4.26 TRAFFIC AND TRANSPORT

4.26.1 Predicted Road Traffic Impacts

This section responds to submissions from stakeholders regarding potential implications of Project traffic on local and regional roads. It also highlights stakeholder concerns regarding the adequacy of the input data and its reflection of current background conditions.

Submission reference: RA7 and RA8

Summary response: Project traffic is likely to use Bulunbulun Road, Gap Road and Werris Creek Road. The capacity of these local roads is able to sufficiently cater for the traffic generated by the Project.

To avoid additional traffic pressures on Breeza village and its road network, in particular Maitland Street and Hogarth Street, Shenhua Watermark is committed to ensuring that Project related traffic will be discouraged from using Hogarth Street to access Bulunbulun Road.

General Commentary on Midblock Capacity of Two-Lane Two-Way Roads

There are many factors that influence the capacity of a two-lane two-way rural road. These include (but are not limited to) lane widths, lateral clearances to road side objects, topography, and proportion of heavy vehicles. Generally, the midblock capacity of a single lane in uninterrupted traffic flow conditions is given by the formula:

$$C = 1800 \times f_w \times 1 / (1 + P_{HV}(E_{HV} - 1))$$

Where,

C = Capacity in vehicles/hour/lane

f_w is an adjustment factor for narrow lanes and lateral offsets to road side objects.

P_{HV} is the proportion of heavy vehicles expressed as a decimal.

E_{HV} is the average passenger car equivalents based on the topographical characteristics of the road (Austroads, 2013).

It is acknowledged that unsealed roads are generally not capable of sustaining small headways in the same manner as sealed roads. This is due to the highly variable conditions such as the amount and type of loose earth material, dust generation and impacts on visibility, skid resistance and ride quality. Whilst these characteristics are not reflected in the input parameters fw, PHV and EHV, this assessment has taken a very conservative approach and adopted a fw factor of 0.5 for unsealed roads. This is the lowest value for this factor and is equivalent to traffic flow constraints of a sealed road with 2.7m lanes and 0m lateral clearances to roadside objects (Austroads, 2013).

Likely Impact of the Project with Respect to Midblock Capacity

Figure 84 provides an indication of the maximum midblock capacity of Bulunbulun Road, Gap Road and Werris Creek Road. This figure also shows the existing traffic volumes and the additional traffic volumes that the Project will add. This is based on the detailed information and assessment provided below.

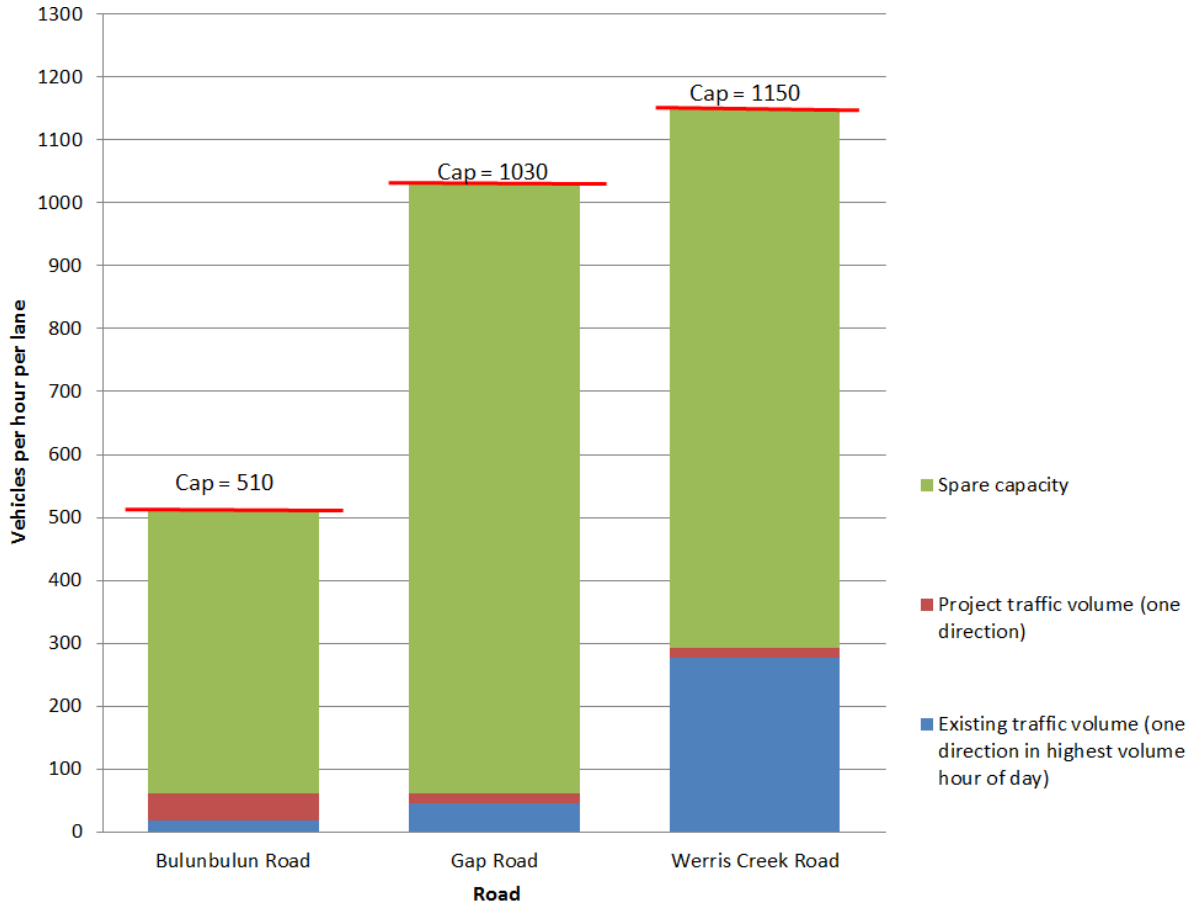


Figure 84
Key Road Midblock Capacity Diagram

**Bulunbulun Road input values for capacity determination: f_w = 0.5 (lowest value adopted since it is partly unsealed),*
P_{HV} = 0.25, E_{HV} = 4.0. Gap Road input values for capacity determination: f_w = 0.85, P_{HV} = 0.16, E_{HV} = 4.0.
Werris Creek Road input values for capacity determination: f_w = 0.95, P_{HV} = 0.48, E_{HV} = 2.0.

Figure 84 shows that the Project will only consume a relatively small portion of the available capacity in each of these three roads. As seen, the residual capacity is in the order of 440-970 vehicles/hour/lane. The Project traffic likely to use Bulunbulun Road, Gap Road and Werris Creek Road would consume 8.2%, 1.7% and 1.5% of the available capacity or less respectively.

Bulunbulun Road

Bulunbulun Road is a 27 km local road connecting the Kamilaroi Highway at Breeza, to Werris Creek Road at Currabubula (see **Figure 85**). Some sections of this road are commonly referred to as Breeza - Currabubula Road and Piallaway Road. The assessment below in this section of the RTS focusses on the entire 27 km extent of the road.

At present, this road is sealed between 0.0 and 1.2 km east of the Kamilaroi Highway, unsealed between 1.2 and 11.4 km east of the Kamilaroi Highway and sealed between 11.4 and 27 km east of the Kamilaroi Highway. The 10.2 km unsealed section is considered to currently be of an acceptable standard given the relatively low volume of traffic using this road. It should be noted that approximately two-thirds of all roads in Australia are unsealed (Austroads, 2009).

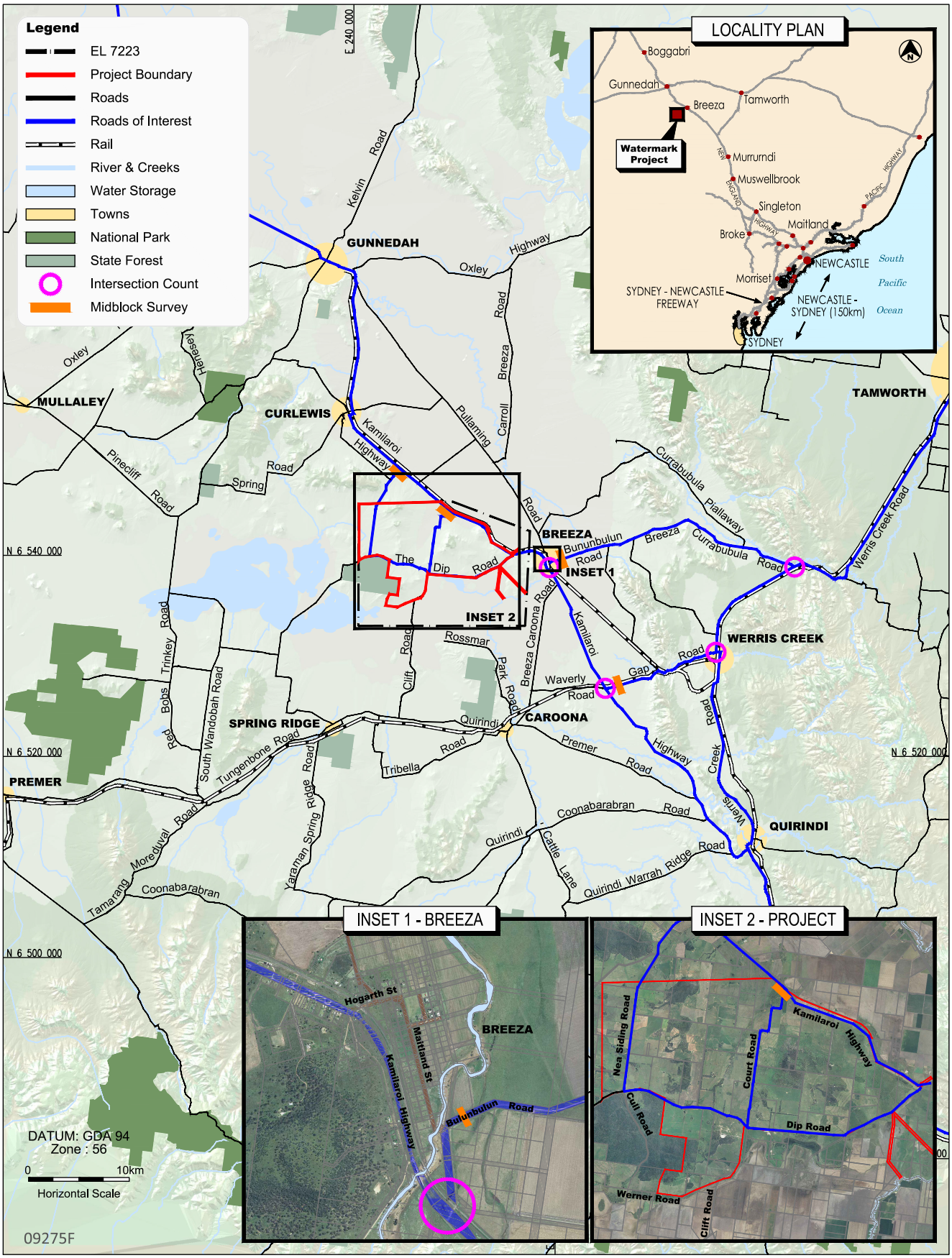
LPSC conducted traffic counts along this road as part of their detailed review of the assessment. The count provided a daily traffic volume of 228 vehicles per day as measured towards the eastern end of the road with 44 of these vehicles (19% of total traffic) being represented by heavy vehicles.

A midblock traffic survey was conducted by Shenhua Watermark between 20 and 26 August 2013 on the section of Bulunbulun Road to the east of Maitland Street, Breeza (the western end of the road – see **Figure 85**). This survey indicated an average of 120 vehicles/day (75% light vehicles and 25% heavy vehicles) using this road with an even directional split for eastbound and westbound traffic. The survey also indicated that the average weekday traffic volume was 141 vehicles/day with the highest volume day (Thursday 22 August 2013) recording a total of 178 vehicles/day. Further, the survey indicated that the maximum traffic volume per direction in any one hour period was 19 vehicles/hour/lane.

