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Part 1 Road Transport Assessment

for the

Howlong Sand and Gravel Expansion Project

State Significant Development 17_8804

Prepared by The Transport Planning Partnership

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Howlong Sand and Gravel Quarry Road Transport Assessment

Prepared for: R.W. Corkery & Co Pty Limited

2 March 2020

The Transport Planning Partnership



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References

Austroads (2017a), Guide to Traffic Management Part 3 Traffic Studies and Analysis.

Austroads (2017b), Guide to Road Design Part 4: Intersections and Crossings – General.

Austroads (2017c), Guide to Road Design Part 4A: Unsignalised and Signalised Intersections.

Austroads (2019), Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings.

Colston Budd Rogers & Kafes (2019), Transport and Accessibility Impact Assessment for Proposed Quarry Expansion, 4343 Riverina Highway, Howlong.

Transportation Research Board (2016), Highway Capacity Manual.

Transport for NSW Centre for Road Safety (2019), viewed on 16 October 2019, https://roadsafety.transport.nsw.gov.au/statistics/interactivecrashstats/lga_stats.html?tablga=4

VicRoads (2019), viewed on 16 October 2019, https://www.vicroads.vic.gov.au/safety-and-road-rules/safety-statistics/crash-statistics



1 Introduction

This report has been prepared on behalf of R.W. Corkery & Co Pty Ltd (RWC) to present the findings of an assessment of the road transport implications of an expansion of the existing quarry operations at the Howlong Quarry (the Quarry) located at 4343 Riverina Highway, Howlong, New South Wales (NSW).

The Quarry has been operating for more than 60 years in this location to supply local construction clients. It currently extracts, processes and transports sand and gravel material at a rate of 30,000 tonnes per annum (tpa). Approval is being sought to continue and expand the Quarry's operations, with an increased annual extraction and processing rate of up to 300,000 tpa in order to supply increasing demand for construction materials in Albury and beyond (the Project).

This report has been prepared as part of an SSD Application (SSD 17_8804) and has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) for the Project, issued on 7 November 2017. Table 1.1 lists the SEARs and the corresponding sections of the report where these are addressed.

Table 1.1: SEARs and Relevant Report Sections

	Traffic and Transport	Addressed in Section
•	Accurate predictions of the road traffic generated by the construction and operation of the development, including a description of the types of vehicles likely to be used for transportation of quarry products	4.1
•	A detailed assessment of potential traffic impacts on the capacity, condition, safety and efficiency of the local and State road network	4.4 4.5 4.6
•	A description of the measures that would be implemented to mitigate any impacts, including concept plans of any proposed upgrades, developed in consultation with the relevant road and rail authorities (if required)	4.7

The relevant general requirements of the SEARs have also been considered in preparation of this assessment, noting that these require that the Environmental Impact Assessment (EIS) for the Project include:

- an assessment of the likely impacts of all stages of the development, including any cumulative impacts, taking into consideration any relevant laws, environmental planning instruments, guidelines, policies, plans and industry codes of practice;
- a description of the measures that would be implemented to avoid, minimise, mitigate and/or offset the likely impacts of the development, and an assessment of:
 - whether these measures are consistent with industry best practice and represent the full range of reasonable and feasible mitigation measures that could be implemented;
 - the likely effectiveness of these measures; and



- whether contingency measures would be necessary to manage any residual risks; and
- a description of the measures that would be implemented to monitor and report on the environmental performance of the development.

Regard has also been given to the Roads and Maritime Services (RMS) input to the SEARs, which indicates that RMS is:

interested in the characteristics of the traffic generated by the development and the impact of the development on the safety and efficiency of the road network... The TIA is to address the potential impacts on the road network, particularly intersections, associated with the development during the lifetime of the project and outline mitigation measures such as intersection upgrades, to be implemented to maintain the standard and safety of the road network and the procedures to monitor and ensure compliance. Consideration of the cumulative impacts of the potential traffic generation when added to existing traffic volumes upon the surrounding road network shall be undertaken. For this development a transport management plan, including a driver code of conduct, may also be appropriate to outline measures to manage traffic related issues related to the haulage of material from the site.

The remainder of this report is set out as follows:

- Section 2 describes the site location, and existing and proposed operations of the Quarry and the Project;
- Section 3 describes the existing road transport environment, including the existing condition of the road network, a review of the road crash history, the operating conditions at key midblock and intersection locations with potential changes to the road transport environment over a ten-year horizon;
- Section 4 assesses the traffic anticipated to be generated by the Project, and its impacts on the road transport environment. Appropriate measures to address the Projectgenerated changes to the road transport environment are identified;
- Section 5 present the conclusions of the study.



2 The Quarry and the Project

2.1 Site Location

The Quarry is located at 4343 Riverina Highway, Howlong, NSW, approximately 25 kilometres (km) west of Albury and 2.4 km east of the urban edge of Howlong township. Vehicular access to the site is provided off Riverina Highway on the northern frontage, with the Murray River bounding the south of the site.

The Quarry's location in the region is shown in Figure 2.1, and its extents are shown in Figure 2.2.



Figure 2.1: Regional Location





Figure 2.2: Howlong Quarry Site Extents

2.2 Existing Quarry Operations

The Quarry has been in operation for over 60 years, and is permitted to extract up to 30,000 TPA of sand and gravel. All vehicular access is via the Quarry Access Road to Riverina Highway, and due to heavy vehicle restrictions on the portion of Riverina Highway between Spitters Creek and Albury, east of the Quarry, all Quarry-generated haulage trucks travel on Riverina Highway to and from the west only. All Quarry-generated haulage trucks with an origin or destination to the east travel via Sturt Street south of Riverina Highway then River Road and roads on the southern side of the Murray River in Victoria to access Albury and its surrounds.



2.3 Project Description

The Project seeks approval to continue and expand quarry operations at the Quarry in order to supply increasing demand for construction materials in Albury and beyond. Sand and gravel material would continue to be extracted, processed on site and transported to supply local construction clients.

The proposed expansion of the Quarry includes:

- an increase in the annual extraction, processing and transport rate from 30,000 tpa to a maximum of 300,000 tpa of sand and gravel
- operation of the Quarry for up to 30 years;
- employment of eight to ten personnel;
- construction of associated site infrastructure and amenities;
- transportation of material off-site via public roads; and
- progressively rehabilitating the site.

Sand and gravel would be despatched between 7.00 am and 10 pm on weekdays, and between 7.00 am and midday on Saturdays. Saturday haulage would occur only occasionally, and no haulage would occur on Sundays. Some trucks may arrive prior to the despatch hours, i.e. from 6.30 am, consistent with existing practice at the Quarry.

Transport would be limited to a maximum of 40 laden loads per day, and are expected to occur over 46 operating weeks per year. Transport operations would be contracted, or trucks and drivers would be supplied by clients.

2.4 Project Access and Haulage Routes

The Project will deliver excavated material to several destinations in the region, with the significant majority of material being delivered to Albury, and lesser amounts to Corowa, and some to regional areas such as Benalla and Wangaratta.

Transportation routes and vehicle access for the operation would not be changed with the Project. Vehicular access would continue to be provided via the existing access to and from Riverina Highway. Due to heavy vehicle restrictions on the portion of Riverina Highway in the Albury City local government area (LGA), east of Splitters Creek, all Project-generated haulage trucks would continue to travel on Riverina Highway to and from the west only. All Project-generated haulage trucks with an origin or destination to the east would continue to travel via Howlong, using Sturt Street south of Riverina Highway then River Road and roads on the southern side of the Murray River in Victoria.



3 Existing Road Transport Environment

3.1 Road Network

The road network serving the Quarry is presented in Figure 3.3 and described below.

The **Quarry Access Road** is a private access road which provides all vehicular access for the Quarry. The Quarry Access Road extends southwards from Riverina Highway approximately 1.8 km east of Kywong-Howlong Road. The private access road is an unsealed two-way, two-lane road with the exception of the single lane bridge which spans Black Swan Anabranch to access the Quarry disturbance site. It has a signposted speed limit of 40 kilometres per hour (km/h) for approximately 1.3 km from its intersection with Riverina Highway, reducing to 15 km/h in proximity to the landowner's residence, and then to 5 km/h on the single lane bridge. South of the bridge, the posted speed limit is 10 km/h.

The Quarry Access Road is generally some 12 m wide. The typical cross-section is shown in Figure 3.1, and the bridge crossing of the Black Swan Anabranch is shown in Figure 3.2.



Figure 3.1: Site Access off Riverina Highway (looking south)





Figure 3.2: Quarry Disturbance Access across Black Swan Anabranch (looking north)

Riverina Highway (B58) is a State declared road which provides connectivity to Deniliquin to the west via Berrigan and Albury to the east. Riverina Highway is generally aligned in an eastwest direction and provides the only vehicular access to the Quarry via the Quarry Access Road. Within the vicinity of the Quarry, Riverina Highway has one travel lane in each direction with sealed shoulders. The posted speed limit is 100 km/h. In the town of Howlong, Riverina Highway is also known as Hawkins Street (east-west) and Sturt Street (north-south) and has a posted speed limit of 50 km/h. A 40 km/h school zone speed limit applies on Hawkins Street past Howlong Public School. East of the intersection with Sturt Street, 45-degree angled kerb side parking is available on either side of Riverina Highway (Hawkins Street).

At the intersection of Hawkins Street and Sturt Street, Riverina Highway turns through 90degrees, continuing northwards before continuing approximately westwards. Outside of the township of Howlong, the speed limit on Riverina Highway is 100 km/h. Approximately 5 km north of Corowa, the Riverina Highway diverts north towards Berrigan.

Sturt Street is a north-south aligned road connecting Riverina Highway in the north and **River Road** to the south, which extends across the Black Swan Anabranch and Murray River, crossing the border into Victoria. Sturt Street provides one traffic lane in each direction with sealed shoulders. It should also be noted that north of the intersection between Riverina Highway and Sturt Street the north leg continues as Riverina Highway.



