

# **WATERMARK**

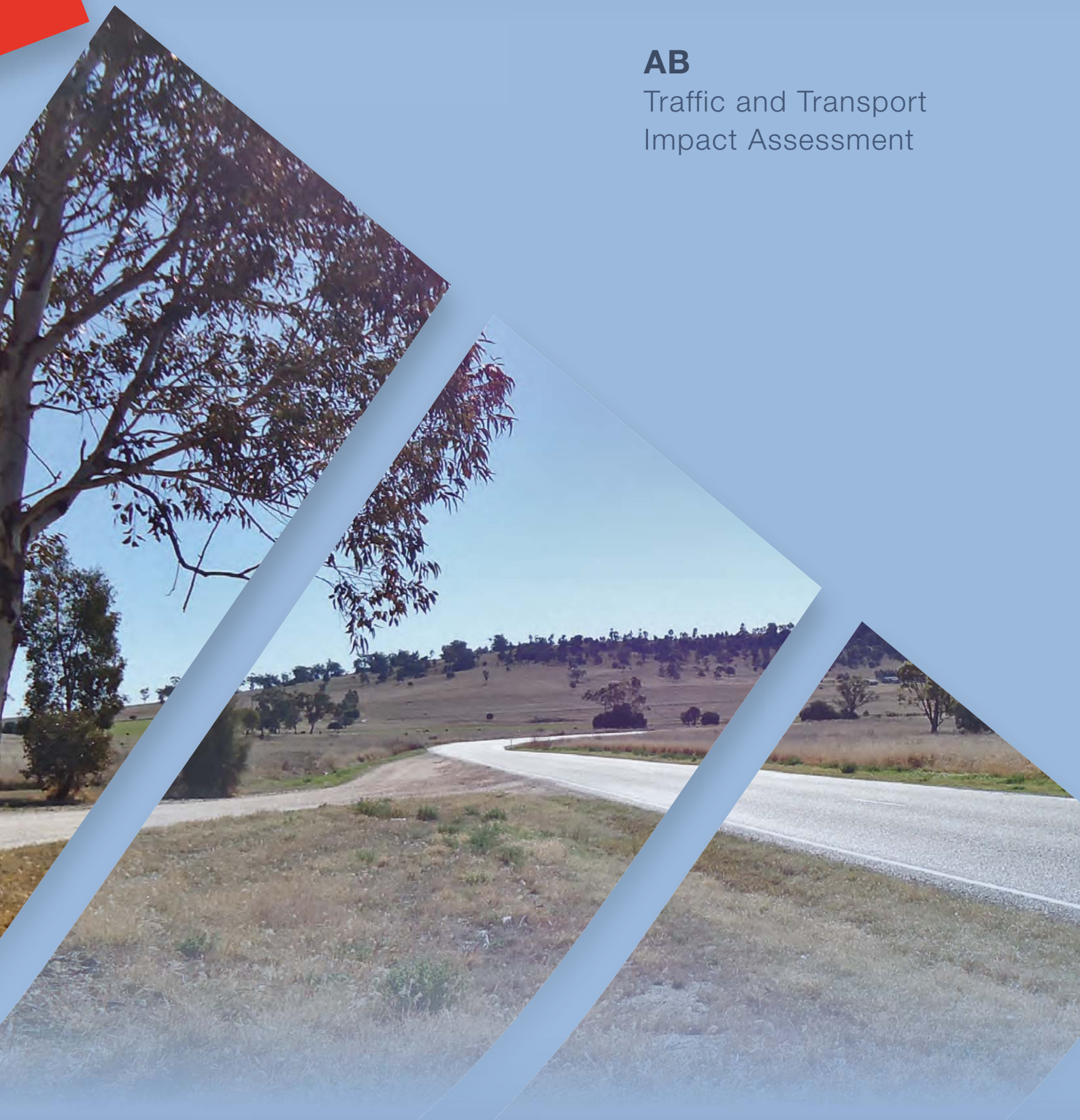
## **COAL PROJECT**

### **ENVIRONMENTAL IMPACT STATEMENT**

February 2013

## **AB**

Traffic and Transport  
Impact Assessment



# **WATERMARK COAL PROJECT**

## **TRAFFIC AND TRANSPORT IMPACT ASSESSMENT**

*Prepared by:*

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11 January 2013

*For:*

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## **EXECUTIVE SUMMARY**

This traffic and transport impact assessment has examined the potential road and rail traffic impacts associated with the Watermark Coal Project, including road traffic impacts, road safety impacts, impacts due to road closures and rail network impacts. The purpose of this assessment is to form part of an Environmental Impact Statement being prepared by Hansen Bailey to support an application for State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning & Assessment Act 1979* for the Project.

The Project is located approximately 25 km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza, within the Gunnedah Local Government Area. The Project will involve the construction and operation of an open cut mining operation with a forecast extraction rate of 10 Million tonnes per annum of Run of Mine coal over a 30 year period.

### **Road Traffic**

The Project will generate traffic movements during both the construction and operational phases of the Project. During the construction phase, the main road traffic generation would be associated with staff movements, and supply trucks. This includes the construction of the mine infrastructure area, coal handling and preparation plant, Mine Access Road, rail spur and associated road-over-rail crossing of the Kamilaroi Highway.

During the operational phase of the Project, the main traffic generating sources would be due to the workers arriving and departing at the start and end of work shifts. As the Project is intended to be a 24 hour operation, traffic generation would be more pronounced at these shift changes as it would include both inbound trips (due to workers scheduled to start work), and outbound trips (workers that would be finishing a work shift).

SIDRA models were prepared for the Kamilaroi Highway/ Mine Access Road as well as the Kamilaroi Highway/ Court Lane intersection, as preliminary indicators of overall impact to the surrounding network. These models were prepared for both the peak construction and peak operational phases.

The models were based on the traffic volume build up due to these project phases and conservatively accounted for the growth in background traffic along the Kamilaroi Highway. The SIDRA modelling confirmed that the traffic generated by both the construction and operational phases of the Project would be efficiently absorbed into the existing traffic stream. This is largely due to the substantial spare capacity available in the network.

## Road Safety

The road safety assessment revealed that the section of the Kamilaroi Highway, in the immediate vicinity of the Project Boundary, has not experienced a high rate of crashes. As such, any additional traffic generated by the Project would not be overly exposed to unacceptable crash risk in the surrounding network.

However, it was recognised that in a high-speed (110km/h) environment, there could be significant crash risks associated with the introduction of turning movements into and out of the Project Boundary. The high speed differential between through traffic and decelerating or queued right-turn traffic could increase drivers' exposure to high-speed rear-end crashes. Similarly, traffic egressing from the Project Boundary would be entering the Kamilaroi Highway at low speed and would be at risk of impact from the high-speed Kamilaroi Highway traffic. As such, this assessment recommends a number of mitigation measures including:

- The Kamilaroi Highway/ Mine Access Road intersection should be a channelised (CHR) T intersection with an indented right-turn lane for southbound traffic. The right-turn lane should provide sufficient length for deceleration and queue storage. The modelling indicated that the right-turn lane should be 140m long.
- The Kamilaroi Highway/ Mine Access Road should also provide sufficient length of indented left-turn lane for northbound traffic on the Kamilaroi Highway South approach. This would allow left-turn vehicles to decelerate in a physically separate lane to that of the high-speed through traffic.
- The Kamilaroi Highway/ Mine Access Road works, as well as the Kamilaroi Highway realignment should be scheduled early in the construction program. This will mean that the facility could also be used by traffic generated in the construction phase.

A road safety review was also carried out for Quirindi-West Tamworth Road, Werris Creek Gap Road and Breeza-Curabubula Road. Quirindi-West Tamworth Road offers a reasonable geometric alignment and pavement conditions for its function as a regional link road between Quirindi and Tamworth. Werris Creek-Gap Road and Breeza-Curabubula Road also have reasonable alignment and clear zone conditions. However, the width of pavement seal on these two roads is variable and may increase risks of left wheelpath tracking over the unsealed shoulder. As such, it is recommended that the respective road authorities (RMS, Gunnedah and Liverpool Plains Councils) continue to carry out the necessary pavement condition surveys to identify any pavement maintenance or upgrade needs along these two routes from time to time.

## **Road Closures**

The impacts of permanent and temporary road closures were also assessed as part of this Traffic and Transport Impact Assessment. The entire length of Court Lane would need to be closed, as well as the section of The Dip Road between Cull and Clift Roads. The closure of Court Lane would result in minimal impact as this road would no longer require local access due to properties being acquired as part of the Project.

The closure of The Dip Road as described above would be required in year 15 of the mine plan. This would require an alternative route via Cull Road, Werner Road and Clift Road. The increase in travel time associated with this alternative route has been calculated and is regarded as acceptable. The alternative route via Cull, Werner and Clift Roads would be developed in consultation with Gunnedah Shire Council. The required approvals for the construction of the alternative route will be sought separately to this application.

Temporary road closures would be required for any road within 500m of blasting activities associated with the Project. This would mainly affect The Dip Road. A number of mitigation and management measures were recommended in order to address the impact of these temporary road closures. These include:

- Locating the start of the road closures well away from intersections to minimise the risk of queues spilling back across the intersections.
- Locating the start of road closures where there is sufficient space and acceptable ground conditions to perform a u-turn.
- The provision of long term and changeable signage which would advise drivers of the prevailing road and access conditions.
- Advising affected residents of any scheduled temporary road closures.
- Scheduling road closures to minimise impacts to school bus services and school zone periods.

## **Rail Network**

The assessment of rail network impacts considered the number of trains generated by the Project, as well as other known mine expansion or development projects. The assessment indicated that up to eight train movements could be generated each haul day due to the Project.

ARTC (2012) have conducted extensive capacity demand forecasting along the rail line and have identified potential weak points along the network. Their strategy document (ARTC, 2012) identifies a range of network upgrades that would be required to facilitate the forecast demand increases.

As these have already been recommended by the ARTC, they are not raised as mitigation measures in this Traffic and Transport Impact Assessment. However, it is recommended that Shenhua Watermark continue to liaise with the ARTC to regularly advise of production forecasts and to keep a watching brief over the timing of various network upgrades. Similarly, there is a need for Shenhua Watermark to stay abreast of the surrounding coal expansion and development projects.

There are 28 railway level crossings along the Werris Creek-Moree Rail Line and Main Northern Rail Line between the Project and the Muswellbrook Junction (the latter being adopted as the southern boundary of the *area of influence* of the Project). These railway level crossings were assessed for their performance and level of safety. Four of these crossings were identified in this Traffic and Transport Impact Assessment as having a potentially significant risk with regard to short stacking and queuing related risks due to cumulative rail movements.

The Australian Transport Council (ATC) regularly assesses the safety of all railway level crossings on public roads under a systematic and structured approach known as the Australian Level Crossing Assessment Model (ALCAM). This routine assessment helps to inform ATC on the relative priority for upgrade of each railway level crossing. In this regard, it is recommended that Shenhua Watermark continue to liaise with ATC to inform them over the forecasted train volumes as well as any scheduling issues that may reduce risks along the network – including short stacking related risks.

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# WATERMARK COAL PROJECT TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

*for*

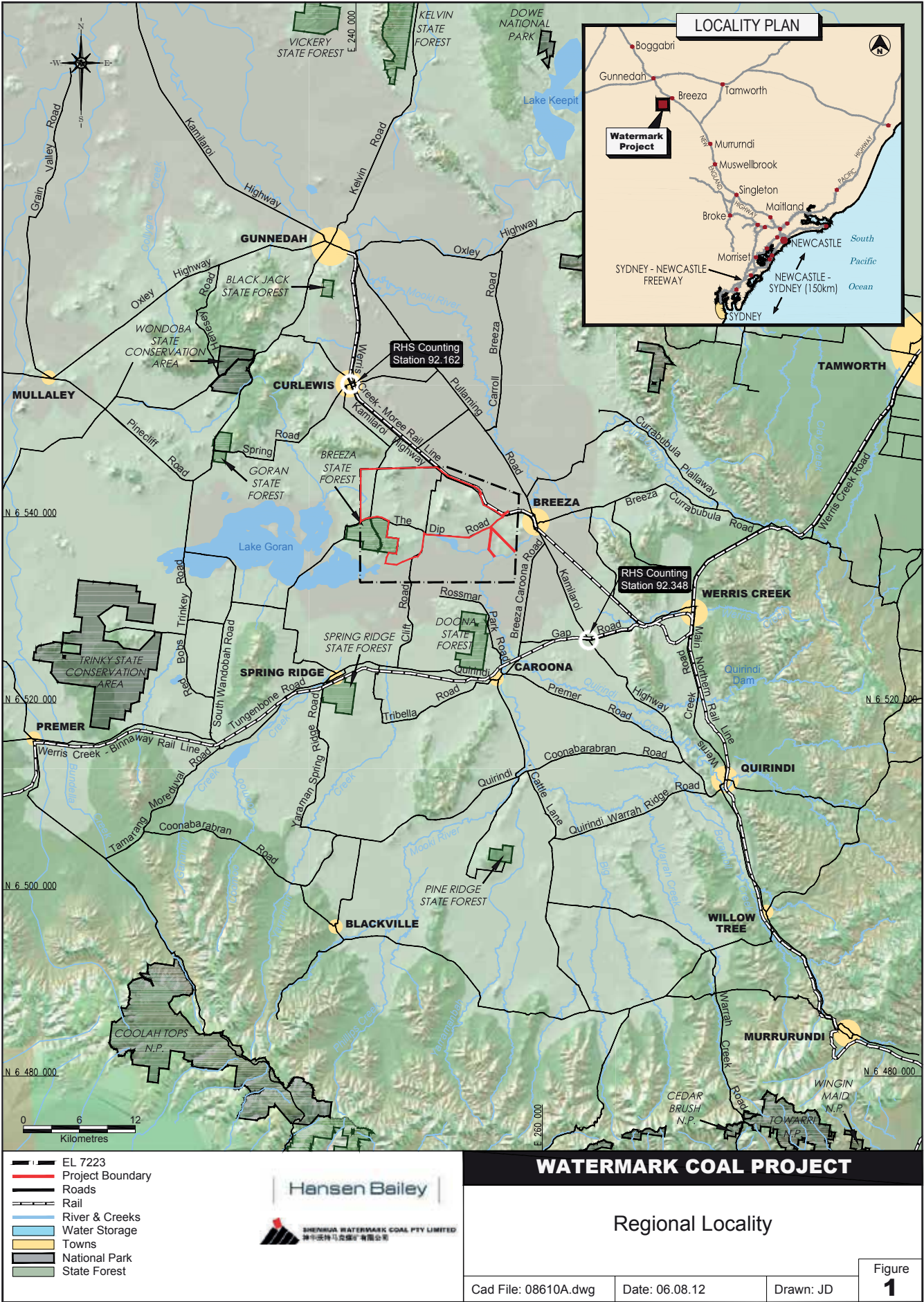
**SHENHUA WATERMARK COAL PTY LIMITED**

## 1 INTRODUCTION

DC Traffic Engineering Pty Ltd was commissioned by Hansen Bailey Pty Ltd (Hansen Bailey) on behalf of Shenhua Watermark Coal Pty Limited (Shenhua Watermark) to undertake a Traffic and Transport Impact Assessment for the Watermark Coal Project (the Project). The purpose of the assessment is to form part of an Environmental Impact Statement (EIS) being prepared by Hansen Bailey to support an application for State Significant Development Consent under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to facilitate the development of an open cut coal mining operation and associated infrastructure.

In October 2008, Shenhua Watermark was granted Exploration Licence (EL) 7223. Shenhua Watermark is a subsidiary of the Shenhua Group.

The Watermark Coal Project (the Project) is located within EL 7223, approximately 25 km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza, within the Gunnedah Local Government Area (LGA). The Project is approximately 282 km by rail from the export Port of Newcastle. **Figure 1** illustrates the regional locality of the Project in relation to the nearest town centres of Breeza and Gunnedah. The Project Application Boundary (Project Boundary) is shown on **Figure 2**.



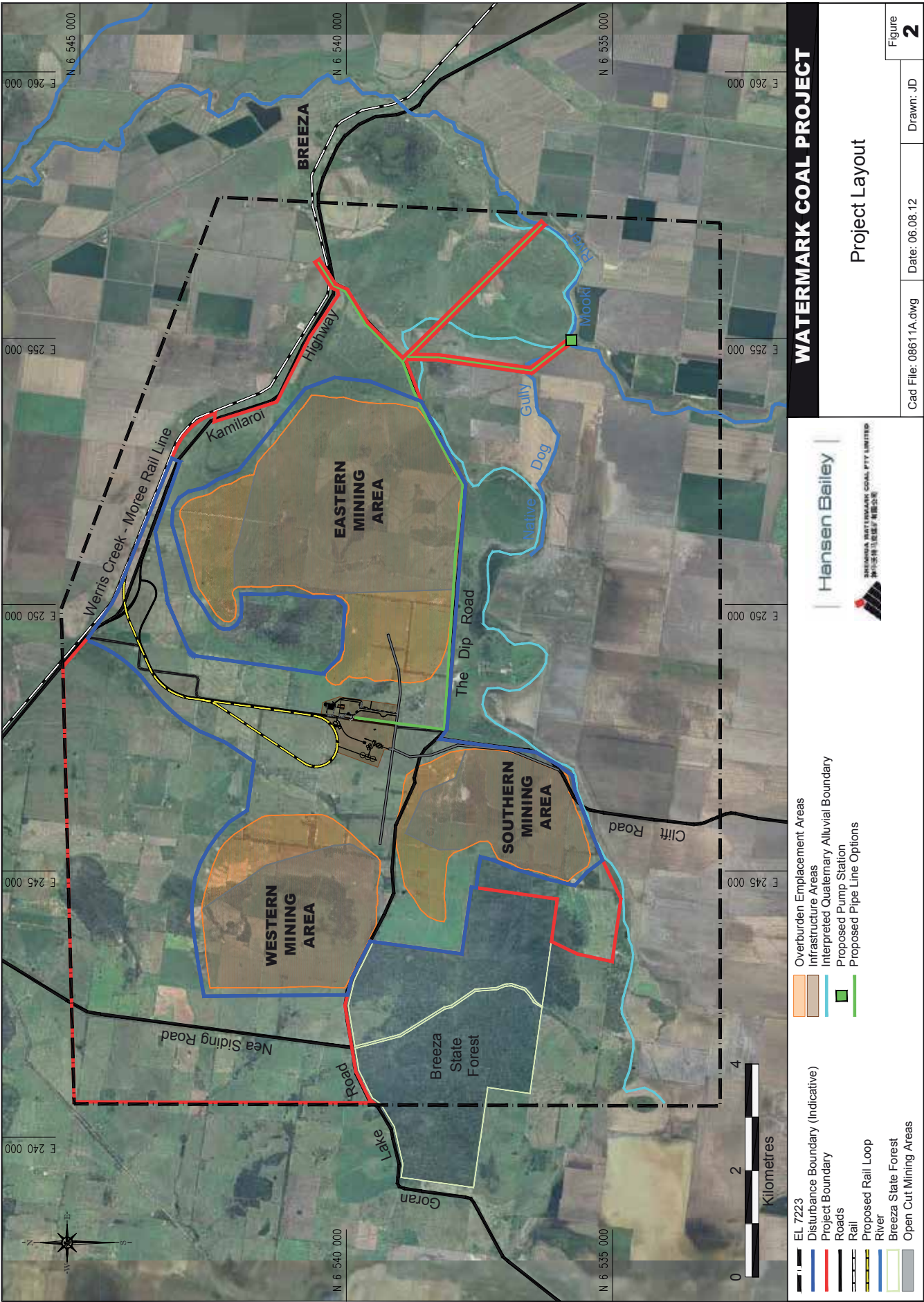
## 1.1 PROJECT DESCRIPTION

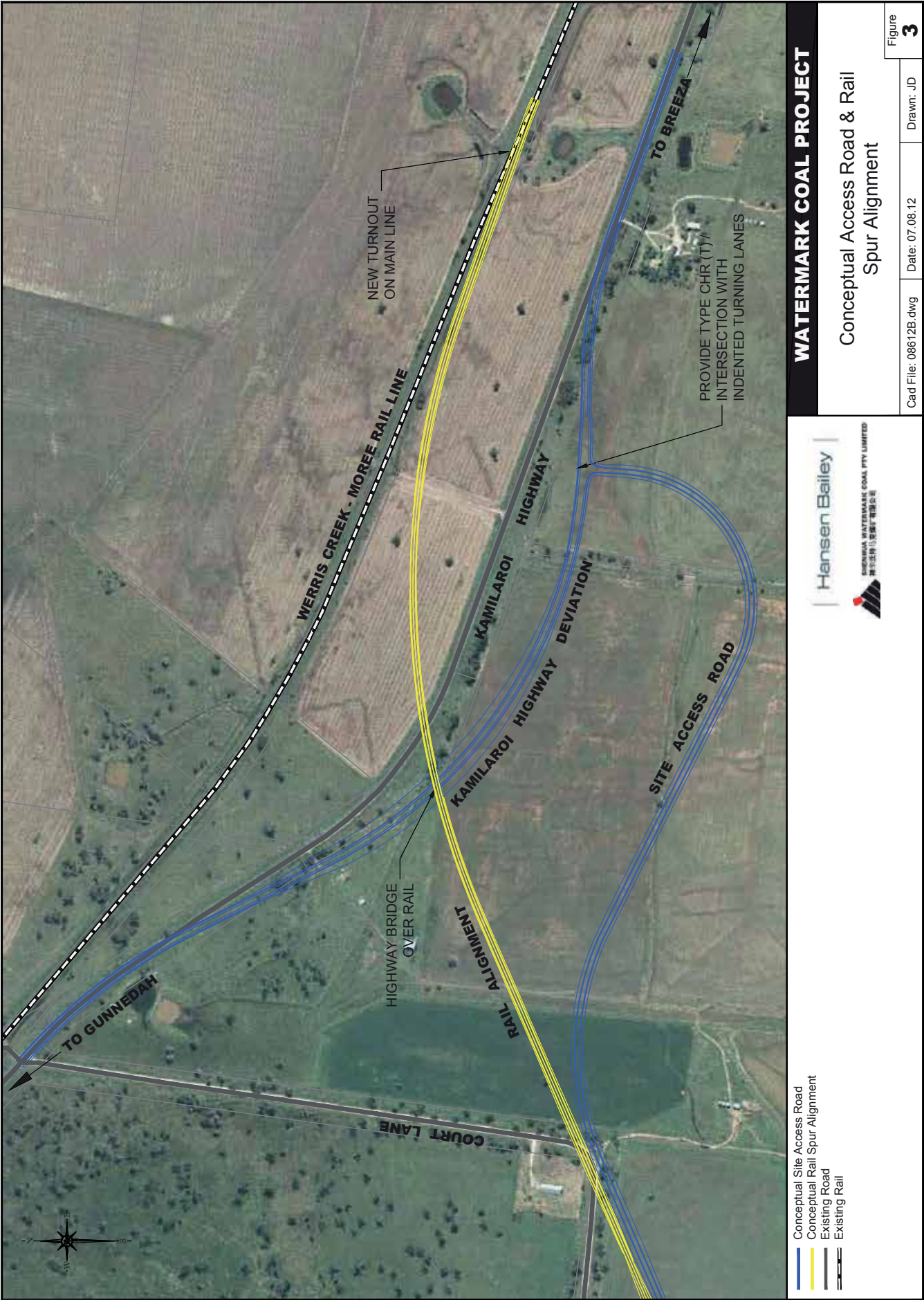
The Project generally comprises:

- The construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for a 30 year period;
- An open cut mining fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts;
- Progressive rehabilitation of all disturbed areas;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput of 10 Mtpa ROM coal;
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas (OEA);
- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated load out facility and connection to the Werris Creek - Moree Railway Line;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of ground and surface water management and reticulation infrastructure including pipelines, pumping stations and associated infrastructure for access to water from groundwater aquifers, the Mooki River and private dams to the north-east of the Project Boundary;
- The installation of communications and electricity reticulation infrastructure; and
- A workforce of up to approximately 600 full-time equivalent employees during construction and up to 600 full-time equivalent employees during the operation of the Project.

The conceptual layout of the Project is shown in **Figure 2**. The conceptual road and rail alignment is shown in **Figure 3**.

The Project will result in the permanent closure of a number of public roads including (i) Court Lane between the Kamilaroi Highway and The Dip Road, (ii) Rowarth Road, (iii) The Dip Road between Clift Road and Nea Siding Road, (iv) Whitby Road, (v) Colley Road, and (vi) a number of other unnamed roads bounded by the Kamilaroi Highway, Court Lane, Nea Siding Road, and The Dip Road. The proposed permanent road closures are shown in **Figure 4**. A map illustrating the conceptual road network following completion of the Project is shown in **Figure 5**.