The Traffic and Transport Impact Assessment (see Appendix AB of the EIS) indicated an operational workforce of 600 full-time equivalents at the peak operational phase of the Project. Furthermore, with two shifts per day and approximately 25% of workers required in each shift, up to 300 persons would be required to travel to and from the Project each day. This would be comprised of up to 150 persons in the first shift and up to 150 persons in the second shift.

These workers are envisaged to reside in surrounding towns and villages including Gunnedah, Curlewis, Tamworth, Werris Creek, Caroona, and Quirindi. It has been assumed that the distribution of workers to places of residence would be reflective of the proximity of each locality as well as the amenities available, including available housing.

Table 73 provides the geographical distribution of the Project's workforce adopted from the Social Impact Assessment (see Appendix AE of the EIS).



WATERMARK COAL PROJECT

SHENHUA WATERMARK COAL PTY LIMITED 神华沃特马克煤矿有限公司

Hansen Bailey ENVIRONMENTAL CONSULTANTS

Regional Road Network

FIGURE 85

Table 73
Predicted Workforce Residential Locations

Expected Final Residential Location of Operational Workforce	No. of Workforce at Peak (Year 21)	Percentage (%) of total
Gunnedah Urban	210	35
Curlewis	30	5
Quirindi	60	10
Werris Creek	60	10
Other rural areas in GSC or LPSC	30	5
Tamworth Regional LGA	150	25
Other areas outside GSC, LPSC and TRC	60	10
Total	**600**	**100**

Based on the information in **Table 73**, worker journeys to and from work were distributed to the following routes (stated as the outbound direction only for simplicity):

- 50% to the Kamilaroi Highway heading to the north to areas such as Curlewis, Gunnedah, Tamworth and beyond; and
- 50% to the Kamilaroi Highway heading to the south, including:
  - 28% to Bulunbulun Road heading to Currabubula, Tamworth and beyond;
  - 11% to Gap Road heading to Werris Creek; and
  - 11% continuing south along the Kamilaroi Highway towards Quirindi and beyond.

The 300 workers travelling to and from the site each day would generate 600 trips/day including both inbound and outbound trips. The 28% distribution to Bulunbulun Road would therefore equate to 168 trips/day directly attributable to the Project. This equates to 42 trips in any one direction along Bulunbulun Road when accounting for the inbound/outbound split as well as the two shifts per day.

This will result in a total traffic volume in any one direction of Bulunbulun Road of 61 vehicles/hour/lane (i.e. 19 baseline vehicles + 42 Project-related vehicles). The combined total of existing and Project related traffic would consume 12.0% or less of the total capacity of any one lane of Bulunbulun Road. Of this, the Project-related traffic would take up no more than 8.2% of the overall capacity available.

As provided in the Traffic and Transport Impact Assessment (see Appendix AB of the EIS), most, if not all worker trips would be via light vehicles with very little heavy vehicle traffic generation envisaged. Light vehicles will impose very little impact to road surfaces.

It should be noted that the service vehicle trips generated by the Project have not been included in this assessment as these would generally occur outside the peak periods when the worker shift changes occur.

Furthermore, Section 3.2.3 of the Traffic and Transport Impact Assessment also indicated that on average up to 14 heavy vehicles (for deliveries including machinery parts, fuel, explosives etc) would visit the Project each day (over a 24 hour period) with up to two heavy vehicles per hour (equating to four heavy vehicle movements when considering the inbound and outbound travel directions). These volumes are not likely to have a significant impact on the road network.

Austroads (2012) supports this by stating *"because it is well established that light vehicles contribute very little to structural deterioration [of road pavement], only heavy vehicles are considered in pavement design".* **Section 4.26.2** provides further context regarding the current pavement condition and associated structures in light of the Project's traffic impacts.

Further details pertaining to the upgrade of local roads, including Bulunbulun Road, are provided in **Section 4.26.7**.

Gap Road

Gap Road is a 12.2 km regional road connecting Werris Creek Road to the Kamilaroi Highway (see **Figure 85**). The entire length of this section is sealed.

The Traffic and Transport Impact Assessment (see Appendix AB of the EIS) indicated that the Gap Road carries approximately 500 vehicles/day (RTA, 2004). LPSC conducted traffic counts along this road as part of their detailed review of the assessment to verify the data provided. The LPSC count provided an average daily traffic volume of 652 vehicles along the Gap Road with 317 of these vehicles (49% of total traffic) represented by heavy vehicles. As such, LPSC suggests that the background data provided in the assessment had been underestimated.

In response, a midblock traffic survey was conducted by Shenhua Watermark between 20 and 26 August 2013, on the section of the Gap Road to the east of the Kamilaroi Highway (see **Figure 85**). This survey revealed that there was an average of 548 vehicles/day (84% light vehicles and 16% heavy vehicles) using this road with an even directional split for eastbound and westbound traffic. The survey also indicated that the average weekday traffic volume was 589 vehicles/day with the highest volume day (Thursday 22 August 2013) recording a total of 635 vehicles/day. Further, the survey indicated that the highest hourly volume of traffic in any one direction was 45 vehicles/hour/lane.

As stated in the commentary on Bulunbulun Road, up to 300 persons would be required to travel to and from the Project each day during the peak operational phase. This will generate 600 trips when considering the journeys to and from work and assuming vehicle occupancy of one person/vehicle. Of this traffic, 11% will be distributed to Gap Road equating to 66 additional trips per day on Gap Road directly attributable to the Project (during the peak operational phase). This equates to 17 trips in any one direction along Gap Road when accounting for the inbound/outbound split as well as the two shifts per day.

As such, the maximum hourly traffic volume in any one direction would be 62 vehicles/hour/lane (i.e. 45 baseline vehicles + 17 Project-related vehicles). This would consume 6.1% of the overall capacity available in that lane on Gap Road. Of this, the Project-related traffic would take up no more than 1.7% of the overall capacity available.

As discussed in the Social Impact Assessment (Appendix AE of the EIS), the construction workforce for the Project will be encouraged to reside in the proposed Workforce Accommodation Facility on Gap Road (MAC Werris Creek) to alleviate pressure on the local housing market.

As detailed in the Social Impact Assessment (Appendix AE of the EIS), Shenhua Watermark will provide a workforce bus service between the Accommodation Facility and the Project during the construction phase of the Project. This will alleviate impacts on the road network during the construction phase of the Project.

The Joint Regional Planning Panel originally granted Development Consent for the MAC Werris Creek accommodation facility on 17 November 2011. Subsequently, on the 14 June 2013, the Supreme Court of NSW upheld an appeal and declared the Development Consent to be invalid and of no effect. Previous zoning issues have now been resolved and a new Development Application for the MAC Werris Creek accommodation facility has been lodged with LPSC and is currently under assessment. In this regard, the use of a local Accommodation Facility for the construction workforce of the Project continues to remain Shenhua Watermark's preferred strategy.

Following the construction phase, it is proposed that all operational employees reside locally. Therefore, the MAC Werris Creek accommodation facility will not be relied upon during the operational phase of the Project.

Section 4.26.2, provides further context regarding the current pavement condition and associated structures in light of the Project's traffic impacts.

Further details pertaining to the upgrade of local roads, including Gap Road, are provided in **Section 4.26.7**.

Werris Creek Road

LPSC conducted traffic counts along this road as part of their detailed review of the assessment. The LPSC count provided an AADT volume of 2,764 vehicles along Werris Creek Road with 1,332 of these vehicles (48% of total traffic) represented by heavy vehicles. In the absence of any other recent traffic counts, Shenhua Watermark has used the LPSC counts as the baseline for assessment.

Although the LPSC counts do not provide an hourly breakdown of traffic volumes, a comparison with other surrounding roads indicates that the maximum one-directional volume per hour would be 10% of the daily traffic volumes. That is, the maximum flow rate under existing conditions would be 276 vehicles/hour/lane.

As stated in the commentary on Bulunbulun Road, up to 300 persons would be required to travel to and from the Project each day during the peak operational phase. This will generate 600 trips when considering the journeys to and from work and assuming vehicle occupancy of one person/vehicle.

Of this traffic, 11% will be distributed to Werris Creek along Werris Creek Road equating to 66 additional trips per day directly attributable to the Project (during the peak operational phase. This equates to 17 trips in any one direction along Werris Creek Road when accounting for the inbound/outbound split as well as the two shifts per day.

As such, the maximum hourly traffic volume in any one direction on Werris Creek Road would be 293 vehicles/hour/lane (i.e. 276 baseline vehicles + 17 Project-related vehicles). This would consume 25.7% of the overall capacity available in that lane on Werris Creek Road. Of this, the Project-related traffic would take up no more than 1.5% of the overall capacity available.

Section 4.26.2, provides further context regarding the current pavement condition and key bridge structures in light of the Project's traffic impacts.

Further details pertaining to the upgrade of local roads, including Werris Creek Road, are provided in **Section 4.26.7**.

Maitland Street and Hogarth Street

GSC has raised the concern that traffic travelling to and from the Project via Bulunbulun Road may attempt to take a short cut through the village of Breeza (see **Figure 85**).

Whilst it is possible that some traffic from the Project may travel through the Breeza village, this volume of traffic is not envisaged to be significant. To quantify this, an assessment of likely travel times was carried out in consideration of the following two routes:

- Route 1 – From the Kamilaroi Highway/ Hogarth Street intersection to the Bulunbulun Road/ Maitland Street intersection via the Kamilaroi Highway and Bulunbulun Road. This is the route that bypasses the Breeza Village; and
- Route 2 – From the Kamilaroi Highway/ Hogarth Street intersection to the Bulunbulun Road/ Maitland Street intersection via the Hogarth Street and Maitland Road.

Route 1 has a total road distance of 2.4 km and has posted speed limits of 80 km/hour, 110 km/hour and 100 km/hour.

Route 2 has a total road distance of 1.4 km. Although there is no posted speed limit, it contains a railway level crossing, six at-grade intersections and two low radii curves. As such, an estimated average travel speed of 60 km/hour was adopted.

Considering the road distance and the speed limits (as well as the achievable speeds given constraints noted above), both routes would have an average travel time of approximately 1:30 minutes. As such from a travel time perspective, there is very little advantage in taking the alternative route via Hogarth Street and Maitland Street. It should be noted that route 1 along the Highway is less challenging and regarded as an easier route since the (outbound) driver can continue along the Kamilaroi Highway and is only required to decelerate once at the Bulunbulun Road intersection. By contrast, the route via Breeza Village requires the driver to slow down and accelerate a number of times as they negotiate the Kamilaroi Highway/ Hogarth Street intersection, the railway level crossing and the low radii curves.

To avoid additional traffic pressures on Breeza village and its road network, in particular Maitland Street and Hogarth Street, Shenhua Watermark is committed to ensuring that Project related traffic will be discouraged from using Hogarth Street to access Bulunbulun Road.

In addition, Shenhua Watermark will support the installation of signage to provide warning against short stacking risks at Hogarth Street level crossing. This will be achieved through ongoing education and internal briefing sessions, and reflected in management plans.

4.26.2 Road Network Safety

This section responds to submissions from LPSC regarding road safety concerns on Werris Creek Road, Bulunbulun Road and Gap Road.

Submission reference: RA8

Summary response: The pre-existing condition and capacity of the local road network is able to sufficiently cater for the traffic generated by the Project. Current intersection and safety performance and clear zone road widths will not be impeded by the predicted additional traffic volumes.

Anstey Creek Bridge, Werris Creek Road

The Anstey Creek Bridge is 29 m long single deck bridge on Werris Creek Road to the immediate north of the intersection with Bulunbulun Road, Currabubula (see **Plate 6**). The deck provides an approximate 7 m tracking width from edgeline to edgeline with an additional 300 mm lateral offset to the concrete parapet. The bridge contains width markers in both approaches as well as approach guardrails. The bridge is located within a 50 km/hour area as part of the Currabubula built up area.