Figure 3.3: Road Network



Source: National Heavy Vehicle Regulator (NHVR) Route Planner

3.2 Intersections

The intersection of **Riverina Highway and Sturt Street** (Figure 3.4) is a four-way intersection, with Riverina Highway as both the eastern (Hawkins Street, give way) and northern (Sturt Street, priority) approaches. Sight distances on approaches to the intersection are considered satisfactory for the approach speed of vehicles, noting the speed limit is 50 km/h.

The configuration of the intersection of Riverina Highway and Sturt Street is shown in Figure 3.4.





Figure 3.4: Riverina Highway and Sturt Street Intersection

The intersection formed between the **Quarry Access Road and Riverina Highway** (Figure 3.5) is a basic rural four way intersection, with no auxiliary turn lanes. There is no localised widening of the sealed surface of Riverina Highway at the intersection, with the Quarry Access Road being unsealed from the edge line of Riverina Highway. The northern approach to the intersection provides access to a rural landholding located opposite the site. Sight distances on approaches to and from the site access are considered satisfactory for the approach speed of vehicles.





Figure 3.5: Riverina Highway and Quarry Access Road Intersection

3.3 Heavy Vehicle Routes

As noted (Section 2.4), the Project will deliver excavated material to several destinations in the region, with the significant majority of material being delivered to Albury, and lesser amounts to Corowa, and some to regional areas such as Benalla and Wangaratta. The approved heavy vehicle routes in NSW are shown in Figure 3.6 while Figure 3.7 illustrates the approved heavy vehicle routes in Victoria.

Riverina Highway, Sturt Street and River Road are approved routes for General Mass Limit (GML) 25 m B-double vehicles. Within the Albury City LGA, east of Splitters Creek, B-double access is not approved, as seen in Figure 3.6.





Figure 3.6: NSW Approved Heavy Vehicle Routes

Source: National Heavy Vehicle Regulator (NHVR) Route Planner





Figure 3.7: Victoria Approved Heavy Vehicle Routes

3.4 Traffic Volumes

3.4.1 Historic Traffic Volumes

RMS collects and publishes traffic volume data at selected locations on its roads. Available data on roads in the vicinity of the Quarry site were reviewed and collated, noting that only limited data is available in this region. The closest RMS count stations are located on River Road (Station ID: 95467) approximately 5 km west of the Quarry, Riverina Highway (Station ID: 95045) approximately 7 km west and Riverina Highway (Station ID: 95042) approximately 16.5 km east of the Quarry.

Data have not been collected at station 95467 and 95042 since 2011 while data has not been collected since 2010 at station 95045. Notwithstanding the available Annual Average Daily Traffic (AADT) data are presented in Table 3.1.

Source: National Heavy Vehicle Regulator (NHVR) Route Planner



Station ID	Data Pariad	Average Vehicles per Day			
	Dala Perioa	All Days	Weekday		
Riverina Highway (95045)	5 June 2010 – 22 June 2010	1,626	1,675		
Riverina Highway (95042)	1 January 2011 – 29 May 2011	2,352	2,509		
River Road (95467)	1 January 2011 – 4 December 2011	1,631	1,730		

Table 3.1: RMS Historic Traffic Volume Data

Reference: RMS

Surveys of traffic on Riverina Highway east of the Quarry Access Road were undertaken during March 2018 (Colston Budd Rogers & Kafes, 2019). The summary results of the traffic surveys are presented in Table 3.2.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Daily (vehicles per day)	2,936	2,978	3,232	3,146	3,315	2,757	2,044
AM Peak Hour (vehicles per hour)	256	240	316	232	254	199	152
PM Peak Hour (vehicles per hour)	255	239	285	284	325	246	186

Table 3.2: Traffic Volumes on Riverina Highway March 2018

Source: Table 3.8 Colston Budd Rogers & Kafes, 2019

The 2018 surveys demonstrate that traffic conditions on Riverina Highway are distinctly different on weekdays compared with weekend days. On weekdays, Riverina Highway carried an average of approximately 3,120 vehicles per day east of the Quarry Access Road.

3.4.2 Project Traffic Surveys

To quantify current traffic conditions on the roads serving the subject site as a baseline against which future conditions can be assessed, a program of traffic surveys was commissioned by TTPP. Automatic tube count surveys were completed over seven days between Monday 23 September 2019 and Monday 30 September 2019 on:

- Quarry Access Road;
- Riverina Highway, to the west of Quarry Access Road; and
- Sturt Street, south of the Riverina Highway intersection.

The tube count surveys collected vehicle volume, classification and speed data at hourly intervals over the seven-day survey period. The results of the surveys are presented in Appendix A.

3.4.3 Surveyed Traffic Volumes

The surveys collected details of the day-to-day variation in traffic and the composition of the traffic based on standard vehicle classifications. Light vehicles include motorcycles, cars,



vans, four-wheel drives (4WDs), and utilities (including those towing a trailer or caravan). Heavy vehicles include single unit trucks and buses and articulated vehicles such as semitrailers, rigid trucks with trailers, B-doubles and road trains.

Table 3.3 presents a summary of the daily traffic volumes at the surveyed locations, being the total number of vehicles passing the surveyed location in both directions of each 24-hour period.

	Quarry Access Road south of Riverina Highway		Riverina H west of Quarry	Highway Access Road	Sturt Street south of Riverina Highway		
	Light	Heavy	Light	Heavy	Light	Heavy	
Monday	35	11	2,597	301	1,507	488	
Tuesday	_A	_A	2,731	358	1,662	416	
Wednesday	44	8	2,787	364	1,703	498	
Thursday	35	8	2,835	334	1,652	439	
Friday	17	8	3,178	299	1,879	344	
Saturday	3	3	1,926	159	1,575	228	
Sunday	4	0	1,915	156	1,506	211	

Table 3.3: Surveyed Daily Traffic Volumes 2019 (vehicles per day)

^A Data missing

The results in Table 3.3 demonstrate that traffic conditions are notably different between weekdays and weekend days. As weekdays are the busier days, this assessment will consider the average weekday conditions rather than average daily conditions.

Over the surveyed week, Riverina Highway west of the Quarry Access Road carried an average of 3,157 vehicles per weekday, of which 332 vehicles (10.5 per cent) were heavy vehicles. Sturt Street south of Riverina Highway carried an average of 2,118 vehicles per weekday, of which 437 (20.6 per cent) were heavy vehicles. The Quarry Access Road carried an average of 42 vehicles per weekday, of which, nine (21 per cent) were heavy vehicles.

Table 3.4 presents a summary of the surveyed peak hourly traffic volumes at the surveyed locations over the average weekday, being the highest number of vehicles passing the surveyed location in both directions during any one hour before or after midday.



	AM	Peak Hou	r	PM Peak Hour			
	Hour	Light	Heavy	Hour Start	Light	Heavy	
Quarry Access Road south of Riverina Highway	6am - 7am	3	2	1pm - 2pm	3	1	
Riverina Highway west of Quarry Access Road	8am - 9am	238	26	4pm - 5pm	261	28	
Sturt Street south of Riverina Highway	10am - 11am	112	30	5pm - 6pm	161	29	

Table 3.4: Surveyed Daily Traffic Volumes 2019 (vehicles per hour)

The results in Table 3.4 demonstrate that on weekdays, the highest traffic volumes do not coincide on the three surveyed roads. The overall busiest hours on Riverina Highway and Sturt Street occurred during the evening peak hour, while average weekday peak hour volumes on the Quarry Access Road were very low.

3.5 Road Safety History

Road crash information was obtained from the Centre for Road Safety (NSW) and Crash Statistics Vic Roads (VIC) across a five-year period between 2014 and 2018 for those roads in proximity to the Quarry and identified as Project heavy vehicle routes. The data include crashes which conform to the national guidelines for reporting and classifying road vehicle crashes based on the following criteria:

- The crash was reported to the police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving vehicle.
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Key findings of the review of the crash history on those routes which may be used by Project heavy vehicles are summarised below. As indicated in Section 3.3, the Quarry would deliver excavated material to several destinations across New South Wales and Victoria. As such, Figure 3.8 indicates the sections of the routes that haulage vehicles are likely to take depending on their destination. It should also be noted that all haulage vehicles would use Riverina Highway (Hawkins Street) between Howlong and the Quarry as highlighted in blue (see Figure 3.8 overleaf).





Figure 3.8: Crash Routes Investigated 2014 to 2018

Basemap: Google Maps Australia

Riverina Highway, between East of Quarry Access Road and Howlong

A total of ten crashes were recorded on this 4.5 km route over the five year period investigated. No crashes occurred at or near the intersection of Riverina Highway and the Quarry Access Road. The location of these ten crashes (bold circle) are shown in Figure 3.9.

- Two crashes involved light vehicles rearing left off the carriageway into an object (Locations 4 and 6), and both occurred in the dark.
- Two crashes involved light vehicle or motorcycle striking an animal (Locations 1 and 10), and both occurred in the dark.
- Three crashes involved rear end crashes between vehicles travelling in the same direction (Locations 2, 3 and 5), all of which occurred within the township of Howlong. One of these crashes (location 3) involved a heavy truck and a car.
- One crash occurred while a vehicle was leaving parking (Location 7), within the Howlong township.
- One crash occurred at the intersection of Hawkins Street and Sturt Street between vehicles travelling in adjacent directions (Location 8). The crash involved a light vehicle and a heavy truck and occurred in daylight.



 One crash involved a light truck striking a pedestrian walking in the same direction (Location 9), and occurred in daylight.



Figure 3.9: Crashes on Riverina Highway, between East of Quarry and Howlong

Source: Transport for NSW Centre for Road Safety (2019)

Riverina Highway, between Sturt Street Howlong and Corowa

A total of six crashes were recorded on this 20.6 km route over the five year period investigated. The locations of these crashes (bold circle) are shown in Figure 3.10.