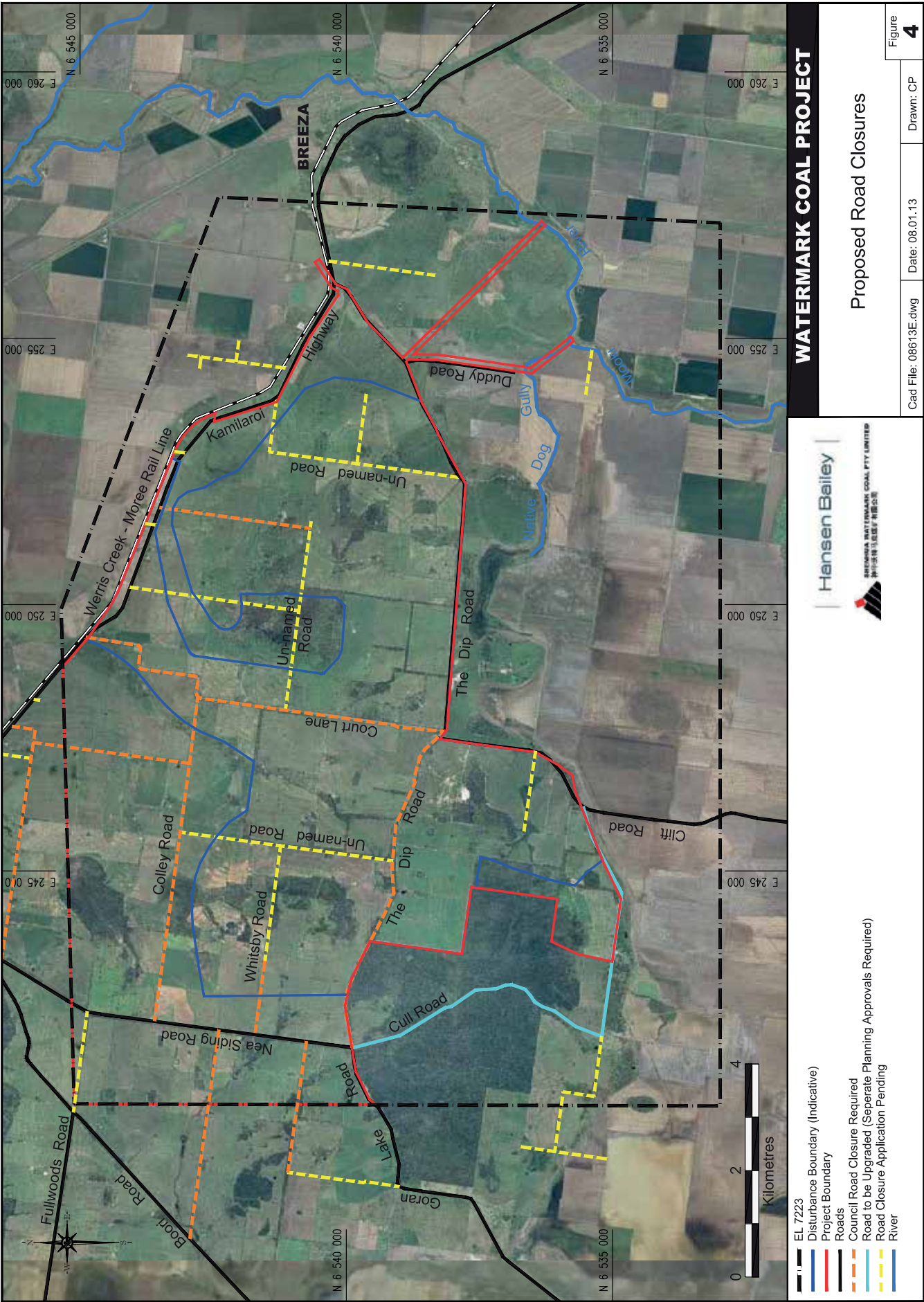




Figure 5

Shenhua Watermark Coal Pty Ltd  
Watermark Project  
SHENHUA WATERMARK COAL PTY LIMITED  
神华水煤有限公司  
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Legend  
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Metres  
Map Projection: Transverse Mercator  
Datum: GDA 1984  
GDA 1984 MGA Zone 56  
Job Number 22-15863  
Revision A  
Date 17 Dec 2012  
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Data source: Google Earth (Processed 2010), Navteq 2001, DE COW, GHD 2012. Created by: suppliers

## 1.2 ASSESSMENT SCOPE

This Traffic and Transport Impact Assessment was undertaken generally in accordance with the *Guide to Traffic Generating Developments* (RTA 2002).

The scope of the traffic and transport impact assessment is based on the Director General's Requirements (DGRs) for the Project. These are detailed in **Table 1** along with a reference to the relevant section of this report.

**Table 1** also provides details of the concerns noted by NSW Roads and Maritime Services (RMS), NSW Planning and Infrastructure, and Liverpool Plains Council in their submissions to the Department of Planning in November 2012. Similarly, the relevant section of the report has also been noted.

**Table 1 Director-General's Requirements and other stakeholder interests**

| Source | Description                                                                                                                                                                                                                                                  | Reference to report section |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| DGR    | (1a) A detailed assessment of the potential impacts of the development on the capacity, safety and efficiency of the local and regional rail network having regard to the strategic objectives and cumulative impacts for passenger and freight rail network | 10.0                        |
|        | (1b) A detailed assessment of the potential impacts of the development on:                                                                                                                                                                                   |                             |
|        | • The capacity and efficiency of the local and regional road network;                                                                                                                                                                                        | 3.0, 4.0                    |
|        | • The safety of the local and regional road network;                                                                                                                                                                                                         | 7.0                         |
|        | • Condition assessment of the existing network;                                                                                                                                                                                                              | 2.0                         |
|        | • Proposed new road infrastructure; and                                                                                                                                                                                                                      | 4.1, 5.0, 6.2.2             |
|        | • Impacts of coal trains on level crossing operations                                                                                                                                                                                                        | 2.3.4, 10.11                |
|        | (2) Details of mine to port or other domestic customer transport movements, train path availability and any required rail infrastructure works                                                                                                               | 10.0                        |
|        | (3) A detailed description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail networks in the surrounding area over the life of the project                                       | 7.2, 9.0, 10.10, 10.11      |
| RMS    | Assessment of the total impact of existing and proposed development on the state road network.                                                                                                                                                               | 3.0, 4.0, 5.0, 6.0          |
|        | Review of intersection sight distances                                                                                                                                                                                                                       | 2.0                         |
|        | Review of the existing and proposed access conditions                                                                                                                                                                                                        | 2.0, 4.0, 5.0               |

| Source                          | Description                                                                                                                                                                                                                                                                                | Reference to report section        |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|                                 | Recommendations for improvements of intersections                                                                                                                                                                                                                                          | 4.0, 9.0                           |
|                                 | Review of servicing and parking arrangements                                                                                                                                                                                                                                               | 8.0                                |
|                                 | Commentary on connectivity to existing developments                                                                                                                                                                                                                                        | 2.0                                |
|                                 | Impacts on transport such as public and school bus routes                                                                                                                                                                                                                                  | 6.0, 9.0                           |
|                                 | Provisions for pedestrians, alternative transport modes such as bicycles                                                                                                                                                                                                                   | 4.1, 6.0                           |
|                                 | Road traffic noise                                                                                                                                                                                                                                                                         | See EIS Acoustic Impact Assessment |
|                                 | Identify design options for grade separation of the proposed rail loop to the Kamilaroi Highway, including justification for the road-rail crossing options                                                                                                                                | 5.0                                |
|                                 | Cost benefit analysis of potential impacts upon the state road network to ensure minimal impact upon the traffic flows                                                                                                                                                                     | 5.0                                |
| Transport for NSW               | Proponent to provide indicative costs of all project-specific infrastructure development (rail, road, utilities along with any land acquisition costs)                                                                                                                                     | 5.0                                |
|                                 | Identification of how and when any required infrastructure and service improvements or management measures will be delivered, including parties responsible for the funding and implementation of the works                                                                                | 5.0                                |
| Liverpool Plains Council        | Assessment of Werris Creek Gap Road, Breeza-Currabubula Road, and Werris Creek-Tamworth Road                                                                                                                                                                                               | 2.1.6, 2.1.7, 2.1.8, 4.3, 7.2      |
|                                 | Assessment of impacts on existing rail level crossings                                                                                                                                                                                                                                     | 2.3.4, 10.11                       |
| NSW Planning and Infrastructure | Provide detailed level of service and safety assessment of the impacts of increased traffic as a result of the proposal on the local road network taking into consideration seasonal increases in traffic. This assessment must include Werris Creek-Gaps Road and Breeza-Curabubula Road. | 2.1.6, 2.1.7, 2.1.8, 4.3, 7.2      |
|                                 | Provide an assessment of the performance and safety of [railway] level crossings from the site to the Upper Hunter, including Scone.                                                                                                                                                       | 10.11                              |

### 1.3 REPORT STRUCTURE

The structure of this report is described as follows:

- **Section 2** provides an overview of the existing road network, and road and rail traffic conditions. The purpose of **Section 2** is to account for the existing issues and constraints and to establish the base case context for comparison with the post-development scenarios.
- **Section 3** describes the road traffic volumes that would be generated during the construction and operational phases of the Project. It also establishes the traffic scenarios that were assessed via traffic modeling which were used to assess the likely road traffic impacts associated with the Project.
- **Section 4** details the results of the traffic modeling undertaken to assess the traffic impacts due to the Project.
- **Section 5** describes the proposed road access routes for the Project.
- **Section 6** identifies permanent and temporary road closures that will occur as a result of the Project, associated time delays or improvements and alternative routes.
- **Section 7** examines the existing road safety issues on key roads surrounding the Project.
- **Section 8** assesses the adequacy of onsite parking for the workforce and heavy vehicles associated with supplies and operational activities.
- **Section 9** recommends mitigation and management measures to minimise road safety and closure impacts.
- **Section 10** provides an assessment of rail network impacts due to the Project as well as a number of other key rail traffic generators in the surrounding region. It also describes the wider rail network impact and the management measures being developed to resolve these impacts.
- **Section 11** summarises the conclusions of the traffic and transport impact assessment.

## 2 EXISTING CONDITIONS

### 2.1 EXISTING ROAD NETWORK

The roads described in this section are broadly categorised as:

- Roads within or immediately adjacent to the Project Boundary such as the Kamilaroi Highway, The Dip Road, Court Lane, Nea Siding Road, Rowarth Road, Colley Road and Whitby Road; or
- Other strategically important routes such as Werris Creek-Gap Road, Breeza-Currabubula Road, and Quirindi-West Tamworth Road.

The existing conditions of these roads are described in **Sections 2.1 to 2.1.9**.

This section refers to 2004 background data as issued by the Roads and Traffic Authority (RTA). It is noted that **Section 3** of this report explains how this data has been adjusted to provide a robust assessment of existing traffic conditions for the Project.

#### 2.1.1 Kamilaroi Highway

The Kamilaroi Highway (MR72) is an undivided rural main road to the east of the Project Boundary. It provides an important regional link from Quirindi and Willow Tree in the south, to Walgett in the north-west quadrant of NSW. This route is under the care and jurisdiction of the RMS.

The Kamilaroi Highway passes through the village of Breeza before continuing north-west towards Gunnedah and Narrabri. It intersects other main roads such as the New England Highway near Willow Tree, the Oxley Highway at Gunnedah, and the Newell Highway at Narrabri. In 2004, the section of the Kamilaroi Highway near the Project Boundary carried approximately 1,500 vehicles/day (RTA, 2004a). Heavy vehicles make up approximately 28% of traffic.<sup>1</sup>

The Kamilaroi Highway is mostly a two-lane, two-way (2L2W) sealed road. In the vicinity of the Project Boundary, minimal width sealed shoulders are provided although the clear zones are generally traversable and hazard-free (See **Plate 1**), and the posted speed limit is 110km/h, except for a short 80km/h zone through the village of Breeza.

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<sup>1</sup> The AADT of 1500 vehicles/day was indicated by RTA (2004a) and also verified by 24-hour, seven-day continuous tube counts carried out in July 2012. The heavy vehicle percentage of 28% was indicated by the July 2012 surveys.



**Plate 1      Looking south on the Kamilaroi Highway towards The Dip Road**

The surrounding land has generally been cleared and consists mainly of grassy plains, large agricultural properties and grain fields. Through the village of Breeza, there are a number of buildings and general amenities as well as grain storage silos. The Werris Creek – Moree Railway Line runs parallel to and on the eastern side of the Kamilaroi Highway. Its close proximity to the Highway has resulted in the construction of many side roads with short stacking issues. The railway line crosses the Kamilaroi Highway at Curlewis and runs along the western side of the highway towards Gunnedah.

### **2.1.2 The Dip Road**

The Dip Road is an unsealed local road that runs east-west along the southern portion of the Project Boundary. It extends from the Kamilaroi Highway (approximately 3km north of Breeza) to Nea Siding Road passing along the northern fringe of the Breeza State Forest.

The Dip Road terminates at the Kamilaroi Highway as a *give way* controlled T intersection. This is a basic right (BAR) turn configuration with no passing or storage facilities provided with regard to right-turning traffic into The Dip Road. One approach and one departure lane have been provided in each intersection leg (see **Plate 2**).

The Dip Road carries approximately 30 vehicles/day as indicated by 24-hour, seven-day tube surveys carried out in July 2012.



**Plate 2** Looking southbound on Kamilaroi Highway towards The Dip Road.

### 2.1.3 Court Lane

Court Lane is a 7.5km unsealed north-south local road that passes through the Project Boundary from the Kamilaroi Highway to The Dip Road. At present, it terminates at the Kamilaroi Highway as a *give way* controlled T intersection and has a BAR configuration (**Plate 3**). There is one approach and one departure lane in each intersection leg. A 1m wide shoulder has been provided on the eastern side of the Kamilaroi Highway but is generally unsuitable as a passing facility with regard to queued right turning vehicles.

Courts Lane carries approximately 35 vehicles/day as indicated by a 24-hour, seven-day continuous tube survey carried out in July 2012.



**Plate 3** Looking northbound on Kamilaroi Highway towards Court Lane.

#### 2.1.4 Nea Siding Road

Nea Siding Road is a local road providing access between the Kamilaroi Highway in the north and The Dip Road in the south. It meets the Kamilaroi Highway as a *give way* controlled cross intersection with one approach and one departure lane per leg. The northern approach is another local road which passes over the Werris Creek-Moree Railway Line. The northern-most section of this road is sealed (**Plate 4**).

The southern extension of Nea Siding Road, from its intersection with The Dip Road is Cull Road.

The section of Nea Siding Road between Kamilaroi Highway and Dip Road carries approximately 50 vehicles/day as indicated by a 24-hour, seven-day continuous tube survey carried out in July 2012.



**Plate 4** Looking south-west along Nea Siding Road from the Kamilaroi Highway.

#### 2.1.5 Whitby Road

Whitby Road is a 3.6km local *no through road* which extends eastward from Nea Siding Road.

#### 2.1.6 Werris Creek-Gap Road

Werris Creek-Gap Road is an east-west route that extends from the Kamilaroi Highway to Werris Creek. It is approximately 12km in length and is located to the south of Breeza. The road has a 2L2W configuration with an approximate sealed width of 6.0m (**Plate 5**). The road currently lacks sealed shoulders although the unsealed shoulders are traversable and the route generally has a reasonable clear zone. The route is signposted as a 100km/h zone.

This route contains a railway level crossing approximately 6km west of the Kamilaroi Highway (near Cana Road). As this is part of the Werris Creek-Moree Railway Line, any train movements generated by the Project would use this crossing.



**Plate 5 Werris Creek-Gap Road looking west towards the Kamilaroi Highway.**

Werris Creek-Gap Road is under the care and control of RMS and is classified as Main Road (MR) 579. Traffic counts collected in 2004 (RTA) indicate that the road carries approximately 500 vehicles/day.

This route connects Quirindi-Tamworth Road at Werris Creek. The combined route of Werris Creek-Gap Road and Quirindi-Tamworth Road provides the most direct road link between the Project and Tamworth. The alternative route via Quirindi would add 40km to the travel journey. Similarly, the alternative route via Gunnedah would add 153km to the travel journey.

This route meets the Kamilaroi Highway as the eastern and terminating leg of a T intersection. The Kamilaroi Highway/ Werris Creek-Gap Road intersection is a basic right turn (BAR) configuration with no formal provisions for right-turning or left-turning traffic. The Kamilaroi Highway has an approximate 1m sealed shoulder. However, this is generally not sufficient for traffic to use as a passing lane as they would have to straddle the unsealed portion of shoulder. As such, it would only be appropriate as a passing facility when used at a very low speed.

The Kamilaroi Highway/ Werris Creek-Gap Road intersection lacks any priority signage and would therefore default to a *give way* controlled intersection as determined by normal right-of-way priority requirements under the NSW Road Rules.

The land surrounding the Kamilaroi Highway/ Werris Creek-Gap Road intersection is generally flat and relatively void of sight obstructing features. As such, there are good sight triangles provided at this intersection to traffic approaching from each direction.

This intersection is one of a pair of staggered T intersections, with the other being the Kamilaroi Highway/ Werris Creek-Caroon Road intersection, further north. In between the pair of staggered T intersections, there is a railway level crossing. This is actively controlled with flashing lights (no boom gates). The railway line is identified as the Binnaway-Werris Creek Railway Line and branches off the Werris Creek-Moree Railway Line. As such, it would not carry rail movements generated by the Project.

### **2.1.7 Breeza- Currabubula Road**

Breeza-Currabubula Road is an east-west route that is parallel to Werris Creek-Gap Road. Similar to the Werris Creek-Gap Road, this road also provides an alternative route between the Project and Tamworth. The route extends from Breeza in the west to Currabubula in the east, covering a distance of 29km. The western portion (approximately 10km) is in Gunnedah Shire LGA, with the eastern portion in the Liverpool Plains LGA. These are also the respective road authorities for this road.

The route is primarily a rural road in low-lying, flat country. The road is susceptible to flooding, particularly from the Mooki River catchment and its tributaries.

Site observations confirm that this route carries a very low volume of traffic and would have spare capacity to absorb additional traffic.

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 significant short stacking risks at Hogarth Street (see **Section 2.3.4**). Furthermore, Hogarth Street approaches the Kamilaroi Highway on an uphill grade and may have restricted visibility to highway traffic.

### **2.1.8 Quirindi-West Tamworth Road**

Quirindi-West Tamworth Road is a 62km route extending from Quirindi to Tamworth via Werris Creek. From Quirindi in the south, the route extends northward passing through Quipolly and Werris Creek. From north of Werris Creek, it extends in a north-east direction, passing through the Melville Ranges and then continuing towards Tamworth.

Both Werris Creek-Gap Road and the Breeza-Currabubula Road meet this road. As such, the Quirindi-West Tamworth Road would also collect the Tamworth-bound traffic from these two routes.

Quirindi-West Tamworth Road comes under the care and jurisdiction of RMS and is classified as MR 130. A traffic counter indicated that this route carries approximately 2,600 vehicles/day (RTA, 2004).

The southern portion (38km) of the road is within the Liverpool Plains LGA whilst the northern portion (24km) of the road is within Tamworth LGA.

### 2.1.9 Other roads

There are a number of other existing local roads within the Project Boundary. These are mostly un-named roads and where relevant these have been discussed in **Section 6.1** with respects to proposed closures of these roads.

## 2.2 EXISTING TRAFFIC CONDITIONS

### 2.2.1 RMS traffic surveys

The closest RMS traffic counting stations to the Project are located at:

- Station 92.348: Kamilaroi Highway, at the railway crossing to the north of Werris Creek Road (Abouds Road), Turilawa. This is a permanent counting station; and
- Station 92.162: Kamilaroi Highway, at the railway crossing to the south of Curlewis.

These counting stations are shown on **Figure 1**.

**Figure 6** provides the year by year traffic data (where available) at each of the counting stations. The data is presented in Average Annual Daily Traffic (AADT) volumes. Each of the plotted points indicates the AADT as surveyed for that corresponding year. As noted, there are some gaps where traffic volume data was not collected and hence there is no AADT (plotted point) shown for those years.

**Figure 6** also shows a “line of best fit” for each of the counting stations. This was used to indicate the general trend in traffic growth over the years from 1980 to 2004 where traffic volumes were collected. It was also adopted as the trend line for traffic growth for the period after 2004 (the last year of published AADT data) and hence used to forecast traffic volumes along the Kamilaroi Highway up to the base year of 2012.

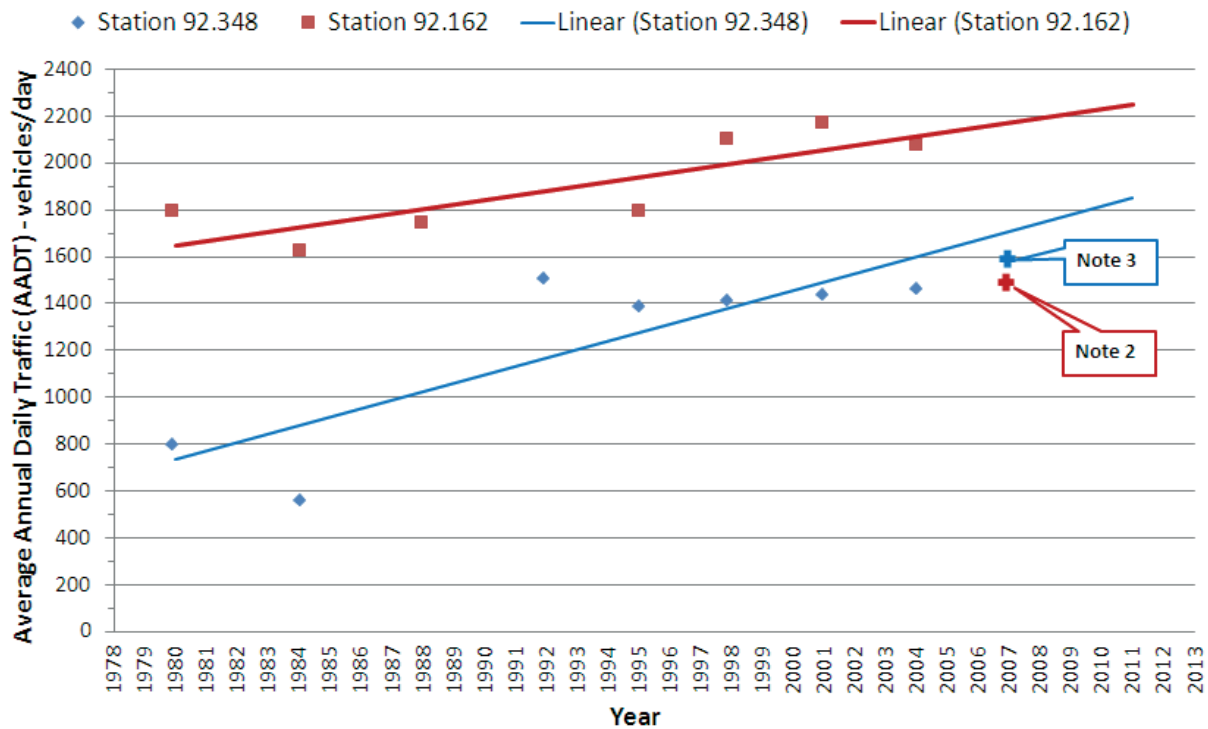


**Figure 6** Traffic volumes (AADT – vehicles/day) surveyed along the Kamilaroi Highway, and projected for future years.

Source: RTA, 2004a

**Figure 6** indicates that traffic has grown at approximately 1.9% p.a. at the Turilawa site (station 92.348) and 0.85% p.a. at the Curlewis site (station 92.162). This study has conservatively assumed an annual traffic growth of 1.9% p.a. to account for growth in background traffic for forecasting future year traffic volumes.

Station 92.348 is a permanent counting station which collects traffic volume information for every day of the year. As such, the average hourly distribution of traffic volume for weekdays and weekend days is available from this station. **Table 2** shows the distribution of traffic volumes for each hour of the average weekday for 2004, the latest year for which there is published traffic volume data.

<sup>2</sup> RMS has provided additional unpublished traffic data for Station 92.162. In 2007, an AADT of 1,495 vehicles/day was recorded at this site as shown. This is substantially less than the projection from the trend line. As such, to ensure a conservative analysis, the traffic volumes for future years was based on the trend line shown.

<sup>3</sup> RMS has provided additional, unpublished traffic data for Station 92.348. In 2007, an AADT of 1,592 vehicles/day was recorded. This is substantially less than the projection from the trend line. As such, to ensure a conservative analysis, the traffic volumes for future years was based on the trend line shown.

**Table 2** also shows the derived 2012 base case volumes as well as the base case volumes for year 15 the Project (assumed to be peak production year and in 2028 based on an assumed commencement year of 2013). The 2012 and 2028 base case volumes were forecasted using the 1.9% p.a. growth rate discussed above.

The volumes shown in **Table 2** for the “*2004 surveyed volumes*”, “*2012 base case volumes*”, and “*2028 base case volumes*” are both directions of traffic combined. In order to forecast the direction-specific volumes, it has been conservatively assumed that in each hour of the day, each direction of travel along the Kamilaroi Highway would carry up to 60% of the total bi-directional traffic volume. That is, rather than adopt a typical 50% split per direction, this assessment has assumed that each direction would carry 60% of the total bi-directional volumes.

**Table 2      2012 and 2028 (Year 15) hourly distribution of traffic volume and assumed directional split – Kamilaroi Highway.**

| Hour commencing | 2004 RTA surveyed volumes (weekdays)                    | 2012 base case volumes                              | 2012 base case volumes (60% directional split) | 2028 base case volumes                              | 2028 base case volumes (60% directional split) |
|-----------------|---------------------------------------------------------|-----------------------------------------------------|------------------------------------------------|-----------------------------------------------------|------------------------------------------------|
| <i>Source</i>   | <i>RTA data (including hourly distribution of data)</i> | <i>Derived volumes using 1.9% p.a. growth rate.</i> | <i>60% of previous column.</i>                 | <i>Derived volumes using 1.9% p.a. growth rate.</i> | <i>60% of previous column.</i>                 |
| <b>0000</b>     | 32                                                      | 73                                                  | 22                                             | 50                                                  | 30                                             |
| <b>0100</b>     | 27                                                      | 31                                                  | 19                                             | 42                                                  | 25                                             |
| <b>0200</b>     | 19                                                      | 22                                                  | 13                                             | 30                                                  | 18                                             |
| <b>0300</b>     | 23                                                      | 27                                                  | 16                                             | 36                                                  | 22                                             |
| <b>0400</b>     | 21                                                      | 24                                                  | 15                                             | 33                                                  | 20                                             |
| <b>0500</b>     | 31                                                      | 36                                                  | 22                                             | 49                                                  | 29                                             |
| <b>0600</b>     | 50                                                      | 58                                                  | 35                                             | 79                                                  | 47                                             |
| <b>0700</b>     | 169                                                     | 196                                                 | 118                                            | 266                                                 | 159                                            |
| <b>0800</b>     | 270                                                     | 314                                                 | 188                                            | 424                                                 | 255                                            |
| <b>0900</b>     | 209                                                     | 243                                                 | 146                                            | 328                                                 | 197                                            |
| <b>1000</b>     | 167                                                     | 194                                                 | 116                                            | 262                                                 | 157                                            |
| <b>1100</b>     | 160                                                     | 186                                                 | 112                                            | 251                                                 | 151                                            |
| <b>1200</b>     | 146                                                     | 170                                                 | 102                                            | 229                                                 | 138                                            |
| <b>1300</b>     | 144                                                     | 167                                                 | 100                                            | 226                                                 | 136                                            |
| <b>1400</b>     | 166                                                     | 193                                                 | 116                                            | 261                                                 | 156                                            |
| <b>1500</b>     | 208                                                     | 242                                                 | 145                                            | 327                                                 | 196                                            |
| <b>1600</b>     | 223                                                     | 259                                                 | 156                                            | 350                                                 | 210                                            |
| <b>1700</b>     | 211                                                     | 245                                                 | 147                                            | 331                                                 | 199                                            |
| <b>1800</b>     | 163                                                     | 189                                                 | 114                                            | 256                                                 | 154                                            |
| <b>1900</b>     | 89                                                      | 103                                                 | 62                                             | 140                                                 | 84                                             |
| <b>2000</b>     | 56                                                      | 65                                                  | 39                                             | 88                                                  | 53                                             |
| <b>2100</b>     | 59                                                      | 69                                                  | 41                                             | 93                                                  | 56                                             |
| <b>2200</b>     | 47                                                      | 55                                                  | 33                                             | 74                                                  | 44                                             |
| <b>2300</b>     | 42                                                      | 49                                                  | 29                                             | 66                                                  | 40                                             |
| <b>Totals</b>   | <b>2732</b>                                             | <b>3176</b>                                         | <b>1906</b>                                    | <b>4292</b>                                         | <b>2575</b>                                    |

The hourly distribution of traffic as shown in **Table 2** indicates that the AM and PM peak hours are 0800-0900h and 1600-1700h respectively.