Plate 6
Anstey Creek Bridge, Werris Creek Road

The traffic volume on Werris Creek Road is approximately 2,700 vehicles/day as provided by LPSC (see **Section 4.26.1**). The *Road Design Guide Part 6 - Safety Barriers* (RTA, 2009) stipulates that for a design speed less than 60 km/hour and where the daily traffic volume is between 1,000 and 3,000 vehicles/day, the required clear zone is 2.5 m. The clear zone is the space adjacent to the travel lanes that should be kept free of non-frangible hazards.

In this regard, the most critical hazards are considered to be the blunt ends of the concrete bridge parapet, which lack sufficient barrier protection. The guardrails on approach to the Anstey Bridge are G4 types which do not provide the required transition in barrier rigidity from non-rigid to rigid safety barrier systems.

As such, errant vehicles may still be at risk of deflecting the guardrails to the point where an *"end-on"* impact with the bridge parapets is possible. This is considered to be an existing hazard which traffic on Werris Creek Road is exposed to. It is acknowledged that RMS manages such hazards on a state wide priority basis. It is also acknowledged that as this is in a 50 km/hour speed environment, the traffic volumes are relatively low, and the road alignment is straight, that this would most likely lack the same priority as other sites.

The Social Impact Assessment (see Appendix AE of the EIS) indicated that up to 25% of the peak operational workforce is likely to live in Tamworth. A further 3% of the workers are likely to live in regional areas in TRC. As such, a conservative 28% of all workers are assumed to live in or around Tamworth and hence likely to use Bulunbulun Road as journey to/from work access route. With 300 (50%) of the peak 600-person operational workforce required to attend the site each day, the 28% distribution to Tamworth would equate to 168 trips per day when accounting for inbound and outbound volumes and assuming a conservative vehicle occupancy rate of one person per vehicle. When added to the existing volumes on Werris Creek Road, there would be a total of 2,868 trips per day using Anstey Bridge with 3% of these being generated by the Project.

The 2,868 vehicles/day would still remain within the 1,000 to 3,000 vehicle/day category and hence the additional traffic generated by the Project will not increase the clear zone width requirements of the road.

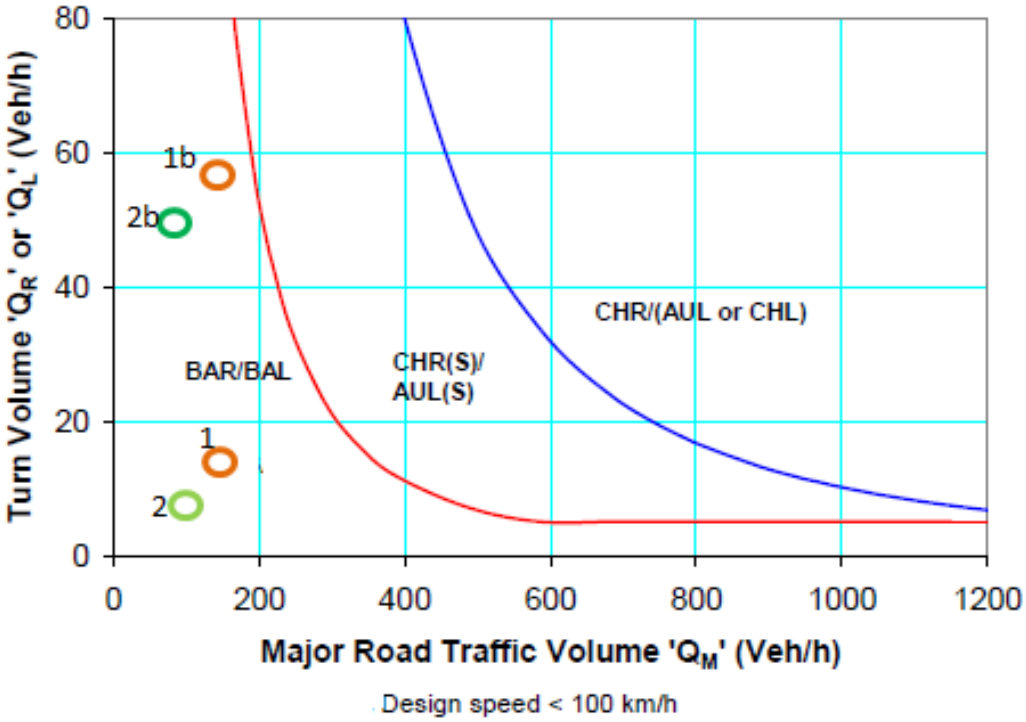
Werris Creek Road/Bulunbulun Road Intersection

The Werris Creek Road/Bulunbulun Road intersection currently has a basic right turn (BAR) T intersection configuration (see **Plate 7**). This does not include any formal facility for right-turning traffic.

Plate 7
Werris Creek Road (Towards Intersection with Bulunbulun Road)

The *Guide to Road Design Part 4A – Unsignalised and Signalised Intersections* (Austroads, 2010) provides guidance on the most appropriate right-turning facilities for unsignalised T intersections. This is based on the volume of right-turning traffic (Q_R) and the opposing through and left-turn movements (Q_M) that are in conflict with the right-turn movement. With regard to the Werris Creek/Bulunbulun Road intersection, Q_R refers to the volume of traffic turning right from Werris Creek Road to Bulunbulun Road. Q_M refers to the northbound through and left-turning traffic on Werris Creek Road. **Figure 86** is an extract from the Austroads Guide for intersections with speed limits less than 100km/hour. This is applicable to the Werris Creek/ Bulunbulun Road intersection since the posted speed limit on Werris Creek Road is 50km/h at this location.

An intersection turning movement survey indicated that the periods of the day which experienced the highest volumes for Q_M and Q_R were between 0800-0900h and 1645-1745h. The 0800-0900h period experienced volumes of 214 vehicles/hour and 14 vehicles/hour for Q_M and Q_R, respectively. The 1645-1745h period experienced volumes of 199 vehicles/hour and 6 vehicles/hour respectively. These have been plotted in **Figure 86** as points 1 and 2, respectively. As seen, both points lie in the BAR region indicating that the existing BAR configuration is acceptable.



Notes: CH = "Channelised"; AU = "Auxilliary"; B = "Basic"; R = "Right turn"; L = "Left turn".

Figure 86
Warrants for T-Intersection Turning Facilities

The Project is likely to generate traffic movements along Bulunbulun Road. This would be mainly comprised of traffic heading to and from Tamworth. The 168 additional vehicle movements/ day, which were conservatively forecasted for Bulunbulun Road, would be made up of a maximum of 42 vehicle movements heading to the Project (based on a two shifts and a 50% inbound/outbound split).

When 42 vehicle movements are added to Q_R, this results in points 1b and 2b as shown in **Figure 86** for the morning (AM) and afternoon (PM) peak hours respectively. The volumes for the AM peak have brought the intersection to just within the CHR(S) region. However, it should be noted that this is a very conservative assessment which has assumed that all inbound and outbound traffic associated with the Project would coincide in the same hour. In reality, there is more likely to be a staggered travel pattern with inbound traffic preceding the outbound traffic. This has also assumed that the shift changes will coincide with the highest volume hours of the AM and PM peak periods. Also, it should be noted that this intersection is within a low-speed (50km/hour) environment with considerably reduced crash risks and less critical need for sheltered turning lanes.

Bulunbulun Road

LPSC provided details of a number of safety issues along Bulunbulun Road. This mainly consists of causeways and culverts. Bulunbulun Road is a rural road consisting of sealed and unsealed portions (see **Plate 8**). The road provides a regional link between the Kamilaroi Highway at Breeza and Werris Creek Road at Currabubula. The speed limit along this route is mainly 100 km/hour.

As discussed in **Section 4.26.1** above, baseline surveys on this road indicate between 120 -228 vehicles/ day under existing conditions (depending on whether the LPSC or Shenhua Watermark baseline data is used and other seasonal factors).

The *Road Design Guide Part 6 - Safety Barriers* (RTA, 2009) stipulates that for a design speed of 100 km/hour and where the daily traffic volume is less than 1,000 vehicles/day, the required clear zone is 6 m.

A road safety inspection carried out on 3 September 2013 by a qualified and accredited level 3 road safety auditor, revealed that all of the culvert head walls and associated vertical drop offs noted in the LPSC submission are within the clear zone of the road. This is an existing safety issue which affects existing road users.

The conservatively forecasted additional 168 vehicle movements along Bulunbulun Road each day as a result of the Project will not change the clear zone requirements as the daily traffic volume (i.e. between 288 – 396 vehicles/ day) would still remain under the threshold limit of 1,000 vehicles/day for a 6 m clear zone.

Plate 8
Culvert Crossing on Bulunbulun Road

Gap Road

LPSC made reference to Gap Road and its narrow formation width and culverts. Gap Road is a sealed road providing an east-west link between the Kamilaroi Highway and Werris Creek. The road has an approximate sealed width of 7.0 to 7.5 m and additional widths of unsealed shoulder and verge, as confirmed through a road safety inspection on 2 September 2013.

As discussed in **Section 4.26.1** above, baseline surveys on this road indicate between 548 -652 vehicles/ day under existing conditions (depending on whether the LPSC or Shenhua Watermark baseline data is used and other seasonal factors).

As per the Austroads guidelines (2010), the recommended minimum road formation width for a road with such vehicles movements/ day is 9.2 to 10.0 m (Austroads, 2010, Table 4.5). This includes sealed lanes and shoulders, as well as unsealed shoulders and verges. Overall, the route has a reasonable clear zone standard with few hazards adjacent to the road. The level and traversable clear zones provides additional width which can be used as trafficable space in the event of a run-off-road crash.

The two exceptions are the railway overbridge and railway level crossings at 5.7 km and 6.4 km west of Werris Creek Road, respectively. These contain non-frangible hazards in the clear zone including bridge support pylons and level crossing infrastructure. These are existing issues compromising the safety of the existing road users.

The additional 66 vehicles/day on this road as generated by the Project during peak operational conditions will not change the minimum road width requirements as stipulated by Austroads (2010). The minimum width requirements would be the same as the existing conditions (e.g. 9.2 to 10.0m width).

4.26.3 Intersection Capacity and Safety

This section responds to submissions from GSC and LPSC regarding the assessment of capacity and safety at key road intersections. It also highlights their concerns regarding the lack of relevant traffic volume information.

Submission reference: RA7 and RA8

Summary response: Ample spare capacity is available at each of the key intersections primarily used by the Project. Traffic to be generated by the Project alone is predicted to consume between 2-9% of the overall available capacity. In this regard, the Project will not increase the demand at these intersections to a point where performance or safety fails.

General Commentary on Intersection Capacity

The concept of an intersection's capacity is not straightforward as in the case of a road's midblock capacity (as described above in **Section 4.26.1**). The *"capacity"* is better referred to as the total traffic volume which leads to the *"onset of failed performance"* of the intersection. The total volume of traffic in these respects may change with different combinations of turning movements.

For example, an intersection with no right-turn demands would generally be able to accommodate more traffic than a similar intersection which has a high right-turn demand.

Notwithstanding this, the *"capacity"* of five key intersections was determined by considering the relative demands for each turning movement as currently experienced. This is depicted in **Figure 87** along with the predicted Project-related traffic.