- Four crashes involved light vehicles leaving the carriageway (Locations 11 to 14). One of these occurred at dusk, two occurred in the dark and one occurred in daylight.
- One crash involved a driver losing control of their vehicle, which remained on the carriageway (Location 15), which occurred at dusk.
- Crash location 16 involved a vehicle striking an animal in the dark.





Figure 3.10: Crashes on Riverina Highway, between Sturt Street and Corowa

Source: Transport for NSW Centre for Road Safety Crash Map

Chiltern-Howlong Road (C381)

As noted previously, haulage vehicles wishing to travel to destinations east or south must turn left at the intersection of Riverina Highway-Sturt Street crossing the border into Victoria and continue southbound along Chiltern-Howlong Road. As such, crash data for a five-year period between 2014-2018 was obtained from Crash Statistics Vic Roads for this 7.7 km long route. The crash locations along Chiltern-Howlong Road are shown in Figure 3.11.

- Two crashes occurred along Chiltern-Howlong Road.
- One crash occurred at the intersection of Gooramadda Road and Chiltern-Howlong Road.
- One crash occurred at the intersection of Chiltern-Howlong Road and Barnawartha Road.
- One crash occurred at the intersection of Chiltern-Howlong Road and Murray Valley Highway.



Figure 3.11: Chiltern-Howlong Road C381, Victoria



Source: Crash Statistics VIC Roads

Crash History Summary

The review of the crash history of the above road sections in the vicinity of the project does not highlight any location with a particularly poor crash history which may suggest an inherent issue with one or more aspects of that location. The intersection of Riverina Highway and the Quarry Access Road has experienced no recorded crashes over the five year period investigated.

3.6 School Buses

As noted (Section 3.1), a 40 km/h school speed zone applies along Riverina Highway (Hawkins Street) adjacent to the Howlong Public School, located within the Howlong township on the northern side of Hawkins Street (Riverina Highway). Howlong Preschool is located opposite Howlong Public School on the southern side of Hawkins Street. The school facilities are serviced by bus stops on both the northern and southern sides of Hawkins Street, as shown in Figure 3.12.

The private bus service Route No. 915 operates at these stops, with three services per day Monday to Friday, and no services on weekends. The bus stop on the south side of Hawkins Street services bus route no. 1 provided by Public Transport Victoria (PTV), which operates one morning and one afternoon bus service.

Bus route no. 915 and bus route no. 1 both provide connectivity to Albury to Corowa via Howlong.



Figure 3.12: Bus Stops on Riverina Highway

3.7 Background Traffic Growth

Changes to existing traffic conditions can be expected to occur which are not directly attributable to any specific development. For the purpose of this assessment, an average growth rate of 1.0 per cent per annum has been assumed to occur on Riverina Highway and Sturt Street in the future, increasing the background peak hourly and daily traffic volumes over time.

A future horizon assuming ten years of growth on Riverina Highway and Sturt Street has been adopted, and the resulting traffic volumes are summarised in Table 3.5. Traffic volumes on Riverina Highway east of the Quarry Access Road have been estimated from the survey results, assuming that heavy vehicles on the Quarry Access Road all approach and depart to/from the west, and light vehicles approach and depart to/from both the east and west.



	AM Peak (vehicles per hour)		PM Peak (vehicles per hour)		Daily (vehicles per day)	
	Light	Heavy	Light	Heavy	Light	Heavy
Surveyed 2019						
Quarry Access Road	3	2	3	1	32	10
Riverina Highway east of Quarry Access Road ^A	238	26	261	28	2,825	321
Riverina Highway west of Quarry Access Road	238	26	261	28	2,825	332
Sturt Street south of Riverina Highway	112	30	161	29	1,676	437
Baseline 2029 ^B					•	
Quarry Access Road	3	2	3	1	32	10
Riverina Highway east of Quarry Access Road ^A	263	29	289	30	3,120	355
Riverina Highway west of Quarry Access Road	263	29	289	30	3,120	366
Sturt Street south of Riverina Highway	124	33	178	32	1,851	483

Table 3.5: Surveyed and Baseline Future Traffic Volumes

A estimated from survey results and likely Quarry traffic distribution

^B with Quarry operating at 2019 surveyed level of activity

Table 3.5 indicates that with ten years of background growth on the public roads, and the Quarry operating at the same level as surveyed in 2019, Riverina Highway can be expected to carry up to 319 vehicles per hour and 3,486 vehicles per day. Sturt Street south of Riverina Highway can be expected to carry 2,334 vehicles per day.

3.8 Road Network Efficiency

3.8.1 Midblock Level of Service

The capacity of a road is defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing roadway, traffic and control conditions. The capacity of a single traffic lane will be affected by factors such as the pavement width and restricted lateral clearances, the presence of heavy vehicles and grades.

Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers. A LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describes progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired



speeds or to manoeuvre in the traffic stream. The service flow rate for LOS E is taken as the capacity of a lane or roadway. In rural situations, LOS C is generally considered to be acceptable. At LOS C, most vehicles are travelling in platoons, and travel speeds are curtailed. At LOS D, platooning increases significantly, and the demand for passing is high, but the capacity to do so is low. The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road.

The Austroads (2017a) Guide to Traffic Management Part 3: Traffic Studies and Analysis provides guidelines for the capacity and performance of two lane, two-way rural roads, which in turn, refers to the Highway Capacity Manual (HCM) (Transportation Research Board, 2016).

The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road, and three classes of road are defined in the HCM. Class I roads are those on which motorists expect to travel at relatively high speeds. They most often serve long-distance trips or provide connecting links between facilities that serve long-distance trips. Class II roads are those on which motorists do not necessarily expect to travel at high speeds, and may function as access routes to Class I facilities, serve as scenic or recreational routes or pass through rugged terrain. Class III roads serve moderately developed areas, and may be portions of a Class I or Class II highway that pass through small towns or developed recreational areas, where local traffic mixes with through traffic, and the density of unsignalised roadside access points increases.

On Class I roads, LOS is defined in terms of Percent Time Spent Following (PTSF) and Average Travel Speed (ATS), with the worst of these criteria being adopted as the LOS. On Class II roads, LOS is defined only in terms of PTSF. The PTSF is a measure of the level of opportunities to overtake, and is estimated from the demand traffic volumes, the directional distribution of that traffic, and the percentage of no-passing zones. On Class III roads, LOS is defined in terms of Percent of Free-Flow Speed (PFFS), which is the ratio of ATS to the free-flow speed, representing the ability of vehicles to travel at or near the posted speed limit. The LOS criteria for two lane roads are as shown in Table 3.6.

Level of Service	Clo	iss I	Class II	Class III
	Average Travel Speed (km/h)	Average TravelPTSFSpeed (km/h)(percent)		PFFS (percent)
А	> 90	≤ 35	≤ 40	> 91.7
В	> 80 - 90	> 35 - 50	> 40 - 55	> 83.3 - 91.7
С	> 70 - 80	> 50 - 65	> 55 - 70	> 75.0 - 83.3
D	> 60 - 70	> 65 - 80	> 70 - 85	> 66.7 - 75.0
E	≤ 60	≥ 80	≥ 85	≤ 66.7

Table 3.6: LOS Criteria for Two Lane Two Way Roads

Source: Austroads (2017a)

Riverina Highway and Sturt Street may be considered as either a Class I or Class II route, and for the purpose of this review, the more stringent criteria for Class I roads have been adopted.

The PTSF resulted in the lower LOS compared to ATS. Table 3.7 summarises the results of the assessment of midblock LOS on Riverina Highway in the vicinity of the Quarry Access Road and Sturt Street south of Howlong (taken to be in the 100 km/h speed limit zone). It should be noted that this calculation method does not apply to the Quarry Access Road as its posted speed limit of 20 km/h is below the lower speed limit threshold of approximately 70 km/h used in the HCM method.

	Peak Hour	Outbou Quarry Ac	Outbound from Quarry Access Road		und to cess Road		
		PTSF	LOS	PTSF	LOS		
Riverina Highway west of Quarry Access Road							
Surveyed 2010	AM Peak	24.0	A	40.9	В		
Surveyed 2019	PM Peak	41.0	В	29.6	A		
D 1' 0000	AM Peak	25.7	A	43.3	В		
Baseline 2024	PM Peak	43.7	В	31.9	A		
Sturt Street south of Howlo	ng						
Survey of 2010	AM Peak	23.6	A	25.0	A		
Surveyed 2019	PM Peak	31.4	A	24.7	A		
Reading 2020	AM Peak	24.4	А	26.1	А		
Baseline 2029	PM Peak	33.1	A	26.2	A		

Table 3.7: Average Weekday Midblock Level of Service

The results indicate that midblock levels of service on Riverina Highway are currently good during the surveyed morning and evening peak hours. With background growth in traffic demands which are unrelated to the Project, levels of service would remain at their current levels, with drivers experiencing only minor delays as a result of other traffic.

3.8.2 Operation of Intersections

At unsignalised intersections with minor roads, where there are relatively low volumes of through and turning vehicles, capacity considerations are usually not significant, and detailed analysis of capacity is not warranted. As a guide, at volumes below the following combinations of maximum hourly volumes at a cross intersection with a two lane two-way road, capacity analysis is not warranted:

- major road 400 vehicles per hour, minor road 250 vehicles per hour;
- major road 500 vehicles per hour, minor road 200 vehicles per hour; and
- major road 650 vehicles per hour, minor road 100 vehicles per hour.

