-km/h
Travel Time (Total)	veh-h/h	6.7	8.0	pers-h/h
Desired Speed	km/h	60.0		
Speed Efficiency		0.93		
Travel Time Index		9.26		
Congestion Coefficient		1.07		
Demand Flows (Total)	veh/h	369	443	pers/h
Arrival Flows (Total)	veh/h	369		
Percent Heavy Vehicles (Demand)	%	1.1		
Percent Heavy Vehicles (Arrivals)	%	1.1		
Degree of Saturation		0.096		
Practical Spare Capacity	%	922.9		
Effective Intersection Capacity	veh/h	3857		
Control Delay (Total)	veh-h/h	0.29	0.34	pers-h/h
Control Delay (Average)	sec	2.8	2.8	sec
Control Delay (Worst Lane by MC)	sec	6.2		
Control Delay (Worst Movement by MC)	sec	6.5	6.5	sec
Geometric Delay (Average)	sec	2.5		
Stop-Line Delay (Average)	sec	0.2		
Idling Time (Average)	sec	0.0		
Intersection Level of Service (LOS)		NA		
95% Back of Queue - Veh (Worst Lane)	veh	0.3		
95% Back of Queue - Dist (Worst Lane)	m	2.3		
Ave. Que Storage Ratio (Worst Lane)		0.00		
Effective Stops (Total)	veh/h	108	130	pers/h
Effective Stop Rate		0.29	0.29	
Proportion Queued		0.11	0.11	
Performance Index		7.6	7.6	
Cost (Total)	$/h	303.24	303.24	$/h
Fuel Consumption (Total)	L/h	26.9		
Carbon Dioxide (Total)	kg/h	63.4		
Hydrocarbons (Total)	kg/h	0.005		
Carbon Monoxide (Total)	kg/h	0.08		
NOx (Total)	kg/h	0.038		

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.
In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 37.6% 6.5% 0.0%

Intersection Performance - Annual Values				
Performance Measure	**Vehicles:**	**All MCs**	**Persons**	
Demand Flows (Total)	veh/y	177,347	212,817	pers/y
Delay (Total)	veh-h/y	137	164	pers-h/y
Effective Stops (Total)	veh/y	51,954	62,345	pers/y

Travel Distance (Total)	veh-km/y	179,389	215,266	pers-km/y
Travel Time (Total)	veh-h/y	3,203	3,843	pers-h/y
Cost (Total)	$/y	145,556	145,556	$/y
Fuel Consumption (Total)	L/y	12,914		
Carbon Dioxide (Total)	kg/y	30,455		
Hydrocarbons (Total)	kg/y	2		
Carbon Monoxide (Total)	kg/y	37		
NOx (Total)	kg/y	18		

1 Hours per Year: 480 (Site)

MOVEMENT SUMMARY

Site: 101 [Goulburn_Grange_PM_Fut (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

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

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival 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	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Goulburn Rd															
1	L2	All MCs	75	0.0	75	0.0	0.084	5.6	LOS A	0.0	0.0	0.00	0.28	0.00	55.2
		LV	75		75		0.084	5.6	LOS A	0.0	0.0	NA	NA	NA	55.2
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
2	T1	All MCs	83	2.5	83	2.5	0.084	0.0	LOS A	0.0	0.0	0.00	0.28	0.00	57.5
		LV	81		81		0.084	0.0	LOS A	0.0	0.0	NA	NA	NA	57.5
		HV	2		2		0.084	0.0	LOS A	0.0	0.0	NA	NA	NA	57.5
Approach			158	1.3	158	1.3	0.084	2.6	NA	0.0	0.0	0.00	0.28	0.00	56.3
North: Goulburn Rd															
8	T1	All MCs	116	1.8	116	1.8	0.096	0.0	LOS A	0.3	2.3	0.18	0.24	0.18	57.6
		LV	114		114		0.096	0.0	LOS A	0.3	2.3	NA	NA	NA	57.6
		HV	2		2		0.096	0.0	LOS A	0.3	2.3	NA	NA	NA	57.6
9	R2	All MCs	55	0.0	55	0.0	0.096	6.5	LOS A	0.3	2.3	0.18	0.24	0.18	55.0
		LV	55		55		0.096	6.5	LOS A	0.3	2.3	NA	NA	NA	55.0
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			171	1.2	171	1.2	0.096	2.1	NA	0.3	2.3	0.18	0.24	0.18	56.7
West: Grange Rd															
10	L2	All MCs	17	0.0	17	0.0	0.035	5.8	LOS A	0.1	0.9	0.24	0.56	0.24	52.2
		LV	17		17		0.035	5.8	LOS A	0.1	0.9	NA	NA	NA	52.2
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
12	R2	All MCs	24	0.0	24	0.0	0.035	6.5	LOS A	0.1	0.9	0.24	0.56	0.24	52.0
		LV	24		24		0.035	6.5	LOS A	0.1	0.9	NA	NA	NA	52.0
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			41	0.0	41	0.0	0.035	6.2	LOS A	0.1	0.9	0.24	0.56	0.24	52.1
All Vehicles			369	1.1	369	1.1	0.096	2.8	NA	0.3	2.3	0.11	0.29	0.11	56.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options 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 (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