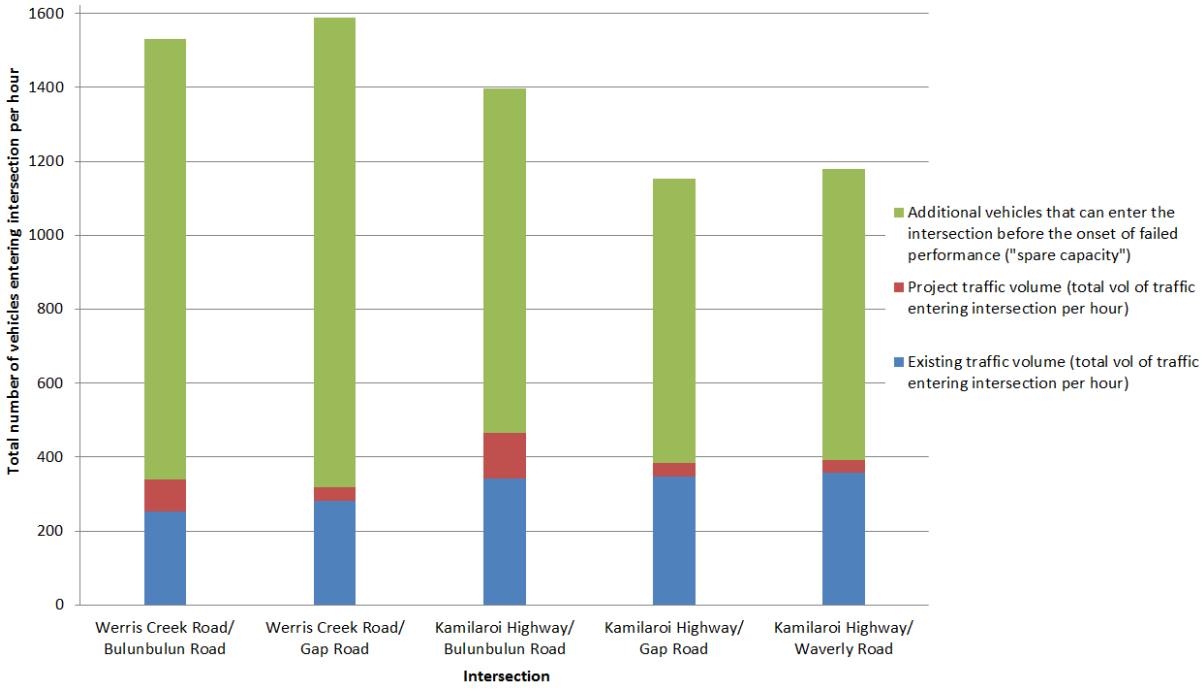


Figure 87
Key Intersections Capacity Diagram

Likely Impact of the Project with Respect to Intersection Capacity

Figure 87 above provides the existing traffic volumes entering each of the five key intersections assessed (blue) as well as the likely increase in traffic volumes as a result of the Project (maroon). The green portion of each bar indicates the additional traffic that can enter each intersection until the onset of failed performance. In this case, the onset of failed performance was the boundary between Levels of Service (LoS) C and D, as a LoS of D is generally undesirable in regional road environments areas.

The additional traffic volumes (green) can be regarded in a similar manner as *"spare capacity".* This assessment indicates that there is ample spare capacity at each of the intersections before the traffic conditions would lead to failed performance. The combined traffic volumes from the existing (baseline) movements and the Project-related movements would consume between 20-33% of the available intersection capacity. Of this, the Project-related traffic alone would consume between 2-9% of the overall capacity available.

More information on the traffic analysis of each intersection is provided below.

Werris Creek Road/ Bulunbulun Road Intersection

An intersection turning movement count was carried out at the Werris Creek Road/ Bulunbulun Road. This survey indicated that the AM and PM peak hours are 0800-0900 and 1645-1745 with a total of 238 vehicles and 217 vehicles entering the intersection, respectively. **Figure 88** provides a summary of the turning movement volumes experienced during AM and PM peak periods.

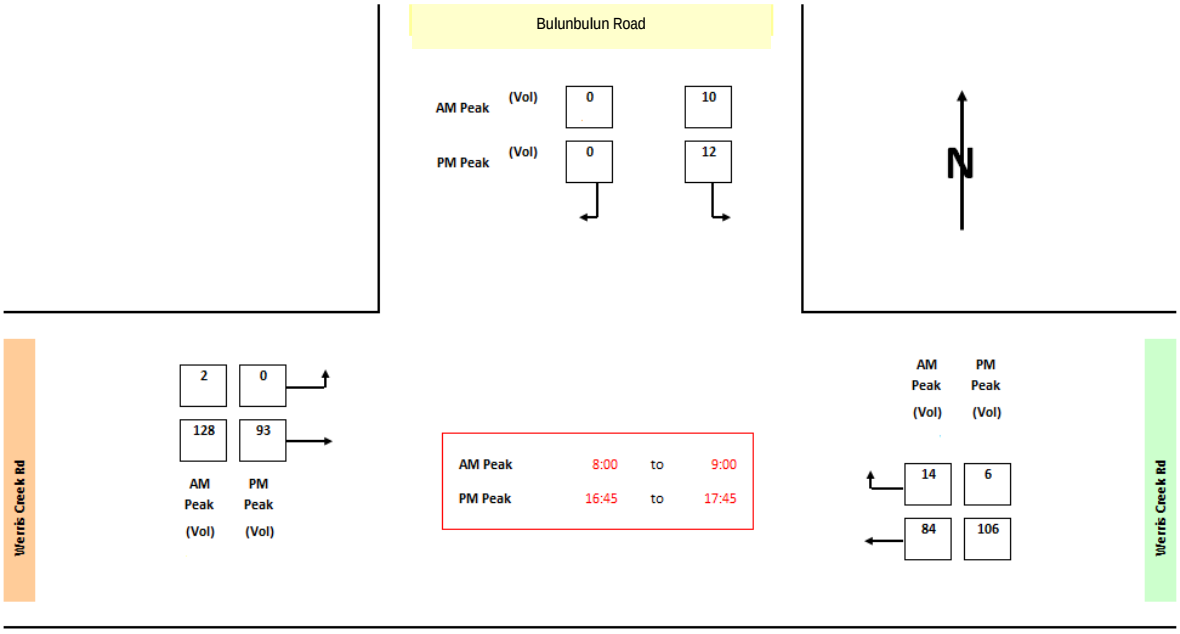


Figure 88
Peak Hour Volumes for Werris Creek Road/Bulunbulun Road Intersection

A SIDRA intersection performance simulation model was created for the AM peak (being the higher volume period of the two peak hours) using the turning movement volumes generated from the traffic counts.

As discussed in **Section 4.26.1**, the Project is likely to generate 168 vehicle movements/day on Bulunbulun Road. This equates to 42 inbound vehicles and 42 outbound vehicles at each of the shift changes. Under the conservative assumption that the inbound and outbound volumes will coincide with each other, as well as with the AM peak period, 42 vehicles were added to the westbound right-turn movement from Werris Creek Road to Bulunbulun Road and 42 vehicles were added to the opposing left-turn from Bulunbulun Road. This is reflective of the likely journey to/from Tamworth. These volumes were added to the base case volumes (2013 background traffic) to determine the likely impact of Project-related traffic on this intersection (see **Table 74**).

Table 74
SIDRA Model Results for Werris Creek Road/Bulunbulun Road Intersection

Scenario	LOS	DOS	Average Delay (Seconds/Vehicle)	Maximum Queue Length (m)
Base Case 2013 (AM)	A	0.075	3.9	3.0 (Werris Creek Road northern approach)
Project Case (AM)	A	0.107	5.5	4.2 (Werris Creek Road northern approach)

The SIDRA modelling indicates that the additional traffic induced by the Project will have marginal impact on the intersection from a capacity perspective. This is reflected by the nil change to the LOS (A) and the minor increases to Degree of Saturation (DOS), average delay and maximum queue lengths. Therefore, the Project will not significantly alter the performance of this intersection.

Werris Creek Road/ Gap Road Intersection

An intersection turning movement count was carried out at the Werris Creek Road/Gap Road intersection. This survey indicated that the AM and PM peak hours are between 0800-0900 and 1645-1745 with a total of 268 vehicles and 228 vehicles entering the intersection, respectively. **Figure 89** provides a summary of the turning movement volumes experienced during AM and PM peak periods.

Figure 89
Peak Hour Volumes for Werris Creek Road/Gap Road Intersection

A SIDRA intersection performance simulation model was created for the AM peak (being the higher volume period of the two peak hours) using the turning movement volumes.

As described in **Section 4.26.1**, the Project is likely to generate 66 vehicle movements/day on Gap Road. This equates to 17 inbound and 17 outbound vehicles at each of the shift changes. Under a conservative assumption that the inbound and outbound volumes will coincide with each other, as well as with the AM peak period, 17 vehicles were added to the northbound left-turn movement from Werris Creek Road to Gap Road and 17 vehicles were added to the opposing right-turn from Gap Road.

As a conservative measure, it has been assumed that this traffic heads to/from Werris Creek. These volumes were added to the base case volumes (2013 background traffic) to determine the likely impact of Project-related traffic on this intersection (see **Table 75**).

Table 75
SIDRA Model Results for Werris Creek Road/Gap Road Intersection

Scenario	LOS	DOS	Average Delay (Seconds/Vehicle)	Maximum Queue Length (m)
Base Case 2013 (AM)	A	0.08	2.4	2.2 (Werris Creek Road northern approach).
Project Case (AM)	A	0.09	3.0	2.2 (Gap Road right turn)

The SIDRA modelling indicates that the additional traffic induced by the Project will have marginal impact on the intersection from a capacity perspective. This is reflected by the nil change to the LOS (A) and maximum queue lengths, and the minor increases to DOS and average delay. Therefore, the Project will not significantly alter the performance of this intersection.

Kamilaroi Highway/ Bulunbulun Road Intersection

An intersection turning movement count was carried out at Kamilaroi Highway/Bulunbulun Road intersection. This survey indicated that the AM and PM peak hours are between 0745-0845 and 1500-1600 with a total of 322 vehicles and 217 vehicles entering the intersection, respectively. **Figure 90** provides a summary of the turning movement volumes experienced during AM and PM peak periods.

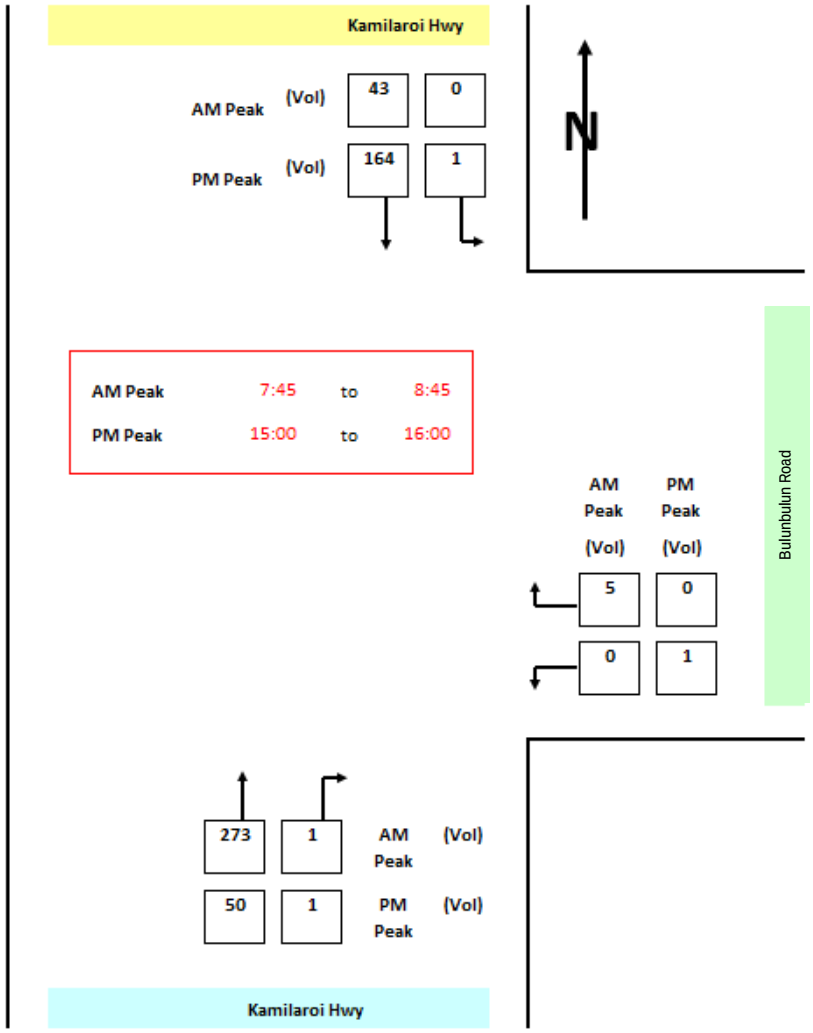


Figure 90
Peak Hour Volumes for Kamilaroi Highway/Bulunbulun Road Intersection

A SIDRA intersection performance simulation model was created for the AM peak (being the higher volume period of the two peak hours) using the turning movement volumes.