### 2.2.2 GHD traffic surveys

Between 13 and 20 November 2009, an automated traffic survey was carried out on the Kamilaroi Highway at Breeza. This survey was carried out by GHD as part of the feasibility study prepared for the Project (GHD, 2011a).

The traffic survey revealed an ADT volume of 1,108 vehicles/day for the survey period. Furthermore, the peak hour traffic volume was recorded as 89 vehicles/hour, and the overall heavy vehicle composition was 27% (GHD, 2011a).

The recorded ADT of 1,108 vehicles/day is substantially less than the volumes measured at counting station 92.348. As such, the RMS data was used to conservatively forecast the 2012 and 2028 base case traffic volumes.

GHD (2011a) also stated that a measured directional split of 50% per direction was observed in the survey. As shown in **Table 2**, this current assessment has applied a directional split of 60% to *both* directions of travel (i.e. collectively both directions would carry 120% of the projected traffic volumes) to conservatively forecast the 2012 and 2028 base case volumes per direction.

### 2.2.3 Other traffic surveys

In July 2012, a number of tube surveys were carried out for this assessment in order to validate the traffic volumes as determined in **Section 2.2.1**. The following midblock locations were surveyed:

- The Kamilaroi Highway to the east of Dip Road;
- The Kamilaroi Highway to the east of Rowarth Lane; and
- The Kamilaroi Highway to the west of Court Lane.

The average daily traffic volumes (ADTs) recorded at each of these points were 1434 vehicles/day, 1313 vehicles/day, and 1416 vehicles/day, respectively. As such, an approximate AADT of 1500 vehicles/day was adopted. This is substantially less than the average weekday volumes previously recorded (RTA, 2004). To be conservative, the volumes in **Table 2** have been adopted for this study. Furthermore, the volumes from **Table 2** were determined from a continuous 365-day sample period (i.e. permanent traffic counting station) which accounts for seasonal fluctuation. By contrast, the 2012 surveys were representative of traffic conditions in one-week in July. This is further justification for using the volumes in **Table 2**.

## 2.3 EXISTING RAIL NETWORK CONDITIONS

Product coal from the Project will be transported to the Port of Newcastle by rail via the Werris Creek-Moree Railway Line. This railway line extends to the south-east and connects with the Main Northern Railway Line at Werris Creek, where it continues to the Port of Newcastle. This line is part of the Hunter Valley Rail Corridor and extends in a south-easterly direction meeting the Muswellbrook-Ulan Railway Line at Muswellbrook.

South of this junction, the rail corridor continues in a south-easterly direction to the Port of Newcastle via Singleton, Branxton and Maitland. The rail network is shown in **Figure 7** and **Figure 8**.

The Australian Rail Track Corporation (ARTC, 2012) provides a broad snapshot of the existing conditions on the Hunter Valley Rail Corridor. Key points have been summarised in **Sections 2.3.1** and **2.3.2**.

### **2.3.1 Rail network and fleet conditions and constraints**

Key rail network and fleet limitations (ARTC, 2011 and 2012) include the following:

- The Hunter Valley Rail Network consists of a dedicated double track line between the Port of Newcastle and Maitland; a shared double track line from Maitland to Muswellbrook; and a shared single track with passing loops from that point north and west;
- Bi-directional train conflicts on the single track sections are managed by use of the limited number of passing loops;
- Many of the passing loops on the single track section to the north of Muswellbrook have insufficient lengths (see **Figure 7**);
- The section of the network immediately surrounding the Project (i.e. from the Dartbrook Junction to the Gunnedah basin) is currently limited to a maximum axle load of 25 tonnes (100 tonne wagons). By contrast, the network south of Dartbrook has a maximum axle load limit of 30 tonnes (120 tonne wagons); and
- The fleet which currently services the coal carrying demands of this network consists of:
  - 22 trains of 91 x 120 tonne wagons (8500 tonnes payload per train).
  - Eight trains of 74 x 120 tonne wagons (7200 tonnes payload per train).
  - Four trains of 72 x 100 tonne wagons (5400 tonnes payload per train).
  - Three trains of 60 x 120 tonne wagons (5500 tonnes payload per train).
  - Four trains of 42 x 100 tonne wagons (3000 tonnes payload per train).
  - Two trains of 2,000 nominal net tonnes composed of non-standard wagons.

### **2.3.2 Operational conditions and constraints**

Key rail network operational limitations (ARTC, 2011 and 2012) include the following:

- Trains with 120 tonne wagons are restricted to 60km/h when loaded and 80km/h when empty. Trains with 100 tonne wagons are restricted to 80km/h when loaded or empty;

- By the end of 2012, the Port of Newcastle is expected to have a total coal capacity of 196 Mtpa following a number of upgrades to the coal loading terminals. At present the theoretical export coal capacity of the Hunter Valley rail network is approximately 189 Mtpa of product coal. However, the practical delivery capacity is approximately 95Mtpa as this accounts for maintenance downtime, surge volume and system reliability;
- ARTC (2009) modelling/ simulation work on existing network performance indicates that trains from the Gunnedah Basin experience approximately 34 minutes delay per every 100km travelled. By comparison, the modelling indicates that trains on the Muswellbrook to Ulan Railway line experience approximately nine minutes delay per every 100km;
- Currently, there are seven trains per direction per day between Narrabri and Gunnedah. This includes coal, other freight and passenger trains. This changes to seven between Gunnedah and Werris Creek, nine between Werris Creek and Scone, and 12 between Scone and Newcastle;
- The Liverpool Ranges at Ardglen present a significant constraint to coal train operations. The steep grades require loaded trains to be “banked” when ascending the grade. This involves the use of additional locomotives. The coupling and re-coupling of wagons, and the return paths of the banker locomotive are all factors affecting travel time and hence capacity of this section. At the time of writing, the NSW Department of Planning and Infrastructure had released the DGRs for the Liverpool Ranges Duplication Project. This Project will broadly involve the duplication of 13km of rail track across the Liverpool Ranges including new loops and turnouts, as well as signalling upgrades. (Department of Planning and Infrastructure, 2012);
- Other steep grades exist on the southern portion of the network and include the Allandale Bank (near Greta), the Minimbah Bank (recently upgraded with a third track) and the Numbah Bank (north of Singleton); and
- Key junctions in the network include the Dartbrook Junction (junction of the Muswellbrook to Ulan and Gunnedah Basin line) and the Maitland Junction (junction of the Main North Line with the passenger line to Brisbane). Key junctions with coal loading loops include those at Whittingham (Mt. Thorley and Bulga), Newdell (Ravensworth, Newdell and Liddell) and Antiene Rail Spur (Drayton and Mt. Arthur). These junctions generate train conflicts which then have an impact on the capacity and operational performance of the network (ARTC, 2011).

### 2.3.3 Known rail network improvement initiatives

ARTC (2011) have completed a comprehensive assessment of upgrade requirements along the Hunter Valley Rail Corridor. These requirements are further discussed in **Section 10**.

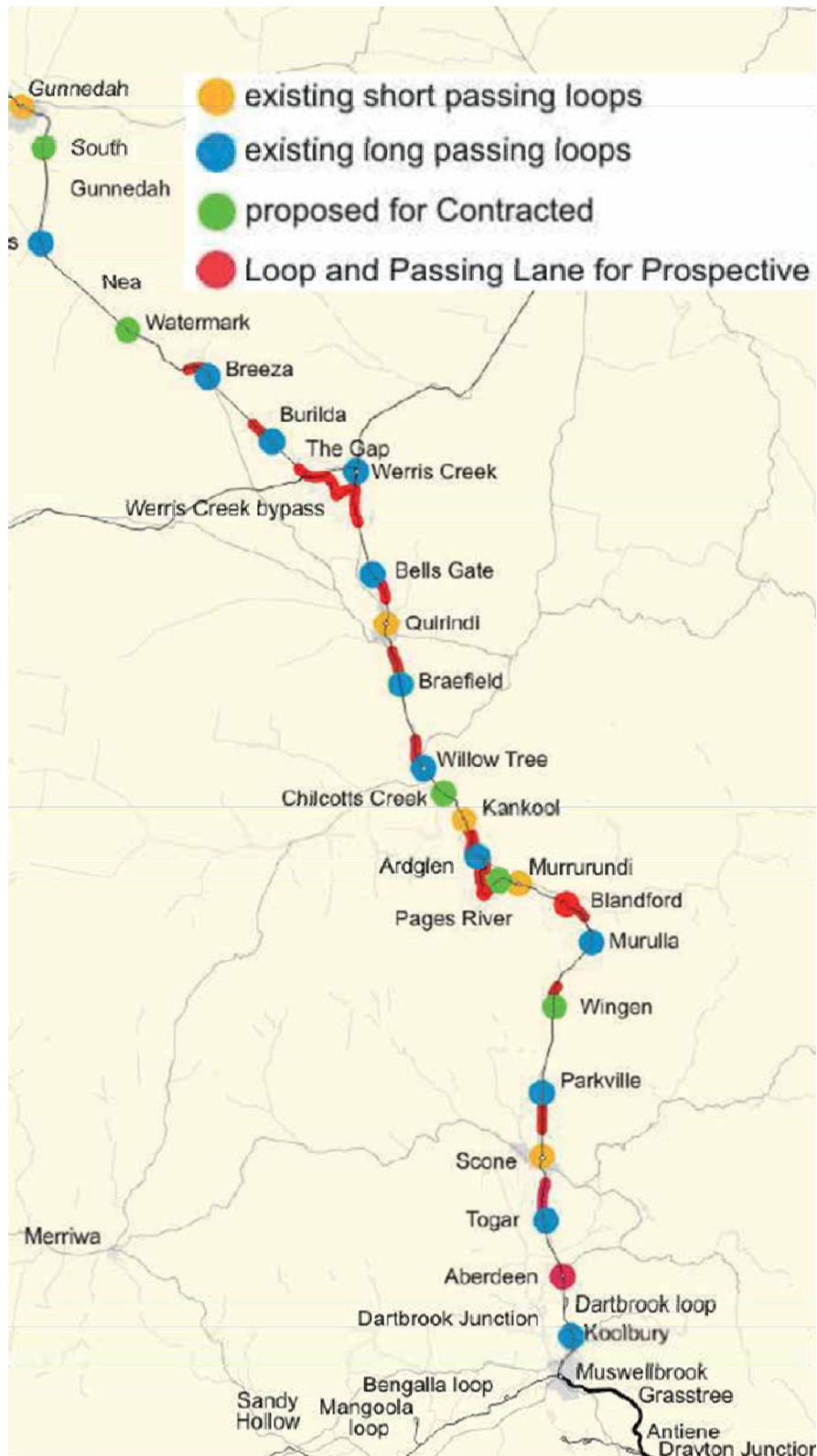


**Figure 7 Hunter Valley coal rail network – northern portion from Narrabri to Muswellbrook (Dartbrook).**Source: ARTC, 2012

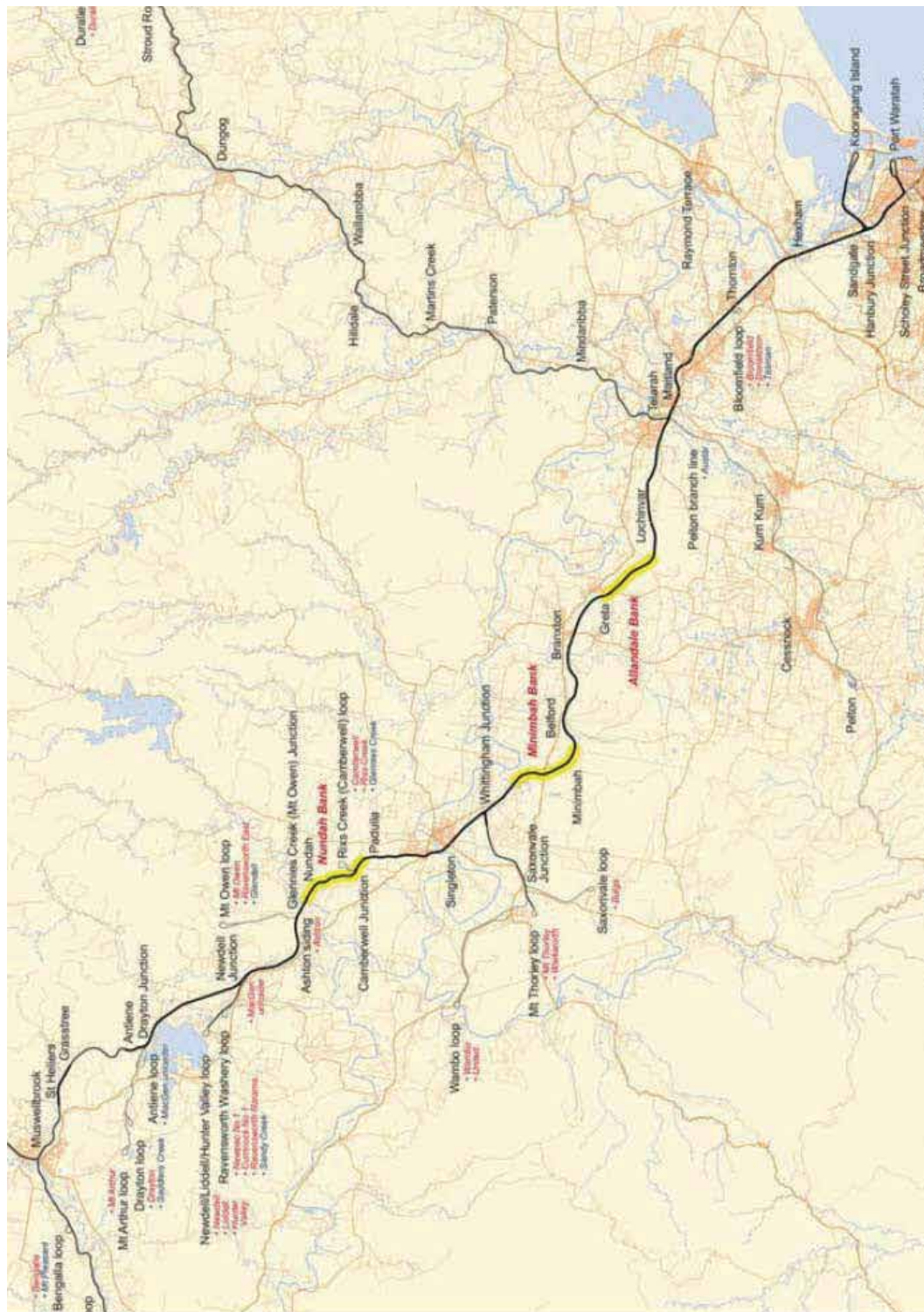


**Figure 8** Hunter Valley coal rail network – southern portion from Muswellbrook (Dartbrook) to Newcastle. Source: ARTC, 2012

#### 2.3.4 Railway level crossings

Section 10.11 provides details of the existing conditions of 28 railway level crossings between the Project and the Muswellbrook Junction (the latter being adopted as the southern boundary of the *area of influence* of the Project).

### 3 ROAD TRAFFIC GENERATION

#### 3.1 CONSTRUCTION TRAFFIC VOLUME BUILD UP

The majority of construction activities are proposed to be undertaken over an approximate 18 month period. Construction activities are proposed to occur 24 hours a day, seven days a week consistent with operational rosters. Construction activities will aim to minimise impacts on the Kamilaroi Highway during the construction of the rail overpass, as far as practicable.

Construction activities are proposed to be established at the mine infrastructure area, while temporary satellite facilities are proposed to be positioned adjacent to the work fronts at the Kamilaroi Highway rail overpass and intersection upgrade.

For the purpose of forecasting traffic movements, it was assumed that a substantial number of construction workers, particularly those that come from other regions, would mostly seek accommodation in local Accommodation Villages (such as Werris Creek).

During the early stages of the construction program, access to the site would be via Court Lane. This would continue until the new Mine Access Road has been completed and opened for Project-related traffic.

##### 3.1.1 Traffic generated by construction personnel

A workforce of up to approximately 600 full-time equivalent employees is proposed during the construction phase of the Project.

The following assumptions have been made with respects to the construction program:

- Construction activities will be carried out 24 hours a day. This study has assumed that the AM peak hour will contain a high proportion of journey to work trips and the peak PM peak hour will contain a high proportion of journey from work trips.
- The peak construction period is likely to be six months after the start of construction. This study has assumed one additional year of traffic growth at the 1.9% p.a. rate discussed in **Section 2.2.1**. This additional growth was then applied to the 2012 base case traffic volumes.
- 40% of the total construction workforce would be required to attend the site in any one shift (240 persons).
- This study has conservatively assumed that 30% of workers would be transported by bus. These workers would be collected from a central pick up point to the south of the Project (i.e. Werris Creek). The shuttle bus was assumed to have an occupancy of 20 persons/bus. This equated to four inbound bus movements and four outbound (empty)

bus movements per hour. The remaining 70% of workers would travel to work by private transport.

- Of the workers that would travel to work by private transport, 60% (100 workers) would travel from the north (Gunnedah, Curlewis, and Tamworth via Gunnedah) and 40% (68 workers) would travel from the south (Quirindi, Werris Creek, and Tamworth via Currabulbula and Breeza).
- As a conservative measure, it was assumed that the peak traffic volumes from the background traffic and predicted traffic volumes associated with the start of construction shift would coincide.
- Workers travelling by private transport were conservatively assumed to have an average vehicle occupancy rate of one person per vehicle (i.e. no car pooling).

### 3.1.2 Heavy vehicle construction traffic

The following assumptions have been made:

- There would be up to 35 one-way truck trips generated per day during the peak construction period.
- These would not be evenly distributed throughout the day. It was assumed that a maximum of 10 one-way trips could be generated per hour (i.e. one truck dispatched every three minutes).
- The trucks would be evenly distributed with regard to travel direction. 50% would arrive from the north, and 50% would arrive from the south. As such, the traffic model has accounted for five laden inbound trucks per hour for each direction, as well as the empty return trips.

### 3.1.3 Summary of traffic generation during construction

Using the above information, the turning movement volumes forecast for the future Mine Access Road during the peak construction phase would be as shown in **Figure 9** and **Figure 10**. **Table 3** and **Table 4** show the corresponding traffic volume build ups for each scenario.

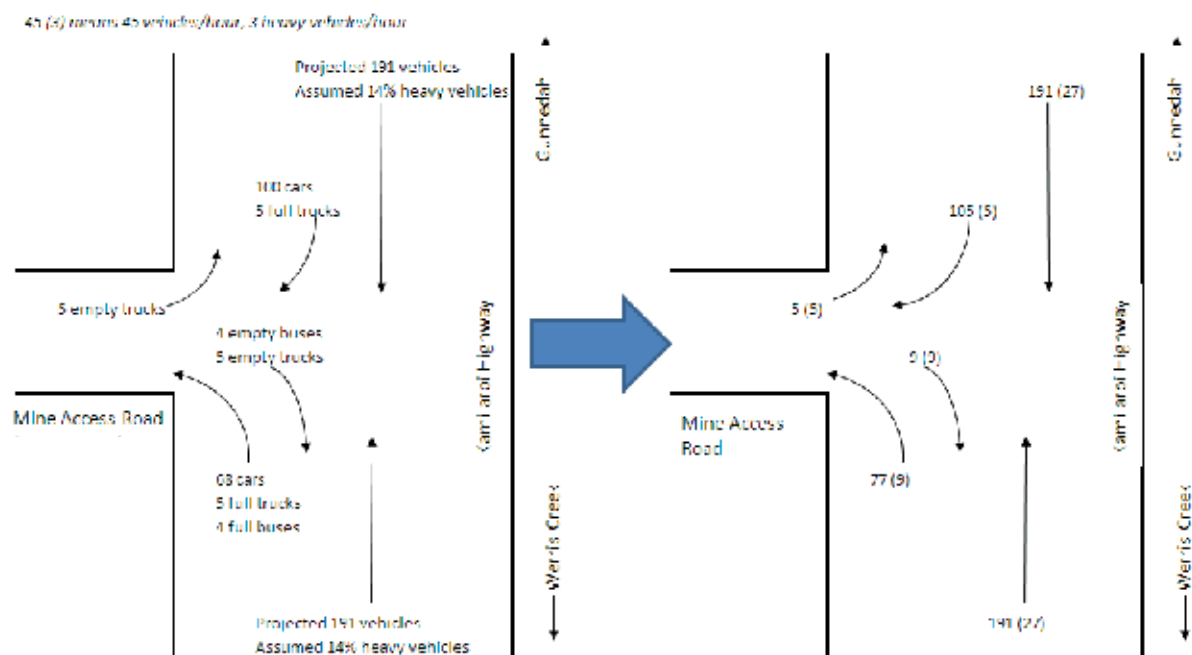


**Figure 9** Forecast turning movements (vehicles/hour) during the AM peak of the peak construction period.

**Table 3** Kamilaroi Highway/ Mine Access Road (or Court Lane) – Traffic volume build up for peak construction period – AM peak.

| Turning movement code | 2012 AM peak volume | Plus growth in background traffic (note ii) | Plus construction traffic (note iii) | Total       |  |
|-----------------------|---------------------|---------------------------------------------|--------------------------------------|-------------|--|
| A                     | 188<br>(26)         | 3<br>(1)                                    | 0<br>(0)                             | 191<br>(27) |  |
| B                     | 0<br>(0)            | 0<br>(0)                                    | 105<br>(5)                           | 105<br>(5)  |  |
| C                     | 188<br>(26)         | 3<br>(1)                                    | 0<br>(0)                             | 191<br>(27) |  |
| D                     | 0<br>(0)            | 0<br>(0)                                    | 77<br>(9)                            | 77<br>(9)   |  |
| E                     | 0<br>(0)            | 0<br>(0)                                    | 5<br>(5)                             | 5<br>(5)    |  |
| F                     | 0<br>(0)            | 0<br>(0)                                    | 9<br>(9)                             | 9<br>(9)    |  |

(i) Top number is total number of vehicles/hour. Number in brackets is total number of heavy vehicles/hour (assumed 14% for the Kamilaroi Highway<sup>4</sup>).

(ii) Assumed one year of growth at 1.9% p.a.

(iii) See Section 3.1.1 and 3.1.2.

<sup>4</sup> Although the GHD survey indicated a heavy vehicle percentage of 27%, this was regarded as being too high for the peak period. The peak periods would tend to be dominated by journey to/from work which would be heavily dominated by light vehicles.

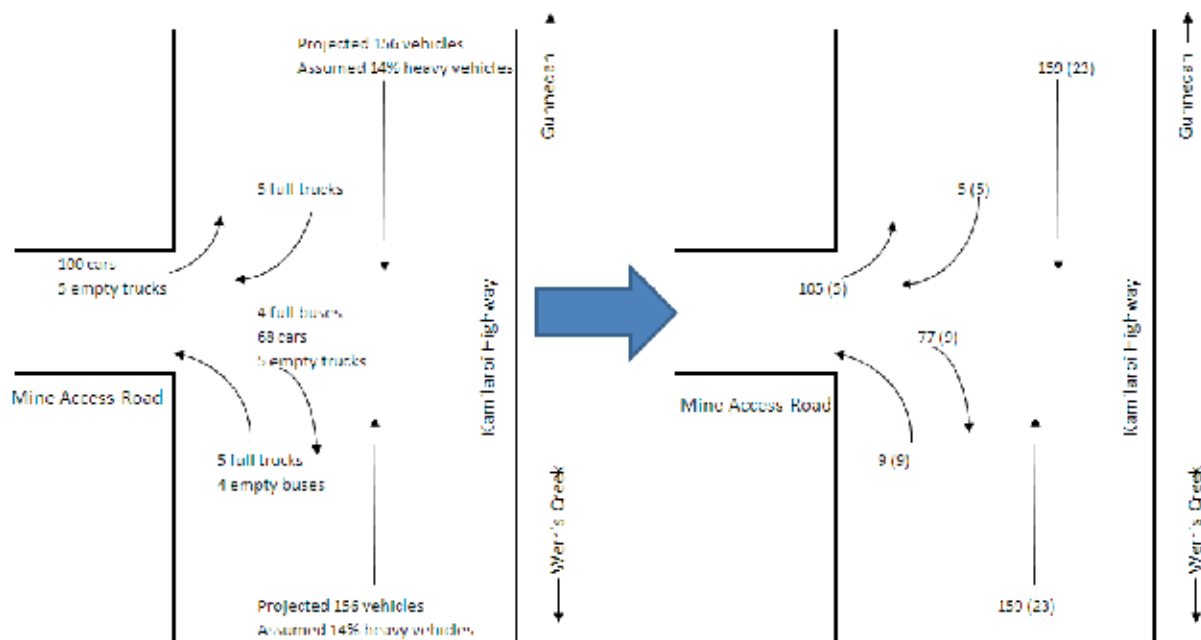


**Figure 10 Forecast turning movements (vehicles/hour) during the PM peak of the peak construction period.**

**Table 4 Kamilaroi Highway/ Mine Access Road (or Court Lane) – Traffic volume build up for peak construction period – PM peak.**

| Turning movement code | 2012 PM peak volume | Plus growth in background traffic (note ii) | Plus construction traffic (note iii) | Total       |
|-----------------------|---------------------|---------------------------------------------|--------------------------------------|-------------|
| A                     | 156<br>(22)         | 3<br>(1)                                    | 0<br>(0)                             | 159<br>(23) |
| B                     | 0<br>(0)            | 0<br>(0)                                    | 5<br>(5)                             | 5<br>(5)    |
| C                     | 156<br>(22)         | 3<br>(1)                                    | 0<br>(0)                             | 159<br>(23) |
| D                     | 0<br>(0)            | 0<br>(0)                                    | 9<br>(9)                             | 9<br>(9)    |
| E                     | 0<br>(0)            | 0<br>(0)                                    | 105<br>(5)                           | 105<br>(5)  |
| F                     | 0<br>(0)            | 0<br>(0)                                    | 77<br>(9)                            | 77<br>(9)   |

(i) Top number is total number of vehicles/hour. Number in brackets is total number of heavy vehicles/hour (assumed 14% for the Kamilaroi Highway<sup>5</sup>).

