ULAN ROAD STRATEGY

Condition 50 of project approval PA08_0184

Project No: 003201

by David McTiernan, Noha Elazar, Riaan Burger

for Ulan Coal Mine Limited,
in conjunction with:
Wilpinjong Coal Operation and
Moolarben Coal Operation

ARRB Group Ltd
www.arrb.com.au

ACN 004 620 651
ABN 68 004 620 651

- Research and Consulting
- Systems

Victoria
500 Burwood Highway
Vermont South VIC 3133
Australia
P: +61 3 9881 1555
F: +61 3 9887 8104
info@arrb.com.au

Western Australia
191 Carr Place
Leederville WA 6007
Australia
P: +61 8 9227 3000
F: +61 8 9227 3030
arrb.wa@arrb.com.au

New South Wales
2-14 Mountain Street
Ultimo NSW 2007
Australia
P: +61 2 9282 4444
F: +61 2 9280 4430
arrb.nsw@arrb.com.au

Queensland
123 Sandgate Road
Albion QLD 4010
Australia
P: +61 7 3260 3500
F: +61 7 3862 4699
arrb.qld@arrb.com.au

South Australia
Suite 507, 147 Pirie Street
Adelaide SA 5000
Australia
P: +61 8 7200 2659
F: +61 8 8223 7406
arrb.sa@arrb.com.au

Luxmoore Parking Consulting
Ground Floor
12 Wellington Parade
East Melbourne VIC 3002
P: +61 3 9417 5277
F: +61 3 9416 2602

International Offices
Xiamen, China
Dubai, United Arab Emirates
Abu Dhabi, United Arab Emirates

Ulan Road Strategy

for Ulan Coal Mine Limited

	Reviewed
Project Leader	David McTiernan
Quality Manager	Arjan Rensen

004247-1
December 2011

ARRB Group Ltd
ABN 68 004 620 651

Victoria
500 Burwood Highway
Vermont South VIC 3133
Australia
P: +61 3 9881 1555
F: +61 3 9887 8104
info@arrb.com.au

Western Australia
191 Carr Place
Leederville WA 6007
Australia
P: +61 8 9227 3000
F: +61 8 9227 3030
arrb.wa@arrb.com.au

New South Wales
2-14 Mountain St
Ultimo NSW 2007
Australia
P: +61 2 9282 4444
F: +61 2 9280 4430
arrb.nsw@arrb.com.au

Queensland
123 Sandgate Road
Albion QLD 4010
Australia
P: +61 7 3260 3500
F: +61 7 3862 4699
arrb.qld@arrb.com.au

South Australia
Level 5, City Central,
Suite 507, 147 Pirie Street
Adelaide SA 5000
Australia
P: +61 8 7200 2659
F: +61 8 8223 7406
arrb.sa@arrb.com.au

Luxmoore Parking Consulting
Ground Floor
12 Wellington Parade
East Melbourne, VIC 3002
P: +61 3 9417 5277
F: +61 3 9416 2602

International offices:
Dubai, United Arab Emirates
Xiamen, People's Republic of China

EXECUTIVE SUMMARY

On 15 November 2010 Ulan Coal Mine Limited (UCML) was granted project approval under Part 3A of the Environmental Planning and Assessment Act (EP&A Act 1979) for the Ulan Coal Continued Operation project.

Condition 50 of the Project Approval (PA08_0184) requires that a strategy be prepared *'…for the upgrade and maintenance of Ulan Road between Mudgee and the entrance to the underground surface facilities at the Ulan Mine over the next 21 years'*.

The consent outlines ten points that are to be addressed by this Ulan Road Strategy. These are:

(a) Be prepared by a suitably qualified, experienced and independent person whose appointment has been endorsed by the Director-General.

(b) Be prepared in consultation with both the RMS and Council.

(c) Determine the design standard of the relevant section of road (and any associated intersections) to the satisfaction of the RMS (based on the relevant road design guideline(s)).

(d) Identify the works required to upgrade the road to the designated design standard.

(e) Estimate the cost of these works and the likely annual costs for maintaining the upgraded road.

(f) Identify any measures that could be implemented to reduce the amount of mine traffic on the road, such as providing long-term parking and in Mudgee to support increased car-pooling, and the likely cost of implementing those measures.

(g) Identify any measures that could be implemented to minimise the traffic noise impacts of mine traffic on Ulan Road on adjoining residences, and the likely costs of implementing these measures.

(h) Include a detailed program for the proposed upgrade and maintenance of the road, implementation of traffic noise mitigation measures, and implementation of any works to support the reduction in the amount of mine traffic on the road.

(i) Calculate what each mine and the council shall contribute towards the implementation of the detailed program outlines in (h) above, including consideration of:

- the likely traffic generated by each mine as a proportion of the total traffic on the road;
- any mine contributions that have been made towards the upgrading of the road in recent years; and
- any relevant planning agreements that deal with the funding or maintenance of the roads in the Mudgee LGA area.

(j) Include a detailed contributions plan for the three mines and the council to support the implementation of the detailed program described in (h) above.

The project consent for the Wilpinjong Coal Operation (WCO) contains a similar condition, with requirement to prepare a road strategy and are included as a stakeholder in the preparation of this strategy.

Under its current consent, the Moolarben Coal Operation (MCO) has no approval condition to require them to develop this strategy.

This report addresses each of the matters contained in condition 50 of the project approval PA08_0184 and provides a strategy for managing Ulan Road.

The Ulan Road Strategy has been prepared by the Australian Road Research Board Group Ltd (ARRB). ARRB is Australia's premier applied research agency for road transport matters and has over 50 years' experience undertaking research and consulting work in all areas of road transport and road management disciplines. ARRB has developed and applies specialist road asset data collection systems that have provided input to key areas of the strategy.

ARRB was endorsed by the Director-General of the NSW Department of Planning (DP&I) and Infrastructure prior to commencement of the project in accordance with part 'a' of condition 50 of the project approval.

The Ulan Road Strategy identifies the whole-of-life mine related and non-mine related traffic impacts on Ulan Road. It also presents the improvement works considered necessary to upgrade and maintain the road to a condition suitable for the projected traffic demand over the 21 years operational life of the mines. It then seeks to apportion the cost of these works to the three mines and to MWRC on a fair and equitable basis using the whole-of-life traffic generated by each of the mine and council stakeholders.

Stakeholder consultation

At the outset, consultation between the three mines, the Mid-Western Regional Council (MWRC) and the Roads and Maritime Services (RMS), formerly the NSW Roads and Traffic Authority, was a requirement for the preparation of this strategy. Stakeholder meetings were held with representatives of each mine, the MWRC and the RMS prior to and during the development of this strategy.

Design standard

Ulan Road is considered a class 3 road under the Austroads approach to road classification, providing both access and mobility functions and catering for a mix of light and heavy vehicular traffic.

Based on the projected vehicle use established in traffic studies for the mine operations, the adopted desirable design standard for Ulan Road, in line with Austroads specifications, is a carriageway width of 11.0 metres. This is comprised of two 3.5 metre sealed lanes, two 1.0 metre sealed shoulders and two 1.0 metre unsealed shoulders.

A minimum design standard specifying an 8.2 metre formation width is also recommended for sections of Ulan Road where road widening works would be impractical. This may be due to significant site constraints or adverse environment impacts, or more commonly the case where a wider road formation is generally considered un-necessary since the existing road formation is considered adequate and in good condition.

The Austroads Guide to Road Design identifies that non-signalised rural road intersections should be a minimum basic right/basic left (BAR/BAL) turn standard. Where traffic volumes warrant it, the design arrangement may require additional width and protected turn lanes up to a channelised right and channelised left (CHR/CHL) design. Each intersection along Ulan Road has been assessed against the Austroads warrants. As an additional consideration, the risk presented to motorists by each intersection not meeting the warrants for a higher order configuration was considered. Where a clear road safety concern was identified, then an upgrade of the intersection was included in the list of upgrade works.

Road condition and maintenance

The existing condition of Ulan Road was assessed using road surface condition index, pavement deflection testing and a visual rating method. Using the results of these assessments, 24.651 km (54.5%) is considered to be in either adequate (existing) or adequate (new) condition.

The remaining 20.585 km length is considered inadequate for existing and projected traffic volumes and requires rehabilitation and widening to the desirable design standard. These works are identified as capital works since they upgrade the standard of the existing road asset.

The outcome of the condition assessments identified sections of adequate condition road that will require some form of maintenance intervention during the 21 year operating period of the mines. These works are identified as maintenance works since they rehabilitate the existing asset and do not involve an upgrade of the asset.

A proactive road asset management plan for Ulan Road for the 21 year life of mine operations has been developed for this strategy. This proactive approach requires regular surface condition and pavement testing to assist determining the level of maintenance intervention required. A three year cycle of testing is suggested, with surface condition assessments every cycle, i.e. every three years, and pavement testing every second cycle, i.e. every 6 years.

An indicative maintenance program has been prepared based on a reseal/pavement rehabilitation design life of 10 and 20 years, respectively. The annual program of maintenance works should be reviewed to incorporate the results of the condition assessment cycle.

Capital works

As mentioned previously, 20.585 km of Ulan requires upgrade to the desirable design standard. This length is considered inadequate for the existing and projected traffic loading due primarily to the narrow width of seal and poor condition of the pavement, particularly at the edge of seal and road shoulders.

Twenty-six road intersections have been identified for some level of upgrade, typically to a BAR/BAL standard.

Of these, eleven intersections will require works to provide a higher design standard than BAR/BAL to cater for larger through and turning traffic conflicts. These upgrades are primarily for reasons of road safety rather than capacity increases.

Works required in addition to road pavement upgrades include safety improvements such as safety barrier fencing and improved signing and delineation.

Apportioning costs

Intersections

The apportioning of costs for intersection works considers the proportion of through versus turning traffic for mine and non-mine related traffic at each intersection and is described in Figure S1 andTable S.1.

The whole-of-life mine related and non-mine related traffic has been used to calculate the proportion of through and turning traffic apportionment.