As described in **Section 4.26.1**, the Project is likely to generate 168 vehicle movements/day on Bulunbulun Road and 66 vehicle movements/day on Gap Road. Therefore, at the shift changes, there is likely to be 42 inbound and 42 outbound vehicles using Bulunbulun Road. Similarly, there is likely to be 17 inbound and 17 outbound vehicles using Gap Road (and therefore needing to pass through this intersection in the northbound/southbound through directions).

It has been conservatively assumed that the inbound and outbound vehicles would coincide, and that this Project-related traffic would also coincide with the AM and PM peak hours noted above. These volumes were added to the base case volumes (2013) to determine the likely impact of Project-related traffic on this intersection (see **Table 76**).

Table 76
SIDRA Model Results for Kamilaroi Highway/Bulunbulun Road Intersection

Scenario	LOS	DOS	Average Delay (Seconds/Vehicle)	Maximum Queue Length (m)
Base Case 2013 (AM)	B	0.158	1.5	8.1 (Kamilaroi Highway southern approach).
Project Case (AM)	B	0.167	4.0	9.2 (Kamilaroi Highway southern approach).

The SIDRA modelling indicates that the additional traffic induced by the Project will have marginal impact on the intersection from a capacity perspective. This is reflected by the nil change to the LOS (B), and the minor increases to DOS, average delay and maximum queue lengths. Therefore, the Project will not significantly alter the performance of this intersection.

Kamilaroi Highway/ Gap Road Intersection

An intersection turning movement count was carried out at the Kamilaroi Highway/Gap Road intersection. This survey indicated that the AM and PM peak hours are between 0745-0845 and 1515-1615 with a total of 331 vehicles and 234 vehicles entering the intersection, respectively. **Figure 91** provides a summary of the turning movement volumes experienced during AM and PM peak periods.

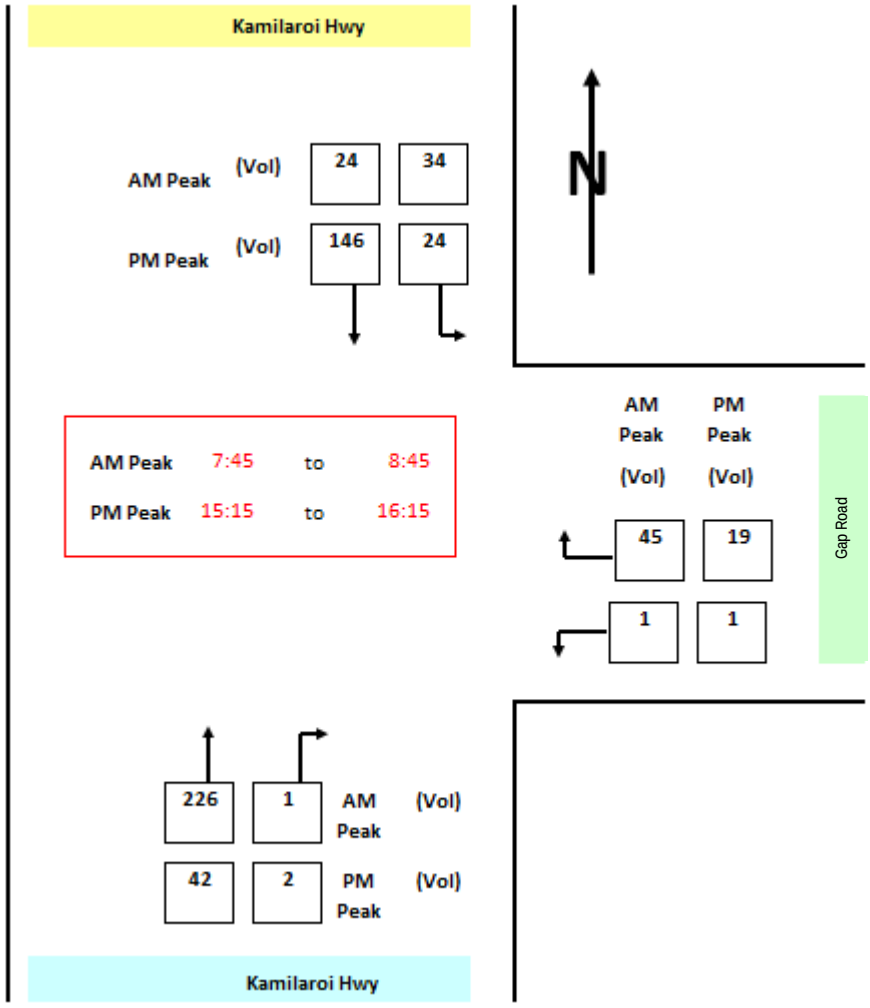


Figure 91
Peak Hour Volumes for Kamilaroi Highway/Gap Road Intersection

A SIDRA intersection performance simulation model was created for the AM peak (being the higher volume period of the two peak hours) using the turning movement volumes.

As described in **Section 4.26.1**, the Project is likely to generate 66 vehicle movements per day on Gap Road. Therefore, at the shift changes, there is likely to be 17 inbound and 17 outbound vehicles using Gap Road. It has been conservatively assumed that the inbound and outbound vehicles would coincide, and that this Project-related traffic would also coincide with the AM and PM peak hours noted above. Based on this traffic generation potential, 17 vehicles were added to the southbound left-turn movement from Kamilaroi Highway to Gap Road, and 17 vehicles were added to the opposing right-turn from Gap Road (see **Table 77**).

Table 77
SIDRA Model Results for Kamilaroi Highway/Gap Road Intersection

Scenario	LOS	DOS	Average Delay (Seconds/Vehicle)	Maximum Queue Length (m)
Base Case 2013 (AM)	B	0.131	4.5	6.6 (Kamilaroi Highway southern approach)
Project Case (AM)	B	0.131	5.4	6.8 (Kamilaroi Highway southern approach)

The SIDRA modelling indicates that the additional traffic induced by the Project will have marginal impact on the intersection from a capacity perspective. This is reflected by the nil change to the LOS (B) and DOS, and the minor increases to average delay and maximum queue lengths. Therefore, the Project will not significantly alter the performance of this intersection.

Kamilaroi Highway/Waverly Road Intersection

An intersection turning movement count was carried out at Kamilaroi Highway/Waverly Road intersection. This survey indicated that the AM and PM peak hours are between 0645-0745 and 1515-1615 with a total of 339 vehicles and 237 vehicles entering the intersection, respectively. **Figure 92** provides a summary of the turning movement volumes experienced during AM and PM peak periods.

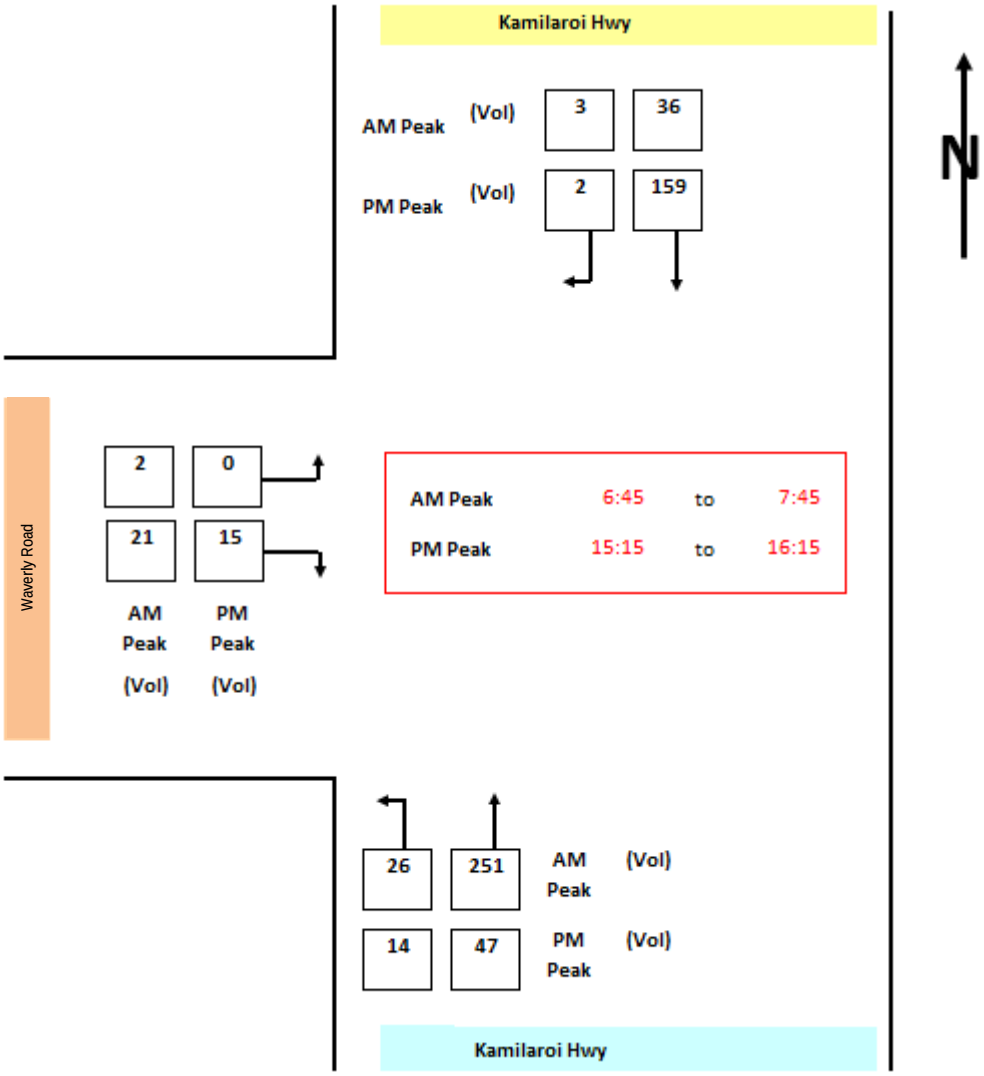


Figure 92
Peak Hour Volumes for Kamilaroi Highway/Waverly Road Intersection

A SIDRA intersection performance simulation model was created for the AM peak (being the higher volume period of the two peak hours) using the turning movement volumes.

As described in **Section 4.26.1**, the Project is likely to generate 66 vehicle movements per day on Gap Road. Therefore, at the shift changes, there is likely to be 17 inbound and 17 outbound vehicles using Gap Road (and hence needing to pass through this intersection in the northbound and southbound through directions). It has been conservatively assumed that the inbound and outbound vehicles would coincide, and that this Project-related traffic would also coincide with the AM and PM peak hours noted above. Based on this traffic generation potential, 17 vehicles were added to the northbound through movement and 17 vehicles were added to the southbound through movement along the Kamilaroi Highway (see **Table 78**).

Table 78
SIDRA Model Results for Kamilaroi Highway/Waverly Road Intersection

Scenario	LOS	DOS	Average Delay (Seconds/Vehicle)	Maximum Queue Length (m)
Base Case 2013 (AM)	B	0.160	2.5	1.4 (Kamilaroi Highway northern approach)
Project Case (AM)	B	0.169	2.5	2.0 (Kamilaroi Highway northern approach)

The SIDRA modelling indicates that the additional traffic induced by the Project will have marginal impact on the intersection from a capacity perspective. This is reflected by the nil change to the LOS (B) and average delay, and the minor increases to DOS and maximum queue lengths. Therefore, the Project will not significantly alter the performance of this intersection.

Safety Assessment at Key Intersections

The T intersection turning facilities assessment (as undertaken for the intersection of Werris Creek Road and Bulunbulun Road earlier in this section) was also carried out for the other key intersections. The results of this assessment have been provided in **Table 79**.

The Werris Creek Road/ Bulunbulun Road intersection was discussed previously. As seen in **Table 79**, the Kamilaroi Highway/ Waverly Road intersection warrants an auxiliary left (AUL) turn facility. However, this is also warranted under existing traffic conditions without the additional traffic due to the Project.