(ii) Assumed one year of growth at 1.9% p.a.

(iii) See Section 3.1.1 and 3.1.2.

<sup>5</sup> Although the GHD survey indicated a heavy vehicle percentage of 27%, this was regarded as being too high for the peak period. The peak periods would tend to be dominated by journey to/from work which would be heavily dominated by light vehicles.

### 3.2 TRAFFIC GENERATION DURING THE OPERATIONAL PHASE

All product coal from the Project will be transported by rail. Therefore the road traffic volumes generated by the Project during the operational period are likely to be due to (i) workers arriving/ departing from work at the start/ end of the work shift, (ii) service vehicles (iii) deliveries including machinery parts, fuel, explosives, and (iv) visitors. The arrival and departure of workers from site is expected to be the dominant source of traffic.

A workforce of up to approximately 600 full-time equivalent employees is anticipated during the peak operational phase of the Project. Maintenance activities, deliveries, coal processing, coal transport and mining operations are proposed to be undertaken 24 hours a day, seven days a week. GHD (2010) assumed that 25% of the total workforce would work in each shift, i.e. workers would generally work four days on, and have four days off.

As such, for the purposes of traffic modelling, the peak periods and traffic volume build ups were determined as described in **Sections 3.2.1** and **3.2.2**.

#### 3.2.1 AM peak

The following assumptions were made to assess the traffic volume build up for the AM peak period:

- The day shift would commence at 0700h and day shift workers would arrive between 0630-0700h;
- The night shift workers would finish their shift at 0700h and all leave the site between 0700-0730h;
- The AM peak was nominated as the one-hour period from 0630-0730h;
- The inbound and outbound traffic would coincide;
- The arrivals and departures would be evenly distributed throughout the hour (i.e. some day workers would arrive late, and some night workers would leave early); and
- The traffic volumes for the Kamlaroi Highway through movements were based on the highest AM hour of 0700-0800h since these are higher than those of the 0600-0700h period, this provides a more conservative assessment (see **Table 2**).

### 3.2.2 PM peak

The following assumptions were made to assess the traffic volume build up for the PM peak period:

- Day shift workers would finish at 1900h and leave the site between 1900-1930h;
- All night shift workers would commence at 1900h and would arrive at site between 1830-1900h;
- The PM peak was nominated as the one-hour period from 1830-1930h; and
- The traffic volumes from the 1800-1900h period were adopted as the PM peak volumes since these are higher than those of the 1900-2000h and hence provide a more conservative assessment (see **Table 2**).

### 3.2.3 Other assumptions

Other relevant assumptions are as follows:

- 14 heavy vehicles would visit the Project Boundary each day during the operational phase. It was assumed that there would be two heavy vehicle visits per peak hour. Each visit would result in one inbound laden movement followed by one non-laden outbound movement (GHD, 2010);
- It was assumed that the employee traffic distribution during the operational phase would be 60% to the north and 40% to the south (GHD, 2010); and
- A conservative vehicle occupancy rate of one person per vehicle was assumed.

Using the above information as well as the base case traffic volumes for the Kamilaroi Highway from **Table 2**, the turning movement volumes forecast for the future Mine Access Road would be as shown in **Figure 11** and **Figure 12** and **Table 5** and **Table 6**.

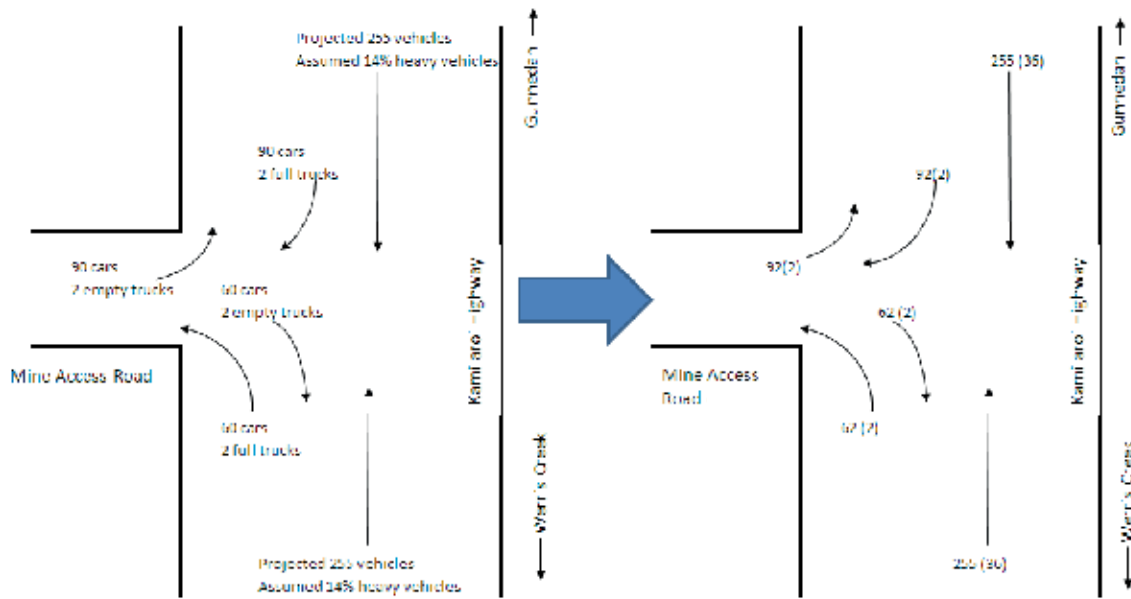


**Figure 11** Forecast turning movements (vehicles/hour) during year 15 of the mine plan (2028) – AM peak.

**Table 5** Kamilaroi Highway/ Mine Access Road – Traffic volume build up for peak operational period – AM peak.

| Turning movement code | 2028 AM peak volume      | Plus operational traffic (note iv) | Total       |  |
|-----------------------|--------------------------|------------------------------------|-------------|--|
| A<br>↓                | 255<br>(36)<br>Note (ii) | 0<br>(0)                           | 255<br>(36) |  |
| B<br>↘                | N/A<br>Note (iii)        | 92<br>(2)                          | 92<br>(2)   |  |
| C<br>↑                | 255<br>(36)<br>Note (ii) | 0<br>(0)                           | 255<br>(36) |  |
| D<br>↖                | N/A<br>Note (iii)        | 62<br>(2)                          | 62<br>(2)   |  |
| E<br>↗                | N/A<br>Note (iii)        | 92<br>(2)                          | 92<br>(2)   |  |
| F<br>↘                | N/A<br>Note (iii)        | 62<br>(2)                          | 62<br>(2)   |  |

(i) Top number is total number of vehicles/hour. Number in brackets is total number of heavy vehicles/hour.

(ii) Extracted from **Table 2**.

(iii) The 2028 volumes for these turning movements are in fact due to the “operational traffic” in the next column. All existing land uses within the Project Boundary will cease to generate traffic, so it is only the Project that will generate these turning movements.

(iv) Details in **Section 3.2.1, 3.2.2 and 3.2.3**.

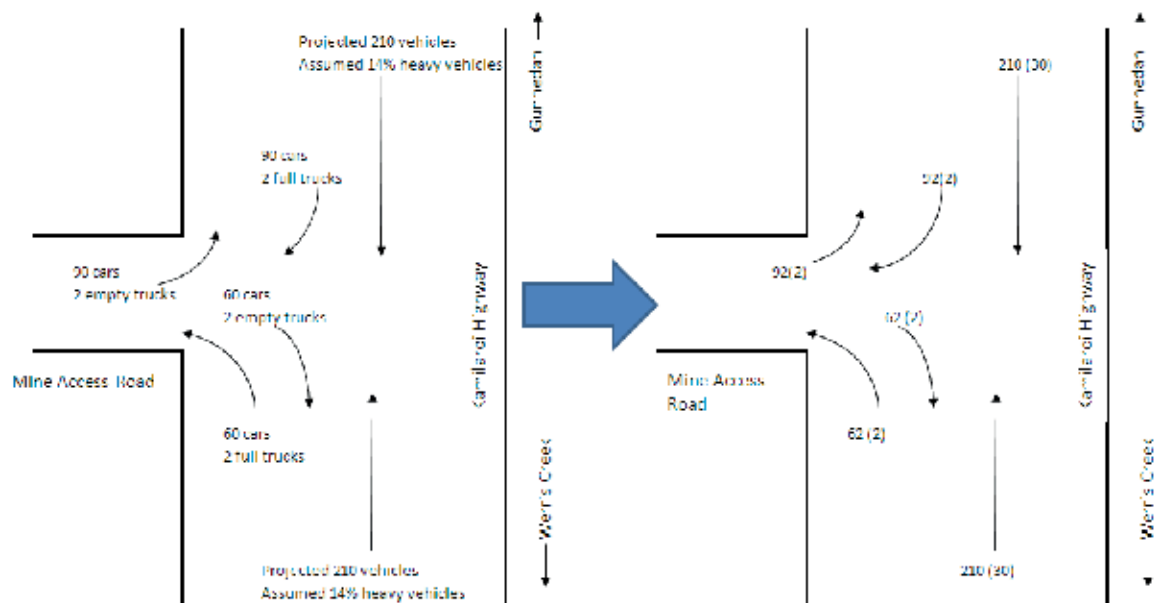


**Figure 12** Forecast turning movements (vehicles/hour) during year 15 of the mine plan (2028) – PM peak.

**Table 6** Kamilaroi Highway/ Mine Access Road – Traffic volume build up for peak operational period – PM peak.

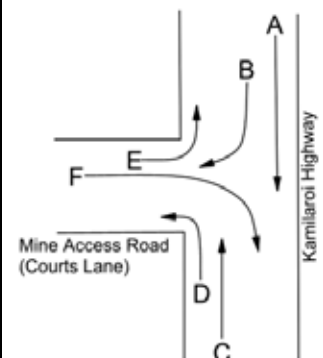
| Turning movement code | 2028 PM peak volume      | Plus operational traffic (note iv) | Total       |
|-----------------------|--------------------------|------------------------------------|-------------|
| A<br>↓                | 210<br>(30)<br>Note (ii) | 0<br>(0)                           | 210<br>(30) |
| B<br>↘                | N/A<br>Note (iii)        | 92<br>(2)                          | 92<br>(2)   |
| C<br>↑                | 210<br>(30)<br>Note (ii) | 0<br>(0)                           | 210<br>(30) |
| D<br>↙                | N/A<br>Note (iii)        | 62<br>(2)                          | 62<br>(2)   |
| E<br>↗                | N/A<br>Note (iii)        | 92<br>(2)                          | 92<br>(2)   |
| F<br>↖                | N/A<br>Note (iii)        | 62<br>(2)                          | 62<br>(2)   |

(i) Top number is total number of vehicles/hour. Number in brackets is total number of heavy vehicles/hour.

(ii) Extracted from **Table 2**.

(iii) The 2028 volumes for these turning movements are in fact due to the “operational traffic” in the next column. All existing land uses within the Project Boundary will cease to generate traffic, so it is only the Project that will generate these turning movements.

(iv) Details in **Section 3.2.1, 3.2.2 and 3.2.3**.



### 3.3 AGRICULTURAL PRODUCT TRANSPORTATION

The Liverpool Plains region has a substantial yield in grain products (including wheat, barley, sorghum, canola and sunflowers), cotton, cattle and sheep. **Table 7** provides detail on the peak harvest/ production months, and where the products are delivered to. It should be noted that these locations are most often only intermediate delivery locations with the products being consigned for further destinations.

**Table 7 Agricultural products in the Liverpool Plains Region**

| Crop          | Peak transport period             | Delivery location*                                                                                                                                                                                                                                                                  | Vehicle configuration        |
|---------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Wheat, barley | November to December              | <ul style="list-style-type: none"> <li>• Caroona Silo</li> <li>• Spring Ridge Silo</li> <li>• Quirindi (private traders)</li> <li>• Nea silo</li> <li>• Killara Feedlot</li> <li>• Warral silo</li> <li>• Werris Creek Silo</li> <li>• Curlewis Silo</li> <li>• Gunnedah</li> </ul> | Semi trailer                 |
| Sorghum       | March to April                    | <ul style="list-style-type: none"> <li>• Caroona Silo</li> <li>• Spring Ridge Silo</li> <li>• Quirindi (private traders)</li> <li>• Nea Silo</li> <li>• Killara Feedlot</li> <li>• Werris Creek Silo</li> <li>• Curlewis Silo</li> <li>• Gunnedah</li> </ul>                        | Semi-trailer                 |
| Canola        | November                          | <ul style="list-style-type: none"> <li>• Willow Tree</li> </ul>                                                                                                                                                                                                                     | Semi-trailer                 |
| Sunflowers    | December to January, April to May | <ul style="list-style-type: none"> <li>• Narrabri</li> <li>• Willow Tree</li> <li>• Gunnedah</li> </ul>                                                                                                                                                                             | Semi-trailer                 |
| Cotton        | April                             | <ul style="list-style-type: none"> <li>• Carroll</li> <li>• Narrabri</li> </ul>                                                                                                                                                                                                     | Semi-trailer                 |
| Cattle        | All year                          | <ul style="list-style-type: none"> <li>• Gunnedah</li> </ul>                                                                                                                                                                                                                        | Semi-trailer & Single Ridged |
| Sheep         | All year                          | <ul style="list-style-type: none"> <li>• Tamworth</li> <li>• Gunnedah</li> </ul>                                                                                                                                                                                                    | Semi-trailer & Single ridged |

\* Note: The delivery location listed is generally only an intermediate delivery location.

From the silos listed in **Table 7**, grain products are either transported to a shipping port for export or transported to a domestic customer. Port-bound product is transported by rail or road to either the Port of Newcastle or Port Kembla. The product bound for domestic customers is usually transported by truck. Cotton is mostly transported by road although small volumes are occasionally transported by rail.

This traffic and transport impact assessment has acknowledged that there are potential impacts on the movement of agricultural products that need to be carefully managed as part of the Project. This is particularly the case since the agricultural industry contains sharp seasonal fluctuations and peaks. Furthermore, the demand for movement of these products may be less foreseeable as the weather conditions and market demands are governing factors on production and sales rates, as well as the traffic that is generated from these industries.

It was anticipated that any growth in traffic demands from the local agricultural industry would be accounted for in the assumed 1.9% p.a. growth in background traffic. As stated previously, this is a conservative growth rate.

## 4 ROAD TRAFFIC IMPACTS

The traffic impacts due to the peak construction and operational phases were modelled using the SIDRA intersection performance simulation software. Separate SIDRA models were prepared for the AM and PM peaks of the construction and operational phases for the Kamilaroi Highway/ Mine Access Road intersection.

The results of the SIDRA models are provided in **Section 4.1** and **4.2**. **Appendix A** provides an explanation of the key traffic performance indicators – level of service (LoS), degree of saturation (DoS), average delay and maximum queue length.

### 4.1 OPERATIONAL PHASE

RTA (2000) provides warrants for turning facilities at rural T-intersections. It describes rural facilities as having basic right turn facilities (BAR configuration), auxiliary lane (AUR configuration) or channelised right-turn lanes (CHR configuration). These are briefly described below:

- **BAR:** A basic T-intersection configuration with no formal right-turn lane or passing facility. The intersection should have a slightly widened sealed shoulder opposite the side road to allow through vehicles to pass around (at slow speed) any vehicles queued to turn right into the side road;
- **AUR:** A T-intersection with an auxiliary passing lane. This lane is a short bypass lane which allows through traffic to pass around a right-turning queued vehicle. In this case, the right-turning vehicle would queue in the main through lane, and the following vehicle would use the auxiliary lane to pass around; and
- **CHR:** A T-intersection with an indented right-turn lane that is separated and protected from the main through lane. In this case, the right turner needs to leave the through lane and enter the indented turn lane. All through vehicles would continue in the main through lane.

These intersection configurations have been depicted in **Figure 13**. The chart in **Figure 14** is used to determine the warrants for each type of T-intersection configuration for the Kamilaroi Highway/Mine Access Road intersection. This is based on the comparison between the turning movement volumes and the conflicting movements at the intersection. With the case of testing warrants for right-turn facilities, the following volumes were used:

- **Qr (92 vehicles/hour) versus Qt+I (317 vehicles/hour):** The right turning volume (Qr) of 92 vehicles/hour was adopted from **Figure 12** and **Table 6** (movement B). The opposing through and left-turn volume (Qt+I) of 317 vehicles/hour was also determined by adding the northbound through volume (movement C) of 255 vehicles/hour to the northbound left-turn volume (movement D) of 62 vehicles/hour (also shown in

- **Figure 12 and Table 6).** When this combination of  $Q_r$  and  $Q_t+I$  values are plotted on **Figure 14**, this indicates that a CHR - intersection configuration is required. These traffic volumes correspond to year 15 of the Project (operational phase, AM and PM peak); and
- $Q_l$  (62 vehicles/hour) versus  $Q_t$  (255 vehicles/hour): The left-turning volume ( $Q_l$ ) of 62 vehicles/hour was adopted from **Figure 11 and Table 5** (see movement D). The conflicting through traffic volume ( $Q_t$ ) is movement C in **Table 4**. When this combination of  $Q_l$  and  $Q_t$  values is plotted on **Figure 14**, this indicates that a CHL (channelised left turn facility) is warranted during year 15 of the Project (operational phase).

As such, A CHR/ CHL T-intersection was adopted as the configuration for the Kamilaroi Highway/ Mine Access Road which was modelled in the traffic capacity assessment.

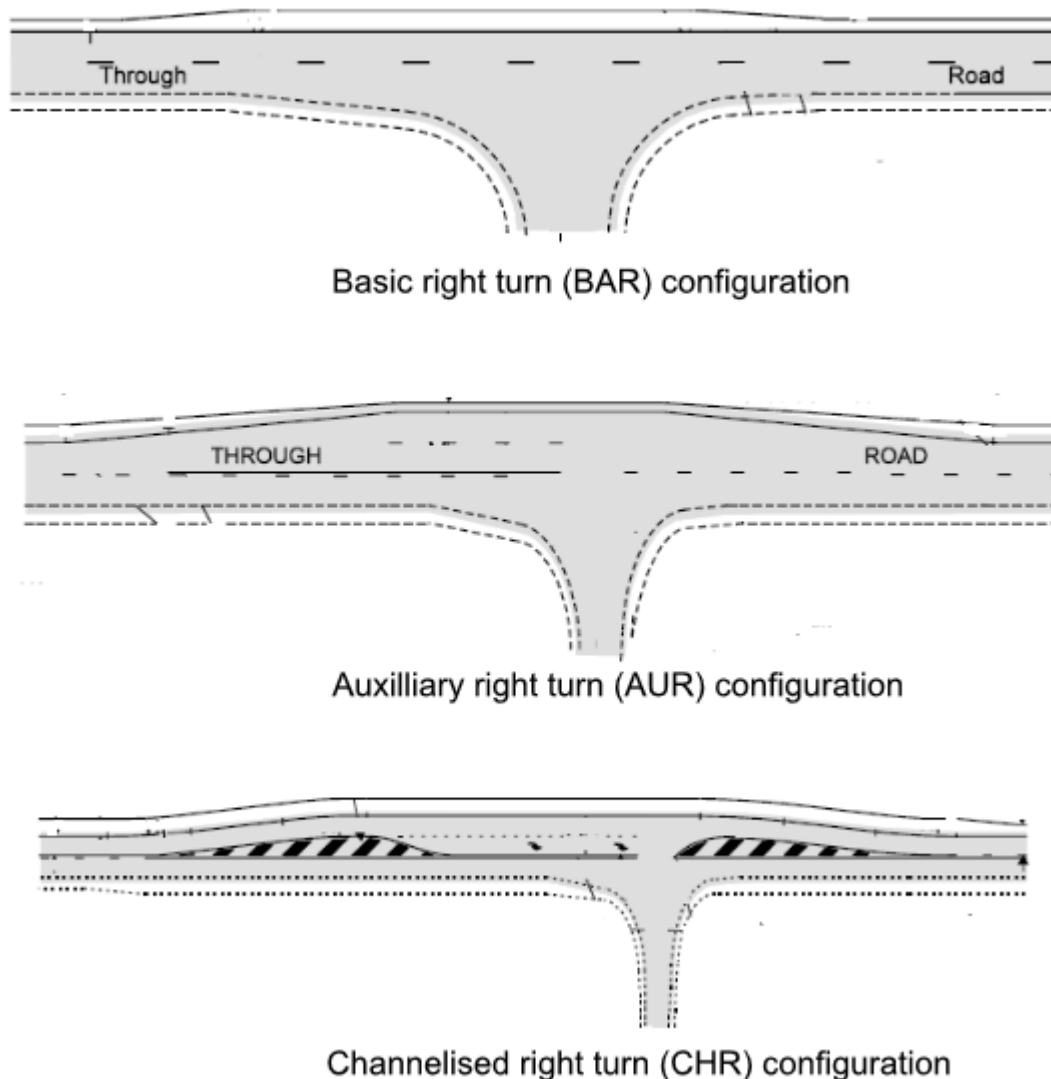


**Figure 13 T-intersection configurations for rural road environments**

Source: RTA, 2000

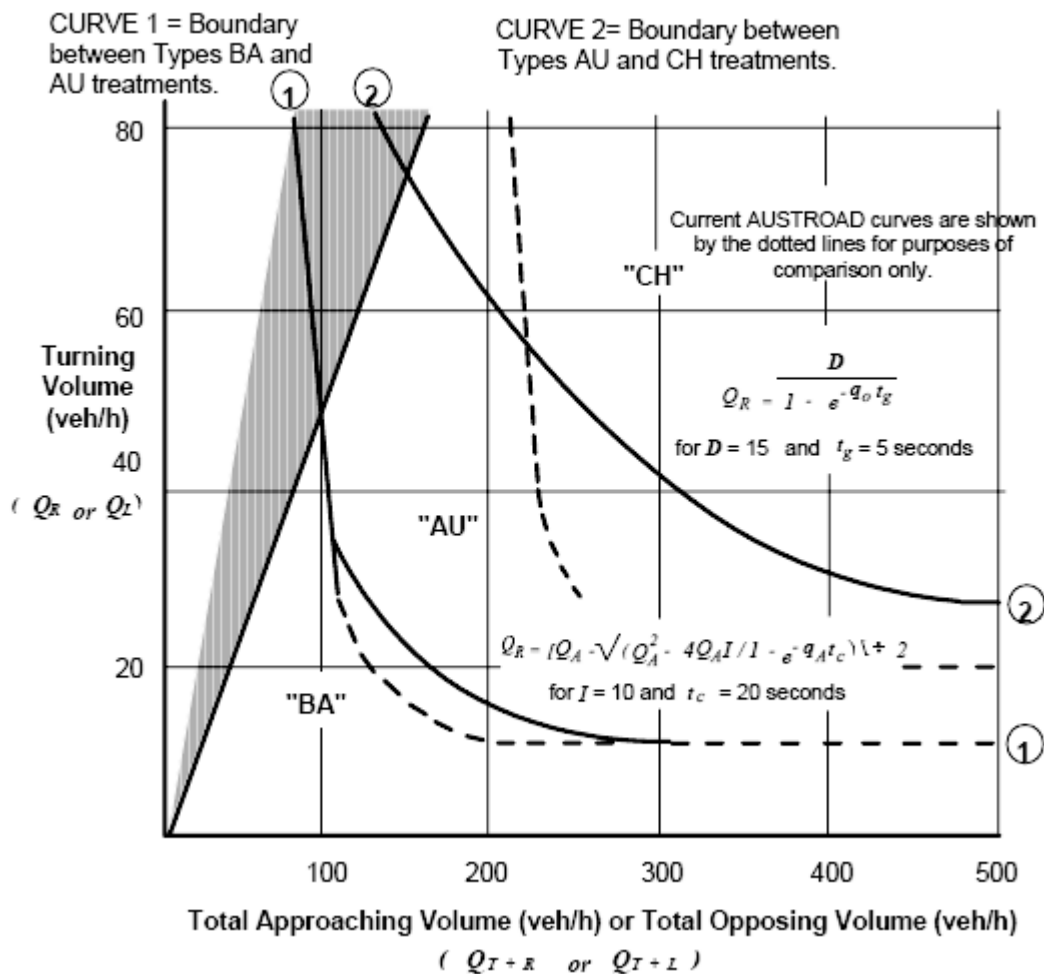


**Figure 14 Warrants for T-intersection facilities for rural road environments**

Source: RTA, 2000

RTA (2000) provides advice on the required dimensions of the indented right and left turn lanes associated with the CHR and CHL configurations respectively. These are based on the deceleration performance of vehicles and hence the length of lane required for safe deceleration to the desired turning speed. In the case of the right-turning traffic from the Kamilaroi Highway to the Mine Access Road, vehicles would be required to decelerate from the 110km/h speed limit to rest as there is a possibility that lack of gaps in the northbound direction would require these vehicles to stop and wait.