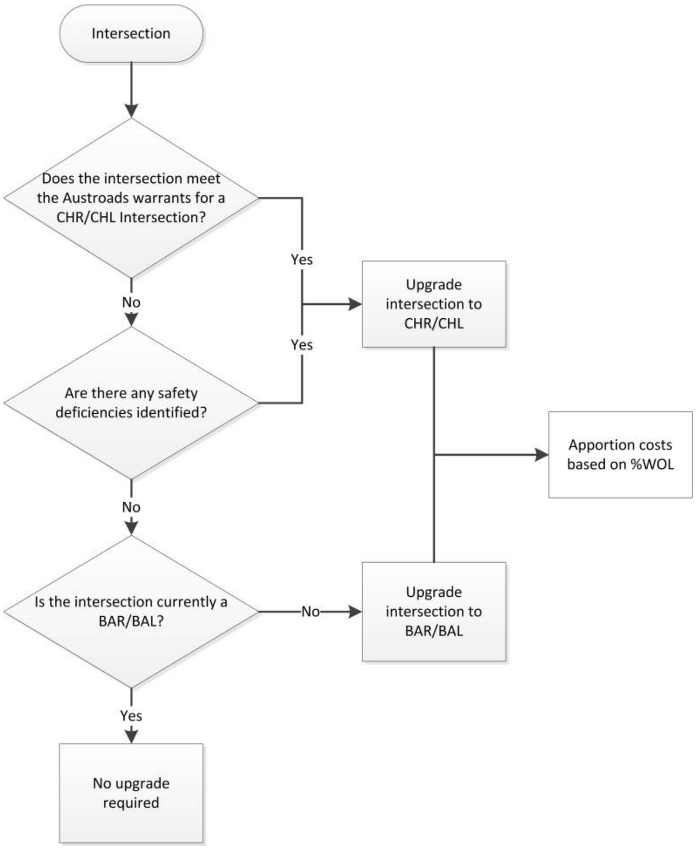


Figure S1: Intersection apportionment

Table S.1: Intersection apportionment

Turning traffic[1] (contribute 50% of need for improvement)		Through traffic[2] (contribute 50% of need for improvement)	
% mines	% council (non-mine)	% mines	% council (non-mine)

Notes

1: The assumptions of previous consulting traffic studies are adopted, i.e. the proportion of mine related traffic travels to/from Mudgee.

2: The proportion of mine vs. non-mine related traffic varies across Ulan Road sections 1, 2, 3 and 4.

Road upgrades

For road upgrade and road maintenance works, the apportionment considers the nexus between the road upgrade element, e.g. additional lane width, sealed shoulder etc., and the mine and non-mine related traffic.

Road maintenance

The apportioning of costs for road maintenance works considers the proportion of the whole-of-life traffic represented by mine and non-mine related activities. These proportions vary along the length of Ulan Road; typically mine related traffic is a higher proportion in the north and a lower proportion in the south.

The apportionment for road upgrade and road maintenance works is described in Table S.2 and is illustrated in the Figure S.2 and S.3.

A breakdown of the whole-of-life traffic proportions for each section along Ulan Road is given in Table S.3, noting that for sections 2, 3 and 4 the profile of the traffic volume changes along their length, as indicated in the traffic counts provided by MWRC. Therefore proportioning mine and non-mine related traffic within these sections was possible to more accurately apportion costs for the various works.

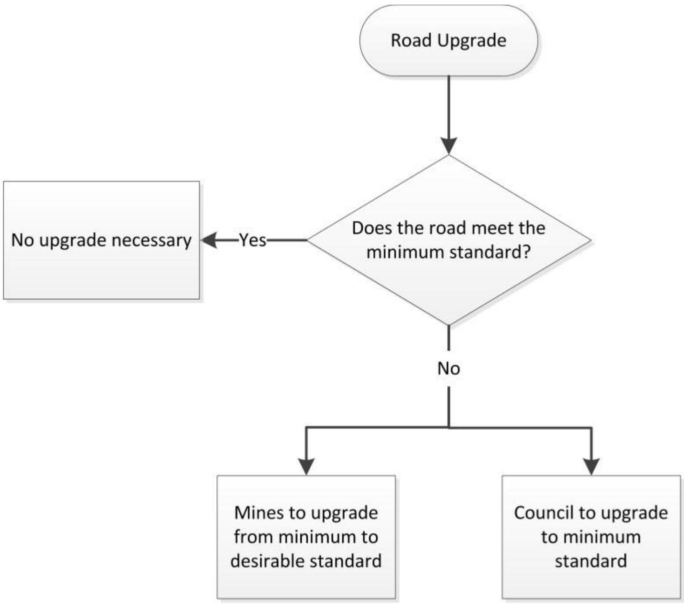
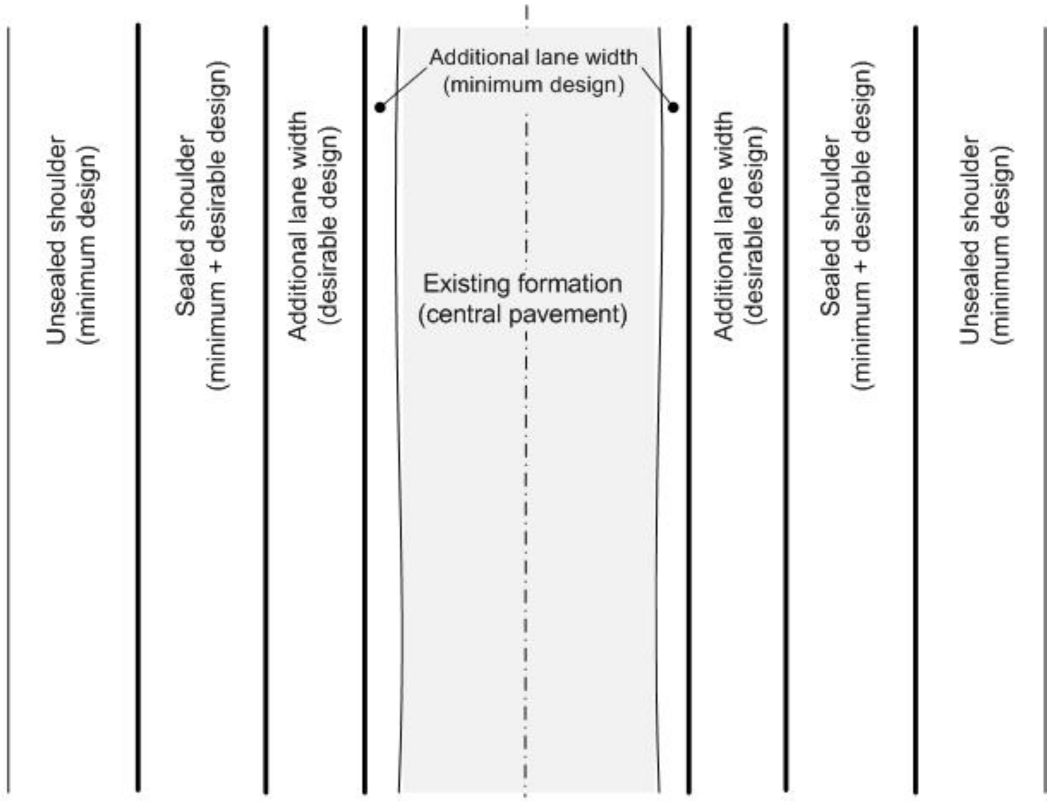


Figure S.2: Cost apportionment Road upgrade

Table S.2: Road upgrade (midblock) apportionment

Works	Mines		MWRC	
	Description of works	Contribution	Description of works	Contribution
Road upgrade	The difference in the cost to upgrade Ulan Road from the minimum to the desirable design formation	100%	The cost to upgrade Ulan Road to the minimum design formation	100%
Road maintenance	Reseal and rehabilitation of the carriageway on a 10/20 year (reseal/rehabilitation) management strategy.	%WoL	Reseal and rehabilitation of the carriageway on a 10/20 year (reseal/rehabilitation) management strategy.	%WoL

Note: %WoL is the proportion of all traffic that is mine and non-mine related traffic for the mines and MWRC, respectively



Apportionment rates

Road upgrade (Mines)	0%	50%	100%	0%	0%	0%	100%	50%	0%
Road upgrade (MWRC)	100%	50%	0%	100%	100%	100%	0%	50%	100%
Road maintenance	% WoL	% WoL	% WoL	%WoL	% WoL	%WoL	% WoL	% WoL	% WoL

Figure S.3: Mine and MWRC contributions to road (midblock) upgrade elements

Table S.3: Whole-of-life traffic proportions for Ulan Road - by section*

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Description	Mine (%)	MWRC (%)
1	0.000	3.785	3.785	Short Street to George Campbell Drive (south), Mudgee Airport turn-off	18.2	81.8
2	3.785	9.574	5.789	George Campbell Drive (south), Mudgee Airport turn-off to Wollar Road (MR208)	39.6 50.6	60.4 49.4
3	9.574	38.655	29.081	Wollar Road (MR208) to Cope Road (MR512)	67.0 79.3 79.0 91.1	33.0 20.7 21.0 8.9
4	38.655	45.236	6.581	Cope Road (MR512) to UCML Admin entrance	92.4 5.6	7.6 94.4

* for sections 2, 3 and 4 the profile of the traffic volume changes along their length, as indicated in the traffic counts provided by MWRC.

Capital upgrade and maintenance costs

Benchmarked unit rates for road construction have been used to estimate the cost of upgrade and maintenance works in this strategy. These adopted unit rates are presented in Table S.4.

Table S.4: Typical unit rates used for cost estimates

Works	Unit	Rate/unit
Road upgrades (widening and rehabilitation)	Per km	$750 000
Intersection upgrades (typical BAR/BAL – CHR/CHL)	item	$10 000 - $250 000
Road maintenance (rehabilitation) 20 years design life	Per km	$597 600
Road maintenance (rehabilitation) 10 years design life	Per km	$351 000

The upgrade of 26 nominated road intersections is estimated to cost $1 780 000.