All other intersections warrant basic right (BAR) and basic left (BAL) turn facilities under both the existing and Project scenarios. As such, the existing facilities at these intersections are regarded as appropriate for the projected traffic volumes during the operational phase of the mine.

With regard to the turning movements from the Kamilaroi Highway and Werris Creek Road into Bulunbulun Road, Waverly Road and Gap Road, consideration was also given to the safety of decelerating and queued traffic and the relative risk of *rear-end* crashes. The SIDRA models (as previously discussed) provide information on the proportion of arriving traffic that are likely to queue at the intersection. This is based on the availability of gaps in conflicting traffic streams. This is a reasonable indicator of the relative risk of traffic being exposed to such crashes.

Table 80 details the SIDRA results with regard to proportion/ volume of right-turning traffic that are likely to queue at the intersections.

As noted in **Table 80**, for the Werris Creek Road/ Bulunbulun Road intersection, there is likely to be an additional 13 right-turning vehicles per hour that would be required to queue at the intersection. However, this intersection, and in particular this approach to the intersection, is in a low-speed (50km/hour) environment with substantially less *rear-end* crash risk compared with higher-speed environments. The table also shows a negligible change in the volume of additional traffic that would be required to queue, and hence be exposed to rear-end crash risks.

Table 79
T-Intersection Turning Facility Assessment

Road	Scenario	Period	Left turn facility assessment			Right turn facility		
			Q_M	Q_L	Result	Q_M	Q_R	Result
Werris Creek Road/ Bulunbulun Road <100km/h (as presented previously)	Existing	AM	128	2	BAL	214	14	BAR
	Project	AM	NO CHANGE		BAL	214	56	CHR
	Existing	PM	93	0	BAL	199	6	BAR
	Project	PM	NO CHANGE		BAL	199	48	BAR
Werris Creek Road/ Gap Road <100km/h	Existing	AM	113	25	BAL	212	18	BAR
	Project	AM	113	42	BAL	229	18	BAR
	Existing	PM	83	11	BAL	185	12	BAR
	Project	PM	83	28	BAL	202	12	BAR
Kamilaroi Highway/ Bulunbulun Road => 100km/h	Existing	AM	43	0	BAL	316	1	BAR
	Project	AM	60	42	BAL	392	1	BAR
	Existing	PM	164	1	BAL	215	1	BAR
	Project	PM	181	18	BAL	291	1	BAR
Kamilaroi Highway/ Gap Road => 100km/h	Existing	AM	24	34	BAL	286	1	BAR
	Project	AM	24	51	BAL	303	1	BAR
	Existing	PM	146	24	BAL	212	2	BAR
	Project	PM	146	41	BAL	229	2	BAR
Kamilaroi Highway/ Waverly Road => 100km/h	Existing	AM	251	26	AUL	313	3	BAR
	Project	AM	268	26	AUL	347	3	BAR
	Existing	PM	47	14	BAL	220	2	BAR
	Project	PM	64	14	BAL	254	2	BAR

Table 80
Proportion/Volume of Queued Right-turn Traffic

Intersection/Turning Movement	Existing AM	Project AM	Comment
Right-turn from Werris Creek Road to Bulunbulun Road.	30% of 15 = 5 vehicles/hour	30% of 59 = 18 vehicles/hour	There would be an additional 13 right-turning vehicles per hour that would queue at the intersection. However, it should be noted that this is in a low-speed (50km/hour) environment with a low rear-end crash risk
Right-turn from Werris Creek Road to Gap Road.	29% of 19 = 6 vehicles/hour	31% of 19 = 6 vehicles/hour	Negligible change in rear-end crash risk compared with the existing scenario.
Right-turn from Kamilaroi Highway to Bulunbulun Road.	18% of 1 = 1 vehicle/hour	30% of 1 = 1 vehicle/hour	
Right-turn from Kamilaroi Highway to Gap Road.	21% of 1 = 1 vehicle/hour	24% of 1= 1 vehicle/hour	
Right-turn from Kamilaroi Highway to Waverly Road.	45% of 3 = 2 vehicles/hour	48% of 3 = 2 vehicles/hour	

** Note that the SIDRA models predicted 0% queued traffic for the left-turn movement from the major road to the side road. This is because this movement is unconstrained and is not required to stop or yield for other traffic.*

Breeza Village Road Network Intersections

As provided further in **Section 4.26.2**, to avoid significant traffic pressures on Breeza village and its road network, including the Kamilaroi Highway/Hogarth Street intersection, Bulunbulun Road/Maitland Street intersection and Maitland Street/Hogarth Street intersection, Shenhua Watermark is committed to ensuring that Project related traffic will be discouraged from using Hogarth Street to access Bulunbulun Road. In addition, Shenhua Watermark will support the installation of signage to provide warning against short stacking risks at Hogarth Street level crossing.

Seasonal Fluctuations in Traffic Volumes

Concerns were raised regarding potential seasonal fluctuation in traffic volumes due to agricultural industries in the surrounding region and how the Project traffic may induce an undesirable cumulative traffic impact on key roads and intersections. It is acknowledged that the *"once-off"* traffic surveys conducted in August 2013 may not be an accurate reflection on the peak traffic conditions from a seasonal fluctuation perspective. In recognition of this, the potential traffic impacts from the Project (as outlined in **Section 4.26.1**) are also conservatively based on baseline data from LPSC. As such, this issue has been examined by determining the *residual capacity* at the following key intersections as discussed previously:

- Werris Creek Road/ Bulunbulun Road;
- Werris Creek Road/ Gap Road;
- Kamilaroi Highway/ Bulunbulun Road;

- Kamilaroi Highway/ Gap Road; and
- Kamilaroi Highway/ Waverly Road.

The assessment methodology involved using the 2013 baseline data and maximum relevant Project volumes and artificially increasing the input traffic volumes in each of the approaches to the intersection, in the SIDRA models, until the modelled level of service (LoS) for the intersection fell to less than a *"C"*. Once the LoS drops to less than a *"C"*, traffic conditions are typified by modelled average delays between 42-55 seconds/vehicle (Akcelik and Associates, 2012). These represent traffic conditions where intersections are operating near capacity. Conditions border on a range in which small increases in traffic volume can significantly increase intersection delay (Austroads, 1988). As such, when intersections drop to a LoS worse than *"C"*, this is regarded as the "onset of intersection failure" in a rural road environment.

Similar to the previous SIDRA assessments outlined above, the AM peak period was modelled as this was the higher volume of the two peak periods. The traffic assessment showed the following results as presented in **Table 81**.

Table 81
Intersection Failure Sensitivity Analysis

Intersection	Traffic Volumes that can be Added to the Intersection Before LoS Drops to Less than "C"	Factor Increase in Traffic Volumes over Project-case Before LoS Drops to Less than "C"
Werris Creek Road/ Bulunbulun Road	More than 1,100 additional vehicles can enter this intersection in the AM peak hour before the modelled LoS drops to less than C.	The input volumes for traffic entering the intersection can be increased by more than 4.5 times before the modelled LoS drops to less than C.
Werris Creek Road/ Gap Road	More than 1,200 additional vehicles can enter this intersection in the AM peak hour before the modelled LoS drops to less than C.	The input volumes for traffic entering the intersection can be increased by more than 5 times before the modelled LoS drops to less than C.
Kamilaroi Highway/ Bulunbulun Road	More than 931 additional vehicles can enter this intersection in the AM peak hour before the modelled LoS drops to less than C.	The input volumes for traffic entering the intersection can be increased by more than 3 times before the modelled LoS drops to less than C.
Kamilaroi Highway/ Gap Road	More than 760 additional vehicles can enter this intersection in the AM peak hour before the modelled LoS drops to less than C.	The input volumes for traffic entering the intersection can be increased by more than 3 times before the modelled LoS drops to less than C.
Kamilaroi Highway/ Waverly Road	More than 780 additional vehicles can enter this intersection in the AM peak hour before the modelled LoS drops to less than C.	The input volumes for traffic entering the intersection can be increased by more than 3 times before the modelled LoS drops to less than C.

This assessment has shown that each of the five intersections has ample spare capacity to absorb more traffic before the modelled intersection LoS drops to less than C (i.e. the *"onset of intersection failure"*). The assessment has shown that the total volume of traffic entering the intersection can be increased by a factor of 3 over those used previously to model the impact of the peak operational phase of the Project, before a LoS D would be experienced. This equates to additional volumes of between 760-1200 vehicles per hour entering the intersection.

The capacity to absorb additional volumes in the order of 760-1200 vehicles per hour is regarded as more than substantial to accommodate any likely fluctuations in traffic volumes due to peak agricultural/ harvesting seasons.

4.26.4 Road Closures

This section responds to the submissions from GSC regarding the closure of local roads and the redistribution of its associated traffic to alternative routes.

Submission reference: RA7

Summary response: The Project will result in the closure of Court Lane and The Dip Road between Clift Road and Nea Siding Road. Given the current usage and lack of residences along these roads and available alternative routes, the Project will not cause significant impacts on the local traffic regime as a result of these closures.

Court Lane

The Project will result in a closure of Court Lane, which currently provides connectivity between the Kamilaroi Highway and Dip Road. The Traffic and Transport Impact Assessment (see Appendix AB of the EIS) stated that *"no residences will remain along this route"* during the life of the Project, due to land acquisitions associated with the mining and infrastructure areas. As such, the only road users that would be affected would be those using this road as a through route between Kamilaroi Highway and The Dip Road.

A midblock tube survey was carried out on this route between 20 and 26 August 2013. This survey indicated that there is an average of 25 vehicles/day that use this route (17 light vehicles and 8 heavy vehicles). It is envisaged that a substantial proportion of these vehicles would have local destinations along the route, which would no longer be the case during the operational phase of the Project. As such, the volume of traffic that would actually be affected would be very low and the proposed closure of this road to public road users is not envisaged to have a significant impact.

Furthermore, when considering the orientation of Court Lane relative to other roads, it offers little advantage as a through route. For example, through traffic travelling from the Kamilaroi Highway north to Spring Ridge would have a shorter journey via Nea Siding Road (on a paved surface). As such, these vehicles would already tend to use Nea Siding Road under the existing conditions and therefore it is unlikely to be any traffic redistribution as a result of the Court Lane closure.

Similarly, through traffic travelling from Kamilaroi Highway south to Spring Ridge would tend to use Waverly Road as a first preference and then The Dip Road as the second option. These routes would offer substantially shorter travel times compared with Court Lane. Therefore, under existing conditions, this traffic is more likely to use these routes over Court Lane.

With regard to the above traffic regime, there is unlikely to be any traffic redistribution as a result of the Court Lane closure. However, an assessment of alternative routes and its capacity to absorb the very small proportion of traffic that could be generated along Court Lane is provided in **Section 4.26.5**.

The Dip Road

The Project will result in the closure of The Dip Road between Clift Road and Nea Siding Road. The Traffic and Transport Impact Assessment (see Appendix AB of the EIS) noted that *"no residences will remain along the affected portion of this route"*, due to land acquisitions associated with the mining and infrastructure areas. As such, the only traffic that would be potentially redistributed to the proposed alternative route of Clift Road - Werner Road - Cull Road would be through traffic travelling between Spring Ridge/ Lake Goran and the Kamilaroi Highway.

With regards to the above traffic regime, there is unlikely to be significant traffic redistribution as a result of The Dip Road closure. However, an assessment of alternative routes and its capacity to absorb the small proportion of traffic that could be generated along The Dip Road is provided in **Section 4.26.5**.

4.26.5 Alternative Road Network Routes

This section responds to the submission by GSC regarding other alternative routes to the Project.

Submission reference: RA7

Summary response: The upgraded Clift Road-Werner Road-Cull Road and the existing Nea Siding Road will offer alternative routes following the closure of local roads during the operation phase of the Project. These alternative routes have sufficient capacity to cater for any minor additional traffic from other avenues. In this regard, the Project will not place excessive traffic pressures on these routes.