Comparing the surveyed and baseline traffic volumes with the threshold volumes above, it is evident that the peak hourly volumes are well below the threshold volumes for analysis, and as such, there is no capacity concerns regarding the operation of the intersections of Riverina Highway with the Quarry Access Road and with Sturt Street. Nevertheless, the operating characteristics of the intersection of Riverina Highway and the Quarry Access Road have been assessed using SIDRA INTERSECTION 8, an analysis program which determines characteristics of intersection operating conditions including the degree of saturation, average delays, and levels of service. The degree of saturation, or x-value, is the ratio of the arrival rate of vehicles to the capacity. The average delay, expressed in seconds per vehicle, is measured over all movements at signalised intersections, and over the movement with the highest average delay at roundabout and priority intersections. Average vehicle delay is the commonly used measure of intersection performance defined by RMS (RTA, 2002). Table 3.8 shows the criteria adopted by RMS for assessing the level of service.

Level of Service (LoS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Sign
A	Less than 14	Good operation	Good operation
В	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
С	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Table 3.8: Intersection Level of Service Criteria

Adapted from RTA (2002)

Table 3.9 presents a summary of the existing and forecast baseline peak hour operating characteristics of the intersection, which is under priority control, thus the reported average delay is for the movement with the highest average delay per vehicle. As a robust assessment, the analysis assumes the morning and evening peak hourly traffic on the Quarry Access Road coincides with the morning and evening peak hourly traffic on Riverina Highway. A small allowance has been made for vehicles entering and exiting the property access opposite the Quarry Access Road during the peak hours. The analysis assumes all heavy vehicle traffic on the Quarry Access Road are large trucks (25 m length) which travel to and from the west, and light vehicles traffic travels to and from both the east and west. Detailed results, including vehicle queues are presented in Appendix B.

		AM Peak		PM Peak			
Intersection	X-Value	Average Delay ^A	LoS	X-Value	Average Delay ^A	LoS	
Surveyed 2019	0.10	9.9	А	0.10	9.3	А	
Baseline 2029	0.11	10.0	А	0.11	9.6	А	

^A seconds per vehicle for movement with highest average delay per vehicle.

On the basis of the above assessment results, it is evident that the intersection currently operates at a satisfactory level of service during peak periods, with spare capacity and



acceptable delays. With the forecast changes to traffic conditions expected without the Project in 2029, the operation of the intersection would continue to be satisfactory.



4 Impacts of the Project

4.1 Traffic Generation

The Project proposes an annual production rate of up to 300,000 tpa of sand and gravel. Based on the Project operating hours (Section 2.3), haulage would take place up to 15 hours per weekday and 5 hours on occasional Saturdays over an expected 46 weeks per year.

A mix of vehicle types would be used for product haulage, including truck and trailer combinations and B-doubles. The payload capacity of these vehicles varies, with an average capacity of 45 t per truck assumed for this assessment. Haulage of 300,000 tonnes of material per year would therefore require 6,667 laden truck loads per year. Assuming continuous operation throughout the 46 operating weeks per year, and excluding Saturday haulage, this would be equivalent to an average of 29 laden truck loads per operating weekday.

Product despatch would be limited to a maximum of 40 laden truck loads per day, which would generate an average of four laden truck departures per hour over the 15-hour haulage period on a weekday, however the Quarry operations tend to be busier during the morning, slowing during the afternoon and evening. Product despatch would be limited to a maximum of six laden trucks in any one hour. The laden truck departures would be matched by an equivalent number of empty truck arrivals.

The Project workforce would travel to and from the site each day by private vehicle. Without allowing for any car sharing, up to 10 workers would attend the Project each day, generating up to 20 light vehicle trips per day, being 10 arrivals in the morning and 10 departures in the evening. The workforce would tend to arrive prior to the start of haulage and leave following completion of haulage, and so would not travel at the same time as the haulage trucks are operating, nor would they travel at the same time as the background peak hours on Riverina Highway and Sturt Street (Section 3.4.3).

Up to three non-employee visitors may be expected to attend the Project on any one day, generating six light vehicle trips per day. These trips may occur at any time during the Project operating hours, however would typically occur during the daytime and it is expected that not more than four visitor trips would occur in any one hour.

Occasional maintenance or delivery heavy vehicles would attend the Project, however would typically be managed to avoid coinciding with the peak haulage days, so are not considered further in this assessment. The traffic generation of the Project assumed for the purpose of this assessment is therefore:

- 26 light vehicle trips per day; and
- 80 heavy vehicle trips per day.



The peak hours for product haulage and visitor traffic may coincide and may occur at any time throughout the operating hours, thus this assessment considers the scenario in which these Project-generated trips coincide with the peak hour of background traffic, regardless of when that peak occurs. The arrival and departure of employees would not coincide with peak haulage or visitor trips and so is not included in the assessment of peak hour conditions.

- 4 light vehicle trips per hour; and
- 12 heavy vehicle trips per hour.

4.2 Traffic Distribution

The distribution of Project-generated traffic would remain the same as the current distribution, with all heavy vehicles approaching and departing to and from the west due to the heavy vehicle restriction to the east on Riverina Highway. All haulage trucks would therefore use Riverina Highway between the Quarry Access Road and Howlong.

The applicant has estimated that at Howlong, approximately 95 per cent of laden trucks would turn left from Hawkins Street to Sturt Street (south) and then continue across the Murray River via River Road, and 5 per cent would turn right and continue along Riverina Highway to Corowa. Due to the campaign nature of quarry operations however, on any one day, the distribution of trucks may vary significantly, such that all trucks may follow a particular route.

For the purpose of this assessment, it is assumed that visitor traffic would be sourced from either the east or west.

Table 4.1 summarises the resulting Project-generated trips on the surrounding road network, which assumes the destination of all quarry products is south or east of the Project.

Road and Location	(ve	Peak Hour chicles per ho	our)	Daily (vehicles per day)			
	Light	Heavy	Total	Light	Heavy	Total	
Quarry Access Road	4	12	16	26	80	106	
Riverina Highway East of Quarry Access Road	2	0	2	13	0	13	
Riverina Highway West of Quarry Access Road	2	12	14	13	80	93	
Sturt Street South of Riverina Highway	2	12	14	13	80	93	

Table 4.1: Project Peak Vehicle Trips on the Road Network



4.3 Future Traffic Volumes

Table 4.2 presents the baseline and resulting future peak hour traffic volumes on the surveyed roads on a busy day with regard to Project traffic generation at the maximum production rate of 300,000 tpa.

Location	Light Vehicles per Day	Heavy Vehicles per Day						
Baseline with 10 Years' Growth – No Project								
Quarry Access Road	32	10						
Riverina Highway East of Quarry Access Road ⁸	3,120	355						
Riverina Highway West of Quarry Access Road	3,120	366						
Sturt Street South of Riverina Highway	1,851	483						
Project Busy Day Traffic								
Quarry Access Road	26	80						
Riverina Highway East of Quarry Access Road	13	0						
Riverina Highway West of Quarry Access Road	13	80						
Sturt Street South of Riverina Highway ^c	13	80						
Future With 10 years' Background Growth and Project Tra	affic							
Quarry Access Road	26	80						
Riverina Highway East of Quarry Access Road	3,117	355						
Riverina Highway West of Quarry Access Road	3,117	436						
Sturt Street South of Riverina Highway ^c	1,848	553						

Table 4.2: Project Impact on Daily Traffic

^A with Quarry operating at 2019 surveyed level of activity

^B estimated

 $^{\rm C}$ assumes all haulage vehicles travel to/from south or east

Table 4.3 presents the existing and resulting future peak hour traffic volumes on the surveyed roads on a busy day with regard to Project traffic generation at the maximum production rate of 300,000 tpa.



Location		AM Peak Hou	r	PM Peak Hour			
Location	Light	Heavy	Total	Light	Heavy	Total	
Baseline with 10 Years' Growth – No	Project ^A						
Quarry Access Road	3	2	3	1	31	10	
Riverina Highway East of Quarry Access Road ^B	263	29	292	289	30	319	
Riverina Highway West of Quarry Access Road	263	29	292	289	30	319	
Sturt Street South of Riverina Highway	124	33	157	178	32	210	
Project Busy Day Traffic						·	
Quarry Access Road	4	12	16	4	12	16	
Riverina Highway East of Quarry Access Road	2	0	0	2	0	0	
Riverina Highway West of Quarry Access Road	2	12	16	2	12	16	
Sturt Street South of Riverina Highway ^c	2	12	16	2	12	16	
Future With 10 years' Background G	rowth and Pro	ject Traffic					
Quarry Access Road	4	12	16	4	12	16	
Riverina Highway East of Quarry Access Road	265	29	294	291	30	321	
Riverina Highway West of Quarry Access Road	265	41	306	291	42	333	
Sturt Street South of Riverina Highway ^c	126	45	171	180	44	224	

Table 4.3: Project Impact on Peak Hourly Traffic (vehicles per hour)

A with Quarry operating at 2019 surveyed level of activity

^B estimated

 $^{\rm C}$ assumes all haulage vehicles travel to/from south or east

The results in Table 4.3 indicate that with the cumulative impacts of the Project operating at its maximum capacity, together with background growth, Riverina Highway can be expected to carry up to 333 vehicles per hour during the peak hour near the Quarry Access Road and Sturt Street can be expected to carry up to 224 vehicles per hour during the peak hours south of Riverina Highway.

4.4 Future Road Network Efficiency

4.4.1 Future Midblock Level of Service

The impact of the Project-generated traffic on the efficiency of the road network has been quantified by considering the future midblock LOS on Riverina Highway in the vicinity of the Quarry Access Road and on Sturt Street south of Howlong with background traffic growth and the Project operating at its capacity. Applying the HCM method (Section 3.8.1), the



results of the assessment are summarised in Table 3.6, again adopting the more stringent criteria for Class I roads, and the lower LOS results based on PTSF rather than ATS.