The cost to upgrade, i.e. widen and rehabilitate, the 20.585 km length of Ulan Road identified as inadequate is estimated to cost $15 438 750.

The maintenance strategy for the operating life of the three mines identifies a whole-of-life cost of $12 732 823. This total figure has been discounted by the amount of funding support that is expected to be received by MWRC over the operational life of the mines from the Roads and Maritime Services via the annual Regional Road Block Grant (RRBG).

The RRBG is calculated to be $5 699 736, leaving an unfunded maintenance cost of $7 033 087 to be apportioned between the mines and MWRC based on the whole-of-life traffic projections. The unfunded ratio, i.e. the ratio of total maintenance cost versus unfunded maintenance cost is 0.55. This ratio is used in conjunction with the whole-of-life apportionment rates to apportion the unfunded maintenance cost between the mines and MWRC.

Impact of traffic noise

Assessment of the likely effect on the level of traffic noise affecting adjoining residences indicates that up to 18 properties are potentially impacted by traffic noise and could be considered for some form of noise mitigation treatment

Noise mitigation measures that are considered feasible options for application along Ulan Road include:

- reducing traffic speed
- using low noise pavements
- architectural treatments for affected residences.

Two treatments offer the most practical and affordable options – reduced speed limit and the most reliable treatment, architectural treatments; the scope of cost for architectural treatments is dependent on a detail assessment of each of the affected dwellings, however an indicative budget cost used by the RMS is $20 000 per dwelling.

Summary cost apportionment

The work program and total cost to each mine and MWRC resulting from each of the apportionment models is presented in Table S.5.

Table S.5: Summary capital and maintenance works cost apportionment

Works	Total Cost	MWRC	RMS	Mines		
				UCML	MCM	WCM
Intersection upgrades	$ 1,780,000	$ 1,148,061	$ -	$ 284,477	$ 221,111	$ 126,351
Road upgrades	$ 15,438,750	$ 12,845,040	$ -	$ 1,167,600	$ 907,520	$ 518,590
Maintenance	$ 12,732,823	$ 2,028,349	$ 5,699,736	$ 2,252,962	$ 1,751,121	$ 1,000,654
Road works subtotal	*$ 29,951,573*	*$ 16,021,451*	*$ 5,699,736*	*$ 3,705,039*	*$ 2,879,753*	*$ 1,645,594*
Road safety	$ 335,200	$ 59,553	$ -	$ 124,041	$ 96,476	$ 55,129
Noise attenuation	$ 360,000	$ -	$ -	$ 160,000	$ 126,000	$ 72,000
Total	$ 30,646,773	$ 16,081,004	$ 5,699,736	$ 3,989,080	$ 3,102,229	$ 1,772,723

Capital and maintenance works program

Based on the whole-of-life traffic projections, the peak mine related traffic for the three mines is expected to occur between year 1 and year 5. For the period after this, through to year 21, mine related traffic is forecast to decline since the mine operations are expected to draw to a close.

Non-mine related traffic is forecast to grow at a rate of 1.8% per annum for the duration of the mine operations, providing a steady and increasing flow of traffic along the length of Ulan Road.

These traffic projections have been used to assist planning the priority and timing of intersection and road upgrades and the frequency of programmed maintenance. Previous traffic studies indicate that upgrade works are not required to manage constraint on capacity, although they will have a beneficial effect.

The capital works identified in this strategy are generally required to meet the desirable standard for the functionality of Ulan Road and to provide an acceptable level of operational safety.

The maintenance works are required to ensure an efficient and sustainable upkeep of Ulan Road under the projected traffic loading.

For maximum benefit to road users, the upgrade works should be implemented as soon as possible. This will ensure the improvements are available for the peak traffic demand identified in the traffic forecasts, which is anticipated to be year 4. An indicative works program has been prepared and is presented in Table S.6. A project expenditure forecast based on this indicative works program and benchmarked unit rates is presented in Table S.7.

Based on a program to deliver the majority of the capital improvements by year 4, the extent of expenditure is estimated to be in excess of $21 million. This amount of works early in the program will cause the greatest disruption to traffic on Ulan Road since it will in all practicality coincide with the projected peak traffic flow.

An added consideration for programming is the overlapping of the capital and maintenance works in year 3. Care will be required to minimise traffic disruptions due to upgrade works and the scheduling of work over years 3, 4 and 5 may stretch the capability of local resources to deliver on the program.

Voluntary planning agreements

Condition 50(i) stipulated that consideration should be given to contributions made by the mines via voluntary planning agreements entered into with MWRC. The costs outlined in Table S.5 do not include any discounting by the amount of previously past or future contributions under existing VPAs.

This strategy provides a comprehensive assessment of the impact on Ulan Road from mine related traffic over the operating life of the mines.

It is recommended that consideration be given to reviewing existing VPAs to ensure fair acknowledgement of previous contributions and that future contributions do not overlap with the apportionments identified in this strategy.

Table S.6: Indicative whole-of-life works program – year 1 to year 21

Section	Start Chainage (km)	End Chainage (km)	Year																					
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	3.785		I				R										L						
2	3.785	6.652			I			R										L						
2/3	6.652	9.734			I			R										L						
3	9.734	17.644			I		I, M						R										R	
3	17.644	22.215		I	I, M								R										R	
3	22.215	26.039						R, I										L					R	
3	26.039	37.407		I, M	I, M	I, M		I					R											
3/4	37.407	45.236		I		H										R								

Notes: Legend for the works indicated above:

I = Intersection

U = Road upgrade (midblock)

R = Reseal

H = Heavy rehabilitation

L = Light rehabilitation

Table S.7: Project expenditure forecast

Sect. No.	Start Ch. (km)	End Ch. (km)	Upgrade Type	1	2	3	4	5	10	13	15	20
1	0	3.785	Intersection	$10,000								
			Midblock									
			Rehab.								$1,328,535	
			Reseal					$180,545				
2	3.785	6.652	Intersection		$150,000							
			Midblock									
			Rehab.								$1,006,317	
			Reseal					$136,756				
2 & 3	6.652	9.734	Intersection		$ 550,000							
			Midblock									
			Rehab.								$1,081,782	
			Reseal					$147,011				
3	9.734	17.644	Intersection		$35,000		$ 20,000					
			Midblock				$2,808,000					
			Rehab.									
			Reseal						$377,307			$377,307
3	17.644	22.215	Intersection	$260,000	$250,000							
			Midblock		$5,477,250							
			Rehab.									
			Reseal						$ 218,037			$218,037
3	22.215	26.039	Intersection					$ 25,000				
			Midblock									
			Rehab.								$1,342,224	
			Reseal					$182,405				$542,254
3	26.039	37.407	Intersection	$30,000	$10,000	$290,000		$ 10,000				
			Midblock	$3,808,500	$1,044,750	$2,300,250						
			Rehab.									
			Reseal						$542,254			
3 & 4	37.407	45.236	Intersection	$140,000								
			Midblock									
			Rehab.			$4,678,610						
			Reseal							$373,443		
Total				$4,248,500	$7,517,000	$7,268,860	$2,828,000	$681,717	$1,137,597	$373,443	$4,758,858	$1,137,597

Recommendations arising from the Ulan Road Strategy

The following recommendations arise from the development of this strategy and are put forward for consideration by UCML, MCO, WCO, MWRC and RMS:

1. The works identified in the strategy to upgrade and maintain Ulan Road over the operating life of the mines be adopted.

2. The method for apportioning costs for upgrade and maintenance works be adopted.

3. Speed limits along Ulan Road should be reviewed with 70 and 90 km/h replacing the current 80 and 100 km/h zones.

   The reason for this action is that that level of the existing roadside development, number of intersections and property accesses combined with the mix of traffic and overall condition of Ulan Road is not conducive to the current speed limit regime and presents an elevated level of risk to motorists.

4. A proactive road inspection and assessment regime should be established to determine the condition of Ulan Road on a three-year cycle with surface condition being assessed every three years and pavement deflection testing undertaken every second cycle (i.e. every six years).

5. The maintenance program and the apportioning of costs associated with the require road maintenance works should be reviewed based on the results of the proactive road inspection and assessment regime.

6. The voluntary planning agreements currently entered by the mines and MWRC should be reviewed to ensure that contributions under this strategy do not overlap with contributions defined in the VPAs.

7. Acknowledge that each mine has made contributions in the past. These contributions should be considered when the mines and MWRC renegotiate funding.

GLOSSARY

Throughout this report there are a range of general and technical acronyms used for often repeated terms. These are described in this glossary to assist the reader of the strategy.

Acronym/term	Definition
ADT	Average daily traffic
ARRB	Australian Road Research Board (ARRB Group Ltd)
AUR/AUL	An intersection layout with auxiliary lanes provided for Right and Left turning traffic. This configuration does not provide dedicated and protected lanes for turning traffic. AUR and AUL may be provide separately at an intersection or may both be present, depending on the volume of turning and through traffic.
AUR/AUL(S)	The same intersection layout as defined above, but with shortened lengths to suit a constrained site.
BAR/BAL	BASIC Right and BAASIC Left configuration for intersections where additional width is provided as a sealed or unsealed shoulder to accommodate passing turning traffic. The additional width is not marked as a passing lane. BAR and BAL may be provide separately at an intersection or may both be present, depending on the volume of turning and through traffic.
CAMs	Curve alignment markers. Used to warn drivers/riders of the presence of a smaller radius curves.
CHR/CHL	An intersection layout with additional lanes provided for Right and Left turning traffic. This configuration provides dedicated and protected lanes for turning traffic. CHR and CHR may be provide separately at an intersection or may both be present, depending on the volume of turning and through traffic.
CHR/CHL(S)	The same intersection layout as defined above, but with shortened lengths to suit a constrained site.
DP&I	NSW Department of Planning
%HV	Percentage of heavy vehicles in the traffic count data (note: following the Austroads classification system, heavy vehicles are defined as a rigid and articulated trucks greater than 4 tonnes GVM)
Midblock	The length of road between intersections
MR208	Main Road 208 – Ulan Cassilis Road between Mudgee and Wollar Road
MR214	Main Road 214 – Ulan Cassilis Road between Wollar Road and north of UCML underground/administration entrance
MCO	Moolarben Coal Operation, Moolarben coal mine as operated by
MWCR	Mid-Western Regional Council
RMS	Transport for NSW, Roads and Maritime Services, formerly NSW Roads and Traffic Authority (RTA)
RRPMs	Raised retro-reflective pavement markers, commonly known as 'cats-eyes'
RUM code	Road user movement code – a numerical code that defines the type of vehicle/pedestrian movements that occurred at the time of a crash
UCML	Ulan Coal Mine Limited (operated by Xstrata Coal)
WCM	Wilpinjong Coal Mine, Wilpinjong coal mine as operated by Peabody Energy Pty Ltd
WoL	Whole-of-life. Used to describe the amount of traffic (or costs) over the life of the mine operations (21 years).