Project-related traffic that travels to/from Tamworth is most likely to use Bulunbulun Road as the primary access route. This route is approximately 75 km long. The alternative routes are via:

- Oxley Highway and Kamilaroi Highway;
- Oxley Highway, Clifton Road, Edward Road and Hogarth Street; and
- Oxley Highway, Clifton Road, Norman Road, Long Point Road, Pullaming Road and Long Mountain Road.

These routes are substantially longer (90 to 102km) and are unlikely to attract the Tamworth-bound trips. It is not expected that there would be a high proportion of workers living to the west of Tamworth such that these alternative routes become more attractive than Bulunbulun Road. As such, there is not envisaged to be a significant Project-induced impact on these alternative routes.

Clift Road-Werner Road-Cull Road

As provided in the Traffic and Transport Impact Assessment (see Appendix AB of the EIS) and in **Section 4.26.7**, the development of the alternative route via Clift Road-Werner Road-Cull Road will be constructed in consultation with GSC. This will generally consist of a rural two-lane-two-way road configuration consistent with the relevant Austroads road design guidelines. The required approvals for the construction of this alternative route will be sought separately to the Project application.

Further details pertaining to the upgrade of local roads, including Cull Road, are provided in **Section 4.26.7**.

Nea Siding Road

Nea Siding Road is the alternative route for through traffic from The Dip Road to Kamilaroi Highway following the closure of Court Lane during the operational phase of the Project. In this regard, an assessment was undertaken to validate if Nea Siding Road has the capacity (under background traffic volumes) to absorb the very small proportion of traffic that could be generated along Court Lane.

A midblock tube survey was also carried out for Nea Siding Road between 20 and 26 August 2013. This indicated that there is an average of 108 vehicles/day. As such, even under a conservative assumption that all 25 vehicles/day on Court Lane are redistributed to Nea Siding Lane, this would result in a total traffic volume of 133 vehicles/day.

The existing layout and condition of Nea Siding Road would be able to accommodate this marginal increase and there is little justification for upgrading this road on sole account of the Court Lane closure. As an indication, a typical midblock capacity of a road is in the order of 1,200 vehicles per hour per lane. The forecasted 133 vehicles per day is well below such capacity limits.

Further details pertaining to the upgrade of local roads, including Nea Siding Road, are provided in **Section 4.26.7**.

4.26.6 Road Traffic Interactions with Surface Water

Kamilaroi Highway

This section responds to concerns regarding the modelled changes to surface water flows and the potential impacts on the Kamilaroi Highway.

Submission reference: RA7 and RA10

Summary response: The Project will result in a slight increase in the duration of flooding inundation from Watermark Gully on the Kamilaroi Highway by less than 5%.

Shenhua Watermark will ensure that the Watermark Gully diversion will return the catchment to pre-mine development flood flow rates and velocities. This will be detailed in the Water Management Plan to be prepared for the Project.

As described in **Section 4.3.12** of this RTS, the impacts of the increased Watermark Gully catchment area on flooding of the Kamilaroi Highway will vary from event to event, depending on the storm duration and intensity. However, based on an assessment of critical duration design storm events, the impacts are likely to increase the duration of inundation by less than 5%.

Shenhua Watermark will ensure that the Watermark Gully diversion will return the catchment to pre-mine development flood flow rates and velocities. This will be detailed in the Water Management Plan to be prepared for the Project.

Details pertaining to changes in local catchment areas as a result of the Project and its interactions with the Kamilaroi Highway are provided in **Section 4.3.12** of this RTS.

4.26.7 Road Network and Intersection Upgrades

This section responds to submissions from stakeholders regarding the requirement and/or warrant for local and State road network and intersection upgrades.

Submission reference: RA7, RA8 and RA10

Summary response: Shenhua Watermark is proposing to upgrade Clift Road, Werner Road and Cull Road to effectively bypass the Southern Mining Area. Beyond this, it is envisaged that a component of the VPA to be agreed with GSC over the Project may go towards more general local council road maintenance.

Local Road Network

GSC and LPSC have requested a number of required upgrades along local roads, including:

- Bulunbulun Road;
- Gap Road;
- Werris Creek Road;
- Nea Siding Road;
- Werner Road; and
- Cull Road.

Both Councils further suggest that proponents of any new mining development, including Shenhua Watermark, contribute funding to upgrade these roads to a desired standard.

Shenhua Watermark is proposing to upgrade Clift Road, Werner Road and Cull Road to effectively bypass the Southern Mining Area and maintain public road access to Lake Goran and Breeza State Forest. The design and construction specifications of these roads will be determined in detailed consultation with Council, should Project approval be granted.

As provided in **Section 4.26.1**, the majority of traffic generated by the Project will be associated with light vehicles, which have very limited impact on the integrity of roads. Austroads (2012) supports this by stating *"because it is well established that light vehicles contribute very little to structural deterioration [of road pavement], only heavy vehicles are considered in pavement design".*

Furthermore, **Section 4.26.2**, provides context regarding the current pavement condition and associated structures in light of the Project's traffic impacts. Given the pre-existing road condition, it should not be the responsibility of Shenhua Watermark to fund all the upgrades, as suggested by Council (with the exception of Cull Road and Werner Road upgrades which are directly required by the Project). However it is envisaged that a component of the VPA to be agreed with GSC over the Project may go towards local council road maintenance.

Local Intersections

LPSC has suggested the following intersections be upgraded as a condition of Development Consent:

- Werris Creek Road/Bulunbulun Road;
- Werris Creek Road/Gap Road;
- Kamilaroi Highway/ Bulunbulun Road;
- Kamilaroi Highway/Gap Road; and
- Kamilaroi Highway/Waverley Road.

As provided in **Section 4.26.3**, the SIDRA modelling indicates that the additional traffic induced by the Project will have marginal impact on the aforementioned intersections from a capacity perspective. This is reflected by the nil change to the LOS and the minor increases to DOS, average delay and maximum queue lengths. In this regard, upgrades to these intersections are not warranted as a consequence of the impacts of the Project alone.

State Road Network

The Project will involve the following works that affect State jurisdiction roads:

- The road-over-rail bridge on the Kamilaroi Highway to facilitate the crossing of the proposed rail spur;
- The associated deviation of the Kamilaroi Highway to accommodate the road-over-rail bridge; and
- The Kamilaroi Highway/ Mine Access Road intersection.

Following the determination of this Project Application, Shenhua Watermark will commence discussions with the relevant road authorities, including RMS, with the intention of entering any required Works Authorisation Deeds (WADs) for the development, adjustment, maintenance, handover and/or decommissioning of any road asset. This agreement will also specify the:

- Detailed design and construction criteria;
- Regime of quality and safety auditing as well as project certification;
- Methods of safeguarding existing assets; and
- Management of surface flooding, where contributed by the Project.

Improvements to the Kamilaroi Highway will be designed and constructed in accordance with the relevant Austroads Guidelines and Australian Standards, in consultation with RMS.

4.26.8 Coal Haulage Limitations

This section responds to a submission by LPSC opposing the movement of coal by road.

Submission reference: RA8

All product coal from the Project will be transported by rail. There is no intention to transport any product coal by road.

4.26.9 Post Mine Closure Access

This section responds to the submission by GSC regarding the proposed access to the Project site post mining for future land uses.

Submission reference: RA7

Summary response: Upon mine closure, any infrastructure including roads, which is beneficial for future use by post mine land owners/users, will be dealt with in accordance with the relevant stakeholder or land owner agreements and in consultation with GSC.

Upon mine closure, any infrastructure including roads, which is beneficial for future use by post mine land owners/users, will be dealt with in accordance with the relevant stakeholder or land owner agreements and in consultation with GSC, as necessary. Figure 5 of the Traffic and Transport Impact Assessment (Appendix AB of the EIS) presented the proposed post mining road network.

An appropriate arrangement of internal access tracks will be provided to facilitate access requirements for maintenance and land management (e.g. fire trails). This will be dependent on land zoning status, ownership and access requirements at various times throughout the Project life.

4.26.10 Requirements under the Roads Act 1993

This section responds to the submissions from stakeholders regarding the relevant dedication and closure requirements under the Roads Act 1993 (Roads Act) for those roads to be directly impacted by the Project.

Submission reference: RA7, RA8 and RA10

Summary response: The Project will involve the construction of a road over rail pass for the Kamilaroi Highway and disturbance of a number of local roads. As such, approvals under section 138 of the Roads Act will be required. Following the grant of Development Consent, Shenhua Watermark will request that GSC apply to the Minister for Roads and Ports to allow for the dedication of land and closure of roads.

The Roads Act provides for the dedication of classified and unclassified roads and confers functions on public authorities in relation to the management of roads. Under section 138(1) of the Roads Act, a structure cannot be erected in, on or over a public road unless the appropriate roads authority has given consent.

The Project will involve the construction of a road over rail pass for the Kamilaroi Highway. Accordingly, consent under section 138 of the Roads Act will be required for this work. Under section 7(4) of the Roads Act, the local council (GSC) is the roads authority for the section of a highway within that LGA. Following the grant of Development Consent, Shenhua Watermark will request that GSC apply to the Minister for Roads and Ports for dedication and occupation of the land associated with the Kamilaroi Highway reserve in order to carry out the proposed works.

Under section 138(2) of the Roads Act, consent from the appropriate roads authority is required for any works that will disturb the surface of the road. The Project will involve disturbance of Court Lane, part of The Dip Road, Rowarth Road, Whitby Road and some unnamed minor roads. As such, approvals under section 138 of the Roads Act will be required prior to their disturbance. Since these roads are neither freeways nor Crown roads, GSC is the roads authority for these roads.

Pursuant to section 89K(1)(f) of the EP&A Act, consent under section 138 of the Roads Act cannot be refused if it is necessary for the carrying out of a project that has been granted Development Consent.

The roads that will be mined through will need to be permanently closed. An application for closure of public roads will need to be made under section 34 of the Roads Act. Section 34 states that:

> *(1) An application for the closing of a public road (other than a freeway) may be made:*
>
> *(a) in the case of a Crown road, by any person, and*
>
> *(b) in the case of any other public road, by the roads authority for the road or by any other public authority.*

Since the relevant roads are not Crown roads, the application can only be made by the relevant roads authority. Pursuant to section 7(4) of the Roads Act, the roads authority for these roads is GSC. At the appropriate time, following the grant of Development Consent, Shenhua Watermark will request that GSC apply to the Minister for Roads and Ports for closure of these roads.

4.26.11 Predicted Rail Traffic Impacts

This section responds to the submission by NSW Transport regarding the Project's rail movements in relation to the broader rail network and strategies.

Submission reference: RA11

Summary response: The Project will result in train movements to and from the Port of Newcastle via the Main Northern Railway Line. ARTC generates and prioritises rail capacity by means of the Hunter Valley Access Undertaking and any mine Development Consent. Shenhua Watermark is consulting with ARTC regarding a take or pay contract for rail access. In this regard, adequate planning will ensure sufficient rail capacity is available to cater for the Project.

The Project will result in train movements to and from the Port of Newcastle. This will be via the Main Northern Railway Line which is a critical route in the Hunter Valley Coal Corridor.

The freight planning needs along the Main Northern Railway Line are managed by ARTC in collaboration with the NSW and Commonwealth governments. Across this railway line, ARTC is responsible for selling access to train operators, capital investment in the rail corridors and management of the network.

The funding for rail upgrade and maintenance is sourced by a mechanism that is described in the Hunter Valley Access Undertaking and endorsed by the ACCC. Mechanisms include the sale of rail paths and/or capital contributions by producers wishing to contract new capacity.

The generation, prioritisation and consultation on Projects required to create capacity is carried out by the processes described in the Hunter Valley Access Undertaking.

The ARTC business model does not allow for creation of capacity unless there is a take or pay contract for rail access in place. Naturally, this contract and therefore ARTC's commitment to develop capacity comes after a mine project receives its Development Consent.

Importantly, ARTC has outlined a series of projects that will create the capacity required for this Project and other mining expansions in this region and has demonstrated an ability to deliver capacity creating infrastructure to meet contracted future tonnages.

4.26.12 Rail Network Upgrades

This section responds to submission by stakeholders regarding the need for rail network infrastructure upgrades as a result of the Project having regard to broader industry strategies, in particular the Werris Creek Bypass Project.