RTA (2000) recommends that a deceleration length of 135m be provided accounting for the maximum rate of deceleration at 3.5m/s/s. For the purposes of developing an intersection layout for the SIDRA model, a right-turn lane length of 160m was adopted to account for the required 135m deceleration length as well as a nominal 25m buffer for potential queue lengths.

It is assumed that no formal pedestrian or bicycle facilities would be required at the Kamilaroi Highway/ Mine Access Road intersection due to the lack of significant pedestrian/bicycle traffic generators in the surrounding environment. Bicycle traffic would still be catered for via the sealed shoulder and the traffic lanes.

By contrast, the left-turn movement from the Kamilaroi Highway South approach into Mine Access Road is an un-opposed movement. As such, it was assumed that a free-flowing slip lane could be provided with a downstream merge in Mine Access Road. This would allow for a reduced length of left-turn lane as there would be no queuing/ storage requirement. The modelled intersection configuration is shown in **Figure 15**.

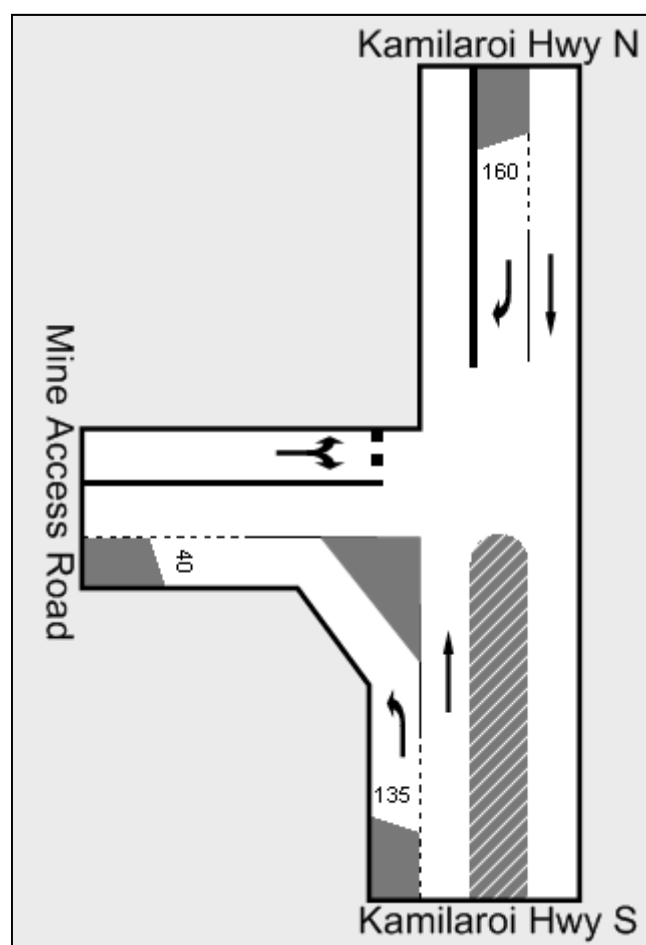


**Figure 15** The configuration of the Kamilaroi Highway/ Mine Access Road intersection adopted for the SIDRA model.

**Table 8** and **Table 9** show the SIDRA model output for this intersection for year 15 of the Project plan, and for the forecasted turning movement volumes as shown in **Figure 9** and **Figure 10**. A more detailed explanation of level of service is provided in **Appendix A**.

The SIDRA model indicated that the maximum queue lengths generated in the right-turn lane would be 3.7m. As such, the modelled maximum queue lengths would be well contained within the 160m right-turn lane. The model also predicts an average delay of 15.8 seconds per vehicle for that approach. It should be noted that traffic delay consists of *dynamic* delay and *static* delay. Dynamic delay consists of the time taken for a vehicle to slow down, negotiate through the intersection, and then speed up to the target speed of the intersection departure. This is particularly prominent for turning movements as there is significant deceleration and acceleration involved. Static delay is the delay incurred when the vehicle is in a queue and is not moving.

The traffic in the Mine Access Road approaching the Kamilaroi Highway would experience average delays of 11 to 12 seconds per vehicle. This would result in maximum queues between 7 to 8m. The performance of this approach could be further improved through flaring the approach to allow the left and right turn movements to queue in separate lanes. However, this would only result in minor improvements compared with the scale of additional works involved (i.e. earthworks, pavement).

**Table 8 SIDRA model output for year 15 (2028) of the Project – Kamilaroi Highway/ Mine Access Road - AM peak period.**

Kamilaroi Highway/ Mine Access Road intersection 2028 AM peak operational  
Giveaway / Yield (Two-Way)

| Movement Performance - Vehicles |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
|---------------------------------|------|-------------------|------|---------------|-------------------|------------------|--------------------------------|-----------------|--------------|-----------------------------|--------------------|
| Mov ID                          | Turn | Demand Flow veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m      | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
| South: Kamilaroi Hwy S          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 4                               | L    | 65                | 3.2  | 0.036         | 14.2              | NA <sup>s</sup>  | NA <sup>s</sup>                | NA <sup>s</sup> | 0.00         | 0.74                        | 73.1               |
| 5                               | T    | 268               | 14.1 | 0.150         | 0.0               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.00                        | 110.0              |
| Approach                        |      | 334               | 12.0 | 0.150         | 2.8               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.14                        | 100.2              |
| North: Kamilaroi Hwy N          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 11                              | T    | 268               | 14.1 | 0.150         | 0.0               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.00                        | 110.0              |
| 12                              | R    | 97                | 2.2  | 0.112         | 15.8              | LOS B            | 0.5                            | 3.7             | 0.39         | 0.78                        | 62.7               |
| Approach                        |      | 365               | 11.0 | 0.150         | 4.2               | LOS B            | 0.5                            | 3.7             | 0.10         | 0.21                        | 95.4               |
| West: Mine Access Road          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 1                               | L    | 97                | 2.2  | 0.234         | 12.1              | LOS A            | 1.1                            | 8.1             | 0.50         | 0.75                        | 54.6               |
| 3                               | R    | 65                | 3.2  | 0.235         | 12.2              | LOS A            | 1.1                            | 8.1             | 0.50         | 0.84                        | 54.6               |
| Approach                        |      | 162               | 2.6  | 0.235         | 12.2              | LOS A            | 1.1                            | 8.1             | 0.50         | 0.79                        | 54.6               |
| All Vehicles                    |      | 861               | 9.8  | 0.235         | 5.1               | NA               | 1.1                            | 8.1             | 0.14         | 0.29                        | 84.8               |

Note: For an explanation of the model fields, see Appendix A.

**Table 9** SIDRA model output for year 15 (2028) of the Project – Kamilaroi Highway/ Mine Access Road - PM peak period.

Kamilaroi Highway/ Mine Access Road intersection 2028 PM peak operational  
Giveaway / Yield (Two-Way)

| Movement Performance - Vehicles |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
|---------------------------------|------|-------------------|------|---------------|-------------------|------------------|--------------------------------|-----------------|--------------|-----------------------------|--------------------|
| Mov ID                          | Turn | Demand Flow veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m      | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
| South: Kamilaroi Hwy S          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 4                               | L    | 65                | 3.2  | 0.036         | 14.2              | NA <sup>s</sup>  | NA <sup>s</sup>                | NA <sup>s</sup> | 0.00         | 0.74                        | 73.1               |
| 5                               | T    | 221               | 14.3 | 0.124         | 0.0               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.00                        | 110.0              |
| Approach                        |      | 286               | 11.8 | 0.124         | 3.2               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.17                        | 98.8               |
| North: Kamilaroi Hwy N          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 11                              | T    | 232               | 13.6 | 0.129         | 0.0               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.00                        | 110.0              |
| 12                              | R    | 97                | 2.2  | 0.105         | 15.5              | LOS B            | 0.5                            | 3.5             | 0.35         | 0.76                        | 63.4               |
| Approach                        |      | 328               | 10.3 | 0.129         | 4.6               | LOS B            | 0.5                            | 3.5             | 0.10         | 0.22                        | 94.3               |
| West: Mine Access Road          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 1                               | L    | 97                | 2.2  | 0.215         | 11.5              | LOS A            | 1.0                            | 7.5             | 0.45         | 0.72                        | 55.2               |
| 3                               | R    | 65                | 3.2  | 0.215         | 11.6              | LOS A            | 1.0                            | 7.5             | 0.45         | 0.82                        | 55.2               |
| Approach                        |      | 162               | 2.6  | 0.215         | 11.5              | LOS A            | 1.0                            | 7.5             | 0.45         | 0.76                        | 55.2               |
| All Vehicles                    |      | 777               | 9.2  | 0.215         | 5.5               | NA               | 1.0                            | 7.5             | 0.14         | 0.32                        | 83.1               |

Note: For an explanation of the model fields, see Appendix A.

The SIDRA model outputs in **Table 8** and **Table 9** indicate that the CHR/ CHL intersection configuration would perform satisfactorily in catering for peak hour traffic volumes throughout the peak operational phase of the Project.

## 4.2 CONSTRUCTION PHASE

It is proposed to construct the Mine Access Road and its intersection with the Kamilaroi Highway early in the construction program, thus offering improved access to the Project for construction-generated traffic. This is both from a safety and traffic performance perspective.

The forecast traffic volumes from **Figure 9** and **Figure 10** were modelled in SIDRA along with the intersection configuration shown in **Figure 15**. The SIDRA model results are shown in **Table 10** and **Table 11** for the AM and PM peak periods respectively.

**Table 10 SIDRA model output for peak construction conditions – Kamilaroi Highway/ Mine Access Road - AM peak period.**

Kamilaroi Highway/ Mine Access Road intersection 2012 AM peak operational  
Giveaway / Yield (Two-Way)

| Movement Performance - Vehicles |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
|---------------------------------|------|-------------------|-------|---------------|-------------------|------------------|--------------------------------|------------------|--------------|-----------------------------|--------------------|
| Mov ID                          | Turn | Demand Flow veh/h | HV %  | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
| South: Kamilaroi Hwy S          |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
| 4                               | L    | 81                | 11.7  | 0.047         | 15.0              | NA <sup>s</sup>  | NA <sup>s</sup>                | NA <sup>s</sup>  | 0.00         | 0.74                        | 73.1               |
| 5                               | T    | 201               | 14.1  | 0.113         | 0.0               | LOS A            | 0.0                            | 0.0              | 0.00         | 0.00                        | 110.0              |
| Approach                        |      | 282               | 13.4  | 0.113         | 4.3               | LOS A            | 0.0                            | 0.0              | 0.00         | 0.21                        | 96.2               |
| North: Kamilaroi Hwy N          |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
| 11                              | T    | 201               | 14.1  | 0.113         | 0.0               | LOS A            | 0.0                            | 0.0              | 0.00         | 0.00                        | 110.0              |
| 12                              | R    | 111               | 4.8   | 0.117         | 15.5              | LOS B            | 0.5                            | 4.0              | 0.34         | 0.75                        | 63.5               |
| Approach                        |      | 312               | 10.8  | 0.117         | 5.5               | LOS B            | 0.5                            | 4.0              | 0.12         | 0.27                        | 91.4               |
| West: Mine Access Road          |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
| 1                               | L    | 5                 | 100.0 | 0.071         | 28.7              | LOS C            | 0.3                            | 3.9              | 0.64         | 0.80                        | 49.6               |
| 3                               | R    | 9                 | 100.0 | 0.072         | 28.7              | LOS C            | 0.3                            | 3.9              | 0.64         | 0.90                        | 49.6               |
| Approach                        |      | 15                | 100.0 | 0.072         | 28.7              | LOS C            | 0.3                            | 3.9              | 0.64         | 0.86                        | 49.6               |
| All Vehicles                    |      | 608               | 14.2  | 0.117         | 5.5               | NA               | 0.5                            | 4.0              | 0.08         | 0.26                        | 90.9               |

Note: For an explanation of the model fields, see Appendix A.

**Table 11 SIDRA model output for peak construction conditions – Kamilaroi Highway/ Mine Access Road - PM peak period.**

Kamilaroi Highway/ Mine Access Road intersection 2012 PM peak operational  
Giveaway / Yield (Two-Way)

| Movement Performance - Vehicles |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
|---------------------------------|------|-------------------|-------|---------------|-------------------|------------------|--------------------------------|------------------|--------------|-----------------------------|--------------------|
| Mov ID                          | Turn | Demand Flow veh/h | HV %  | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
| South: Kamilaroi Hwy S          |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
| 4                               | L    | 9                 | 100.0 | 0.009         | 22.8              | NA <sup>s</sup>  | NA <sup>s</sup>                | NA <sup>s</sup>  | 0.00         | 0.76                        | 69.4               |
| 5                               | T    | 164               | 14.1  | 0.092         | 0.0               | LOS A            | 0.0                            | 0.0              | 0.00         | 0.00                        | 110.0              |
| Approach                        |      | 174               | 18.8  | 0.092         | 1.2               | LOS A            | 0.0                            | 0.0              | 0.00         | 0.04                        | 105.4              |
| North: Kamilaroi Hwy N          |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
| 11                              | T    | 164               | 14.1  | 0.092         | 0.0               | LOS A            | 0.0                            | 0.0              | 0.00         | 0.00                        | 110.0              |
| 12                              | R    | 5                 | 100.0 | 0.012         | 24.3              | LOS B            | 0.1                            | 0.7              | 0.40         | 0.74                        | 52.3               |
| Approach                        |      | 169               | 16.8  | 0.092         | 0.8               | LOS B            | 0.1                            | 0.7              | 0.01         | 0.02                        | 107.0              |
| West: Mine Access Road          |      |                   |       |               |                   |                  |                                |                  |              |                             |                    |
| 1                               | L    | 111               | 4.8   | 0.222         | 10.7              | LOS A            | 1.1                            | 8.4              | 0.38         | 0.68                        | 56.2               |
| 3                               | R    | 81                | 11.7  | 0.222         | 11.1              | LOS A            | 1.1                            | 8.4              | 0.38         | 0.75                        | 56.2               |
| Approach                        |      | 192               | 7.7   | 0.222         | 10.8              | LOS A            | 1.1                            | 8.4              | 0.38         | 0.71                        | 56.2               |
| All Vehicles                    |      | 535               | 14.2  | 0.222         | 4.5               | NA               | 1.1                            | 8.4              | 0.14         | 0.27                        | 80.8               |

Note: For an explanation of the model fields, see Appendix A.

The SIDRA outputs in **Table 10** and **Table 11** indicate that if the Kamilaroi Highway/ Mine Access Road was built and opened to traffic early in the construction program, it should be able to adequately service the traffic demands generated by the construction phase of the Project. This is indicated by the modelled LoS of C or better for each movement. Also, the maximum queue lengths are less than 9m in both cases.

Although the SIDRA model output shows significant delays (15-25 seconds/vehicle) for the left and right turns from Kamilaroi Highway to Mine Access Road, these would be mostly comprised of *dynamic* delay rather than *static* delay.

In the event that the Mine Access Road and associated intersection at the Kamilaroi Highway is not constructed early in the construction program, then construction traffic would need to use Court Lane to enter the Project Boundary. A SIDRA model was also prepared for the AM peak period for the existing Kamilaroi Highway/ Court Lane intersection. The model results are shown in **Table 12** and can be compared with those in **Table 10**.

**Table 12 SIDRA model output for peak construction conditions – Kamilaroi Highway/ Court Lane intersection - AM peak period.**

| Movement Performance - Vehicles |      |             |       |           |               |                  |                            |          |              |                     |               |
|---------------------------------|------|-------------|-------|-----------|---------------|------------------|----------------------------|----------|--------------|---------------------|---------------|
| Mov ID                          | Turn | Demand Flow | HV    | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue Vehicles | Distance | Prop. Queued | Effective Stop Rate | Average Speed |
|                                 |      | veh/h       | %     | v/c       | sec           |                  | veh                        | m        |              | per veh             | km/h          |
| South: Kamilaroi Hwy S          |      |             |       |           |               |                  |                            |          |              |                     |               |
| 4                               | L    | 81          | 11.7  | 0.160     | 14.7          | LOS B            | 0.0                        | 0.0      | 0.00         | 1.50                | 65.9          |
| 5                               | T    | 201         | 14.1  | 0.160     | 0.0           | LOS A            | 0.0                        | 0.0      | 0.00         | 0.00                | 110.0         |
| Approach                        |      | 282         | 13.4  | 0.160     | 4.2           | LOS B            | 0.0                        | 0.0      | 0.00         | 0.43                | 95.8          |
| North: Kamilaroi Hwy N          |      |             |       |           |               |                  |                            |          |              |                     |               |
| 11                              | T    | 201         | 14.1  | 0.243     | 2.3           | LOS A            | 2.0                        | 15.3     | 0.49         | 0.00                | 79.1          |
| 12                              | R    | 111         | 4.8   | 0.242     | 16.6          | LOS B            | 2.0                        | 15.3     | 0.49         | 1.19                | 69.6          |
| Approach                        |      | 312         | 10.8  | 0.242     | 7.3           | LOS B            | 2.0                        | 15.3     | 0.49         | 0.42                | 76.2          |
| West: Courts Lane               |      |             |       |           |               |                  |                            |          |              |                     |               |
| 1                               | L    | 5           | 100.0 | 0.076     | 30.0          | LOS C            | 0.3                        | 4.1      | 0.67         | 0.81                | 48.8          |
| 3                               | R    | 9           | 100.0 | 0.076     | 30.4          | LOS C            | 0.3                        | 4.1      | 0.67         | 0.92                | 48.8          |
| Approach                        |      | 15          | 100.0 | 0.076     | 30.2          | LOS C            | 0.3                        | 4.1      | 0.67         | 0.88                | 48.8          |
| All Vehicles                    |      | 608         | 14.2  | 0.243     | 6.5           | NA               | 2.0                        | 15.3     | 0.27         | 0.44                | 82.3          |

Note: For an explanation of the model fields, see Appendix A.

The model outputs in **Table 12** show that overall, the traffic performance of the Kamilaroi Highway/ Court Lane intersection would be acceptable for traffic generated by the Project during the construction phase. This is reflected by the marginal differences between the modelled average delays, and LoS between this model and that of the proposed Kamilaroi Highway/ Mine Access Road intersection in **Table 10**. It should be noted that the Court Lane intersection is currently a basic right (BAR) configuration with no right-turn storage lane for Kamilaroi Highway southbound traffic. Furthermore, unlike the intersection configuration in **Figure 15**, the Court Lane intersection does not have a continuous left-turn slip lane.

Despite the satisfactory modelled traffic performance shown in **Table 12**, the current intersection layout poses a safety concern. With the Kamilaroi Highway signposted at 110km/h, any queued traffic waiting to turn right into Court Lane would be at risk of a major rear-end collision with following traffic. The increase in the proportion of queued traffic from 0.34 (**Table 9**) to 0.49 (**Table 11**) for this movement represents a 44% increase.

Furthermore, this existing Court Lane intersection offers no physical protection for queued or decelerating right-turning traffic (i.e. via an indented turn lane). As such, the Kamilaroi Highway / Mine Access Road intersection is required to be built in the early part of the construction phase to minimise risks of major high-speed rear-end crashes as described.

### 4.3 POTENTIAL TRAFFIC IMPACTS ON OTHER REGIONAL ACCESS ROADS

#### 4.3.1 Quirindi-West Tamworth Road

Quirindi-West Tamworth Road comes under the care and jurisdiction of RMS and is classified as MR 130. A traffic counter indicated that this route carries approximately 2,600 vehicles/day (RTA, 2004). Up to 300 vehicles/hour are estimated to use this road during the highest volume hour of the day<sup>6</sup>.

A midblock level of service analysis for the Quirindi-West Tamworth Road was carried out as part of this Traffic and Transport Impact Assessment in accordance with the *Highway Capacity Manual* (TRB, 2000) (see **Appendix B**). The purpose of this analysis was to assess the existing performance of this route from a traffic flow perspective. This method assesses midblock traffic performance on two lane highways by considering (i) the average travel speed achievable as well as (ii) the percentage of time that a driver spends following another vehicle. A conservative approach was taken which assumed that 40% of the route does not allow for overtaking. In reality this would be in the order of 20%.

The analysis indicated that under a peak hour traffic volume of 300 vehicles/hour, the road would operate under a midblock Level of Service (LoS) of B. LoS B conditions are characterised by reasonably good traffic flow conditions with less than 50% of drivers subjected to following another vehicle. Drivers would be able to sustain an average speed of 80 km/h or more under relatively uninterrupted traffic flow conditions. As such, the existing LoS of B is considered to represent good traffic performance.

Two sensitivity tests were carried out for the Quirindi-West Tamworth Road in accordance with the *Highway Capacity Manual* method (TRB, 2000) (**Appendix B**). This was for the purpose of determining how much spare capacity the route has before dropping to a LoS of D<sup>7</sup> or worse. *Sensitivity test 1* (**Appendix B**) involved reducing the average travel speed until the outputted LoS became D. This test indicated that the average travel speed would need to drop to less than 70km/h and that this would result if the traffic volume on the road increased to 813 vehicles/hour or more. This represents a safety margin of 513 vehicles/hour (difference between 813 and 300 vehicles/hour).

<sup>6</sup> Assuming that up to 10% of the daily traffic volume uses the road in the highest volume hour.

<sup>7</sup> LoS D is considered to be the onset of poor midblock traffic performance. This is characterised by a significant loss of free movement due to the high volumes of traffic on the road.

As such, there is ample spare capacity along this road to absorb more traffic before traffic conditions deteriorate to LoS D or worse.

*Sensitivity test 2 (Appendix B)* involved increasing the percentage of time that a driver spends following another vehicle until the outputted LoS became D or worse. This test indicated that the driver would need to spend more than 65% of their time following another vehicle for this to occur. This would be experienced if the traffic volumes increased to 452 vehicles/hour or greater. As such, there is sufficient spare capacity (i.e. 152 vehicles/hour) to ensure that midblock LoS remain better than D even under the operational phase of the Project.

**Table 5** and **Table 6** indicate that the Project is likely to generate in the order of 120 vehicle/hour to/from the south of the Project. Furthermore, it is unlikely that all of this traffic would use Quirindi-West Tamworth Road. As such, there is sufficient capacity to absorb the Project's traffic and even allow for additional travel demand based on seasonal fluctuations. It is again emphasised that a conservative approach was taken by assuming that 40% of the route does not allow overtaking.

All workings/ calculations for the midblock LoS analysis are provided in **Appendix B**.

#### **4.3.2 Werris Creek-Gap Road**

This route is under the care and control of RMS and is classified as Main Road (MR) 579. Traffic counts collected in 2004 (RTA) indicate that the road carries approximately 500 vehicles/day. With an estimated peak hour traffic volume of 50 vehicles/hour (i.e. 10% of the daily traffic volume), this road would have substantially more spare capacity (i.e. in excess of 400 additional vehicles/hour) compared with Quirindi – West Tamworth Road. This is more than adequate to absorb the additional Project-related traffic as well as any seasonal fluctuations.

The analysis described in Section 4.3.1 indicated that the hourly traffic volume on a two-lane-two-way rural road in this environment would need to exceed 452 vehicles/hour before the road exhibits a poor LoS of D or worse. As Werris Creek-Gap Road is a similar road type and hence has a similar midblock capacity, there is ample spare capacity in this road to ensure that the midblock LoS remains better than D under the operational phase of the Project. As previously stated, **Table 5** and **Table 6** indicate that the Project is likely to generate in the order of 120 vehicles/hour to/from the south of the Project. Furthermore, it is very unlikely that all these vehicles will use Werris Creek-Gap Road.

### 4.3.3 Breeza- Currabubula Road

Breeza – Currabubula Road is a local road under the care and jurisdiction of Gunnedah and Liverpool Plains Shire Councils. It provides an east-west link between the Project and Werris Creek, and then Tamworth via the Quirindi-West Tamworth Road (MR130).

There was no traffic volume information available for this road. However, from site observations it carries a similar volume of traffic as Werris Creek-Gap Road. It also has a similar configuration (two-lane-two-way, high-speed rural road) and hence midblock capacity as Quirindi-West Tamworth Road and Werris Creek-Gap Road. As such, it can also be concluded from the analysis described in Section 4.3.1 that there is ample spare capacity in this route to sustain a midblock LoS better than D even with the Project-related traffic and seasonal fluctuations accounted for.

## 5 ROAD ACCESS

### 5.1 KAMILAROI HIGHWAY

The Kamilaroi Highway is proposed to be realigned in the vicinity of the current intersection with Court Lane. This will involve a minor (170m) deviation of the highway to the south of the existing alignment.

The realignment would result in an adjustment of both the horizontal and vertical geometry of the route. In the horizontal plane, the highway would deviate further away from the Werris Creek-Moree Railway Line to provide more length and lateral space for the railway spur to branch off this line and cross over the new highway alignment. In the vertical plane, the realigned section of highway would ascend and pass over the railway spur allowing the railway spur to maintain the desired level grade.

GHD (2010) stated that a road-over-rail bridge was the most preferable option (compared with a rail-over-road bridge or a railway level crossing). This was primarily due to the high-speed of the Kamilaroi Highway traffic which makes a railway level crossing option unsuitable. A rail-over-road bridge would require up to 700m of bridge structure and may not be economically feasible.

The Project also proposes the construction of the Mine Access Road connection to the Kamilaroi Highway. This intersection will be located at the eastern end of the realignment. This will be a priority controlled T intersection with a channelised right turn (CHR) configuration.

**Figure 3** illustrates the conceptual realignment of the Kamilaroi Highway, the alignment of the Mine Access Road and the rail spur and the location of the road-over-rail bridge.