CONTENTS

TABLES

FIGURES

1 INTRODUCTION

Ulan Coal Mines Limited (UCML), Moolarben Coal Operation (MCO) and Wilpinjong Coal Operation (WCO) are located in the central west of New South Wales, approximately 38 km north-northeast of Mudgee and 19 km northeast of Gulgong.

In November 2010, UCML received project approval (PA08_0184) from the NSW Department of Planning and Infrastructure (DP&I) for continued operations. This approval covers both current and proposed mining of the Ulan Mine Complex for the next 21 years at a rate of up to 20 Mtpa (million tonnes per annum) of product coal. This project approval incorporates both underground and open cut mining operations undertaken on a 24-hours a day, 7-days a week basis.

This Ulan Road Strategy (the Strategy) has been prepared to address condition 50 of planning approval PA08_0184 issues by DP&I.

Although not specifically included in the UCML project approval, both MCO and WCO have or are likely to be subject to the same requirements as UCML with respect to preparing a Ulan Road Strategy. Therefore, this Strategy includes consideration of the operations for both Moolarben and Wilpinjong Coal Operations.

1.1 Purpose

The purpose of this strategy is to:

- Identify the capital and maintenance works necessary to ensure the condition and standard of Ulan Road is suitable for the projected traffic impact over the life of the approved UCML operations.
- Calculate the contribution toward the capital and maintenance works required for Ulan Road over the life of the approved UCML operations.
- Identify a detailed program of works for the required upgrade and maintenance of Ulan Road

1.2 Project scope

The scope of this strategy is specified by condition 50 of the project approval, PA08_0184, issued by the NSW Department of Planning and Infrastructure.

In summary, this Ulan Road Strategy (the Strategy) is to:

- Consider the length of Ulan Road between Mudgee and the entrance to the underground surface facilities at the Ulan Mine, a distance of approximately 45.2 km.
- Identify the works required to upgrade Ulan Road to the designated design standard.
- Identify the works required to maintain Ulan Road in a serviceable condition suitable for the expected level of traffic over the life of the mine operations.
- Estimate the cost of the upgrade and maintenance works.
- Identify any measures that could be implemented to reduce the amount of mine traffic on the road and minimise the traffic noise impacts of mine traffic on Ulan Road on adjoining residences.
- Apportion costs for implementing all works and measures and identify a program to implement these works.

1.3 Report structure

The remainder of this Strategy report is structured as follows:

Section 2 and 3 – provides a brief background to the Strategy, identifying inputs from previous studies, data and other information made available by the stakeholders.

Section 4 – outlines the guiding principles and the approach applied in preparing this Strategy.

Section 5 – presents the basis to the design standard adopted for Ulan Road, which establishes the level and extent of works required to manage the projected increase in traffic.

Section 6 – provides an overview of the traffic analysis used as an input to the Strategy, drawing from the traffic impact assessments undertaken for each site by others.

Section 7 – presents the results of the road condition based on the surface condition, pavement strength and a visual assessment.

Section 8 – outlines the extent of works required to provide the adopted design standard and the schedule maintenance required to manage the road over the operational life of the mines.

Section 9 - discuss the method for apportioning the upgrade and maintenance works to the mines and MWRC and includes all capital and maintenance works program over the operational life of the mines.

Section 10 – presents a summary of the cost apportionment.

2 PLANNING

2.1 Project Approval Requirements

The Project Approval was assessed and approved under Part 3A of the EP&A Act 1979. Condition 50 of PA08_0184 requires UCML to develop a road strategy of managing the upgrade and maintenance of Ulan Road.

Table 2.1 presents condition 50 of the Project Approval, PA08_0184, and identifies where in the strategy the requirement for each part is discussed and addressed.

Table 2.1: UCML Condition of consent - condition 50

By the end of December 2011, unless the Director-General directs otherwise, the Proponent shall prepare to the satisfaction of the Director-General a strategy for the upgrade and maintenance of Ulan Road between Mudgee and the entrance to the underground surface facilities at the Ulan mine over the next 21 years. This strategy must be prepared in conjunction with the owners of both the Moolarben and Wilpinjong mines, and the cost of preparing the strategy should be shared equally between the Proponent and the owners of these mines.		
Part	Condition	Report Section
A	Be prepared by a suitably qualified, experienced and independent person whose appointment has been endorsed by the Director-General.	Appendix A
B	Be prepared in consultation with both the RMS and Council.	Section 2.2 Appendix B
C	Determine the design standard of the relevant section of road (and any associated intersections) to the satisfaction of the RMS (based on the relevant road design guideline(s)).	Section 5
D	Identify the works required to upgrade the road to the designated design standard.	Section 8
E	Estimate the cost of these works and the likely annual costs for maintaining the upgraded road.	Section 9.2.3, Section 9.5
F	Identify any measures that could be implemented to reduce the amount of mine traffic on the road, such as providing long-term parking and in Mudgee to support increased car-pooling, and the likely cost of implementing those measures.	Section 6.2
G	Identify any measures that could be implemented to minimise the traffic noise impacts of mine traffic on Ulan Road on adjoining residences, and the likely costs of implementing these measures.	Section 8.1.4
H	Include a detailed program for the proposed upgrade and maintenance of the road, implementation of traffic noise mitigation measures, and implementation of any works to support the reduction in the amount of mine traffic on the road.	Section 8 Section 9.5.2
I	Calculate what each mine and the council shall contribute towards the implementation of the detailed program outlined in (h) above, including consideration of: ▪ the likely traffic generated by each mine as a proportion of the total traffic on the road; ▪ any mine contributions that have been made towards the upgrading of the road in recent years; and ▪ any relevant planning agreements that deal with the funding or maintenance of the roads in the Mudgee LGA area.	Section 9
J	Include a detailed contributions plan for the three mines and the council to support the implementation of the detailed program described in (h) above.	Section 9.1.3, Section 9.2.4, Section 10

2.2 Consultation

In preparing this strategy, a program of consultation with and between the three mines, the Mid-Western Regional Council (MWRC) and Transport for NSW Roads and Maritime Services (RMS) Western Region was developed. The consultation involved meeting and corresponding with each stakeholder to identify key data such as road traffic volume counts, crash history, existing traffic and environment impact assessments. Information was also sought concerning current funding agreements (e.g. voluntary planning agreements, grants etc.) and the level of expenditure by MWRC on Ulan Road.

A summary of the consultation process undertaken is given in Table 2.2.

Table 2.2: Stakeholder consultation meetings

No.	Date	Meeting	Attending	Key points
1	15/12/2010	Mine Steering Committee meeting	▪ UCML ▪ MCO ▪ WCO	▪ Discussion over coordination and development of Ulan Road Strategy
2	2/2/2011	Stakeholder meeting	▪ MCO ▪ WCO ▪ RMS ▪ MWRC	▪ Discuss development of Strategy ▪ Initiate baseline traffic count survey
3	27/6/2011	Stakeholder meeting	▪ UCML ▪ MWRC	▪ Provided an update on Ulan Road Strategy progress
4	13/7/2011	Road Safety meeting	▪ UCML ▪ MCO ▪ WCO ▪ RMS ▪ NSW Police	▪ Discussion about road safety initiatives and additional police presence on Ulan Road
5	16/8/2011	Correspondance	▪ UCML ▪ MCO ▪ WCO ▪ RMS	▪ Consulted stakeholders on Project Scope and Consultant selection
6	28/9/2011	Mine Steering Committee meeting	▪ UCML ▪ MCO ▪ WCO	▪ Overview of the project scope and method ▪ Discussion of proposed design x-section ▪ Planned speed limit review (by RMS) ▪ Existing and proposed works along Ulan Road ▪ Linemarking renewal
7	28/09/2011	Stakeholder inception (UCML Adminstration offices)	▪ MWRC ▪ UCML ▪ MCO ▪ WCO ▪ RMS ▪ ARRB	▪ Overview of the project scope and method ▪ Discussion of proposed design x-section ▪ Planned speed limit review (by RMS) ▪ Existing and proposed works along Ulan Road ▪ Linemarking renewal

No.	Date	Meeting	Attending	Key points
8	8/11/2011	Mine Steering Committee meeting	▪ UCML ▪ MCO ▪ WCO	▪ Presentation of the results of road condition analysis ▪ Confirmation of key data – road design, RRBG funding ▪ Outcomes of preliminary findings ▪ Council advised cost rate for reconstruction work ▪ Council process for considering the report
9	8/11/2011	Stakeholder progress (MWRC Administration offices)	▪ MWRC ▪ UCML ▪ MCO ▪ ARRB	▪ Presentation of the results of road condition analysis ▪ Confirmation of key data – road design, RRBG funding ▪ Outcomes of preliminary findings ▪ Council advised cost rate for reconstruction work ▪ Council process for considering the report
10	29/11/2011	Mine Steering Committee meeting	▪ UCML ▪ MCO ▪ WCO	▪ Presentation of the results of road condition analysis ▪ Confirmation of key data – road design, RRBG funding ▪ Outcomes of preliminary findings ▪ Council advised cost rate for reconstruction work ▪ Council process for considering the report
11	5/12/2011	Stakeholder – draft report presentation (Executive Summary) (MWRC Administration offices)	▪ MWRC ▪ UCML ▪ MCO ▪ WCO ▪ RMS ▪ ARRB	▪ Presentation of key findings and approach to apportioning traffic and costs ▪ Discussion about apportioning approach and amount of contributions

3 BACKGROUND

This section provides background to the traffic impact assessment and other information used in preparing this Strategy.