	Peak Hour	Outbou Quarry Ac	nd from cess Road	Inbound to Quarry Access Road					
		PTSF	LOS	PTSF	LOS				
Riverina Highway west of Quarry Access Road									
Reading 2020	AM Peak	25.5	A	43.2	В				
Baseline 2029	PM Peak	43.6	В	31.8	A				
D : 10000	AM Peak	27.1	A	43.7	В				
Project 2029	PM Peak	44.3	В	33.0	A				
Sturt Street south of Howlog	ng								
Reading 2020	AM Peak	24.4	A	26.1	A				
Baseline 2029	PM Peak	33.1	A	26.2	A				
Project 2029	AM Peak	25.4	A	26.7	A				
	PM Peak	34.1	A	27.7	A				

Table 4.4: Impact of the Project on Average Weekday Midblock Level of Service

The results indicate that the Project traffic would have only minor impacts on the PTSF experienced by drivers on Riverina Highway and Sturt Street, and would have no impact on the midblock levels of service.

4.4.2 Future Operation of Intersections

The impact of the Project-generated traffic on the operation of the intersection of Riverina Highway with the Quarry Access Road has been assessed by analysing the forecast peak hourly traffic volumes using SIDRA INTERSECTION. Similar to Section 3.8.2, as a robust assessment, the analysis assumes the morning and evening peak hourly traffic on the Quarry Access Road coincides with the morning and evening peak hourly traffic on Riverina Highway, noting that Project-generated traffic is likely to be somewhat lower later in the day compared with the morning. A small allowance has been made for vehicles entering and exiting the property access opposite the Quarry Access Road during the peak hours. Detailed results, including vehicle queues are presented in Appendix B.



		AM Peak		PM Peak					
Intersection	X-Value	Average Delay ^A	LoS	X-Value	Average Delay ^A	LoS			
No Project									
Surveyed 2019	0.10	9.9	А	0.10	9.3	А			
Baseline 2029	0.11	10.0	А	0.11	9.6	А			
With Project									
With Project 2019	0.11	11.7	А	0.10	13.4	А			
With Project 2029	0.12	12.0	А	0.11	13.9	А			

Table 4.5: Future Peak Hour Operating Conditions Riverina Highway and Quarry Access Road

^A seconds per vehicle for movement with highest average delay per vehicle.

The SIDRA results demonstrate that the intersection of the Quarry Access Road with Riverina Highway can be expected to operate at a good level of service should the peak product haulage coincide with the peak hourly traffic on Riverina Highway. The movement with the highest average delay in future would be the right turn in to the Quarry Access Road, and through movements on Riverina Highway would experience negligible delays. No upgrade of the intersection would be required to provide any additional capacity.

4.5 Intersection Treatment

The minimum layout for a rural road access should be designed for the largest vehicles likely to use the access. Austroads (2017b) presents rural access layouts suitable for use by articulated vehicles, and notes that a road intersection layout should be adopted where there is a high demand for articulated vehicles. The number of articulated vehicle trips forecast to use the Quarry Access Road with the Project operating at capacity would be limited to a maximum of 40 inbound and 40 outbound movements per day, or up to six inbound and six outbound movements in any one hour. This level of activity is considered to warrant a road intersection layout, and the Austroads (2019) warrants for the treatment of rural road intersections have therefore been considered.

Austroads (2019) sets out warrants for rural intersection treatments on the major road, which are based on the number of turning and through vehicle movements at the intersection. On the basis of the warrant on roads with an operating speed of 100 km/h or more, the forecast peak hourly volumes at the intersection would warrant the minimum preferred treatment. The general minimum preferred treatment at rural road intersections are Basic Auxiliary Left (BAL) and Basic Auxiliary Right (BAR) treatments.

The rural BAL treatment on the major road has a widened shoulder, which assists vehicles turning left into the minor road to move further off the through carriageway, making it easier for through vehicles to pass a vehicle turning left into the minor road. It is noted that there is expected to be no demand for heavy vehicles to turn left from Riverina Highway to the Quarry Access Road, however it remains appropriate to provide a BAL treatment suitable for light vehicles.



The rural BAR treatment features a widened shoulder on the major road that allows through vehicles, having slowed, to pass to the left of vehicles turning right into the minor road. The BAL treatment on the minor road allows turning movements to occur from a single lane, with a shoulder that is too narrow to be used by left-turning vehicles, so as to prevent vehicles from standing two abreast at the holding line.

These design features are preferred to safely manage the movement of vehicles in the high speed rural environment, and it is therefore recommended that BAL and BAR treatments be provided at the intersection of the Quarry Access Road with Riverina Highway, and that the design of those treatments be consistent with Austroads requirements, taking into account the characteristics of the largest vehicle expected to use the Quarry Access Road, and incorporating the property access on the northern side of Riverina Highway opposite the Quarry Access Road.

Safe Intersection Sight Distance (SISD) is the minimum sight distance which should be provided on the major road at any intersection, and is measured from a driver's eye height (car 1.1 m, truck 2.4 m) to an object height of 1.25 m at the potential conflict point and assumes the driver on a minor road is situated 7.0 m (minimum 5.0 m) from the potential conflict point on the major road. SISD allows for approaching drivers to see an articulated vehicle which has properly commenced a manoeuvre from a leg without priority, but its length creates an obstruction. Austroads (2017c) indicates that the desirable minimum SISD is 248 m for the general minimum driver reaction time of 2.0 s and assuming a level road surface. Observations on site suggest that the available sight distance for both eastbound and westbound drivers on Riverina Highway exceeds 248 m, which is satisfactory.

4.6 Road Safety Implications

The review of the road crash history of the road network serving the Project (Section 3.5) did not identify any causation factors associated with the existing road network that may be exacerbated by increased traffic demands.

4.7 Mitigation Measures

The assessment results above demonstrate that no measures would be required to provide additional capacity to accommodate the Project traffic. Existing approved heavy vehicles routes are of an adequate standard to accommodate the Project heavy vehicles, noting that the Project proposes use of existing approved heavy vehicle routes, and so would not introduce heavy vehicles to any roads not currently used by heavy vehicles.

As described in Section 4.5, and consistent with Austroads (2017b) where there is a high demand for articulated vehicles, it is recommended that the existing intersection of the Quarry Access Road with Riverina Highway be upgraded to meet basic rural road intersection standard. Such treatment should include a BAR treatment suitable for Projectgenerated trucks turning right into the Quarry Access Road, and a BAL treatment for light



vehicles turning left into the Quarry Access Road. A BAL treatment should also be provided on the Quarry Access Road suitable for the Project-generated trucks to exit the Quarry Access Road without crossing the centreline of Riverina Highway. A conceptual layout fot the intersection is presented in Appendix C. These treatments would enhance safety for the turning vehicles and minimise interference to through traffic, and would be designed and constructed in consultation with RMS.

The increase in truck trips generated by the Project would increase the likelihood of haulage trucks needing to pass each other at or near the intersection of the Quarry Access Road and Riverina Highway or on the single lane bridge over the Black Swan Anabranch. It is recommended that operational protocols be implemented to require truck drivers to maintain communication with each other, to minimise the potential for conflicts between vehicles travelling in opposing directions, and to clarify priority at those locations. A suitable space should be provided on each side of the Black Swan Anabranch bridge, in which a truck can wait clear of the swept path of a truck travelling in the opposing direction. Similarly, a suitable space should be designated within the Quarry site for an outbound truck on the Quarry Access Road to wait clear of the swept path of an inbound truck, which should be given priority.

It is recommended that drivers of Project trucks be subject to operational protocols relating to driver behaviour and interaction with other roads users, which would be included in a Project Traffic Management Plan (TMP). The TMP would form part of the employee contract or transport contractual arrangements and would address such matters as:

- compliance with access routes;
- road rules, laws and regulations, including the use of mobile phones;
- respecting the rights of other road users and displaying courtesy to other motorists;
- maintaining the required minimum headway between departures of laden trucks;
- maintaining safe following distances between vehicles, and increasing separation in poor weather;
- vehicle condition and maintenance;
- medical fitness of the driver;
- covering of loads;
- reporting of any unsafe driving practices or incidents;
- maintaining communication with other drivers to minimise the potential for delays to traffic on the public road near the site access; and
- driver behaviour expectations at any specific locations or situations on the public road network including near schools.



5 Conclusions

This study has found that the Project would be accommodated on the surrounding road network with acceptable impacts on the capacity, efficiency and safety of the road network. It is recommended that:

- The intersection of the Quarry Access Road with Riverina Highway be upgraded to basic rural road intersection standard, consistent with Austroads requirements; and that
- a Project TMP be developed and implemented including operational protocols relating to driver behaviour and interaction with other haulage trucks, school buses and other roads users.