The highway realignment, road-over-rail overpass and proposed Kamilaroi Highway/ Mine Access Road intersection present a number of potential opportunities which are described as follows:

- The proposed realigned section of highway would allow the Mine Access Road and its intersection with the highway to be constructed “off-line” with little hindrance associated with working adjacent to live highway traffic. It also minimises disruptions and lane closure requirements of the highway.
- The realigned section of highway would reduce the skew angle between the railway line and the highway. This simplifies the bridge design and shortens the span length of the overpassing deck.

- There would be opportunities to improve the alignment of the Kamilaroi Highway at this location. The concept design indicates that the existing curve to the south of Court Lane would be replaced with the construction of a higher radius curve which would improve road safety.

A schedule of road safety audits would be carried out for the design and pre-opening stages of the Kamilaroi Highway works to confirm critical sight lines between drivers using the new intersection at Mine Access Road. This is particularly due to the proposed realignment works which may result in new curves, crests and other potentially sight-restricting elements.

The design of the realignment of the Kamilaroi Highway, the Mine Access Road, the rail spur and the road-over-rail bridge will be carried out in consultation with RMS and the Gunnedah LGA. The costs associated with these works will be confirmed as the detailed design is developed.

## 5.2 THE DIP ROAD

The proposed Southern Mining Area will mine through the section of The Dip Road between Court Lane and Cull Road. As such, 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 (see **Figure 4**). The required approvals for the construction of the alternative route will be sought separately to this application. The proposed route is approximately 13km in length between The Dip Road/ Clift Road intersection and the Nea Siding Road/ Cull Road/ Goran Lake Road intersection. This is compared with the existing 6.3km route along The Dip Road between the same two points. This alternative route will increase travel times by an average of five minutes per vehicle.

Road alignment adjustments would be required to effectively and safely direct The Dip Road westbound traffic into Clift Road. It is envisaged that this would be in accordance with the Austroads Road Design Guide. Advanced signs would also be required to advise drivers of the proposed alignment of the road as well as the adjusted travel distances. Advanced guidance signs would also be required to advise drivers how to access key destinations.

Road alignment adjustments would also be required to direct traffic from the Cull Road alignment to Nea Siding Road. Similarly, advanced warning and guidance signs would be required to advise drivers of these changes. An appropriate schedule of road safety audits will be carried out at design and/or pre-opening stages of the Project.

The design of the upgrades to Clift Road, Werner Road and Cull Road and road alignment adjustments will be carried out in consultation with RMS and the Gunnedah LGA. The costs associated with these works will be confirmed as the detailed design is developed.

## 6 ROAD CLOSURES

### 6.1 IMPACTS OF PERMANENT ROAD CLOSURES

**Figure 4** shows the roads that will be permanently closed due to the development and operation of the Project. These are also described in **Table 13** along with the number of residences affected, and the alternative routes that would be required.

**Table 13 Roads that will be permanently closed and impacts to local and regional access.**

| Road name    | From              | To                          | Length of closure     | Parties affected                                                                                                                     | Alternative routes and travel time implications                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------|-------------------|-----------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Court Lane   | Kamilaroi Highway | The Dip Road                | 7.5km (entire length) | No residences will remain along this route. There will be a loss of through connectivity between Kamilaroi Highway and The Dip Road. | Road users that would normally use this road as a through route would need to take the alternative route via The Dip Road to the Kamilaroi Highway. The length of this alternative route is 18.5km compared with the existing length of 7.5km along Court Lane.<br><br>The alternative route would have an approximate travel time of 12 minutes compared with the estimated travel time of seven minutes for the entire length of Court Lane <sup>8</sup> . |
| Rowarth Road | Kamilaroi Highway | Cul-de-sac at southern end. | 6.3km (entire length) | No residences would remain along this route.                                                                                         | This road will be closed to public access and would not be used by through traffic. Also as there would be no remaining residences along this route, there are no alternative travel requirements for road users.                                                                                                                                                                                                                                            |
| Whitby Road  | Nea Siding Road   | Unnamed road                | 3.6km                 | No residences would remain along this route.                                                                                         | This road will be closed to public access and would not be used by through traffic. Also as there would be no remaining residences along this route, there are no alternative travel requirements for road users.                                                                                                                                                                                                                                            |

<sup>8</sup> This is based on an assumed average travel speed of 65km/h along Court Lane and an average travel speed of 90km/h along Kamilaroi Highway and The Dip Road.

| Road name                                                                                               | From       | To              | Length of closure | Parties affected                                                    | Alternative routes and travel time implications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------|------------|-----------------|-------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The Dip Road                                                                                            | Clift Road | Nea Siding Road | 6.3km             | No residences will remain along the affected portion of this route. | <p>A <i>dry weather only</i> alternative route would be available via Clift Road-Werner Road-Cull Road. This alternative route is approximately 13km and will be developed in consultation with Gunnedah Shire Council.</p> <p>The alternative route via Clift Road, Werner Road, and Cull Road would have an approximate travel time of 10 minutes compared with the existing travel time of five minutes along the affected portion of The Dip Road.</p> <p>The detour as described above would be required by year 15 of the mine plan.</p> |
| Other unnamed paper roads as bounded by Kamilaroi Highway, Court Lane, Nea Siding Road and The Dip Road |            |                 | Entire routes     | There would be no remaining residences along these routes.          | These roads will be closed to public access and will not be used by through traffic. Also as there would be no remaining residences along these routes, there are no alternative travel requirements for road users.                                                                                                                                                                                                                                                                                                                           |

## 6.2 IMPACTS OF TEMPORARY ROAD CLOSURES

### 6.2.1 Temporary closures due to blasting activities

Any public roads that are within 500m of blasting activities carried out as part of the Project would be temporarily closed. Blasting activities would generally last 15-20 minutes and would occur during the day time hours from 0900-1700h. Affected roads may be closed up to three times a week. There would be a maximum of 120 road closures per year. **Table 14** provides road closure predictions for the Project.

**Table 14 Predicted temporary road closures and management measures.**

| Road name    | From                                  | To           | When               | Parties affected and management measures                                                                                                                                                                         |
|--------------|---------------------------------------|--------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The Dip Road | Immediately west of Kamilaroi Highway | Clift Road   | Year 10 to Year 21 | Residents along Werner Road would need to use Cull Road to access the Kamilaroi Highway.<br><br>Residents along Duddy Road would need to use the Dip Road to access the Kamilaroi Highway.                       |
| Clift Road   | 1.5km south of Project Boundary       | The Dip Road | Year 21 to Year 25 | Residents along Werner Road would need to use Cull Road to access the Kamilaroi Highway.<br><br>Residents along Clift Road would need to use Quirindi Premier Road to the south to access the Kamilaroi Highway. |
| Werner Road  | 1.5km west of the Project Boundary    | Clift Road   | Year 21 to Year 25 | Residents along Werner Road would need to wait until the road re-opens after blasting activities to access or egress from their properties. This would incur delays up to 20 minutes.                            |

### 6.2.2 Kamilaroi Highway realignment and railway overpass

A rail spur will extend from the Werris Creek-Moree Railway Line with a rail junction located to the east of the Kamilaroi Highway/ Court Lane intersection. From this junction, the rail spur would pass under the Kamilaroi Highway (GHD, 2010), then turn to the south and run parallel with the contours of Mount Watermark.

A section of the Kamilaroi Highway, immediately east of the Court Lane intersection would need to be realigned in order to minimise the skew angle between the road and railway line. The new Mine Access Road would extend from this realigned section of the Kamilaroi Highway.

The concept plan presents a number of advantages in terms of constructability under live traffic. The following strategy could be broadly followed in order to minimise the need for road closures and road occupancy along the Kamilaroi Highway (it is emphasised that this is only a concept staging plan to demonstrate the constructability of the works and the minimal impact to highway traffic):

- Construct the realigned section of the Kamilaroi Highway (including the bridge structures) “off line” thereby minimising impacts to the existing Kamilaroi Highway. Most of these roadworks would not affect the Kamilaroi Highway and it could remain open to traffic in both directions during construction;
- Construct the tie-ins at each end, i.e. the connections to the existing highway. There would be a number of traffic management strategies that could be used including (i) lane closure and alternating single lane flows using traffic controllers or temporary traffic signals, (ii) construction of a temporary side track to deviate highway traffic further “off line” to provide space for the tie-in works;
- Keep the existing highway operational with barriers used to close off public access to the new alignment;
- Construct the Mine Access Road “off-line” and before any public access is required.
- Switch highway traffic to the new alignment and close off public access to the old highway alignment. The old highway would continue to be used by construction traffic.
- Construct railway spur without any impact to Kamilaroi Highway traffic (as they would now be on the new alignment); and
- Court Lane would remain open for construction vehicle access or as long as it is needed for public access.

The strategy outlined above is a conceptual strategy only, for the purpose of demonstrating the constructability of these works and the low level impact of these works on public traffic. The actual construction strategy is likely to vary from this.

## 7 ROAD SAFETY

### 7.1 CRASH RISKS

Crash data was supplied by RMS for the period between 1 July 2005 and 30 June 2011 which is the latest six-year period for which there is fully validated, non-provisional crash data available. Data was provided for the following roads:

- The Kamilaroi Highway between the Mooki River Bridge to 200m west of Nea Siding Road; and
- The Dip Road.

During the six-year period, five crashes were recorded on the Kamilaroi Highway, and one crash on The Dip Road. Three of these crashes were injury crashes and three were non-injury crashes.

**Figure 16** shows the location of each crash event as well as the crash type as depicted by the arrows.

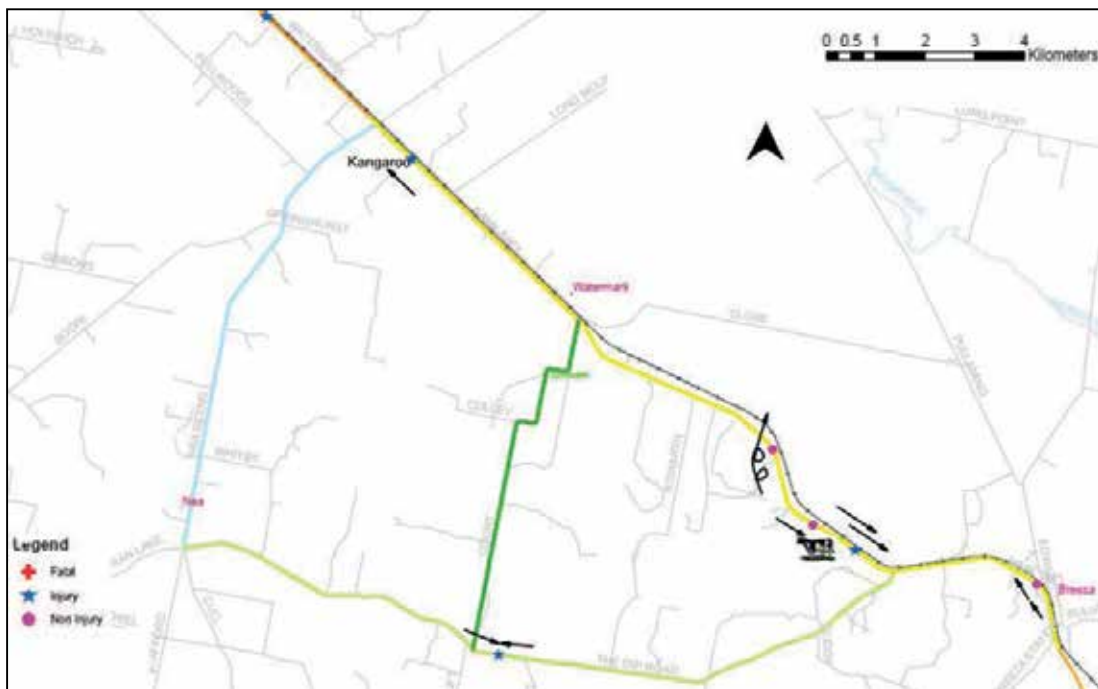


**Figure 16** Reported crashes in the five-year period from 1 July 2005 to 30 June 2010

Source: RTA, 2011a

The five crashes on the Kamilaroi Highway between Mooki River and 200m west of Nea Siding Road, equates to 8.3 crashes/ 100 million-vehicles-kilometres-travelled (MVKT)<sup>9</sup>. This is significantly lower than the state average of 32.8 crashes per 100MVKT calculated in 2004 (RTA, 2004b). This crash rate implies that each driver would be exposed to one crash event every 12 MVKT they travel.

Whilst 8.3 crashes/ 100 MVKT and exposure is not regarded as a high risk, there is still a need to consider road safety impacts, particularly since this Project will introduce new traffic to the surrounding network. Of most critical importance is the proposed Kamilaroi Highway/ Mine Access Road intersection which represents a conflict point between turning vehicles with gap acceptance requirements, and high-speed through vehicles along the highway. The channelisation of right and left turns, as discussed in **Section 4** would provide reasonable safety provisions by allowing queued or decelerating traffic to be laterally offset from the higher speed through vehicles.

RMS advised that there were no crashes recorded for Nea Siding Road and Court Lane in the six-year dataset period.

## **7.2 SAFETY ISSUES ON OTHER REGIONAL ACCESS ROADS**

### **7.2.1 Quirindi-West Tamworth Road**

This is a two-lane-two-way rural road with large radii curves and relatively level vertical alignment. As such, the road is regarded from a road design and road safety perspective as having a low risk with respect to *loss of control* and *run off road* crashes. Throughout most of its length, the route provides reasonable standard clear zones with grass covered, level verges with little risk of destabilising an errant vehicle. There are a number of non-frangible trees within the clear zone of the road but these are generally sparsely distributed. Furthermore, as the verges are level and traversable, these provide drivers with a reasonable level of recoverable space to take corrective or evasive action.

This route offers a reasonable level of safety for the traffic volumes it carries, and for its function as a regional link road between Quirindi and Tamworth as major regional towns. It is generally consistent in the design and form of other rural routes of similar function. **Table 5** and **Table 6** indicate that the Project would generate in the order of 120 vehicles/hour to/from the south of the Project. Furthermore, it is very unlikely that all of this traffic would use Quirindi-West Tamworth Road. As such, the traffic volumes along this route would retain the rural traffic flow characteristics (i.e. uninterrupted traffic flow, and minimal vehicle-to-vehicle conflicts and interaction) which are appropriate for this type of road.

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<sup>9</sup> Crash rate based on an average AADT of 1500 vehicles/day, and a distance of 18.4km between the Mooki River and 200m west of Nea Siding Road.

### 7.2.2 Werris Creek-Gap Road

This is a two-lane-two way rural road with large radius curves and relatively level vertical alignment. However, the pavement width is significantly less than that of Quirindi – West Tamworth Road. As a result, most of the route is not furnished with edge lines or sealed shoulders. The edge of seal is variable and may increase the probability of left-wheel path tracking over the unsealed shoulder or over the edge of seal. This may increase the risk of *loss of control* crashes. This road could be further improved by providing sealed shoulders or by making the edge conditions more uniform (less variable). Notwithstanding the above, the road does provide reasonable clear zones which are traversable and relatively free of non-frangible hazards.

It is recommended that RMS carry out necessary pavement condition surveys to determine any maintenance or upgrade needs along this route and to bring this road up to an appropriate standard for its existing function and usage.

**Table 5** and **Table 6** indicated that the Project will generate in the order of 120 vehicles/hour to/from the south of the Project. Furthermore, not all of this traffic would use Werris Creek-Gap Road. The approximate 60 vehicles per direction would have a marginal impact on this road above the existing traffic and safety conditions.

### 7.2.3 Breeza- Currabubula Road

This road has similar conditions to Werris Creek – Gap Road. It is recommended that Gunnedah and Liverpool Plains Councils carry out necessary pavement condition surveys to determine any maintenance or upgrade needs along this route. This is in order to bring the road up to an appropriate standard for its existing function and usage.

## 8 ADEQUACY OF ONSITE PARKING

### 8.1 LIGHT VEHICLE FACILITIES

GHD (2011b) indicated that 162 car parking, including two disabled parking spaces and 12 light mine vehicle parking spaces, would be provided on site as part of the mine infrastructure area. These would be located immediately adjacent to the administration building.

**Section 3.2** indicated that up to 150 workers would be required to attend the site in any shift. As such, even with a conservative vehicle occupancy rate of 1.0 person per vehicle, there would be a surplus of 12 car spaces. A more realistic occupancy rate of 1.2 persons/vehicle would result in a parking demand of 125 parking spaces and hence a surplus of 37 parking spaces. As such, the proposed parking supply would exceed the demand.

It should be noted that a 1.0 person/vehicle occupancy rate would be a worst-case scenario. In reality, some carpooling would take place as well as some workers being dropped off without any parking demand generated. A 1.2 person/vehicle occupancy rate is equivalent to every fifth car having two occupants, or alternatively, every sixth person being dropped off and picked up from work.

Although the proposed parking supply is sufficient, there may still be risk of parking overflow, particularly at shift changeovers. However, this is not envisaged to be a common problem as not all work roles would be continuous operations and require workers from the following shift to arrive at the site before the end of the previous shift. Also, the departure times of workers are typically more variable compared to commencement times. Notwithstanding this, there would be a surplus of 12 to 37 car spaces as determined above.

### 8.2 HEAVY VEHICLE FACILITIES

GHD (2011b) advised that the following heavy vehicle facilities would be provided as part of the mine infrastructure area:

- A bus drop off zone;
- A bus parking area;
- A covered ambulance bay; and
- A heavy vehicle re-fuelling and wash-down area.

Heavy vehicle traffic generated by the Project would typically be for the supply or removal of materials. This would include fuel tankers, waste removal services, and haulage of equipment and spare parts. These vehicles would generally travel directly to their final destination within the Project Boundary and only generate very short term parking demands. It would be rare that any heavy vehicle would need to stay at the site long enough to warrant the provision of permanent heavy vehicle parking areas.

## 9 ROAD MITIGATION AND MANAGEMENT

### 9.1 ROAD SAFETY

A summary of the recommended mitigation and management measures for road safety has been provided as follows:

- The Kamilaroi Highway/ Mine Access Road intersection should be a channelised (CHR) T intersection with an indented right-turn lane for southbound traffic. The right-turn lane should provide sufficient length for deceleration so that there is no requirement for deceleration in the upstream portion of the through traffic lane. The right-turn lane should also provide enough storage length to accommodate the modelled queue lengths. The modelling work indicates that the right-turn lane should be 140m long;
- The Kamilaroi Highway/ Mine Access Road intersection should also provide sufficient length of indented left-turn lane for northbound traffic on the Kamilaroi Highway south approach. This would allow left-turn vehicles to decelerate in a physically separate lane to that of the high-speed through traffic. The left-turn lane should be long enough to accommodate the full deceleration from 110km/h to the safe turning speed. Alternatively, if a continuous uninhibited left-turn slip lane was provided from the Kamilaroi Highway South approach to the Mine Access Road (with a downstream merge within the Mine Access Road), the length of deceleration lane could be reduced;
- The Kamilaroi Highway/ Mine Access Road intersection works, as well as the Kamilaroi Highway realignment will be scheduled early in the construction program. This will further minimise risks of major high-speed rear-end crashes throughout the life of the Project; and
- From the Kamilaroi Highway, there are two possible routes that provide access to Breeza-Curabubula Road. These are Hogarth Street and Currabubula Road. Both of these roads have railway level crossings over the Werris Creek-Moree Railway Line with significant short stacking risks at Hogarth Street. Furthermore, 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.

### 9.2 TEMPORARY ROAD CLOSURES

A summary of the recommended mitigation and management measures for temporary road closures has been provided as follows:

**Blasting**

- The eastern end of The Dip Road closure should be positioned a reasonable distance from the Kamlaroi Highway to minimise the risk of queue spillback onto the highway;
- The boundaries of each road closure should be positioned where there are clear and traversable verges and clear sight lines to allow drivers to u-turn if desired;
- Long-term signage should be installed at the boundaries of the road closure to advise that the road is subject to regular, short-term closures. The signage regime should also advise road users on alternative routes and access where possible;
- Changeable signs (i.e. hinged signs) should be provided at the boundaries of the road closure to advise road users when the road is closed;
- Similar changeable signs should be provided at key intersections upstream of the closure to allow road users to take alternative routes;
- Changeable signs (i.e. bracketed signs with insertable sleeve signs) should be provided to advise road users when the next road closure is scheduled for;
- Blasting activities that require closure of public roads should not be carried out during times when school buses are active in the area; and
- Blasting activities should not be scheduled during peak traffic periods of the day.
- Contact numbers should be provided on road closure signage to allow contact by emergency services.

**Kamlaroi Highway realignment and railway overpass**

- Liaise with RMS to identify acceptable road closure and traffic management measures;
- Liaise with Gunnedah Shire Council to keep them informed of traffic management and construction staging plans; and
- Prepare a construction traffic management plan and staging drawings in consultation with RMS and Gunnedah Shire Council.

## 10 RAIL NETWORK IMPACTS AND MANAGEMENT MEASURES

The ARTC have been keeping a watching brief on the forecast demands for rail movements along the Werris Creek-Moree Rail Line as part of their regular revision to the *Hunter Valley Corridor Capacity Strategy Consultation Document*. This Strategy, which was last revised in 2012, examines the foreseeable growth in rail traffic demand and compares this to the capacity of the coal logistics chain, including rail loading, train movements, and unloading activities. The Strategy also examines the extent to which the capacity of the network has increased due to maintenance and upgrade works completed since the previous version of the Strategy. In these respects, the ARTC Strategy is the ideal starting point for assessing the available capacity in the coal logistics chain as well as the cumulative impacts due to foreseeable development in the Gunnedah Basin.

Notwithstanding the holistic nature of the ARTC Strategy and the associated consultation and network analysis, it is possible that more recent development proposals have not been fully accounted for in the demand forecasts. Such recent proposals that have been identified include the Boggabri Continuation of Mining Project, Maules Creek Coal Project, Narrabri Coal Mine Stage 2, Tarrawonga Mine Modification, Vickery Coal Project, Vickery South Project and Caroon Coal Project. As the extent of industry consultation in the ARTC Strategy was not transparent, it has been conservatively assumed that these projects have not been accounted for (or alternatively not fully accounted for) in the ARTC forecasts.

### 10.1 PROJECT IMPACTS

It has been assumed that the Project would have a maximum extraction rate of 10Mt of ROM coal per annum. Due to losses from rejects and tailings, this is anticipated to result in a maximum product coal yield of 6Mtpa. Although mining activities would take place seven days a week, it has been conservatively assumed that rail hauls would take place up to six days a week. This equates to 312 haul days per year.

Each train would have 72 wagons with an average product coal payload of 79 tonnes per wagon. This equates to a total approximate payload of 5,688 tonnes per train.

Using the above figures, there would be approximately 2,110 train movements required per year including 1,055 laden southbound (port-bound) trains, and 1,055 non-laden northbound (Project-bound) trains per annum. This equates to eight train movements per day (accounting for inbound and outbound traffic).

The loading facilities in the proposed rail loop will have a minimum capacity of loading 5,500 tonnes of product coal per hour. As such, it would take approximately one hour to load each train. Provided that there are no other constraints in the logistics supply chain from mine to port, there would be ample spare capacity within this rail load out facility to increase the daily quantity of coal transported out from the Project Boundary.

## **10.2 BOGGABRI CONTINUATION OF MINING PROJECT**

Hyder (2010) stated that the proposed Boggabri Continuation of Mining Project would lead to an additional 5.5Mt of product coal yield per year (above the existing production rate). When this occurs, there is likely to be an additional 2,040 train movements per year (1,020 laden and 1,020 non-laden). This equates to eight trains per haul day (four laden and four non-laden).

## **10.3 MAULES CREEK COAL PROJECT**

Hyder (2010) stated that the proposed coal project at Maules Creek would result in 10.8Mt of product coal yield per annum. This would generate 4,000 train movements per year (2,000 laden and 2,000 non-laden), or 14 train movements per haul day (seven laden and seven non-laden).

## **10.4 NARRABRI COAL MINE STAGE 2**

Narrabri Coal Mine Stage 2, owned by Whitehaven has prepared an EA to increase production from 0.7Mtpa (Stage 1 approval) to 5.3Mtpa (Stage 2 approval) of product coal. This would generate an additional 1,740 train movements per year (870 laden and 870 non-laden), or six train movements per haul day (three laden and three non-laden).

## **10.5 TARRAWONGA MINE MODIFICATION**

Tarrawonga Coal Mine is located to the south of the Boggabri Continuation of Mining Project and Maules Creek Coal Project and currently has approval to produce 2Mtpa of product coal. The product coal is transported by truck via a dedicated haul route from the mine to the Whitehaven CHPP on the southern side of the Kamilaroi Highway to the north-west of Gunnedah. From there, it is transported to the Port of Newcastle. A modification has been lodged to seek approval for an increase production from 2 to 3 ROM Mtpa. This would lead to an additional 350 train movements per year (175 laden and 175 non-laden) or one train movement per haul day (on average).

## **10.6 VICKERY COAL PROJECT**

Vickery Coal Project, owned by Whitehaven, is preparing an EA to recommence mining operations at Vickery Coal Mine, producing 4 Mtpa of ROM coal over a 30 year period (Whitehaven Coal Mining Ltd, 2011). Conservatively assuming that approximately 3.5 Mtpa of product coal will be produced by the project, this would generate an additional 1,230 train movements per year (615 laden and 615 non-laden), or six train movements per day (three laden and three non-laden).

## 10.7 VICKERY SOUTH PROJECT

The Vickery South Project is a coal exploration project located immediately south of the former Vickery Coal Mine near Gunnedah, NSW. Preliminary feasibility testing has estimated that approximately 3 Mtpa of ROM coal would be produced over a 16 year life of mine (Coalworks, 2012). Conservatively assuming that approximately 2.5 Mtpa of product coal will be produced by the project, this would generate an additional 880 train movements per year (440 laden and 440 non-laden), or four train movements per day (two laden and two non-laden).

## 10.8 CAROONA COAL PROJECT

The BHP Caroonna Project is located immediately south of the Project Boundary. This Project is still undeveloped and in the exploration phase. Although BHP have publicly noted this will be an underground mining operation, they have not released any details on the forecast yield or development timeframes. As such, this project was not considered in the cumulative impact assessment.