3.1 Traffic impact assessments

The strategy is to consider the cumulative impact of increased traffic arising from the three coal mine operations, UCML, MCO and WCO.

Each mine independently commissioned a traffic impact study for their respective expansion proposals. The traffic studies were incorporated into the environmental impact assessment that supports the development application for each proposal. The studies were not undertaken concurrently; there is a good level of consideration of the impacts arising from all three proposed mine expansion projects in two of the studies.

Table 3.1 outlines the chronology and scope of each study.

Table 3.1: Summary of traffic impact assessments referenced in the Strategy

Study title	Consultant	Date	Scope
Moolarben Coal Project – Traffic Impact, Road Safety and Railway Level Crossing Assessment	SKM	August 2006	▪ Stage 1 Moolarben Coal Project ▪ Coal production up to 10 million tonnes per annum ▪ Establish facility, entrance to Ulan Road and traffic impact on Ulan Road (and others)
Moolarben Coal Project Stage 2 – Traffic Impact Assessment	SKM	November 2008	▪ Stage 2 Moolarben Coal Project ▪ Expands coal production up to 13 million tonnes per annum ▪ Revises traffic impact on Ulan Road (and others)
Traffic and Transport Impact Assessment for the Ulan Coal Continued Operations Project	Transport and Urban Planning Associates (TUP)	August 2009	▪ UCML Continued Operations Project ▪ Moolarben Coal Project Stage 2 ▪ Expands coal production for WCM from 13 Mtpa to 15 Mtpa ▪ Assesses impact on Ulan Road (and others)
Wilpinjong Coal Mine – Mining Rate Modification Road Transport Assessment	Halcrow	March 2010	▪ Expands coal production for WCM from 13 Mtpa to 15 Mtpa ▪ UCML Continued Operations Project ▪ Moolarben Coal Project Stage 2 ▪ Assesses traffic impact on Ulan Road (and others)

Both the Transport and Urban Planning and the Halcrow studies incorporate the traffic projections of all three mine expansion proposals. The SKM studies review the effect of traffic from the Moolarben Stage 1 and Stage 2 proposal.

Each of the studies identify recommendations relating to improvements along Ulan Road in response to the impact from increases in traffic and to provide appropriate levels of road safety for road users.

The conclusions and recommendations of these studies have been used as a basis to preparing this Strategy. The recommended works presented in these studies outlined in Table 3.2.

Table 3.2: Works and improvements identified for Ulan Road (all studies)

Location	Works and improvements	Study
Ulan Road/Cope Road intersection	Existing AUR auxiliary lane for right turn from Ulan Road should be upgraded to a CHR right turn bay treatment	Transport Urban Planning
Ulan Road/Wollar Road intersection MR214/MR208	Existing need for the BAR and BAL to be upgraded with auxiliary lanes (note: this is an existing deficiency and is required for safety)	Both SKM and Transport Urban Planning
Ulan Road (length)	Delineation and road edge formation and shoulder provision (note: this is an existing deficiency and is required for safety)	Both SKM and Transport and Urban Planning

In preparing this Strategy, ARRB has assessed the need for works and improvements supplemental to that identified in the above table. This is based on an evaluation of the condition of Ulan Road at the time of the detailed road condition survey as assessed against the current Austroads Guides.

The works and improvements included in the apportionment model are outlined in the works program in Section 8.

3.2 Stage of implementation

The traffic impact assessment of the proposed mine operations provided traffic projections that were valid at the time of submission.

At the time of preparing this Strategy, construction elements of some proposals had commenced and are nearing completion. The traffic impact assessments may therefore no longer represent a projection of future impacts since some effects of traffic may already have been realised.

The progress of the various development stages is as follows:

Table 3.3: Status of mine operations (October 2011)

Mine operation	Status
Ulan Coal Mine	▪ Five-year construction period commenced in 2011
Moolarben – Stage 1	▪ Operating
Moolarben – Stage 2	▪ Not yet operating. No consent issued at this time
Wilpinjong Coal Mine	▪ Construction period due to be completed by the end of 2011 ▪ Operation expected in 2012

Adjustment to the timing of traffic projections and the scheduling of works and improvements has been made to reflect the status of each development outlined in the above table.

3.3 Funding contributions

Part i of condition 50 stipulates that, in calculating what each mine and council shall contribute towards the implementation of works and improvements, consideration, amongst other matters, should be given to:

- any mine contributions that have been made towards the upgrading of the road in recent years; and

- any relevant planning agreements that deal with the funding or maintenance of the roads in the Mudgee LGA area.

The UCML, MCO and WCO operations have each provided Council with funding for the upgrade and maintenance of road infrastructure. The mines have also made ‘social contributions’ for specific and non-specific purposes.

The project brief also identifies that the Strategy shall review all funding agreements or amounts paid to MRWC by the RMS and other funding agencies for works on Ulan Road.

Information concerning funding to MRWC as made available to ARRB is summarised in Table 3.4.

Table 3.4: Summary of contributions to MWRC

Funding purpose	Funding amount ($)	Timeframe	Comments
UCML			
Cope Road – maintenance[1]	1 050 000		$50 000 per annum for 21 years
Community Infrastructure Fund[1]	3 475 000		Instalment 1 $2 000 000 Instalment 2 $1 475 000
Social contributions[1]	3 810 202	1994 – 2010 +	Council rates agreement 1998, 2003, 2005, 2006
General fund, Cope Road, Ulan Road[1]	678 000	Pre-1987	Stage 1 and Stage 2 UCML approval $1 746 268 (2009 $s)
Cope Road and Ulan Road[1]	570 000	Circa 1981	Barter deal with Merriwa Council $1 505 460 (2009 $s)
Moolarben Coal Project			
Ulan Road and Cope Road[2]	1 000 000	2009	Voluntary planning agreement Paid in three annual instalments
General road maintenance[2]	1 250 000	2010	Paid in full
Wilpinjong Coal Mine			
Lump sum payment[1]	450 000		Purpose of this amount is not specified in the Planning Agreement
Community Infrastructure Contribution[1]	800 000		$40 000 per annum for 20 years commencing Year 2 of coal shipment
Road Maintenance Contribution[1]	630 000		$30 000 per annum for life of the mine (estimated 21 years).
Ulan Road[2]	600 000	2011	Negotiations to transfer funding from
NSW Roads and Traffic Authority			
Regional Road Block Grant[2]	690 079	5 years	Allocation varies over 5 years 2007/08 – 2011/12
Capital funding[2]	530 000	5 years	$330 000 in 2009/10 + $200 000 in 2011/12
Mid-Western Regional Council			
Voluntary Planning Agreement[2]	1 338 787	5 years	Income varies over 5 years 2007/08 to 2011/12
Council allocation[2]	1 402 966	5 years	Allocation varies over 5 years 2007/08 – 2011/12

1. Information supplied by the respective mine
2. Information supplied by MRWC

4 ADOPTED PRINCIPLES AND APPROACH

The mine operations at Ulan, Moolarben and Wilpinjong employ a considerable number of local people directly and through the supply of contracted services. It is recognised that the mines are an important element of the local economy and they contribute to the diversity and vibrancy of the local community.

All stakeholders agree that the effect of mine operations on Ulan Road need to be investigated and managed. This includes identifying appropriate levels of funding for capital improvements and the ongoing maintenance of Ulan Road by the mines where a nexus exists with the required works and the operations of each mine.

This strategy, drawing from traffic impact assessments undertaken in support of development proposals, seeks to provide a mechanism for all parties to understand the relative impact on Ulan Road and a means for providing the necessary road infrastructure that serves the local community. To ensure an appropriate approach is applied, some fundamental principles need to be established and agreed by all stakeholders.

4.1 Cost apportionment

This Strategy seeks to identify the works along Ulan Road that are considered necessary to properly and appropriately manage the impact of traffic generated by the operations at Ulan, Moolarben and Wilpinjong coal mines. This includes:

- capital upgrade works to ensure sufficient capacity on Ulan Road and at side-road intersections
- measures to ensure an appropriate level of safety for road users of Ulan Road
- a maintenance works program addressing the accelerated effects of deterioration on the road
- treating identified residences for the effect of increases in noise associated with mine related traffic.

The underlying principles of this Strategy are:

- a nexus should exist between the need for an improvement to Ulan Road and the impact from the development of the three mines
- a nexus should exist between the cost to maintain Ulan Road and the impact from the development of the three mines
- the cost of identified capital and maintenance works is to be shared across the three mine operations and MWRC based on the proportion of the whole-of-life traffic generated by each of the mines. MWRC shall be responsible for the funding associated with the whole-of-life traffic not connected with the three mines, e.g. existing residents, farms, wineries, tourism etc.

Discussion on the calculation of whole-of-life traffic generated along Ulan Road is presented later in this strategy report. Similarly the works required to manage the project traffic and the costs associated with these is discussed later in this strategy report.

4.2 Road and pavement design

An important step to determining the design standard for Ulan Road is to establish the underlying principles and approach for defining the performance criteria.

The guiding principles for road design and performance in Australia is the Austroads guide series. These guides cover the following discipline areas:

- Road Design
- Traffic Management
- Road Safety
- Asset Management
- Pavement Technology

Each Austroads guide has multiple parts covering a particular aspect of the discipline area. Where used as a basis of discussion or a recommendation in this strategy, the guide and the specific part is fully referenced.

Reference has also been made to other guides and technical directions covering road design and management.