Appendix A

Traffic Surveys



Road	Quarry Access Road		
Location	At 4343 Riverina Hwy	Average Weekday	19
Suburb	Howlong	All Day Average	14
Site No.	1	Weekday Heavy's	18.2%
Start Date	Wednesday 25/09/2019	All Day Heavy's	18.5%
Direction	Northbound		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	30-Sep		25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	5		7	5	2	1	0		
PM Peak	4		4	3	2	1	1		
0:00	0		0	0	0	0	0	0	0
1:00	0		0	0	0	0	0	0	0
2:00	0		0	0	0	0	0	0	0
3:00	0		0	0	0	0	0	0	0
4:00	0		0	0	0	0	0	0	0
5:00	0		0	0	0	0	0	0	0
6:00	0		0	0	0	0	0	0	0
7:00	3		7	5	0	0	0	4	3
8:00	1		1	1	1	0	0	1	1
9:00	5		0	1	0	0	0	2	1
10:00	1		0	0	2	0	0	1	1
11:00	1		1	4	2	1	0	2	2
12:00	0		4	1	0	0	1	1	1
13:00	4		2	0	2	0	0	2	1
14:00	1		1	1	1	1	0	1	1
15:00	0		2	1	1	0	0	1	1
16:00	2		1	2	2	0	0	2	1
17:00	2		3	2	1	0	0	2	1
18:00	0		2	3	0	0	1	1	1
19:00	0		0	0	0	0	0	0	0
20:00	0		0	0	0	0	0	0	0
21:00	0		0	0	0	0	0	0	0
22:00	0		0	0	0	0	0	0	0
23:00	0		0	0	0	0	0	0	Ö
Total	20		24	21	12	2	2	19	14
% Heavies	25.0%		12.5%	14.3%	25.0%	50.0%	0.0%	18.2%	18.5%





Road	Quarry Access Road		
Location	At 4343 Riverina Hwy	Average Weekday	22
Suburb	Howlong	All Day Average	16
Site No.	1	Weekday Heavy's	23.6%
Start Date	Wednesday 25/09/2019	All Day Heavy's	24.2%
Direction	Southbound		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	30-Sep		25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	6		11	3	4	2	0		
PM Peak	4		3	2	2	0	1		
0:00	0		0	0	0	0	0	0	0
1:00	0		0	0	0	0	0	0	0
2:00	0		0	0	0	0	0	0	0
3:00	0		0	0	0	0	0	0	0
4:00	0		0	0	0	0	0	0	0
5:00	0		0	1	0	0	0	0	0
6:00	6		11	3	2	1	0	6	4
7:00	0		2	2	0	0	0	1	1
8:00	3		0	3	0	0	0	2	1
9:00	4		0	3	3	0	0	3	2
10:00	1		3	2	1	2	0	2	2
11:00	3		3	1	4	1	0	3	2
12:00	0		1	2	1	0	1	1	1
13:00	4		1	1	0	0	0	2	1
14:00	1		1	1	0	0	0	1	1
15:00	4		3	0	2	0	0	2	2
16:00	0		0	0	0	0	0	0	0
17:00	0		2	1	0	0	1	1	1
18:00	0		1	2	0	0	0	1	1
19:00	0		0	0	0	0	0	0	0
20:00	0		0	0	0	0	0	0	0
21:00	0		0	0	0	0	0	0	0
22:00	0		0	0	0	0	0	0	0
23:00	0		0	0	0	0	0	0	Ö
Total	26		28	22	13	4	2	22	16
% Heavies	23.1%		17.9%	22.7%	38.5%	50.0%	0.0%	23.6%	24.2%





Road	Quarry Access Road		
Location	At 4343 Riverina Hwy	Average Weekday	42
Suburb	Howlong	All Day Average	29
Site No.	1	Weekday Heavy's	21.1%
Start Date	Wednesday 25/09/2019	All Day Heavy's	21.6%
Direction	Two ways		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	30-Sep		25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	9		11	7	6	2	0		
PM Peak	8		5	5	3	1	2		
0:00	0		0	0	0	0	0	0	0
1:00	0		0	0	0	0	0	0	0
2:00	0		0	0	0	0	0	0	0
3:00	0		0	0	0	0	0	0	0
4:00	0		0	0	0	0	0	0	0
5:00	0		0	1	0	0	0	0	0
6:00	6		11	3	2	1	0	6	4
7:00	3		9	7	0	0	0	5	3
8:00	4		1	4	1	0	0	3	2
9:00	9		0	4	3	0	0	4	3
10:00	2		3	2	3	2	0	3	2
11:00	4		4	5	6	2	0	5	4
12:00	0		5	3	1	0	2	2	2
13:00	8		3	1	2	0	0	4	2
14:00	2		2	2	1	1	0	2	1
15:00	4		5	1	3	0	0	3	2
16:00	2		1	2	2	0	0	2	1
17:00	2		5	3	1	0	1	3	2
18:00	0		3	5	0	0	1	2	2
19:00	0		0	0	0	0	0	0	0
20:00	0		0	0	0	0	0	0	0
21:00	0		0	0	0	0	0	0	0
22:00	0		0	0	0	0	0	0	0
23:00	0		0	0	0	0	0	0	Ó
Total	46		52	43	25	6	4	42	29
% Heavies	23.9%		15.4%	18.6%	32.0%	50.0%	0.0%	21.1%	21.6%





Road	Riverina Hwy		
Location	West Of Quarry Access Rd	Average Weekday	1601
Suburb	Howlong	All Day Average	1448
Site No.	2	Weekday Heavy's	7.8%
Start Date	Monday 23/09/2019	All Day Heavy's	7.2%
Direction	Eastbound		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	149	168	164	176	189	127	123		
PM Peak	138	158	167	144	154	95	118		
0:00	1	2	3	6	5	11	7	3	5
1:00	2	4	4	4	1	6	6	3	4
2:00	0	6	2	4	2	3	4	3	3
3:00	1	2	2	0	2	3	2	1	2
4:00	12	9	8	8	11	7	3	10	8
5:00	20	31	28	31	27	7	8	27	22
6:00	69	69	74	65	65	14	16	68	53
7:00	110	118	132	121	103	41	25	117	93
8:00	149	168	164	176	189	93	53	169	142
9:00	117	136	143	133	169	115	123	140	134
10:00	132	131	128	120	151	116	93	132	124
11:00	107	113	99	120	148	127	93	117	115
12:00	89	101	86	85	140	95	95	100	99
13:00	89	87	111	107	107	87	100	100	98
14:00	104	91	103	119	141	52	79	112	98
15:00	138	158	167	144	154	50	118	152	133
16:00	120	125	121	133	103	63	83	120	107
17:00	75	95	108	109	99	40	76	97	86
18:00	46	51	57	70	51	41	29	55	49
19:00	28	13	25	24	30	25	19	24	23
20:00	10	15	16	17	12	22	16	14	15
21:00	14	9	11	14	16	22	9	13	14
22:00	11	7	9	7	8	13	6	8	9
23:00	11	12	13	14	17	12	1	13	11
Total	1455	1553	1614	1631	1751	1065	1064	1601	1448
% Heavies	7.4%	8.6%	9.2%	8.0%	6.2%	4.5%	4.6%	7.8%	7.2%





Road	Riverina Hwy		
Location	West Of Quarry Access Rd	Average Weekday	1556
Suburb	Howlong	All Day Average	1401
Site No.	2	Weekday Heavy's	13.2%
Start Date	Monday 23/09/2019	All Day Heavy's	12.7%
Direction	Westbound		

				Day of Week	[
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	92	107	104	96	134	96	101		
PM Peak	157	174	176	165	174	123	126		
0:00	2	0	0	5	1	2	5	2	2
1:00	0	1	0	2	2	5	8	1	3
2:00	2	2	1	0	1	2	6	1	2
3:00	2	0	1	2	0	2	4	1	2
4:00	9	2	3	8	2	1	3	5	4
5:00	17	23	25	29	19	8	3	23	18
6:00	76	90	84	84	72	33	15	81	65
7:00	82	84	89	81	82	32	23	84	68
8:00	81	101	104	92	96	50	30	95	79
9:00	67	69	89	92	92	62	64	82	76
10:00	92	65	82	72	114	92	73	85	84
11:00	86	107	80	96	134	96	101	101	100
12:00	101	88	96	93	110	115	126	98	104
13:00	89	103	102	98	124	123	111	103	107
14:00	115	128	133	127	154	92	96	131	121
15:00	109	138	127	127	163	54	78	133	114
16:00	156	174	176	165	174	69	82	169	142
17:00	157	164	140	137	161	51	55	152	124
18:00	93	88	70	78	74	49	46	81	71
19:00	34	34	52	38	51	14	24	42	35
20:00	34	30	27	43	38	19	17	34	30
21:00	20	24	23	34	25	14	19	25	23
22:00	16	16	22	25	27	18	13	21	20
23:00	3	5	11	10	10	17	5	8	9
Total	1443	1536	1537	1538	1726	1020	1007	1556	1401
% Heavies	13.4%	14.6%	14.1%	13.2%	11.0%	10.9%	10.6%	13.2%	12.7%





Road	Riverina Hwy		
Location	West Of Quarry Access Rd	Average Weekday	3157
Suburb	Howlong	All Day Average	2849
Site No.	2	Weekday Heavy's	10.5%
Start Date	Monday 23/09/2019	All Day Heavy's	9.9%
Direction	Two ways		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	230	269	268	268	285	223	194		
PM Peak	276	299	297	298	317	210	221		
0:00	3	2	3	11	6	13	12	5	7
1:00	2	5	4	6	3	11	14	4	6
2:00	2	8	3	4	3	5	10	4	5
3:00	3	2	3	2	2	5	6	2	3
4:00	21	11	11	16	13	8	6	14	12
5:00	37	54	53	60	46	15	11	50	39
6:00	145	159	158	149	137	47	31	150	118
7:00	192	202	221	202	185	73	48	200	160
8:00	230	269	268	268	285	143	83	264	221
9:00	184	205	232	225	261	177	187	221	210
10:00	224	196	210	192	265	208	166	217	209
11:00	193	220	179	216	282	223	194	218	215
12:00	190	189	182	178	250	210	221	198	203
13:00	178	190	213	205	231	210	211	203	205
14:00	219	219	236	246	295	144	175	243	219
15:00	247	296	294	271	317	104	196	285	246
16:00	276	299	297	298	277	132	165	289	249
17:00	232	259	248	246	260	91	131	249	210
18:00	139	139	127	148	125	90	75	136	120
19:00	62	47	77	62	81	39	43	66	59
20:00	44	45	43	60	50	41	33	48	45
21:00	34	33	34	48	41	36	28	38	36
22:00	27	23	31	32	35	31	19	30	28
23:00	14	17	24	24	27	29	6	21	20
Total	2898	3089	3151	3169	3477	2085	2071	3157	2849
% Heavies	10.4%	11.6%	11.6%	10.5%	8.6%	7.6%	7.5%	10.5%	9.9%