INTERSECTION SUMMARY

Site: 101 [Goulburn_Grange_AM_Fut +10yrs (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

New Site
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Intersection Performance - Hourly Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Travel Speed (Average)	km/h	56.2	56.2 km/h
Travel Distance (Total)	veh-km/h	469.9	563.8 pers-km/h
Travel Time (Total)	veh-h/h	8.4	10.0 pers-h/h
Desired Speed	km/h	60.0	
Speed Efficiency		0.94	
Travel Time Index		9.29	
Congestion Coefficient		1.07	
Demand Flows (Total)	veh/h	465	557 pers/h
Arrival Flows (Total)	veh/h	465	
Percent Heavy Vehicles (Demand)	%	3.9	
Percent Heavy Vehicles (Arrivals)	%	3.9	
Degree of Saturation		0.127	
Practical Spare Capacity	%	530.4	
Effective Intersection Capacity	veh/h	3660	
Control Delay (Total)	veh-h/h	0.35	0.42 pers-h/h
Control Delay (Average)	sec	2.7	2.7 sec
Control Delay (Worst Lane by MC)	sec	6.3	
Control Delay (Worst Movement by MC)	sec	6.8	6.8 sec
Geometric Delay (Average)	sec	2.3	
Stop-Line Delay (Average)	sec	0.4	
Idling Time (Average)	sec	0.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.5	
95% Back of Queue - Dist (Worst Lane)	m	3.5	
Ave. Que Storage Ratio (Worst Lane)		0.00	
Effective Stops (Total)	veh/h	123	147 pers/h
Effective Stop Rate		0.26	0.26
Proportion Queued		0.14	0.14
Performance Index		9.5	9.5
Cost (Total)	$/h	386.76	386.76 $/h
Fuel Consumption (Total)	L/h	36.2	
Carbon Dioxide (Total)	kg/h	86.0	
Hydrocarbons (Total)	kg/h	0.007	
Carbon Monoxide (Total)	kg/h	0.10	
NOx (Total)	kg/h	0.109	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.
In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 33.6% 5.4% 0.0%

Intersection Performance - Annual Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Demand Flows (Total)	veh/y	222,960	267,553 pers/y

Delay (Total)	veh-h/y	167	200	pers-h/y
Effective Stops (Total)	veh/y	58,918	70,702	pers/y
Travel Distance (Total)	veh-km/y	225,540	270,648	pers-km/y
Travel Time (Total)	veh-h/y	4,014	4,817	pers-h/y
Cost (Total)	$/y	185,645	185,645	$/y
Fuel Consumption (Total)	L/y	17,376		
Carbon Dioxide (Total)	kg/y	41,284		
Hydrocarbons (Total)	kg/y	3		
Carbon Monoxide (Total)	kg/y	48		
NOx (Total)	kg/y	52		

1 Hours per Year: 480 (Site)

MOVEMENT SUMMARY

Site: 101 [Goulburn_Grange_AM_Fut +10yrs (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

New Site
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival 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	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Goulburn Rd															
1	L2	All MCs	13	0.0	13	0.0	0.103	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	57.1
		LV	13		13		0.103	5.6	LOS A	0.0	0.0	NA	NA	NA	57.1
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
2	T1	All MCs	180	7.1	180	7.1	0.103	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	59.6
		LV	167		167		0.103	0.0	LOS A	0.0	0.0	NA	NA	NA	59.6
		HV	13		13		0.103	0.0	LOS A	0.0	0.0	NA	NA	NA	59.6
Approach			192	6.7	192	6.7	0.103	0.4	NA	0.0	0.0	0.00	0.04	0.00	59.4
North: Goulburn Rd															
8	T1	All MCs	89	5.8	89	5.8	0.065	0.0	LOS A	0.2	1.3	0.16	0.19	0.16	58.1
		LV	83		83		0.065	0.0	LOS A	0.2	1.3	NA	NA	NA	58.1
		HV	5		5		0.065	0.0	LOS A	0.2	1.3	NA	NA	NA	58.1
9	R2	All MCs	27	0.0	27	0.0	0.065	6.8	LOS A	0.2	1.3	0.16	0.19	0.16	55.4
		LV	27		27		0.065	6.8	LOS A	0.2	1.3	NA	NA	NA	55.4
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			115	4.4	115	4.4	0.065	1.6	NA	0.2	1.3	0.16	0.19	0.16	57.5
West: Grange Rd															
10	L2	All MCs	109	0.0	109	0.0	0.127	6.2	LOS A	0.5	3.5	0.31	0.59	0.31	52.0
		LV	109		109		0.127	6.2	LOS A	0.5	3.5	NA	NA	NA	52.0
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
12	R2	All MCs	47	0.0	47	0.0	0.127	6.7	LOS A	0.5	3.5	0.31	0.59	0.31	51.7
		LV	47		47		0.127	6.7	LOS A	0.5	3.5	NA	NA	NA	51.7
		HV	0		0		-	-	-	-	-	NA	NA	NA	-
Approach			157	0.0	157	0.0	0.127	6.3	LOS A	0.5	3.5	0.31	0.59	0.31	51.9
All Vehicles			465	3.9	465	3.9	0.127	2.7	NA	0.5	3.5	0.14	0.26	0.14	56.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options 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 (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