4.3 A Safe System approach

Over the last decade, drawing from international experience, there has been a change leading to a more holistic view in the approach to managing safety on public road networks in Australia. This view has been developed and adopted nationally by Austroads and each state road authority and is known as a Safe System approach.

A Safe System approach is central to the Austroads guides series and it informs action for works and improvements contained in this strategy for Ulan Road.

Austroads (2009c) identifies that:

> A safe road environment should serve the safety needs of all road users. It is one which:
>
> - provides as low a level of risk as practicable, within budgetary constraints, for all road users
> - incorporates the application of appropriate design principles and geometric design standards, good delineation under all conditions, adequate surface skid resistance and a roadside free of unforgiving hazards
> - includes sufficient traffic management devices to guide and control the passage and speed of road users efficiently and safely.
>
> The road environment comprises physical elements that road users perceive, and to which they respond. A safe road environment is one which elicits the correct responses from road users. That is, in an ideal safe road environment road users respond correctly, stay on track, avoid collisions, and reach their destinations. In a realistic situation, road users make mistakes. A safe road environment should aim to minimise the number of mistakes made and the severity of their consequences.

It goes on to state that:

> Fundamental principles for managing safety in road design, traffic management, and remedial treatment practice include:
>
> - speed management (aiming to limit kinetic energy in the road traffic system, so that crashes are less likely due to longer decision-response distances, and human injury tolerances are not exceeded when crashes occur)
> - conflict management (aiming to control manoeuvres at locations such as intersections, or where pedestrians are prevalent, to avoid conflicts and reduce crash risk)
> - hazard management (removing or treating hazardous obstacles in the road environment so that injuries from crashes are contained within survivable limits or crashes are less likely due to greater recovery space)
> - road user information management (ensuring an adequate, clear and timely release of information through signals, signs and markings to guide road user decisions and behaviour).

The Safe System approach is conceptually represented by Figure 4.1:

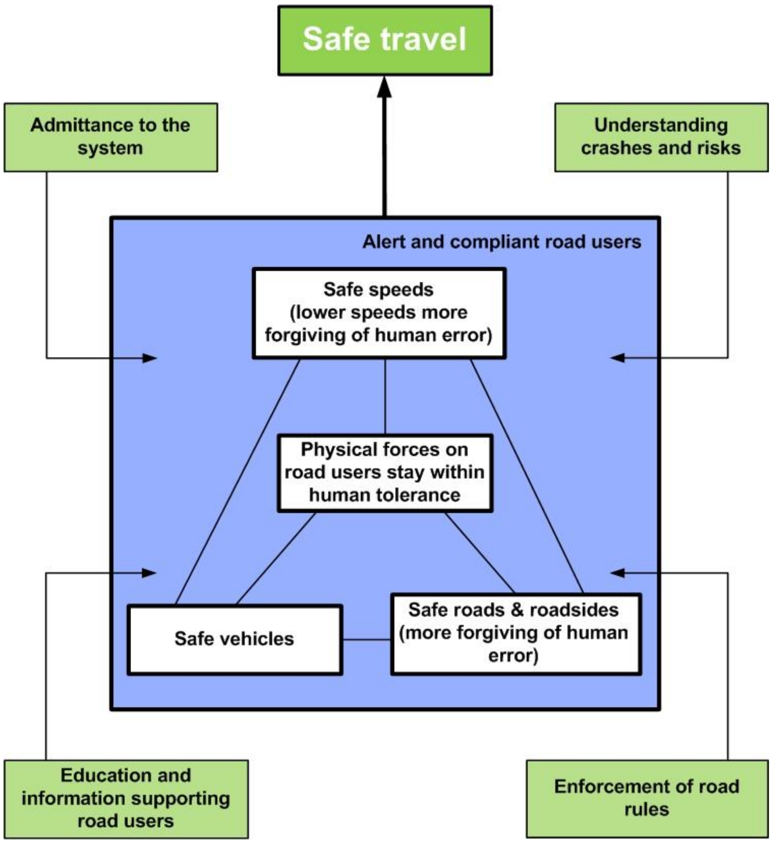


Figure 4.1: The Safe System approach framework

The approach was first adopted in the National Road Safety Action Plan in 2005 and has been reiterated in the National Road Safety Strategy 2011 - 2020 forming the guiding principle to managing and improving road safety across Australia. RMS (as the NSW Roads and Traffic Authority) adopted a Safe System approach, and since 2007 have been using it as a basis to planning and implementing road improvements across the State.

It can be seen, from Figure 4.1, that the Safe System approach covers the areas outlined in condition 50 of the development consent. Applying a Safe System approach is therefore a key principle that has informed the preparation of this Strategy.

4.4 Road asset management

A road asset management approach another key principle that has been adopted for this Ulan Road Strategy. This considers the timing of interventions based on regular condition assessments of the surfacing/functional and structural aspects of the road.

Austroads (2009g) defines this approach as follows:

> Road asset management is a comprehensive and structured approach to the long-term provision and maintenance of physical road infrastructure using sound engineering, economic, business and environmental principles to facilitate the effective delivery of community benefits.

Road asset management has been proven to be more efficient than the traditional approach where works are scheduled based on predetermined intervals, as whole-of-life costs are considered in order to determine the correct response to measured conditions.

This approach requires that policies are set with regard to issues related to the service provided to the road users, e.g. safety, serviceability, functional and structural condition. Based on the adopted policies, intervention levels may be set that are related to physical condition measures, e.g. the need for a reseal may be triggered when the total of the cracked surface area exceeds a pre-set value, rather than programmed at fixed intervals.

5 DESIGN STANDARD

The Austroads Guide to Road Design, Part 3 (2009d) establishes specific objectives in relation to geometric road design. These include:

- provision of a road that is safe to travel on for all road users at the appropriate travel speeds, and a roadside that reduces the incidence and severity of crashes
- maintenance of a degree of uniformity to provide a consistent and operationally effective driving experience relative to the functional class of road
- development of economically efficient designs to maximise the limited funds available for road construction and maintenance
- adequate provision for the future requirements of the road network
- cater for the types of vehicles expected to use the road
- mitigation of environmental impacts (during construction and operation) both in the immediate vicinity of the road and over a wider area.

Determining a design standard for Ulan Road has included consideration of each of these objectives.

5.1 Road Status

5.1.1 Administration

The road from Mudgee to Ulan Coal Mine is generally known as Cassilis/Ulan Road.

Between Mudgee and Budgee Budgee the road is designated Main Road 208 (MR208). From Budgee Budgee north to the LGA boundary the road is designated Main Road 214 (MR214).

The MWRC is the road authority for MR214, as defined by the NSW Roads Act 1993. For the purposes of administrative control and funding, MR208 and MR214 are regional roads under the care and control of MWRC.

As regional roads, MR208 and MR214 attract funding from the RMS Regional Road Block Grant funding agreement. Typically, regional road block grant funding is comprised of three components:

- Roads component
- Traffic facilities component
- Supplementary component.

Funding under this agreement is untied, meaning Council has discretionary authority to allocate funds across its regional road network within the areas of the three defined components under priorities that it establishes.

For ease of reference the route from Mudgee to Ulan Mine that is the subject of this Strategy report shall be called Ulan Road.

5.1.2 Traffic composition

The traffic volumes along Ulan Road vary along its length, reflecting the change in land-use. During 2011 the MWRC installed traffic classifier counters at various locations along the length of Ulan Road. These traffic count locations are indicated in Figure 5.1.

To the south is Mudgee, local wineries, the cemetery, airport and rural residential development. Traffic volume counts undertaken in 2011 are between 2 919 and 7 454 vehicles per day with an estimated 5 to 7% heavy vehicles.

Travelling north the level of development diminishes, dominated by rural activities with several connecting roads providing links to villages and small communities. Traffic volume counts for the same period are between 2 000 and 2 296 vehicles per day with an estimated 9 - 18% heavy vehicles.

North of Ulan village are the main operations for the Ulan, Moolarben and Wilpinjong coal mines. Traffic volume counts recorded by MWRC are between 1 010 and 2 489 vehicles per day with an estimated 10 - 21% heavy vehicles.

Ulan Road is accessible to 25/26 metre B-double trucks, with restrictions in place limiting travel speed to a maximum of 80 km/h.

5.1.3 Road referencing

For ease and consistency in referencing locations along Ulan Road, all road chainages quoted in this strategy report are based on the chainages established via the Hawkeye Network Survey Vehicle used for road inventory and condition data collection.

Based on a review of traffic count data and considering pavement condition assessments, Ulan Road has been divided into four sections. The extent of each section is described in Table 5.1 and are used throughout the remainder of this report.

Each section begins and ends at a key road junction and have a relatively uniform traffic volume and road formation.

Table 5.1: Road section descriptions

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Description
1	0.000	3.785	3.785	Short Street to George Campbell Drive (south), Mudgee Airport turn-off
2	3.785	9.574	5.789	George Campbell Drive (south), Mudgee Airport turn-off to Wollar Road (MR208)
3	9.574	38.655	29.081	Wollar Road (MR208) to Cope Road (MR512)
4	38.655	45.236	6.581	Cope Road (MR512) to UCML Admin entrance

Figure 5.1: Traffic counts on Ulan Road

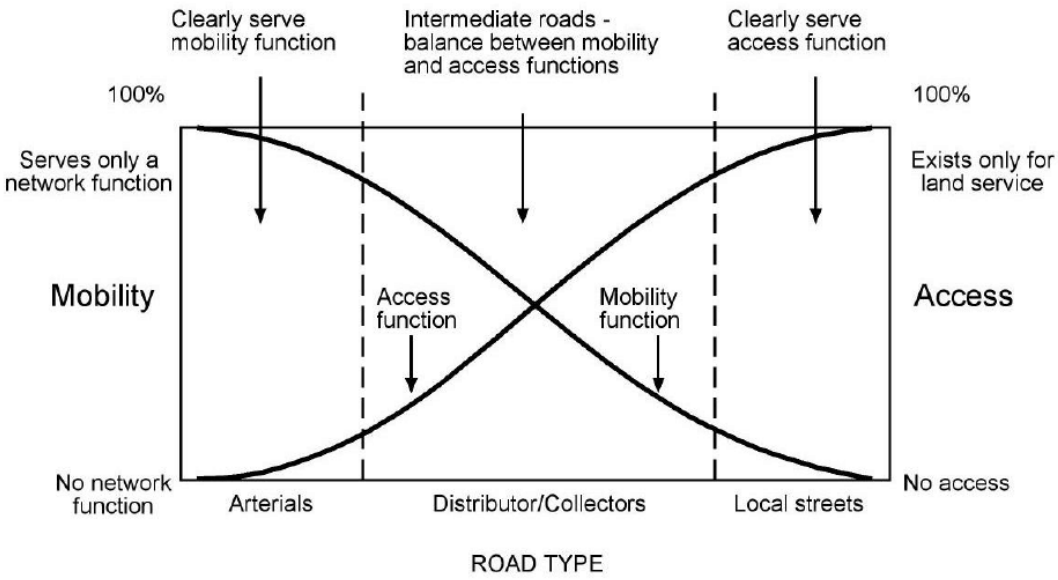
5.1.4 Road hierarchy

Important to establishing an appropriate geometric and pavement design standard is confirming the status of Ulan Road within a network road hierarchy.