Road	Stuart St		
Location	South Of Riverina Hwy	Average Weekday	1053
Suburb	Howlong	All Day Average	1000
Site No.	3	Weekday Heavy's	23.3%
Start Date	Monday 23/09/2019	All Day Heavy's	21.1%
Direction	Northbound		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	78	74	73	78	96	102	88		
PM Peak	90	102	101	97	101	88	93		
0:00	2	1	4	5	7	4	3	4	4
1:00	3	2	4	0	2	1	1	2	2
2:00	3	5	1	5	3	2	0	3	3
3:00	2	1	5	6	3	2	3	3	3
4:00	5	9	4	10	10	3	4	8	6
5:00	19	17	26	17	23	10	4	20	17
6:00	54	72	70	60	40	20	15	59	47
7:00	66	65	70	68	49	29	19	64	52
8:00	64	74	69	78	81	49	47	73	66
9:00	55	68	67	52	69	82	65	62	65
10:00	78	64	73	50	81	102	57	69	72
11:00	71	73	62	65	96	100	88	73	79
12:00	74	61	62	60	91	88	93	70	76
13:00	63	67	71	78	101	87	82	76	78
14:00	74	74	79	94	75	51	87	79	76
15:00	83	70	96	97	99	40	71	89	79
16:00	90	102	88	94	80	44	74	91	82
17:00	77	87	101	85	67	41	64	83	75
18:00	52	45	52	63	52	39	35	53	48
19:00	28	23	20	23	29	24	26	25	25
20:00	17	17	18	16	8	26	9	15	16
21:00	13	12	13	10	15	10	5	13	11
22:00	11	7	12	10	10	13	6	10	10
23:00	5	7	10	10	9	5	3	8	7
Total	1009	1023	1077	1056	1100	872	861	1053	1000
% Heavies	27.8%	22.4%	25.9%	23.3%	17.5%	14.8%	14.2%	23.3%	21.1%





Road	Stuart St		
Location	South Of Riverina Hwy	Average Weekday	1065
Suburb	Howlong	All Day Average	1016
Site No.	3	Weekday Heavy's	18.0%
Start Date	Monday 23/09/2019	All Day Heavy's	16.1%
Direction	Southbound		

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	72	81	79	78	84	94	95		
PM Peak	101	115	117	102	114	106	85		
0:00	2	1	2	3	1	3	3	2	2
1:00	0	1	2	1	4	1	2	2	2
2:00	3	2	3	4	3	0	4	3	3
3:00	4	7	3	6	6	3	2	5	4
4:00	4	9	4	4	3	2	3	5	4
5:00	28	22	22	23	11	14	4	21	18
6:00	41	44	49	39	20	13	8	39	31
7:00	72	81	79	78	43	38	22	71	59
8:00	46	61	58	46	56	62	49	53	54
9:00	62	78	65	62	77	93	63	69	71
10:00	72	48	65	56	71	94	95	62	72
11:00	62	68	66	63	84	90	94	69	75
12:00	70	79	75	76	88	106	85	78	83
13:00	68	59	88	72	92	83	85	76	78
14:00	62	75	89	80	94	62	65	80	75
15:00	92	99	93	94	114	55	71	98	88
16:00	80	90	117	95	98	39	53	96	82
17:00	101	115	102	102	114	58	60	107	93
18:00	65	68	65	58	70	37	43	65	58
19:00	23	14	22	26	16	28	21	20	21
20:00	12	13	21	9	14	15	8	14	13
21:00	9	10	13	14	21	13	7	13	12
22:00	5	3	7	8	9	11	4	6	7
23:00	3	8	14	16	14	11	5	11	10
Total	986	1055	1124	1035	1123	931	856	1065	1016
% Heavies	21.1%	17.7%	19.5%	18.6%	13.5%	10.6%	10.4%	18.0%	16.1%





Road	Stuart St		
Location	South Of Riverina Hwy	Average Weekday	2118
Suburb	Howlong	All Day Average	2015
Site No.	3	Weekday Heavy's	20.6%
Start Date	Monday 23/09/2019	All Day Heavy's	18.6%
Direction	Two ways	i	

	Day of Week								
Starting	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Ave	All Days
Time	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	W'day	Ave
AM Peak	150	146	149	146	180	196	182		
PM Peak	178	202	205	191	213	194	178		
0:00	4	2	6	8	8	7	6	6	6
1:00	3	3	6	1	6	2	3	4	3
2:00	6	7	4	9	6	2	4	6	5
3:00	6	8	8	12	9	5	5	9	8
4:00	9	18	8	14	13	5	7	12	11
5:00	47	39	48	40	34	24	8	42	34
6:00	95	116	119	99	60	33	23	98	78
7:00	138	146	149	146	92	67	41	134	111
8:00	110	135	127	124	137	111	96	127	120
9:00	117	146	132	114	146	175	128	131	137
10:00	150	112	138	106	152	196	152	132	144
11:00	133	141	128	128	180	190	182	142	155
12:00	144	140	137	136	179	194	178	147	158
13:00	131	126	159	150	193	170	167	152	157
14:00	136	149	168	174	169	113	152	159	152
15:00	175	169	189	191	213	95	142	187	168
16:00	170	192	205	189	178	83	127	187	163
17:00	178	202	203	187	181	99	124	190	168
18:00	117	113	117	121	122	76	78	118	106
19:00	51	37	42	49	45	52	47	45	46
20:00	29	30	39	25	22	41	17	29	29
21:00	22	22	26	24	36	23	12	26	24
22:00	16	10	19	18	19	24	10	16	17
23:00	8	15	24	26	23	16	8	19	17
Total	1995	2078	2201	2091	2223	1803	1717	2118	2015
% Heavies	24.5%	20.0%	22.6%	21.0%	15.5%	12.6%	12.3%	20.6%	18.6%





Appendix B

Sidra Intersection Outputs

Site: 101 [Existing 2019 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2019 Surveyed AM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	Quarry	Access Rd										
1	L2	1	0.0	0.002	4.4	LOS A	0.0	0.1	0.24	0.86	0.24	40.4
3	R2	1	0.0	0.002	9.2	LOS A	0.0	0.1	0.24	0.86	0.24	36.3
Appro	ach	2	0.0	0.002	6.8	LOS A	0.0	0.1	0.24	0.86	0.24	38.3
East: I	Riverina	Hwy East										
4	L2	1	0.0	0.057	7.8	LOS A	0.0	0.0	0.00	0.01	0.00	88.2
5	T1	100	15.8	0.057	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	99.3
Appro	ach	101	15.6	0.057	0.1	NA	0.0	0.0	0.00	0.01	0.00	99.2
North:	Property	y Access R	d									
9	R2	1	0.0	0.001	5.8	LOS A	0.0	0.0	0.37	0.82	0.37	30.4
Appro	ach	1	0.0	0.001	5.8	LOS A	0.0	0.0	0.37	0.82	0.37	30.4
West:	Riverina	Hwy West										
10	L2	1	0.0	0.101	8.9	LOS A	0.1	0.6	0.02	0.02	0.02	33.5
11	T1	178	6.5	0.101	0.1	LOS A	0.1	0.6	0.02	0.02	0.02	99.3
12	R2	4	50.0	0.101	9.9	LOS A	0.1	0.6	0.02	0.02	0.02	34.0
Appro	ach	183	7.5	0.101	0.3	NA	0.1	0.6	0.02	0.02	0.02	94.1
All Vel	nicles	287	10.3	0.101	0.3	NA	0.1	0.6	0.02	0.02	0.02	94.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: 101 [Existing 2019 PM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2019 Surveyed PM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c_	Average Delay sec-	Level of Service	95% Back Vehicles veh	of Queue Distance m_	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/b
South	Quarry	Access Rd	,,,	110	000		Von					NTU/T
1	L2	2	50.0	0.005	7.5	LOS A	0.0	0.3	0.38	0.89	0.38	35.0
3	R2	1	0.0	0.005	9.3	LOS A	0.0	0.3	0.38	0.89	0.38	36.0
Appro	ach	3	33.3	0.005	8.1	LOS A	0.0	0.3	0.38	0.89	0.38	35.4
East: I	Riverina	Hwy East										
4	L2	1	0.0	0.099	7.8	LOS A	0.0	0.0	0.00	0.00	0.00	88.4
5	T1	178	11.8	0.099	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.6
Appro	ach	179	11.8	0.099	0.1	NA	0.0	0.0	0.00	0.00	0.00	99.5
North:	Propert	y Access R	d									
9	R2	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.38	0.82	0.38	30.4
Appro	ach	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.38	0.82	0.38	30.4
West:	Riverina	Hwy West										
10	L2	1	0.0	0.069	8.2	LOS A	0.0	0.1	0.01	0.01	0.01	33.5
11	T1	126	6.7	0.069	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	99.5
12	R2	1	0.0	0.069	8.0	LOS A	0.0	0.1	0.01	0.01	0.01	34.1
Appro	ach	128	6.6	0.069	0.1	NA	0.0	0.1	0.01	0.01	0.01	96.5
All Vel	hicles	312	9.8	0.099	0.2	NA	0.0	0.3	0.01	0.02	0.01	95.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: 101 [Baseline 2029 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2029 Baseline No Project AM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South	: Quarry	Access Rd										
1	L2	1	0.0	0.002	4.5	LOS A	0.0	0.1	0.26	0.85	0.26	40.4
3	R2	1	0.0	0.002	9.4	LOS A	0.0	0.1	0.26	0.85	0.26	36.3
Appro	ach	2	0.0	0.002	6.9	LOS A	0.0	0.1	0.26	0.85	0.26	38.2
East:	Riverina	Hwy East										
4	L2	1	0.0	0.063	7.8	LOS A	0.0	0.0	0.00	0.01	0.00	88.3
5	T1	111	16.2	0.063	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	99.4
Appro	ach	112	16.0	0.063	0.1	NA	0.0	0.0	0.00	0.01	0.00	99.2
North:	Propert	y Access Rd										
9	R2	1	0.0	0.002	6.0	LOS A	0.0	0.0	0.39	0.82	0.39	30.4
Appro	ach	1	0.0	0.002	6.0	LOS A	0.0	0.0	0.39	0.82	0.39	30.4
West:	Riverina	Hwy West										
10	L2	1	0.0	0.111	9.0	LOS A	0.1	0.6	0.02	0.02	0.02	33.5
11	T1	197	6.4	0.111	0.1	LOS A	0.1	0.6	0.02	0.02	0.02	99.3
12	R2	4	50.0	0.111	10.0	LOS A	0.1	0.6	0.02	0.02	0.02	34.0
Appro	ach	202	7.3	0.111	0.3	NA	0.1	0.6	0.02	0.02	0.02	94.6
All Ve	hicles	317	10.3	0.111	0.3	NA	0.1	0.6	0.02	0.02	0.02	94.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: 101 [Baseline 2029 PM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2029 Baseline No Project PM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total	Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back Vehicles	of Queue Distance	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed
South	: Quarrv	Access Rd	%	V/C	sec	_	ven	m	_	_	_	Km/n
1	L2	2	50.0	0.005	7.8	LOS A	0.0	0.3	0.40	0.89	0.40	35.0
3	R2	1	0.0	0.005	9.6	LOS A	0.0	0.3	0.40	0.89	0.40	35.9
Appro	ach	3	33.3	0.005	8.4	LOS A	0.0	0.3	0.40	0.89	0.40	35.3
East:	Riverina	Hwy East										
4	L2	1	0.0	0.109	7.8	LOS A	0.0	0.0	0.00	0.00	0.00	88.4
5	T1	197	11.8	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.6
Appro	ach	198	11.7	0.109	0.1	NA	0.0	0.0	0.00	0.00	0.00	99.5
North:	Propert	y Access R	d									
9	R2	1	0.0	0.002	6.2	LOS A	0.0	0.0	0.40	0.82	0.40	30.4
Appro	ach	1	0.0	0.002	6.2	LOS A	0.0	0.0	0.40	0.82	0.40	30.4
West:	Riverina	a Hwy West										
10	L2	1	0.0	0.075	8.2	LOS A	0.0	0.1	0.01	0.01	0.01	33.5
11	T1	139	6.1	0.075	0.0	LOS A	0.0	0.1	0.01	0.01	0.01	99.6
12	R2	1	0.0	0.075	8.1	LOS A	0.0	0.1	0.01	0.01	0.01	34.1
Appro	ach	141	6.0	0.075	0.1	NA	0.0	0.1	0.01	0.01	0.01	96.8
All Ve	hicles	343	9.5	0.109	0.2	NA	0.0	0.3	0.01	0.02	0.01	96.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: 101 [Project 2019 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2019 With Project AM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles												
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h	
South:	Quarry	Access Rd											
1	L2	7	85.7	0.016	8.3	LOS A	0.1	1.4	0.32	1.00	0.32	32.2	
3	R2	1	0.0	0.016	9.3	LOS A	0.1	1.4	0.32	1.00	0.32	36.0	
Appro	ach	8	75.0	0.016	8.4	LOS A	0.1	1.4	0.32	1.00	0.32	32.7	
East: F	Riverina l	Hwy East											
4	L2	1	0.0	0.057	7.8	LOS A	0.0	0.0	0.00	0.01	0.00	88.2	
5	T1	100	15.8	0.057	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	99.3	
Appro	ach	101	15.6	0.057	0.1	NA	0.0	0.0	0.00	0.01	0.00	99.2	
North:	Property	Access Ro	d										
9	R2	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.38	0.82	0.38	30.4	
Appro	ach	1	0.0	0.001	6.0	LOS A	0.0	0.0	0.38	0.82	0.38	30.4	
West:	Riverina	Hwy West											
10	L2	1	0.0	0.110	9.7	LOS A	0.2	1.6	0.05	0.03	0.05	33.4	
11	T1	178	6.5	0.110	0.2	LOS A	0.2	1.6	0.05	0.03	0.05	99.0	
12	R2	7	85.7	0.110	11.7	LOS A	0.2	1.6	0.05	0.03	0.05	34.0	
Approa	ach	186	9.6	0.110	0.7	NA	0.2	1.6	0.05	0.03	0.05	91.1	
All Vel	nicles	297	13.5	0.110	0.7	NA	0.2	1.6	0.04	0.05	0.04	88.4	