## 10.9 CUMULATIVE RAIL NETWORK IMPACTS

The combined impact of the Boggabri Continuation of Mining Project, Narrabri Coal Mine Stage 2, Tarrawonga Mine Modification, Vickery Coal Project, Vickery South Project, Maules Creek Coal Project and the Project are likely to generate a total of 47 additional train movements per haul day (accounting for inbound movements as well). This equates to an average of one southbound laden train every hour, and one northbound non-laden train every hour, on the section of the Werris Creek-Moree Railway Line between Narrabri and Muswellbrook.

In addition, the ongoing competition for train paths for the movement of passenger services, freight and agricultural products also adds timetabling constraints on the movement of coal to the port.

## 10.10 WIDER NETWORK IMPACTS AND MANAGEMENT MEASURES

The *2012-2021 Hunter Valley Corridor Capacity Strategy Consultation Document* (ARTC, 2012) provides a detailed review of the existing deficiencies on the Hunter Valley Rail Corridor which includes the rail network up to Narrabri and Ulan. This document covers a wide range of deficiencies in the coal supply chain from individual mines to the port. Although the movement of coal from the Project would be affected by deficiencies at any point in this supply chain, those to the south of Muswellbrook are a more “global” problem which affect a much wider range of customers including mines along the Ulan rail line as well as the mines to the south of Muswellbrook.

By contrast, the forecast train movements generated by the Project would be directly affected by the section of the network between Narrabri and Muswellbrook. ARTC (2012) describes a number of network deficiencies as well as proposed upgrades.

It is important to note that the network upgrades proposed in the ARTC document are not formal recommendations for mitigation measures for this study.

The biggest constraints to the movement of coal are the single line and steep grades at the Liverpool Ranges at Ardglen which was briefly described in **Section 2.3.2**. The steep grades at this location require loaded trains (on the northern bank) to be supported by banker locomotives. This is a major impediment since the return of the banker locomotive to the base of the grade adds a northbound path which would otherwise be negated if the train did not require banker support.

The Liverpool Ranges Duplication Project will resolve these issues and increase capacity of this section of the network by as much as 140Mtpa. This would be achieved by:

- Reducing/eliminating train paths associated with the return of banker locomotives (non-productive movements), hence providing more paths for “productive” movements;
- Providing some level of passing opportunity through track duplication. This could increase the number of paths, as opposing train movements are not required to share a common single track; and
- Allowing longer train units to be used and thereby increasing the coal payload per train. Currently, train lengths are limited to the length of passing loops.

The interim period up to the opening of the upgrade will continue to exhibit the existing network performance constraints due to the steep grades.

The Liverpool Ranges Duplication Project, as well as the other network upgrades planned by ARTC will also have benefits with regard to the transportation of passengers, freight and agricultural products. The increased capacity will open up more train paths and hence more operational flexibility for these services. The improvement to the grades may also mean that longer trains with larger payloads could be used. Overall, any rail network improvement that provides benefits for coal trains would have similar benefits for the rail movement of passengers, freight and agricultural products.

The Watermark Passing Loop Project is currently at the REF stage and involves the construction of 1.9km of passing loop at Watermark, and associated signalling upgrades. This project is located approximately 10km south of Curlewis and 12km north of Breeza.

The completion of the passing loop is part of ARTC's overarching aim to increase rail capacity and operational flexibility on the North West Rail Line between Gunnedah and Werris Creek and support the anticipated future increase in coal exports from the region (Upper Hunter Valley Alliance, 2012). Although the passing loop is located upstream of the proposed Watermark rail turnout, this facility will generally have a positive impact on rail movements in the vicinity of the Project.

Acknowledging that the ARTC carry out frequent reviews of their *Hunter Valley Corridor Capacity Strategy Consultation Document*, it is recommended that Shenhua Watermark continue to liaise with the ARTC to keep ARTC informed of production forecasts and availability of train paths, and the scheduled timing of rail network upgrades. Similarly, Shenhua Watermark should stay abreast of the surrounding coal expansion and development projects for similar reasons. A number of neighbouring coal mine projects will also need to be involved in the consultation process.

#### 10.11 RAILWAY LEVEL CROSSINGS AND MANAGEMENT MEASURES

The geographical extent of the rail network over which the Project is regarded as having a potentially significant impact is regarded in this assessment as:

*The extent of the rail network where the Project's rail traffic will make up 10% or more of the overall rail traffic volumes.*

The Hunter Valley Rail Corridor carries rail traffic generated by coal mines, agricultural produce (crops and livestock), as well as passenger trains. In general, there is a lack of rail traffic volume data which collectively accounts for rail movements generated by all three of these major sources. As such, this Traffic and Transport Impact Assessment has relied on ARTC forecasts for coal volumes (in tonnes) for 2016.

ARTC (2012) forecasted a total of 45 Mtpa of product coal that will pass through the section of the Hunter Valley Rail Network between Werris Creek and Scone in 2016 (ARTC, 2012). As such, the forecasted 6 Mtpa of product coal generated by the Project will make up 14% of the total rail output for coal transportation at this point in the network.

ARTC (2012) also forecasted a total of 125 Mtpa of product coal that will pass through the section of the Hunter Valley Rail network at Muswellbrook Junction. As such, the forecasted 6 Mtpa of product coal generated by the Project will make up 5% of the total rail output for coal transportation at this point in the network.

It can therefore be concluded that the point where the Project ceases to generate 10% or more of the total rail traffic volume would be between Scone and Muswellbrook<sup>10</sup>. As a conservative measure, the Muswellbrook Junction has been regarded as the cut-off point in these respects.

The analysis described above is also conservative since it only considers coal trains. If passenger trains and agriculture trains volumes could be accounted for, then this would further reduce the relative proportion of rail movements generated by the Project.

Between the Project and Muswellbrook rail junction (as the identified cut-off point described above) there are 28 railway level crossings of public roads. A desktop assessment was carried out on each of these crossings using maps and publicly available aerial and streetview imagery. This was limited to the imagery that was available for each site as well as the currency of that imagery.

RTA (2011b) defines five main safety risk categories for railway level crossings. Of primary importance to all railway level crossings are risk categories 1 and 2 which are defined below:

- *Risk category 1 - Road user fails to stop while a train is approaching:* An assessment of each of the railway level crossings was carried out in this regard by examining the type of traffic control in place and whether it is appropriate or not.
- *Risk category 2 - Road user fails to keep clear while a train is approaching:* An assessment of each of the railway level crossings was carried out in this regard by examining the risk of queuing over the railway level crossing and the length of road available to accommodate a queue.

Table 15 provides a summary of the desktop assessment of each of the 28 railway level crossings. From this table, the highest risk sites identified were:

- White Street, 20m south of New England Highway, Blandford.
- Livingston Street, 25m east of New England Highway, Wingen.
- Gateleys Road, 35m east of New England Highway, Wingen.
- Halcolm Road, 25m east of New England Highway, north of Aberdeen.

These sites all contain short stacking risks under the existing traffic conditions, whereby traffic queued at nearby intersections may queue back over the railway line. The queues would be due to the close proximity of the crossings to a major highway (New England Highway) which carries a relatively high volume of traffic. This may leave vehicles stranded on the crossing when a train approaches.

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<sup>10</sup> This is based on an assumed fixed ratio between product coal tonnages and number of train movements generated.

Furthermore, there are very few “escape paths” available for stranded vehicles at these locations. Table 15 also provides some strategies for improving each of these four crossings.

It should also be noted that all railway level crossings on public roads in NSW are assessed on a regular basis under the Australian Level Crossing Assessment Model (ALCAM). ALCAM is a structured dataset for capturing detailed survey information for an inventory of crossings. It is also a methodology for assessing risks associated with the level crossings enabling crossings to be ranked according to their ALCAM risk scores. This helps to inform decisions about which level crossings require further treatment. ALCAM can also be used to test the effectiveness of proposed treatments.

ALCAM is administered by the Australian Transport Council (ATC). The results of the regular ALCAM assessments are used to inform funding decisions on upgrades to or closures of level crossings. The relative priority of each railway level crossing may change as improvements are carried out and as train and road traffic volumes change. As such, it is recommended that Shenhua continue to liaise with ARTC and the ATC regarding forecasted train volumes and scheduling of rail movements.

**Table 15** Summary of desktop assessment on railway level crossings.

| Location of railway level crossing | Reference to nearest cross road.     | Locality        | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                       | Commentary regarding risk category 2                                                                                                                                                                                          |
|------------------------------------|--------------------------------------|-----------------|---------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hogarth Street                     | 60m north east of Kamilaroi Highway  | Breeza          | 31°14'51.61"S | 150°28'02.84"E | Adequate controls in place – STOP sign controlled railway level crossing.<br>Reasonable visibility to rail line from both road approaches. | Reasonable storage length available - The 60m distance between Kamilaroi Highway and rail line, and the frequency of gaps in Kamilaroi Highway traffic reduce the risk of queue spillback across the railway level crossing.  |
| Curabubula Road                    | 115m north east of Kamilaroi Highway | South of Breeza | 31°15'39.87"S | 150°28'27.74"E | Adequate controls in place – STOP sign controlled railway level crossing.<br>Reasonable visibility to rail line from both road approaches. | Reasonable storage length available - The 115m distance between Kamilaroi Highway and rail line, and the frequency of gaps in Kamilaroi Highway traffic reduce the risk of queue spillback across the railway level crossing. |

| Location of railway level crossing | Reference to nearest cross road.                  | Locality             | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                                                            | Commentary regarding risk category 2                                                                                                                                                                                                                        |
|------------------------------------|---------------------------------------------------|----------------------|---------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cana Road                          | 270m north of Gap Road (Werris Creek-Breeza Road) | West of Werris Creek | 31°20'46.40"S | 150°34'36.89"E | (Lack of imagery to carry out desktop assessment)                                                                                                                               | Reasonable storage length available - The 275m distance between Gap Road and rail line, and the frequency of gaps in Gap Road traffic reduce the risk of queue spillback across the railway level crossing.                                                 |
| Werris Creek Road                  | Immediately north of South Street.                | Werris Creek         | 31°21'57.86"S | 150°38'39.37"E | Adequate controls in place – flashing signal controlled railway level crossing. Reasonable visibility to rail line from both main road approaches as well as from South Street. | Little risk of queue-related risks. Werris Creek Road traffic has priority and does not need to give way to side road traffic. There would be sufficient gaps available to prevent excessive queue build up due to right-turning traffic into South Street. |
| Lowes Creek Road                   | 500m east of Werris Creek Road                    | Quipolly             | 31°25'40.04"S | 150°39'22.81"E | Adequate controls in place – STOP sign controlled railway level crossing. Reasonable visibility to rail line from both road approaches.                                         | Little risk of queue-related risks due to the 500m length between the rail line and Werris Creek Road.                                                                                                                                                      |

| Location of railway level crossing | Reference to nearest cross road.              | Locality          | Latitude      | Longitude      | Commentary regarding risk category 1                                                            | Commentary regarding risk category 2                                                                                                                                                                                     |
|------------------------------------|-----------------------------------------------|-------------------|---------------|----------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bridges Road (Bells Gate Road)     | 2.2km north of Werris Creek Road              | North of Quirindi | 31°27'43.61"S | 150°40'23.81"E | <i>(Lack of imagery to carry out desktop assessment)</i>                                        | Little risk of queue-related risks due to the 2.2km length between the rail line and Werris Creek Road.                                                                                                                  |
| Nowland Street – Allnut Street     | 70m east of Hawker Street (Werris Creek Road) | Quirindi          | 31°30'02.63"S | 150°40'55.34"E | Adequate controls in place – flashing signal controlled railway level crossing with boom gates. | Reasonable storage length available - The 70m distance between Hawker Street and the rail line, and the frequency of gaps in Hawker Street traffic reduce the risk of queue spillback across the railway level crossing. |

| Location of railway level crossing | Reference to nearest cross road.                             | Locality          | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                    | Commentary regarding risk category 2                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------|--------------------------------------------------------------|-------------------|---------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Henry Street                       | 30m east of George Street-Station Street (Werris Creek Road) | Quirindi          | 31°30'29.52"S | 150°40'49.33"E | Adequate controls in place – flashing signal controlled railway level crossing with boom gates.                                         | Sufficient controls provided regarding potential queue-related risks. Boom gates are activated in advanced of the train arriving at the railway level crossing. This would control the potential queue spillback across the railway level crossing. Additional regulatory signs have been provided to prohibit queuing across the George Street/ Station Street/ Henry Street roundabout. |
| Callaghans Lane                    | 150m north of Kamilaroi Highway                              | South of Quirindi | 31°32'37.58"S | 150°41'36.80"E | Adequate controls in place – STOP sign controlled railway level crossing. Reasonable visibility to rail line from both road approaches. | Little risk of queue-related risks due to the 150m length between the rail line and the Kamilaroi Highway.                                                                                                                                                                                                                                                                                |
| Castlevue Hill Road                | 100m east of Kamilaroi Highway                               | South of Quirindi | 31°33'30.50"S | 150°41'49.36"E | Adequate controls in place – STOP sign controlled railway level crossing.                                                               | Little risk of queue-related risks due to the 100m length between the rail line and the Kamilaroi Highway.                                                                                                                                                                                                                                                                                |

| Location of railway level crossing | Reference to nearest cross road.      | Locality         | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                                                                                               | Commentary regarding risk category 2                                                                                                                                                                                                                                                                                                          |
|------------------------------------|---------------------------------------|------------------|---------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Merriwa Road                       | 75m south-west of New England Highway | Willow Tree      | 31°39'09.63"S | 150°43'41.93"E | Adequate controls in place – flashing signal controlled railway level crossing.                                                                                                                                    | Reasonable storage length available - The 75m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing.                                                                                                              |
| Glenyalla Road                     | 50m south-west of New England Highway | North of Ardglen | 31°41'40.28"S | 150°46'15.19"E | Adequate controls in place – STOP sign controlled railway level crossing. There is evidence of batter widening to improve sight benches from the western approach of Glenyalla Road to the railway level crossing. | Considerable short stacking queue risk due to the limited (50m) distance between the New England Highway and the rail line. Traffic volumes on Glenyalla Road unlikely to be high enough to generate significant queuing. There are reasonable "escape routes" into the level verges on the north eastern side of the railway level crossing. |

| Location of railway level crossing | Reference to nearest cross road. | Locality | Latitude      | Longitude      | Commentary regarding risk category 1                                                            | Commentary regarding risk category 2                                                                                                                                                                                                                   |
|------------------------------------|----------------------------------|----------|---------------|----------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High Street                        | 40m north of Bounty Street.      | Ardglen  | 31°44'17.61"S | 150°47'11.87"E | Adequate controls in place – flashing signal controlled railway level crossing with boom gates. | Little risk of queue-related risks. High Street traffic has priority and does not need to give way to side road traffic. There would be sufficient gaps available to prevent excessive queue build up due to right-turning traffic into Bounty Street. |
| Polding Street                     | 87m south of Haydon Street       | Ardglen  | 31°46'03.83"S | 150°50'07.24"E | Adequate controls in place – flashing signal controlled railway level crossing.                 | Little risk of queue-related risks due to low volumes on the road approaches.                                                                                                                                                                          |

| Location of railway level crossing | Reference to nearest cross road. | Locality  | Latitude      | Longitude      | Commentary regarding risk category 1                                            | Commentary regarding risk category 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------|----------------------------------|-----------|---------------|----------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| White Street                       | 20m south of New England Highway | Blandford | 31°47'34.73"S | 150°54'09.06"E | Adequate controls in place – flashing signal controlled railway level crossing. | Considerable short stacking queue risk due to the limited (20m) distance between the New England Highway and the rail line. A range of measures could be considered to further improve safety in these respects such as (i) banning long vehicles from using White Street and providing appropriate detours, (ii) shifting the New England Highway traffic lanes further north (by re-painting the lines) to increase the storage length available, or (iii) designating the southern shoulder of New England Highway (to the north west of the intersection) as an escape route for stranded vehicles. |

| Location of railway level crossing | Reference to nearest cross road. | Locality | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                          | Commentary regarding risk category 2                                                                                                                                                                                                                                                                                                                   |
|------------------------------------|----------------------------------|----------|---------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Livingston Street                  | 25m east of New England Highway  | Wingen   | 31°53'01.54"S | 150°52'52.25"E | Adequate controls in place<br>– STOP sign controlled railway level crossing.<br>Reasonable visibility to rail line from both road approaches. | Considerable short stacking queue risk due to the limited (25m) distance between the New England Highway and the rail line. Measures could be considered to further improve safety in these respects such as designating the eastern shoulder of New England Highway (to the south east of the intersection) as an escape route for stranded vehicles. |

| Location of railway level crossing | Reference to nearest cross road. | Locality           | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                       | Commentary regarding risk category 2                                                                                                                                                                                                                                                                                                                   |
|------------------------------------|----------------------------------|--------------------|---------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gateleys Road                      | 35m east of New England Highway  | Wingen             | 31°53'39.44"S | 150°52'49.70"E | Adequate controls in place – STOP sign controlled railway level crossing.<br>Reasonable visibility to rail line from both road approaches. | Considerable short stacking queue risk due to the limited (35m) distance between the New England Highway and the rail line. Measures could be considered to further improve safety in these respects such as designating the eastern shoulder of New England Highway (to the south east of the intersection) as an escape route for stranded vehicles. |
| Banool Road                        | 335m east of New England Highway | North of Parkville | 31°57'56.66"S | 150°52'04.96"E | <i>(Lack of imagery to carry out desktop assessment)</i>                                                                                   | Reasonable storage length available - The 335m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing.                                                                                                                      |

| Location of railway level crossing | Reference to nearest cross road. | Locality       | Latitude      | Longitude      | Commentary regarding risk category 1                                                            | Commentary regarding risk category 2                                                                                                                                                                                              |
|------------------------------------|----------------------------------|----------------|---------------|----------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mareeba Road                       | 255m east of New England Highway | Parkville      | 31°59'04.64"S | 150°52'04.47"E | Adequate controls in place – flashing signal controlled railway level crossing with boom gates. | Reasonable storage length available - The 255m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing. |
| Smith Road                         | 370m east of New England Highway | North of Scone | 32°00'35.83"S | 150°52'03.69"E | <i>(Lack of imagery to carry out desktop assessment)</i>                                        | Reasonable storage length available - The 370m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing. |

| Location of railway level crossing | Reference to nearest cross road. | Locality       | Latitude      | Longitude      | Commentary regarding risk category 1                                                                                                                                                                   | Commentary regarding risk category 2                                                                                                                                                                                              |
|------------------------------------|----------------------------------|----------------|---------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Common Lane                        | 420m east of New England Highway | North of Scone | 32°01'28.08"S | 150°52'03.27"E | <i>(Lack of imagery to carry out desktop assessment)</i>                                                                                                                                               | Reasonable storage length available - The 420m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing. |
| New England Highway                | 25m west of Muffet Street        | Scone          | 32°02'42.93"S | 150°52'01.85"E | Adequate controls in place – flashing signal controlled railway level crossing with boom gates. Furthermore, ARTC (2012) advised that RMS is assessing options to improve this railway level crossing. | Little risk of queue-related risks. The New England Highway traffic has priority and does not need to give way to side road traffic.                                                                                              |

| Location of railway level crossing | Reference to nearest cross road. | Locality       | Latitude      | Longitude      | Commentary regarding risk category 1                                            | Commentary regarding risk category 2                                                                                                                                                                                                 |
|------------------------------------|----------------------------------|----------------|---------------|----------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Liverpool Street                   | 105m west of New England Highway | Scone          | 32°03'02.05"S | 150°51'58.29"E | Adequate controls in place – flashing signal controlled railway level crossing. | Little risk of queue-related risks. Liverpool Street has two-lanes in approach to the roundabout intersection with New England Highway. The flashing signals would reduce the eastbound traffic flows entering the downstream queue. |
| Turanville Road                    | 155m west of New England Highway | South of Scone | 32°05'59.53"S | 150°52'04.59"E | Adequate controls in place – flashing signal controlled railway level crossing. | Reasonable storage length available - The 155m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing.    |

| Location of railway level crossing | Reference to nearest cross road. | Locality          | Latitude      | Longitude      | Commentary regarding risk category 1                                            | Commentary regarding risk category 2                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------|----------------------------------|-------------------|---------------|----------------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Halcolm Road                       | 25m east of New England Highway  | North of Aberdeen | 32°08'41.16"S | 150°52'57.93"E | Adequate controls in place – flashing signal controlled railway level crossing. | Considerable short stacking queue risk due to the limited (25m) distance between the New England Highway and the rail line. Measures could be considered to further improve safety in these respects such as (i) banning long vehicles from using Halcolm Road and providing appropriate detours (i.e. via Halcombe Road North), or (ii) designating the eastern shoulder of New England Highway (to the south east of the intersection) as an escape route for stranded vehicles. |

| Location of railway level crossing   | Reference to nearest cross road.       | Locality     | Latitude      | Longitude      | Commentary regarding risk category 1                                            | Commentary regarding risk category 2                                                                                                                                                                                                            |
|--------------------------------------|----------------------------------------|--------------|---------------|----------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| McAdam Street                        | 145m north east of New England Highway | Aberdeen     | 32°09'36.83"S | 150°53'24.55"E | Adequate controls in place – flashing signal controlled railway level crossing. | Reasonable storage length available - The 145m distance between New England Highway and rail line, and the frequency of gaps in New England Highway traffic reduce the risk of queue spillback across the railway level crossing.               |
| McCullys Gap Road (Sandy Creek Road) | 40m east of New England Highway        | Muswellbrook | 32°14'29.93"S | 150°54'11.72"E | Adequate controls in place – flashing signal controlled railway level crossing. | Considerable short stacking queue risk due to the limited (40m) distance between the New England Highway and the rail line. There are reasonable "escape routes" into the level verges on the south western side of the railway level crossing. |

| Location of railway level crossing | Reference to nearest cross road. | Locality     | Latitude      | Longitude      | Commentary regarding risk category 1                                                            | Commentary regarding risk category 2                                                                                                                                                                                             |
|------------------------------------|----------------------------------|--------------|---------------|----------------|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Brook Street                       | 110m west of New England Highway | Muswellbrook | 32°15'47.27"S | 150°53'15.03"E | Adequate controls in place – flashing signal controlled railway level crossing with boom gates. | Little risk of queue-related risks. Brook Street has two-lanes in approach to the signalised intersection with New England Highway. The flashing signals would reduce the eastbound traffic flows entering the downstream queue. |

## 11 CONCLUSIONS

This traffic and transport impact assessment has considered the potential road and rail traffic impacts associated with the Project, the potential impacts due to road closures, and potential road safety impacts.

### 11.1 ROAD TRAFFIC

During the construction phase of the Project, the main road traffic generation would be primarily associated with staff movements, and supply trucks. SIDRA models were prepared for the Kamilaroi Highway/ Mine Access Road as well as the Kamilaroi Highway/ Court Lane intersection, as the preliminary indicator of overall impact to the surrounding network. This accounted for the traffic volume build-up due to the construction phase as well as a conservative account of background traffic growth. The SIDRA modelling strongly indicates that the traffic generated by the construction phase of the Project would be absorbed into the existing traffic stream. This is largely due to the substantial spare capacity available in the network.

During the operational phase, Project-related traffic would include staff movements to and from the Project Boundary as well as supplies and consumables. The main inbound movements would be staff movements prior to the start of each work shift. The main outbound movements would be staff movements following the end of each work shift. SIDRA models were also prepared for the Kamilaroi Highway/ Mine Access Road as a preliminary indicator of overall impact to the surrounding network. These models accounted for the traffic volume build-up of the peak operational phase, coupled with a conservative growth in background traffic. Furthermore, it was assumed that the peak movements associated with the Project's shift changes would coincide with the AM and PM peak periods in background traffic. The SIDRA modelling strongly indicates that the traffic generated by the operational phase would be absorbed into the existing traffic stream. Like the construction phase, there would still be substantial spare capacity in the surrounding network during the peak of the operational phase.

### 11.2 ROAD SAFETY

The road safety (crash data) assessment indicated that the section of the Kamilaroi Highway in the immediate vicinity of the Project Boundary has not experienced a high rate of crashes. As such, any additional traffic generated by the Project would not be overly exposed to unacceptable crash risk in the surrounding network.

However, it is recognised that in a high-speed (110km/h) environment, there *could* be significant crash risk associated with the introduction of turning movements into and out of the Project Boundary.

Without safety improvements to the road intersections, the high speed differential between through traffic and decelerating or queued right-turn traffic could increase drivers' exposure to high-speed rear-end crashes. Similarly, traffic egressing from the Project Boundary would be entering the Kamilaroi Highway at low speed and would be at risk of impact from the high-speed Kamilaroi Highway traffic. As such, this assessment has recommended that the Kamilaroi Highway/ Mine Access Road intersection be a channelised (CHR) T intersection with an indented right-turn lane for southbound traffic and also provide sufficient length of indented left-turn lane for northbound traffic on the Kamilaroi Highway south approach.

The regional routes of Quirindi- West Tamworth Road, Werris Creek-Gap Road, and Breeza-Currabubula Road were also assessed for safety issues. These routes generally provide a good geometric alignment and hence reduce the risk of *loss of control* and *run off road* crashes. However, Werris Creek-Gap Road, and Breeza-Currabubula Road contain variable and weathered pavement edge conditions. As such, this Traffic and Transport Impact Assessment has recommended that RMS and Gunnedah/ Liverpool Plains Councils carry out pavement condition surveys to assess the relative need for maintenance and/or upgrade works on these routes regardless of the Project.

### **11.3 ROAD CLOSURES**

Permanent road closures would include all roads within the Disturbance Boundary which would need to be closed to allow mining activities to take place. The most significant roads affected would be Court Lane and the section of The Dip Road between Clift Road and Cull Road.

The Mine Access Road would replace Court Lane and be the main access point for all Project traffic. This will not be a public access road.

An alternative route would be provided for the The Dip Road closure via an upgraded Cull Road, upgraded and new Werner Road, and Clift Road. The increase in travel time associated with this alternative route is regarded as acceptable. The required approvals for the construction of the alternative route will be sought separately to this application.