The Austroads Guide to Traffic Management (Austroads 2009a) outlines the key factors that should be considered when seeking to establish the classification of a road within a road hierarchy.

> The mixture of functions met by roads across a network is usually expressed as a functional hierarchy. The basis of a traffic management plan for a road network is the development of an agreed road hierarchy by means of which roads can be classified according to their existing, or their intended, function. Road management to pursue operational, safety or other (e.g. amenity) benefits – by design, traffic management, and/or other remedial action – must take account of the functional hierarchy of roads within the network.
>
> The function of a road is reflected in traffic characteristics such as volume, speed, and mix of vehicular and non-motorised traffic. The function should also be reflected in the physical characteristics of the road, such as formation width, number and width of lanes, proximity and protection of potential hazards.
>
> Roads, generally, are classified on the basis of how they currently operate, but consideration should also be given as to how they are expected or desired to function in the future, in terms of the relative significance of the traffic function versus the land access function for a particular road, and its desirable operating speeds and traffic volumes.

To assist determining a road class when considering the mix of mobility versus land access functions that a road may serve, Austroads 2009e provides the chart in Figure 5.2.



Source: Austroads Guide to Traffic Management Part 5 Road Management, Austroads 2009e.

Figure 5.2: Road type and function – mobility vs. access

Ulan Road provides primarily a mobility function but given the number of property accesses and road intersections along its length, it also serves an access function. Based on this functional mix Ulan Road falls within the areas of the major distributor category, tending towards the boundary of the arterial class.

For rural roads, Austroads has established an alternate hierarchy with five discrete road classes defined under either arterial or local road categories. This rural road hierarchy is outlined in Table 5.2.

Table 5.2: Austroads functional classification of rural roads

Road class	Functional role
Arterial roads	
Class 1	Those roads, which form the principal avenues for communications between major regions, including direct connections between capital cities.
Class 2	Those roads, not being Class 1, whose main function is to form the principal avenue of communication for movements between: ▪ a capital city and adjoining states and their capital cities; or ▪ a capital city and key towns; or ▪ key towns.
Class 3	Those roads, not being Class 1 or 2, whose main function is to form an avenue of communication for movements: ▪ between important centres and the Class 1 and Class 2 roads and/or key towns; or ▪ between important centres; or ▪ of an arterial nature within a town in a rural area.
Local roads	
Class 4	Those roads, not being Class 1, 2 or 3, whose main function is to provide access to abutting property (including property within a town in a rural area).
Class 5	Those roads, which provide almost exclusively for one activity or function, which cannot be assigned to Classes 1 to 4.

Source: Austroads Guide to Road Design Part 2 Design Considerations, 2006.

Based on the current and the expected function for the route, considering the type and volume of traffic, it is concluded that Class 3 of the hierarchy in Table 5.2 is an appropriate classification for Ulan Road.

In addition to the road classifications outlined in Austroads, MWRC has adopted a road hierarchy for roads in the LGA. This hierarchy and the description for each class is presented on the MWRC website:

- Arterial Road – A road that carries predominantly through traffic from one region to another, thus is forming the principal avenue of communication for traffic movements. It is the top level of road in the road hierarchy.
- Sub-Arterial Road – Road connecting arterial roads to areas of development, and carrying traffic directly from one part of a region to another.
- Collector Road – A road that collects and distributes traffic in an area, as well as serving abutting property.
- CBD Road – Roads within the central business district that provide direct access to the commercial precinct. Whilst they have high traffic volumes, they are predominately destinations, not through access roads.
- Main / Minor Local Road – A road or street used primarily for access to abutting properties.
- Local Access Road – Low volume roads typically carrying less than 10 vehicles per day and serving a limited number of properties.
- Un-maintained Road - Typically these roads service a limited number of properties and their ongoing maintenance cannot be justified on a cost benefit basis.

The Council hierarchy classes differ from the Austroads hierarchy classes, but the definitions are consistent. The Austroads road class of major distributor is comparable to Council's designation of sub-arterial and is therefore to be used for guiding the required design criteria.

5.2 Design longitudinal section

The terrain between Mudgee and Ulan Mine is flat to gently rolling/undulating.

The horizontal alignment of the road is fixed within the existing road corridor and consists of long lengths of straight road joined by large radius, and occasionally smaller radius, curves.

It is not expected that any significant horizontal realignment will be required to improve Ulan Road.

Ensuring adequate driver sight distance for the design speed is the primary criterion for vertical longitudinal road alignment design. Where the vertical alignment cannot be designed to provide the sight distances specified in the Austroads and RMS design guides, then appropriate traffic management restrictions will be necessary.

For Ulan Road this will primarily consist of restricting vehicle overtaking by means of suitable line marking supplemented with warning and advisory signs.

It is not expected that any dedicated overtaking lane arrangement is necessary and so overtaking will be available by entering the opposing lane to pass slower moving vehicles.

5.3 Design cross-section

The design cross-section has a significant influence on the traffic safety performance of a road and is influenced by the type and volume of traffic expected to be using the road.

The road cross-section is comprised of trafficable lanes, sealed/unsealed shoulders and treatment of the roadside verge area.

Also important to consider in the design cross-section is the means of delineating the road.

The Austroads Guide to Road Design Part 3 provides discussion about road cross-section. For rural roads the traffic lane and shoulder width is typically set based on the design average annual daily traffic volume (AADT), as set out in Table 5.3.

Table 5.3: Single carriageway rural road widths (m)

Element	Design AADT				
	1 - 150	150 - 500	500 – 1 000	1 000 – 3 000	>3 000
Traffic lanes	3.7 (1 x 3.7)	6.2 (2 x 3.1)	6.2 – 7.0 (2 x 3.1/3.5)	7.0 (2 x 3.5)	7.0 (2 x 3.5)
Total shoulder	2.5	1.5	1.5	2.0	2.5
Min. shoulder seal	0	0.5	0.5	1.0	1.5
Total carriageway	8.7	9.2	9.2 – 10.0	11.0	12.0

1. Traffic lane widths include centre-lines but are exclusive of edge-lines.
2. Where significant numbers of cyclists use the roadway, consideration should be given to fully sealing the shoulders. Suggest use of a maximum size 10mm seal within a 20 km radius of towns.
3. Wider shoulder seals may be appropriate depending on requirements for maintenance costs, soil and climatic conditions or to accommodate the tracked width requirements for Large Combination Vehicles.
4. Short lengths of wider shoulder seal or lay-bys to be provided at suitable locations to provide for discretionary stops.
5. Full width shoulder seals may be appropriate adjacent to safety barriers and on the high side of superelevation.
6. A minimum 7.0 m seal should be provided on designated heavy vehicle routes (or where the AADT contains more than 15% heavy vehicles).

Source: Austroads 2009d

The 2011 and projected traffic volumes for the majority of the length of Ulan Road fall within the 1 000 to 3 000 vehicles per day range.

Based on the existing and projected traffic volumes, the desirable design road cross section is recommended to be 11.0 metres in width, comprised of 2 x 3.5 m + 2 x 1.0 m sealed + 2 x 1.0 m unsealed shoulders and is illustrated in Figure 5.3. This formation is consistent with the recommendation of the Transport and Urban Planning study for UCML.

Consultation with MWRC also indicates acceptance of the desirable cross section indicated in Figure 5.3. MWRC has recently reconstructed lengths of Ulan Road generally to this design road cross-section, although the provision of 1.0 metre of unsealed shoulder has generally not been achieved.

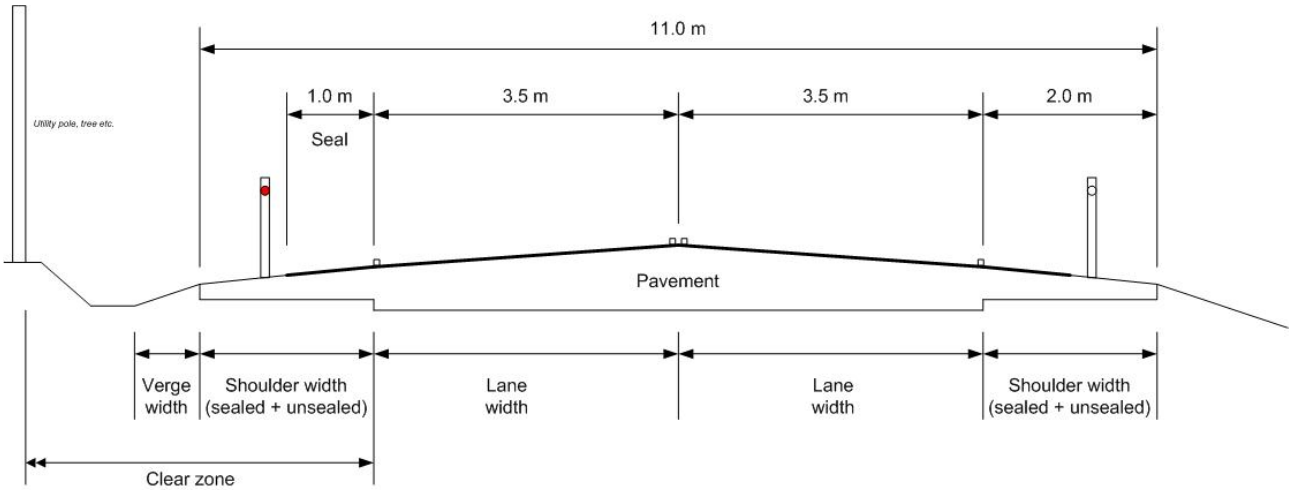


Figure 5.3: Recommended design (desirable) cross-section for Ulan Road

With reference to Table 5.3, significant lengths of Ulan Road currently meet the cross-section width for the 500 – 1 000 design AADT range, i.e. the road is typically comprised of 2 x 3.2 m lanes + 2 x 0 to 0.5 m sealed shoulders + 0 to 0.5 m unsealed shoulders. These lengths of Ulan Road have marked lane edgelines and a well-formed edge of seal and the pavement appears to be in a good condition.