Submission reference: RA7, RA8 and RA11

Summary response: Shenhua Watermark is committed to ongoing consultation with ARTC to ensure that it has the most up to date information on the Project to consider it in the preparation of its integrated rail network design. Furthermore, the Project has been assessed having consideration of the broader rail network and associated proposals as published by ARTC. In this regard, adequate planning will ensure sufficient rail capacity is available to cater for the Project.

Project-Related Rail Infrastructure Upgrades

The Project will require the construction of a proposed rail spur, rail loop and its connection to the Werris Creek-Moree Railway Line to facilitate the transport of coal to the Port of Newcastle.

Shenhua Watermark is continually consulting with ARTC to ensure that it has the most up to date information over the Project to consider in the preparation of its integrated rail network design.

Broader Rail Network Considerations

The Project has been assessed having consideration of the broader rail network and associated proposals as provided by the *2013-2022 Hunter Valley Corridor Capacity Strategy* (ARTC, 2013).

Currently long coal trains standing in the Werris Creek Loop create operational complexities at Werris Creek, where a large proportion of non-coal trains need to access the yard, which is blocked by a coal train in the loop. The strategy describes an opportunity to increase operational flexibility within the rail network through reopening and reconfiguring the alternative and historic Gap-Werris Creek Line.

The need to address operational issues at Werris Creek is an existing network issue that is being planned for by ARTC irrespective of this Project. How this issue is resolved is a matter for ARTC, in consultation with industry and relevant stakeholders. As demands on the network change, ARTC modifies its strategy and some projects are replaced with others that are then assessed to be the best way to resolve the need.

4.26.13 Rail Traffic Interactions with Agriculture

This section responds to the submission by stakeholders regarding the Project's rail requirements and the broader rail capacity having regard to existing and seasonally fluctuating agricultural rail to port requirements.

Submission reference: RA11 and SIG6

Summary response: Only after passenger and grain services are catered for does ARTC allocate the remaining paths to general freight trains and coal trains. In this regard, the Project will not place unnecessary pressure on the rail capacity for agriculture.

ARTC are responsible for the sale of train (access) paths to the Main Northern Railway Line. The individual customers include passenger rail services and various freight movers including coal, agricultural produce and containers.

In regard to the allocation of train paths, the first and highest priority is given to passenger services.

In order to safeguard access to the network for the movement of agricultural produce, ARTC has reserved a portion of train paths for grain and other agricultural traffic on a seasonal basis. Only after passenger and grain services are catered for does ARTC allocate the remaining paths to general freight trains and coal trains.

4.26.14 Railway Level Crossings

This section responds to the submission by GSC regarding the risks associated with the railway level crossing, in particular Hogarth Street, in relation to the Project's traffic. As the Submission raised concerns about potential severance of cross-line access (particularly emergency access), this Response provides a commentary on the level crossings at Hogarth Street, Werris Creek Road, Henry Street (Quirindi), and Nowland Street (Quirindi). Other railway level crossings are in a more rural road environment with less prominent risks in these respects.

Submission reference: RA8

Summary response: Several railway level crossings within the local area, including the crossing at Hogarth Street, currently experience delays and restricted cross-railway access. The Project is not expected to have a significant traffic impact on queuing nor the recovery time back to normal conditions on these railway level crossings. In particular, Shenhua Watermark is committed to ensuring that Project related traffic will be discouraged from using Hogarth Street to access Bulunbulun Road in order to minimise risks at the associated railway level crossing.

Hogarth Street Railway Level Crossing

From the Kamilaroi Highway, there are two possible routes that provide access to Breeza-Currabubula Road. These are Hogarth Street and Currabubula Road. Both of these roads have railway level crossings over the Werris Creek-Moree Railway Line with potential short stacking risks at Hogarth Street.

The Hogarth Street railway level crossing is situated 60 m north east of the Kamilaroi Highway at Breeza. The crossing itself is controlled by flashing signals and boom gates. However, Hogarth Street approaches the Kamilaroi Highway on an uphill grade and may have restricted visibility to highway traffic. Signs should be installed to provide warning against short stacking risks at the Hogarth Street site.

Site observations at several railway level crossings in the area indicate that a typical train with up to 82 wagons requires a total crossing period of three minutes. During this period, the traffic volume on Hogarth Street would need to exceed (the equivalent rate of) 170 vehicles/hour per direction in order for a queue to spill back into the Kamilaroi Highway intersection. It is unlikely that such traffic volumes would be experienced on this road, especially since Bulunbulun Road itself only carries up to 250 vehicles per day. Furthermore, Shenhua Watermark is committed to ensuring that Project related traffic will be discouraged from using Hogarth Street to access Bulunbulun Road.

Werris Creek Road Railway Level Crossing

Werris Creek Road runs on an approximate parallel alignment to the north-south alignment of the Main Northern Railway Line. As such, the road contains a pair of reverse curves in order to establish a more perpendicular crossing of the railway line.

The railway level crossing is controlled by flashing signals and contains the required advanced warning signs and pavement markings generally in accordance with *AS 1742.7-2007 Manual of Uniform Traffic Control Devices - Railway Crossings*. This includes a 45 km/hour advisory speed limit sign and associated REDUCE SPEED signs.

During the site inspection (1900h), a 72 wagon train with three locomotives was observed using the crossing. This required a total flashing signal period of 2:50 minutes. During this period, a total of seven vehicles arrived at the crossing; four on the northern side and three on the southern side. The average waiting time for each vehicle was 1:30 minutes. Following the passing of the train, the queues dissipated in 20 seconds and no further vehicles arrived at the back of these platoons during the clearance phase.

The delays observed are considered to be acceptable and the road exhibited a rapid recovery back to uninterrupted traffic flow conditions.

In their paper entitled "*Investigating efficiency at level crossings - Simulation of road and rail signalling improvements"*, Hall and Somers (2012) describe *"mild"* level closures of level crossings as ones with closure times up to 3:06 minutes. Delays beyond this are regarded as *"severe"*. Whilst it is acknowledged that delays at railway level crossings may exceed the observed 2:50 minute period, these tend to be statistical outliers, with the average delays between 3-4 minutes.

Plate 9 shows the full extent of queuing observed on the northern side of the railway level crossing after the 2:50 minute flashing red period.

Plate 9
Werris Creek Road Railway Level Crossing

An estimated 11% of journey to/from work traffic (66 vehicles/day) from the Project would be distributed to Werris Creek. If these were conservatively assumed to travel to the south and hence need to cross this railway level crossing, there could be up to 17 additional vehicles per hour per direction at the shift changes. This equates to 0.3 vehicles / minute. As such, during a 2:50 minute flashing red light period, up to one vehicle could arrive at the railway level crossing. This is not expected to significantly increase the cumulative delay associated with the facility. It is also unlikely to affect the recovery time back to normal operating conditions following the passing of the train.

Henry Street Railway Level Crossing

The east-west alignment of Henry Street crosses the Main Northern Railway Line at a perpendicular angle. The level crossing is controlled by flashing signals and boom gates on the two Henry Street approaches. The western approach is more critical than the eastern approach due to its close proximity to the roundabout at George Street (see **Plate 10**).

The approaches to the crossing are furnished with advanced warning signs and pavement markings generally in accordance with *AS 1742.7-2007 Manual of Uniform Traffic Control Devices - Railway Crossings*. These include the standard RAIL X marking as well as box markings in the control area of the crossing. The crossing is also located in a 40 km/hour speed zone.

Plate 10
Henry Street Railway Level Crossing

With respects to access for emergency services, it should be emphasised that the delays and restricted cross-railway access is an existing issue and is not one that is introduced by the Project. Notwithstanding this, the Duke Street-Russell Street underpass on the southern side of Quirindi provides an uninhibited route across the railway line. This is a rail-over-road bridge with a 5 m vertical clearance.

Between the two common points of Dewhurst Street/Russell Street and the George Street/Henry Street intersections, the alternative route via Duke Street-Russell Street is 1.9 km longer. At an average travel speed of 50 km/hour, this equates to 2:15 minutes of additional travel time.

Approximately 66 vehicles (11%) of the 300 journey to/from work trips per day associated with the Project are likely to head towards Quirindi. This would equate to up to 17 vehicles per hour per direction of travel (0.3 vehicles/minute) at the shift change. As such, during a 2:15 minute flashing red period, up to one additional vehicle (as generated by the Project) could arrive at the railway level crossing.

This is not expected to have a significant impact on queuing nor the recovery time back to normal conditions. This is a very conservative assessment assuming that all Quirindi-bound traffic is required to cross this railway level crossing.

Nowland Street Railway Level Crossing

Nowland Street is an east-west road and forms the western approach to the crossing. Allnut Street is on a north-east to south-west alignment and approaches the crossing at a 45 degree angle. The level crossing is controlled by flashing signals and boom gates. The approaches to the crossing contain signs and pavement markings generally in accordance with *AS 1742.7-2007 Manual of Uniform Traffic Control Devices - Railway Crossings* (see **Plate 11**).

Plate 11
Nowland Street Railway Level Crossing

With respects to emergency services access, it should be emphasised that the delays and restricted cross-railway access is an existing issue and is not one that is introduced by the Project. Notwithstanding this, an alternative route via Duke Street-Russell Street is available for long term access restrictions.

This alternative route would require an additional travel distance of 6.5 km. At an average travel speed of 60 km/hour, this would equate to 8 minutes of travel time. As such, it would be more worthwhile to remain on the Allnut Street route and accept the delays at the level crossing.

Approximately 66 vehicles (11%) of the 300 journey to/from work trips per day associated with the Project is likely to head towards Quirindi. This would equate to up to 17 vehicles per hour per direction of travel (0.3 vehicles/minute) at the shift change. As such, during a 2:15 minute when a train passes through, up to one additional vehicle (as generated by the Project) could arrive at the railway level crossing.

This is not expected to have a significant impact on queuing nor the recovery time back to normal conditions. This is a very conservative assessment assuming that all Quirindi-bound traffic is required to cross this railway level crossing.

General Commentary on Railway Level Crossings

The Australian Level Crossing Assessment Model is an assessment tool used to identify key potential risks at level crossings and to assist in the prioritisation of railway level crossings according to their comparative safety risk. It is used to support a rigorous defensible process for decision making for road and pedestrian level crossings as well as a method to determine the most cost effective treatment.

This method is used by the NSW and Australian Governments to assess and prioritise the safety needs of railway level crossings. This provides for a cross-the-board consistent approach to the identification of safety deficiencies, and the subsequent rectification of these. The model considers the relative exposure to safety risks for both road users and train movements.

All railway level crossings involving the crossing of a public road are included in the ongoing Australian Level Crossing Assessment Model assessment process.

4.26.15 Infrastructure Contributions

This section responds to submissions from GSC and LPSC requesting funding for the maintenance of the local and subregional road and rail network.

Submission reference: RA7 and RA8

Summary response: Shenhua Watermark will bear the cost of Project-related infrastructure and is negotiating with local councils for which they may elect to contribute some of this funding to the maintenance and upgrading of their road networks.

Shenhua Watermark is also committed to consulting with relevant regulatory agencies in the future regarding broader road and rail network strategies.

Subregional Infrastructure

LPSC has recommended to DP&I that proponents of new mining developments that involve changes to regional road and rail networks, should contribute to the funding, development and implementation of appropriate measures to alleviate any pressure generated by such development on this infrastructure.

As provided in **Section 4.27** of this RTS, the cost of any new infrastructure or changes to the existing network (road and rail) directly required for the Project will be borne by Shenhua Watermark. Any broader road and rail network upgrades proposed by third parties (e.g. RMS or ARTC) will typically be funded by such parties through the relevant pathways (e.g. access fees). However, Shenhua Watermark is committed to consulting with relevant regulatory agencies in the future regarding subregional infrastructure strategies to improve existing networks where the Project and other sources are involved.

Voluntary Planning Agreements

As provided in **Section 4.27** of this RTS, Shenhua Watermark has made an offer to GSC, LPSC and TRC, which LPSC and TRC have accepted. Discussions are progressing with GSC over the terms of the VPA.