INTERSECTION SUMMARY

Site: 101 [Goulburn_Grange_PM_Fut + 10yrs (Site Folder: General)]

Output produced by SIDRA INTERSECTION Version: 9.1.3.210

New Site
Site Category: (None)
Give-Way (Two-Way)
Design Life Analysis (Final Year): Results for 10 years

Intersection Performance - Hourly Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Travel Speed (Average)	km/h	56.0	56.0 km/h
Travel Distance (Total)	veh-km/h	455.6	546.7 pers-km/h
Travel Time (Total)	veh-h/h	8.1	9.8 pers-h/h
Desired Speed	km/h	60.0	
Speed Efficiency		0.93	
Travel Time Index		9.25	
Congestion Coefficient		1.07	
Demand Flows (Total)	veh/h	450	540 pers/h
Arrival Flows (Total)	veh/h	450	
Percent Heavy Vehicles (Demand)	%	1.1	
Percent Heavy Vehicles (Arrivals)	%	1.1	
Degree of Saturation		0.118	
Practical Spare Capacity	%	729.0	
Effective Intersection Capacity	veh/h	3810	
Control Delay (Total)	veh-h/h	0.36	0.43 pers-h/h
Control Delay (Average)	sec	2.8	2.8 sec
Control Delay (Worst Lane by MC)	sec	6.4	
Control Delay (Worst Movement by MC)	sec	6.8	6.8 sec
Geometric Delay (Average)	sec	2.5	
Stop-Line Delay (Average)	sec	0.3	
Idling Time (Average)	sec	0.0	
Intersection Level of Service (LOS)		NA	
95% Back of Queue - Veh (Worst Lane)	veh	0.4	
95% Back of Queue - Dist (Worst Lane)	m	3.0	
Ave. Que Storage Ratio (Worst Lane)		0.00	
Effective Stops (Total)	veh/h	136	163 pers/h
Effective Stop Rate		0.30	0.30
Proportion Queued		0.13	0.13
Performance Index		9.3	9.3
Cost (Total)	$/h	370.27	370.27 $/h
Fuel Consumption (Total)	L/h	32.9	
Carbon Dioxide (Total)	kg/h	77.6	
Hydrocarbons (Total)	kg/h	0.006	
Carbon Monoxide (Total)	kg/h	0.09	
NOx (Total)	kg/h	0.047	

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
NA (TWSC): Level of Service is not defined for major road approaches or the intersection as a whole for Two-Way Sign Control (HCM LOS rule).
Two-Way Sign Control Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand effects.
In Network analysis, Arrival Flows will be reduced if Upstream Capacity Constraint exists.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
Site Model Variability Index (Average value of largest changes in Lane Degrees of Saturation from the third to the last Main (Timing-Capacity) Iterations): 0.0 %
Number of Iterations: 3 (Maximum: 10)
Largest change in Lane Degrees of Saturation for the last three Flow-Capacity Iterations: 40.5% 7.7% 0.0%

Intersection Performance - Annual Values			
Performance Measure	**Vehicles:**	**All MCs**	**Persons**
Demand Flows (Total)	veh/y	216,185	259,423 pers/y

Delay (Total)	veh-h/y	171	205	pers-h/y
Effective Stops (Total)	veh/y	65,253	78,303	pers/y
Travel Distance (Total)	veh-km/y	218,674	262,408	pers-km/y
Travel Time (Total)	veh-h/y	3,908	4,690	pers-h/y
Cost (Total)	$/y	177,729	177,729	$/y
Fuel Consumption (Total)	L/y	15,800		
Carbon Dioxide (Total)	kg/y	37,260		
Hydrocarbons (Total)	kg/y	3		
Carbon Monoxide (Total)	kg/y	45		
NOx (Total)	kg/y	22		

1 Hours per Year: 480 (Site)