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

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 is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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🥮 Site: 101 [Project 2019 PM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2019 With Project PM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Quarry	Access Rd										
1	L2	7	85.7	0.019	10.3	LOS A	0.1	1.7	0.44	0.97	0.44	31.8
3	R2	1	0.0	0.019	9.5	LOS A	0.1	1.7	0.44	0.97	0.44	35.4
Approa	ach	8	75.0	0.019	10.2	LOS A	0.1	1.7	0.44	0.97	0.44	32.2
East: F	Riverina	Hwy East										
4	L2	1	0.0	0.099	7.8	LOS A	0.0	0.0	0.00	0.00	0.00	88.4
5	T1	178	11.8	0.099	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.6
Approa	ach	179	11.8	0.099	0.1	NA	0.0	0.0	0.00	0.00	0.00	99.5
North:	Property	Access R	d									
9	R2	1	0.0	0.002	6.2	LOS A	0.0	0.0	0.40	0.82	0.40	30.4
Approa	ach	1	0.0	0.002	6.2	LOS A	0.0	0.0	0.40	0.82	0.40	30.4
West:	Riverina	Hwy West										
10	L2	1	0.0	0.084	11.4	LOS A	0.2	2.0	0.10	0.04	0.10	33.3
11	T1	126	6.7	0.084	0.6	LOS A	0.2	2.0	0.10	0.04	0.10	97.6
12	R2	7	85.7	0.084	13.4	LOS A	0.2	2.0	0.10	0.04	0.10	33.8
Approa	ach	135	10.9	0.084	1.4	NA	0.2	2.0	0.10	0.04	0.10	87.3
All Veh	nicles	323	13.0	0.099	0.9	NA	0.2	2.0	0.05	0.05	0.05	88.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: 101 [Project 2029 AM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2029 With Project AM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South:	Quarry	Access Rd										
1	L2	7	85.7	0.017	8.5	LOS A	0.1	1.4	0.34	1.00	0.34	32.2
3	R2	1	0.0	0.017	9.6	LOS A	0.1	1.4	0.34	1.00	0.34	35.9
Appro	ach	8	75.0	0.017	8.7	LOS A	0.1	1.4	0.34	1.00	0.34	32.6
East: F	Riverina	Hwy East										
4	L2	1	0.0	0.063	7.8	LOS A	0.0	0.0	0.00	0.01	0.00	88.3
5	T1	111	16.2	0.063	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	99.4
Appro	ach	112	16.0	0.063	0.1	NA	0.0	0.0	0.00	0.01	0.00	99.2
North:	Property	Access R	d									
9	R2	1	0.0	0.002	6.2	LOS A	0.0	0.0	0.40	0.82	0.40	30.3
Approa	ach	1	0.0	0.002	6.2	LOS A	0.0	0.0	0.40	0.82	0.40	30.3
West:	Riverina	Hwy West										
10	L2	1	0.0	0.121	10.0	LOS A	0.2	1.7	0.05	0.03	0.05	33.4
11	T1	198	6.9	0.121	0.2	LOS A	0.2	1.7	0.05	0.03	0.05	99.0
12	R2	7	85.7	0.121	12.0	LOS A	0.2	1.7	0.05	0.03	0.05	34.0
Approa	ach	206	9.7	0.121	0.7	NA	0.2	1.7	0.05	0.03	0.05	91.8
All Vel	nicles	327	13.5	0.121	0.7	NA	0.2	1.7	0.04	0.05	0.04	89.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Site: 101 [Project 2029 PM Riverina Hwy and Quarry Access]

Riverina Highway and Quarry Access Road 2029 With Project PM Peak Site Category: (None) Stop (Two-Way)

Move	Movement Performance - Vehicles											
Mov ID	Turn	Demand Total veh/h	Flows HV %	Deg. Satn v/c_	Average Delay sec	Level of Service	95% Back Vehicles veh	of Queue Distance m_	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h_
South	: Quarry	Access Rd										
1	L2	7	85.7	0.020	10.9	LOS A	0.1	1.7	0.46	0.97	0.46	31.6
3	R2	1	0.0	0.020	9.8	LOS A	0.1	1.7	0.46	0.97	0.46	35.3
Appro	ach	8	75.0	0.020	10.8	LOS A	0.1	1.7	0.46	0.97	0.46	32.1
East:	Riverina	Hwy East										
4	L2	1	0.0	0.109	7.8	LOS A	0.0	0.0	0.00	0.00	0.00	88.4
5	T1	197	11.8	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	99.6
Appro	ach	198	11.7	0.109	0.1	NA	0.0	0.0	0.00	0.00	0.00	99.5
North:	Propert	y Access R	d									
9	R2	1	0.0	0.002	6.5	LOS A	0.0	0.0	0.42	0.82	0.42	30.3
Appro	ach	1	0.0	0.002	6.5	LOS A	0.0	0.0	0.42	0.82	0.42	30.3
West:	Riverina	Hwy West										
10	L2	1	0.0	0.092	11.9	LOS A	0.3	2.2	0.10	0.04	0.10	33.3
11	T1	140	6.8	0.092	0.6	LOS A	0.3	2.2	0.10	0.04	0.10	97.5
12	R2	7	85.7	0.092	13.9	LOS A	0.3	2.2	0.10	0.04	0.10	33.8
Appro	ach	148	10.6	0.092	1.4	NA	0.3	2.2	0.10	0.04	0.10	88.0
All Vel	hicles	356	12.7	0.109	0.9	NA	0.3	2.2	0.05	0.04	0.05	89.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab). Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Appendix C

Intersection Treatment Concept Plan



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^{DWG No.} 193 F	39CAD001 IGURE 1	
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PROJECT No.	SCALE	REV.
19339	1:500 @A3	А



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