Temporary road closures would be required for any road within 500m of blasting activities associated with the Project. This would mainly affect The Dip Road. A number of mitigation and management measures were recommended in order to address impact of these temporary road closures such as signage, notifications, and set blasting periods.

## 11.4 RAIL NETWORK

The assessment of rail network impacts considered the number of trains generated by the Project, as well as other known mine expansion or development projects. The assessment indicated that up to eight train movements (four laden and four non-laden) could be generated each haul day.

ARTC (2012) have already conducted extensive capacity demand forecasting along this line and have identified potential weak points along the network. Their strategy document (ARTC, 2012) identifies a range of network upgrades that would be required to facilitate the forecast demand increases. As these have already been recommended by the ARTC, they are not raised as mitigation measures in this study. However, it is recommended that Shenhua Watermark continue to liaise with the ARTC to regularly inform of production forecasts and to keep a watching brief over the timing of various network upgrades. Similarly, there is a need for Shenhua Watermark to stay abreast of the surrounding coal expansion and development projects.

This Traffic and Transport Impact Assessment has also examined 28 railway level crossings between the Project and Muswellbrook Junction for their performance and level of safety. This was regarded as the portion of the Hunter Valley Rail Network that could be potentially impacted by Project-related rail traffic. The assessment identified the following four railway level crossings which have existing significant short stacking risks:

- White Street, 20m south of New England Highway, Blandford;
- Livingston Street, 25m east of New England Highway, Wingen;
- Gateleys Road, 35m east of New England Highway, Wingen; and
- Halcolm Road, 25m east of New England Highway, north of Aberdeen.

It was also noted that all railway level crossings of public roads are assessed under ALCAM, a national scheme for the consistent assessment of these facilities. The ALCAM assessments are commissioned by the ATC on a regular basis and are used to inform funding decisions for upgrades or closures of railway level crossings. As these are covered under a national scheme, this Traffic and Transport Impact Assessment has recommended that Shenhua continue to liaise with ARTC and ATC with regards to forecasted train volumes and scheduling details so that these can be used to update the ALCAM assessments.

## 12 REFERENCES

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GHD (2010) *Shenhua Watermark – Prefeasibility Traffic Assessment.*

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## **APPENDIX A**

### ***Explanation of key traffic performance indicators***

### Level of service (LoS)

The SIDRA intersection simulation software is used to determine the likely traffic performance indicators including level of service (LoS), degree of saturation (DoS), average delay and maximum queue length (represented by 95th percentile queue length). At signalised and roundabout intersections, the LoS criteria are related to average intersection delay (seconds per vehicle). At sign controlled intersections (give way and stop), the LoS is based on the average delay (seconds per vehicle) for the worst movement. The following table summarises the intersection LoS criteria.

| Level of Service | Average Delay (seconds per vehicle) | Traffic Signals, Roundabout                                                                                  | Give Way and Stop Signs                                            |
|------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| A                | Less than 14                        | Good operation                                                                                               | Good operation                                                     |
| B                | 15 to 28                            | Good with acceptable delays and spare capacity                                                               | Acceptable delays and spare capacity                               |
| C                | 29 to 42                            | Satisfactory                                                                                                 | Satisfactory, but accident study required                          |
| D                | 43 to 56                            | Operating near capacity                                                                                      | Near capacity and accident study required                          |
| E                | 57 to 70                            | At capacity.<br>At signals, incidents will cause excessive delays.<br>Roundabouts require other control mode | At capacity; requires other control mode                           |
| F                | Greater than 71                     | Unsatisfactory with excessive queuing                                                                        | Unsatisfactory with excessive queuing; requires other control mode |

Source: RTA Guide to Traffic Generating Developments, 2002.

### Degree of saturation (DoS)

DoS is defined as the ratio of demand flow to capacity, and therefore has no unit. As it approaches 1.0, extensive queues and delays could be expected. For DoS greater than 1.0, a small increment in traffic volumes would result in an exponential increase in delays and queue length. For a satisfactory situation, the DoS should be less than the nominated practical degree of saturation, usually 0.90. The intersection DoS is based on the movement with the highest ratio.

### Average delay

Delay is the difference between interrupted and uninterrupted travel times through the intersection and is measured in seconds per vehicle. The delays include queued vehicles decelerating and accelerating to and/or from stop, as well as delays experienced by all vehicles negotiating the intersection. At signalised and roundabout intersections, the average intersection delay is usually reported and is taken as the weighted average delay by summing the product of the individual movement traffic volumes and their corresponding calculated delays and dividing these by the total number of vehicles entering the

intersection. At sign controlled intersections, the average delay for the worst movement is usually reported.

### Maximum queue length

Queue length is the number of vehicles waiting at the hold line and is usually quoted as the 95<sup>th</sup> percentile back of queue, which is the value below which 95 percent of all observed queue lengths fall. For signalised intersections, it is measured as the number of vehicles per traffic lane at the start of the green period, when the traffic starts moving again after a red signal. The intersection queue length is usually taken from the movement with the longest queue length.

### Explanation of SIDRA model outputs

An example of a SIDRA model output is provided below. An explanation of the model outputs follows the table.

Kamilaroi Highway/ Mine Access Road intersection 2028 AM peak operational  
Giveaway / Yield (Two-Way)

| Movement Performance - Vehicles |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
|---------------------------------|------|-------------------|------|---------------|-------------------|------------------|--------------------------------|-----------------|--------------|-----------------------------|--------------------|
| Mov ID                          | Turn | Demand Flow veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m      | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
| South: Kamilaroi Hwy S          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 4                               | L    | 65                | 3.2  | 0.036         | 14.2              | NA <sup>s</sup>  | NA <sup>s</sup>                | NA <sup>s</sup> | 0.00         | 0.74                        | 73.1               |
| 5                               | T    | 268               | 14.1 | 0.150         | 0.0               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.00                        | 110.0              |
| Approach                        |      | 334               | 12.0 | 0.150         | 2.8               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.14                        | 100.2              |
| North: Kamilaroi Hwy N          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 11                              | T    | 268               | 14.1 | 0.150         | 0.0               | LOS A            | 0.0                            | 0.0             | 0.00         | 0.00                        | 110.0              |
| 12                              | R    | 97                | 2.2  | 0.112         | 15.8              | LOS B            | 0.5                            | 3.7             | 0.39         | 0.78                        | 62.7               |
| Approach                        |      | 365               | 11.0 | 0.150         | 4.2               | LOS B            | 0.5                            | 3.7             | 0.10         | 0.21                        | 95.4               |
| West: Mine Access Road          |      |                   |      |               |                   |                  |                                |                 |              |                             |                    |
| 1                               | L    | 97                | 2.2  | 0.234         | 12.1              | LOS A            | 1.1                            | 8.1             | 0.50         | 0.75                        | 54.6               |
| 3                               | R    | 65                | 3.2  | 0.235         | 12.2              | LOS A            | 1.1                            | 8.1             | 0.50         | 0.84                        | 54.6               |
| Approach                        |      | 162               | 2.6  | 0.235         | 12.2              | LOS A            | 1.1                            | 8.1             | 0.50         | 0.79                        | 54.6               |
| All Vehicles                    |      | 861               | 9.8  | 0.235         | 5.1               | NA               | 1.1                            | 8.1             | 0.14         | 0.29                        | 84.8               |

**“South: Kamilaroi Hwy S”:** This indicates that the approach in question is the southern approach to the intersection, which is the Kamilaroi Highway South approach.

**L, T, R:** Refer to the *left-turn*, *through*, and *right-turn* movements in that approach respectively.

**Demand flow:** is the traffic volume for the corresponding turning movement.

**HV%:** means the percentage of heavy vehicles in the corresponding traffic stream.

**Deg Satn:** Refers to the degree of saturation (DoS) for that turning movement. See the explanation for DoS provided in this Appendix.

**Average delay (seconds/vehicle):** Traffic delay consists of dynamic delay and static delay. Dynamic delay consists of the time taken for a vehicle to slow down, negotiate through the intersection, and then speed up to the target speed of the intersection departure. This is particularly prominent for turning movements as there is significant deceleration and acceleration involved. Static delay is the delay incurred when the vehicle is in a queue and is not moving.

**LoS:** Refers to Level of Service as explained in this Appendix.

**95% back of queue:** This is the queue length in vehicles and in metres which is only exceeded for 5% of the time. This is regarded as the maximum queue length for design purposes.

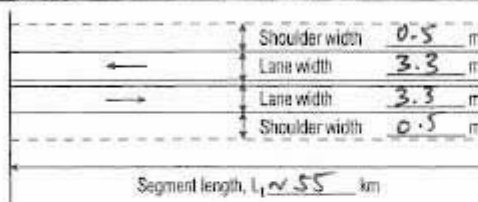
**Prop queued:** This refers to the proportion of traffic in the corresponding traffic stream that is queued.

**Effective stop rate per vehicle:** This is the average number of stops per vehicle. This considers vehicles in a queue and whether they progress to the front of the queue via series of start-stops (move ups) in which case there would be a high stop rate, or whether the vehicle tends to progress toward the queue head in one go. For priority-controlled intersections (not traffic signals) where queue progression is largely related to the randomness of gap availability and gap acceptance, there tends to be a relatively higher effective stop rate for vehicles in the low priority movements.

**Average speed:** The average speed of vehicles in the corresponding traffic stream.

## **APPENDIX B**

### ***Midblock level of service analysis for Quirindi-West Tamworth Road***

| TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General Information</b>                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Analyst: <u>DCT</u>                                                                                                                                                                                                                                                   | Site Information: Highway <u>MR 130, Quirindi-West Tamworth Rd</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Agency or Company: <u>SHENHUA WATERMARK</u>                                                                                                                                                                                                                           | From/To: _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Date Performed: <u>3/1/2013</u>                                                                                                                                                                                                                                       | Jurisdiction: _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Analysis Time Period: <u>Peak hour</u>                                                                                                                                                                                                                                | Analysis Year: _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <input checked="" type="checkbox"/> Operational (LOS) <input type="checkbox"/> Design ( $V_p$ ) <input type="checkbox"/> Planning (LOS) <input type="checkbox"/> Planning ( $V_p$ )                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Input Data</b>                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|  <p>Shoulder width: <u>0.5</u> m<br/>Lane width: <u>3.3</u> m<br/>Lane width: <u>3.3</u> m<br/>Shoulder width: <u>0.5</u> m</p> <p>Segment length, <math>L_1</math> <u>55</u> km</p> |  <p><input checked="" type="checkbox"/> Class I highway      <input type="checkbox"/> Class II highway<br/>Terrain: <input type="checkbox"/> Level      <input checked="" type="checkbox"/> Rolling<br/>Two-way hourly volume: <u>300</u> veh/h (<math>V</math>)<br/>Directional split: <u>70</u> / <u>130</u><br/>Peak-hour factor, PHF: <u>0.88</u> (Ex 12-9)<br/>% Trucks and buses, <math>P_T</math>: <u>10</u> %<br/>% Recreational vehicles, <math>P_R</math>: <u>0</u> %<br/>% No-passing zone: <u>40</u> %<br/>Access points/km: <u>2</u> /km</p> |
| <b>Average Travel Speed</b>                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Grade adjustment factor, $f_g$ (Exhibit 20-7)                                                                                                                                                                                                                         | <u>0.71</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9)                                                                                                                                                                                                            | <u>2.5</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9)                                                                                                                                                                                                               | <u>NA.</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Heavy-vehicle adjustment factor, $f_{HV}$ $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$                                                                                                                                                                        | $= \frac{1}{1 + (0.1 \times 1.5) + 0} = 0.87$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Two-way flow rate, $V_p$ (pc/h) $V_p = PHF \times V \times f_g \times f_{HV}$                                                                                                                                                                                         | $= \frac{300}{0.88 \times 0.71 \times 0.87} = 552$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| $V_p$ * highest directional split proportion $^2$ (pc/h)                                                                                                                                                                                                              | $= 552 \times 0.7 = 386$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Free-Flow Speed from Field Measurement                                                                                                                                                                                                                                | Estimated Free-Flow Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Field measured speed, $S_{FM}$ _____ km/h                                                                                                                                                                                                                             | Base free-flow speed, BFFS <u>100</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Observed volume, $V_f$ _____ veh/h                                                                                                                                                                                                                                    | Adj. for lane width and shoulder width, $f_{LS}$ (Exhibit 20-5) <u>7.5</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Free-flow speed, FFS _____ km/h                                                                                                                                                                                                                                       | Adj. for access points, $f_A$ (Exhibit 20-6) <u>1.33</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| $FFS = S_{FM} + 0.0125 \left( \frac{V_f}{V_{FM}} \right)$                                                                                                                                                                                                             | Free-flow speed, FFS _____ km/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Adj. for no-passing zones, $f_{np}$ (km/h) (Exhibit 20-11)                                                                                                                                                                                                            | $FFS = BFFS - f_{LS} - f_A = 100 - 7.5 - 1.33 = 91$ km/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Average travel speed, ATS (km/h) $ATS = FFS - 0.0125 V_p - f_{np}$                                                                                                                                                                                                    | $91 - (0.0125 \times 552) - 3.3 = 80.8$ km/h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Percent Time-Spent-Following</b>                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Grade adjustment factor, $f_g$ (Exhibit 20-3)                                                                                                                                                                                                                         | <u>0.77</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10)                                                                                                                                                                                                           | <u>1.8</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10)                                                                                                                                                                                                              | <u>NA.</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Heavy-vehicle adjustment factor, $f_{HV}$ $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$                                                                                                                                                                        | $= \frac{1}{1 + (0.1 \times 0.8) + 0} = 0.93$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Two-way flow rate, $V_p$ (pc/h) $V_p = PHF \times V \times f_g \times f_{HV}$                                                                                                                                                                                         | $= \frac{300}{0.88 \times 0.77 \times 0.93} = 476$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| $V_p$ * highest directional split proportion $^2$ (pc/h)                                                                                                                                                                                                              | $= 476 \times 0.7 = 333$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Base percent time-spent-following, BPTSF (%) $BPTSF = 100 [1 - \exp(-0.000879 V_p)]$                                                                                                                                                                                  | $= 100 \times 25.4\%$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Adj. for directional distribution and no-passing zone, $f_{dnp}$ (%) (Exhibit 20-12)                                                                                                                                                                                  | $= 18.2$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{dnp}$                                                                                                                                                                                                       | $= 25.4 + 18.2 = 43.6\%$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Level of Service and Other Performance Measures</b>                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)                                                                                                                                                                                                 | <u>B</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Volume to capacity ratio, $w/c$ $w/c = \frac{V_p}{3,200}$                                                                                                                                                                                                             | <u>=</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Peak 15-min vehicle-kilometers of travel, $VkmT_{15}$ (veh-km) $VkmT_{15} = 0.25 V_p \left( \frac{V}{PHF} \right)$                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Peak-hour vehicle-kilometers of travel, $VkmT_{60}$ (veh-km) $VkmT_{60} = V \times L_1$                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Peak 15-min total travel time, $TT_{15}$ (veh-h) $TT_{15} = \frac{VkmT_{15}}{ATS}$                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Notes</b>                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1. If $V_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.<br>2. If highest directional split $V_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

$$BPTSF = 100 (1 - e^{-0.000879 \times 333})$$

Sensitivity test: ① For LOS to drop to D, average speed would need to drop to  $< 70$  km/h.

② For LOS to drop to D, percentage time spent following would need to increase to 76%.

*Sensitivity test 1*

| TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General Information</b><br>Analyst: <u>DCT</u><br>Agency or Company: <u>Shenhua Watermark</u><br>Date Performed: <u>3/1/2013</u><br>Analysis Time Period: <u>Peak hour - sensitivity</u>                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Site Information</b><br>Highway: <u>MR130</u><br>From/To: _____<br>Jurisdiction: _____<br>Analysis Year: _____                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <input checked="" type="checkbox"/> Operational (LOS) <input type="checkbox"/> Design ( $v_p$ ) <input type="checkbox"/> Planning (LOS) <input type="checkbox"/> Planning ( $v_p$ )                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Input Data</b>                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <p>Shoulder width: <u>0.5</u> m<br/>           Lane width: <u>3.3</u> m<br/>           Lane width: <u>3.3</u> m<br/>           Shoulder width: <u>0.5</u> m<br/>           Segment length, <math>L_1</math>: <u>~55</u> km</p> | <input checked="" type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway<br>Terrain: <input type="checkbox"/> Level <input checked="" type="checkbox"/> Rolling ( $v$ )<br>Two-way hourly volume: <u>813</u> veh/h<br>Directional split: <u>70 / 30</u><br>Peak-hour factor, PHF: <u>0.88</u><br>% Trucks and buses, $P_T$ : <u>10</u> %<br>% Recreational vehicles, $P_R$ : <u>0</u> %<br>% No-passing zone: <u>40</u> %<br>Access points/km: <u>2</u> /km |
| <b>Average Travel Speed</b>                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Grade adjustment factor, $f_G$ (Exhibit 20-7)                                                                                                                                                                                  | <u>0.71</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9)                                                                                                                                                                     | <u>2.5</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9)                                                                                                                                                                        | <u>NA</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Heavy-vehicle adjustment factor, $f_{HV}$ $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$                                                                                                                                 | <u>SS 0.87</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Two-way flow rate, $^1 v_p$ (pc/h) $v_p = PHF \cdot f_G \cdot f_{HV} \cdot V$                                                                                                                                                  | <u>= 1496 <math>\therefore V = 813</math></u>                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| $v_p$ * highest directional split proportion $^2$ (pc/h)                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Free-Flow Speed from Field Measurement</b>                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Field measured speed, $S_{FM}$ _____ km/h                                                                                                                                                                                      | Base free-flow speed, BFFS <u>100</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Observed volume, $V_f$ _____ veh/h                                                                                                                                                                                             | Adj. for lane width and shoulder width, $f_{LS}$ (Exhibit 20-5) <u>7.5</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                  |
| Free-flow speed, FFS _____ km/h                                                                                                                                                                                                | Adj. for access points, $f_A$ (Exhibit 20-6) <u>1.33</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                                    |
| FFS = $S_{FM} + 0.0125 \left( \frac{V_f}{f_{HV}} \right)$                                                                                                                                                                      | Free-flow speed, FFS <u>91</u> km/h                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|                                                                                                                                                                                                                                | FFS = BFFS - $f_{LS}$ - $f_A$                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Adj. for no-passing zones, $f_{np}$ (km/h) (Exhibit 20-11)                                                                                                                                                                     | <u>3.3</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Average travel speed, ATS (km/h) $ATS = FFS - 0.0125 v_p - f_{np}$                                                                                                                                                             | <u>69 km/h <math>\therefore v_p = 1496</math></u>                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Percent Time-Spent-Following</b>                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Grade adjustment factor, $f_G$ (Exhibit 20-8)                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10)                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10)                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Heavy-vehicle adjustment factor, $f_{HV}$ $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Two-way flow rate, $^1 v_p$ (pc/h) $v_p = PHF \cdot f_G \cdot f_{HV} \cdot V$                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| $v_p$ * highest directional split proportion $^2$ (pc/h)                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Base percent time-spent-following, BPTSF (%) $BPTSF = 100 [1 - \exp(-0.000879 v_p)]$                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Adj. for directional distribution and no-passing zone, $f_{dnp}$ (%) (Exhibit 20-12)                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{dnp}$                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Level of Service and Other Performance Measures</b>                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)                                                                                                                                                          | <u>D</u>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Volume to capacity ratio, $v/c$ $v/c = \frac{v_p}{3,200}$                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Peak 15-min vehicle-kilometers of travel, $V_{kmT_{15}}$ (veh-km) $V_{kmT_{15}} = 0.25 L_1 \left( \frac{V}{PHF} \right)$                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Peak-hour vehicle-kilometers of travel, $V_{kmT_{60}}$ (veh-km) $V_{kmT_{60}} = V \cdot L_1$                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Peak 15-min total travel time, $TT_{15}$ (veh-h) $TT_{15} = \frac{V_{kmT_{15}}}{ATS}$                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Notes</b>                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.<br>2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

Working backwards from LOS D on Average Travel speed threshold to determine critical midblock traffic volume to tip road into LOS D.

## Sensitivity test 2

| TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General Information</b>                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Analyst                                                                                                                                                                             | DCT                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Agency or Company                                                                                                                                                                   | Shenhua Watermark                                                                                                                                                                                                                                                                                                                                                                                                   |
| Date Performed                                                                                                                                                                      | 2/1/2013                                                                                                                                                                                                                                                                                                                                                                                                            |
| Analysis Time Period                                                                                                                                                                | Peak hour - sensitivity                                                                                                                                                                                                                                                                                                                                                                                             |
| <input checked="" type="checkbox"/> Operational (LOS) <input type="checkbox"/> Design ( $v_p$ ) <input type="checkbox"/> Planning (LOS) <input type="checkbox"/> Planning ( $v_p$ ) |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Site Information</b>                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Highway                                                                                                                                                                             | MR 130                                                                                                                                                                                                                                                                                                                                                                                                              |
| From/To                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Jurisdiction                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Analysis Year                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Input Data</b>                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <p>Shoulder width 0.5 m</p> <p>Lane width 3.3 m</p> <p>Lane width 3.3 m</p> <p>Shoulder width 0.5 m</p> <p>Segment length, <math>L_s</math> ~ 55 km</p>                             | <input checked="" type="checkbox"/> Class I highway <input type="checkbox"/> Class II highway<br>Terrain <input type="checkbox"/> Level <input checked="" type="checkbox"/> Rolling<br>Two-way hourly volume 452 veh/h (V) *<br>Directional split 70 / 30<br>Peak-hour factor, PHF 0.88<br>% Trucks and buses, $P_T$ 10 %<br>% Recreational vehicles, $P_R$ 0 %<br>% No-passing zone 40 %<br>Access points/km 2 /km |
| <b>Average Travel Speed</b>                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Grade adjustment factor, $f_G$ (Exhibit 20-7)                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-9)                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-9)                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Heavy-vehicle adjustment factor, $f_{HV}$ $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Two-way flow rate, $^1 v_p$ (pc/h) $v_p = PHF \cdot f_G \cdot f_{HV}$                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| $v_p$ * highest directional split proportion $^2$ (pc/h)                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Free-Flow Speed from Field Measurement                                                                                                                                              | Estimated Free-Flow Speed                                                                                                                                                                                                                                                                                                                                                                                           |
| Field measured speed, $S_{FM}$ km/h                                                                                                                                                 | Base free-flow speed, BFFS km/h                                                                                                                                                                                                                                                                                                                                                                                     |
| Observed volume, $V_f$ veh/h                                                                                                                                                        | Adj. for lane width and shoulder width, $f_{LS}$ (Exhibit 20-5) km/h                                                                                                                                                                                                                                                                                                                                                |
| Free-flow speed, FFS km/h                                                                                                                                                           | Adj. for access points, $f_A$ (Exhibit 20-6) km/h                                                                                                                                                                                                                                                                                                                                                                   |
| FFS = $S_{FM} - 0.0125 \left( \frac{V_f}{f_{HV}} \right)$                                                                                                                           | Free-flow speed, FFS km/h                                                                                                                                                                                                                                                                                                                                                                                           |
| Adj. for no-passing zones, $f_{np}$ (km/h) (Exhibit 20-11)                                                                                                                          | FFS = BFFS - $f_{LS}$ - $f_A$                                                                                                                                                                                                                                                                                                                                                                                       |
| Average travel speed, ATS (km/h) $ATS = FFS - 0.0125 v_p - f_{np}$                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Percent Time-Spent-Following</b>                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Grade adjustment factor, $f_G$ (Exhibit 20-8)                                                                                                                                       | 0.77                                                                                                                                                                                                                                                                                                                                                                                                                |
| Passenger-car equivalents for trucks, $E_T$ (Exhibit 20-10)                                                                                                                         | 1.8                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Passenger-car equivalents for RVs, $E_R$ (Exhibit 20-10)                                                                                                                            | NA                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Heavy-vehicle adjustment factor, $f_{HV}$ $f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$                                                                                      | = 0.93                                                                                                                                                                                                                                                                                                                                                                                                              |
| Two-way flow rate, $^1 v_p$ (pc/h) $v_p = PHF \cdot f_G \cdot f_{HV}$                                                                                                               | = 718 $\therefore V = 452$                                                                                                                                                                                                                                                                                                                                                                                          |
| $v_p$ * highest directional split proportion $^2$ (pc/h)                                                                                                                            | = 46.8 $\therefore v_p = 718$                                                                                                                                                                                                                                                                                                                                                                                       |
| Base percent time-spent-following, BPTSF (%) $BPTSF = 100[1 - \exp(-0.000879 v_p)]$                                                                                                 | = 18.2                                                                                                                                                                                                                                                                                                                                                                                                              |
| Adj. for directional distribution and no-passing zone, $f_{dnp}$ (%) (Exhibit 20-12)                                                                                                | 65% therefore BPTSF = 65 - 18.2 = 46.8                                                                                                                                                                                                                                                                                                                                                                              |
| Percent time-spent-following, PTSF (%) $PTSF = BPTSF + f_{dnp}$                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Level of Service and Other Performance Measures</b>                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)                                                                                                               | D                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Volume to capacity ratio, $w/c$ $w/c = \frac{V_p}{3200}$                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Peak 15-min vehicle-kilometers of travel, $VkmT_{15}$ (veh-km) $VkmT_{15} = 0.25 L_s \left( \frac{V}{PHF} \right)$                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Peak-hour vehicle-kilometers of travel, $VkmT_{60}$ (veh-km) $VkmT_{60} = V \cdot L_s$                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Peak 15-min total travel time, $TT_{15}$ (veh-h) $TT_{15} = \frac{VkmT_{15}}{ATS}$                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Notes</b>                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1. If $v_p \geq 3,200$ pc/h, terminate analysis—the LOS is F.<br>2. If highest directional split $v_p \geq 1,700$ pc/h, terminate analysis—the LOS is F.                            |                                                                                                                                                                                                                                                                                                                                                                                                                     |

Working backwards from LOS D on PTSF threshold to determine critical midblock traffic volume to tip road into LOS D