Example locations of this formation are illustrated in Appendix F.2.

Although narrower than the desirable width, this existing pavement width is considered adequate for the current and projected traffic. Therefore it is recommended that this design formation be retained as an absolute minimum width pavement.

Widening is not considered necessary until such time as these sections require reconstruction due to excessive pavement wear and failure.

Traffic volumes along sections 1 and 2, south of Wollar Road, are considerably higher than those recorded for sections 3 and 4. For example in section 2 near the Mudgee airport traffic volumes are in the range up to 3 600 vehicle per day; just north of the Hollyoak Bridge (in section 1), the traffic volumes are in the order of 7 500 vehicles per day. Based on the Austroads criteria in Table 5.3 a wider shoulder formation and sealed shoulder component could be specified. However, there are a number of constraints to providing the full additional width indicated in Table 5.3, such as embankments, significant trees, property boundaries etc. and the additional width is not considered to offer any significant benefit to road capacity or safety.

However, sections 1 and 2 have more frequent road intersections and properties entrances, increasing the likelihood of turning vehicles into and off Ulan Road, as compared to sections north of Wollar Road. It is suggested that local widening and sealing at intersections and frequently used property entrances would provide added safety and road maintenance benefits at reduced cost. This is discussed further in Section 5.4.

5.4 Intersection design

There are four primary types of unsignalised priority controlled intersections specified in the Austroads Guide to Road Design *Part 4A: Unsignalised and Signalised Intersections*. These are

- basic (BAR/BAL)
- auxiliary (AUR/AUL)
- channelised (CHR/CHL)
- roundabout.

Variations of the AUR and CHR configurations are available for use at constrained locations and at reduced cost. These use shorter length components and are designated AUR(S) and CHR(S).

The first three intersection types may utilise either a GIVE WAY or STOP sign control. Roundabouts utilise a roundabout GIVE WAY control (unless signalised as may occur in heavily congested areas).

Austroads outlines that when determining the type of intersection that should apply, it is important to consider:

- the level of conflict between the volume of traffic passing through the intersection and the volume of traffic turning at the intersection.
- traffic safety, particularly in high speed rural road environments.

Austroads (2009f) identifies the BAR/BAL intersection to be the simplest form of intersection treatment that is ‘most appropriately used where the volume of turning and through traffic is low’.

Additional width and turning or passing lanes may be provided to maintain traffic flows and to ensure the safety of motorists by separating opposing or potentially conflicting traffic manoeuvres. The design specifications and warrants for the basic, auxiliary and channelised intersection type treatments are presented in Austroads (2009f) and are reproduced in Appendix C for information. It should be noted that RMS does not use the AUR/AUL configuration and therefore where an intersection may meet the warrant for an AUR/AUL then it is necessary to escalate the treatment (and cost) to a CHR/CHL configuration.

There are some 43 intersections and major property entrances along Ulan Road with many of these considered to be adequately treated using a BAR/BAL configuration. Some, due to the road configuration and/or higher turning volumes may warrant higher order treatment.

5.5 Road pavement and maintenance

The Austroads Guide to Pavement Design (2009g) does not differentiate between different pavements based on road classification. Instead, the principles of design are universally applied, while road class differentiation is allowed for through the concept of Design or Project Reliability (Austroads 2009h). Project reliability may be defined as the probability that a pavement condition may be exceeded during the design life of a pavement. Typical project reliabilities are shown in Table 5.4.

Table 5.4: Project reliability for different road classes

Road class	Project reliability (%)
Freeway	95–97.5
Highway: lane AADT>2000	90–97.5
Highway: lane AADT<2000	85–95
Main road: lane AADT>500	85–95
Other roads: lane AADT<500	80–90

Source: Austroads 2009h

In preparing this Strategy a project reliability of 90% is adopted.

6 TRAFFIC AND ROAD SAFETY ANALYSIS

This section seeks to summarise the findings of the traffic studies undertaken for each mine proposal and develops the whole-of-life projection of traffic demand on Ulan Road. It presents some analysis of the traffic movement along Ulan Road and reviews the crash history to determine if there are specific issues that may need to be addressed to ensure the safety of road users.

Condition 50 of the project approval also requires the strategy to investigate means to reduce the traffic generated by the mine expansions. Specifically, the condition stipulated consideration be given to measures such as carpooling and this is discussed in the context of the mine operations and effect on traffic using Ulan Road.

6.1 Traffic generation

6.1.1 Peak traffic demand projections

The traffic studies for the development of the mines identify construction and operation phases. The traffic generation varies for each phase, with a period of transition between the two occurring.

Key points arising from the predicted levels of traffic identified in the traffic studies for each mine are summarised in Table 6.1.

Table 6.1: Summary of traffic generation by mines

Mine	Traffic projection
Ulan Mine	▪ Operational period – 21 years ▪ Highest traffic demand – year 4 (during construction phase) ▪ Peak AM period 6 am to 7 am with 440 trips ▪ Additional 782 two-way trips generated for the average day ▪ 4.7 – 5.0% heavy vehicles
Moolarben Mine	▪ Highest traffic demand – year 2 (during construction phase) ▪ Peak period 6 am to 7 am with 207 trips ▪ Peak PM period 5 pm to 6 pm with 96 trips ▪ Additional 244 two-way trips generated for the average day
Wilpinjong Mine	▪ Operational period – 21 years ▪ Highest traffic demand – year 1 (during construction phase) ▪ Peak AM period 6 am to 7 am with 264 trips ▪ Peak PM period 6 pm to 7 pm with 257 trips

The traffic studies developed projections of the traffic generated by the mines over the operating life based on estimates of the number of staff and contractors to be employed at key stages. Added to this was an estimate of additional traffic due to visitors to each site and deliveries in support of day-to-day operations. The peak traffic demand was determined by looking at the mine shift times and overlapping with construction phases and other traffic that could be expected during the working day.

The traffic studies also identified the main traffic movement splits north, east, west and south of the mines.

MWRC collected classified traffic volume counts over a period of three months during the first half of 2011. Data for a five-week period during April and May was made available for the preparation of this strategy.

The location of the count stations, the average daily traffic (ADT) and proportion of heavy vehicles (%HV) determined from the MRWC data are indicated in Figure 6.1.

Origin-destination and intersection turning count surveys were not undertaken. This limits the ability to identify directly the traffic generated by each mine site and the movement along Ulan Road. Therefore an accurate assessment of the proportion of the total traffic at key locations along Ulan Road is difficult.

Notwithstanding this, an estimate of the proportion of the traffic flow has been made using the traffic studies, the estimates of staff and contractors and the traffic count data supplied by MWRC.

For the purpose of estimating the proportion of traffic attributable to the mines and general traffic, Ulan Road has been dissected into four sections of relatively uniform standard and traffic volume. These sections and the traffic volumes are described in Table 6.2.

Table 6.2: Ulan Road sections and traffic profile

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Description	AADT	% heavy vehicles
1	0.000	3.785	3.785	Short Street to George Campbell Drive (south), Mudgee Airport turn-off	3 625 - 7 454	5.3 – 6.8
2	3.785	9.574	5.789	George Campbell Drive (south), Mudgee Airport turn-off to Wollar Road (MR208)	2 919	7.0
3	9.574	38.655	29.081	Wollar Road (MR208) to Cope Road (MR512)	2 000 - 2 296	7.2
4	38.655	45.236	6.581	Cope Road (MR512) to UCML Admin entrance	1 010 – 2 489	10.2 – 18.1

Figure 6.1: 2011 Traffic counter locations

6.1.2 Whole-of-life traffic projections

The calculation of traffic volumes over the life of the mine operations was based on the projection of staff and contractor complement for each year of construction and operation with allowance for visitor and delivery traffic.

Using the traffic splits indicated in the traffic studies, the amount of mine related traffic travelling between the Cope Road/Ulan Road intersection and Mudgee was estimated for each year of operation.

Comparing the above estimates with traffic counts undertaken by MWRC during 2011 permitted the base year proportion of mine versus general community (non-mine related) traffic along each section of Ulan Road. A growth rate of 1.8% per annum was applied to the 2011 general community traffic over the 21 year period of operation of the mines.

The actual and forecast traffic volumes along with the whole-of-life volumes are presented in Appendix E.1.

Due to the decline in mine related traffic over the life of the mines and the annual increase in general community traffic, the gap between the two traffic streams closes over time. The rate of convergence varies depending on the location along Ulan Road being considered. Plots of the change in traffic show this convergence; at locations south of the Wollar Road intersection the trend lines for mine and general community related traffic cross over reflecting a larger proportion of the traffic stream being due to non-mine related activities.

The plots in Figure 6.2 to Figure 6.5 are examples of the changing trends for traffic flows over time.

Plots for all the Ulan Road traffic count locations are provided in Appendix E.3.

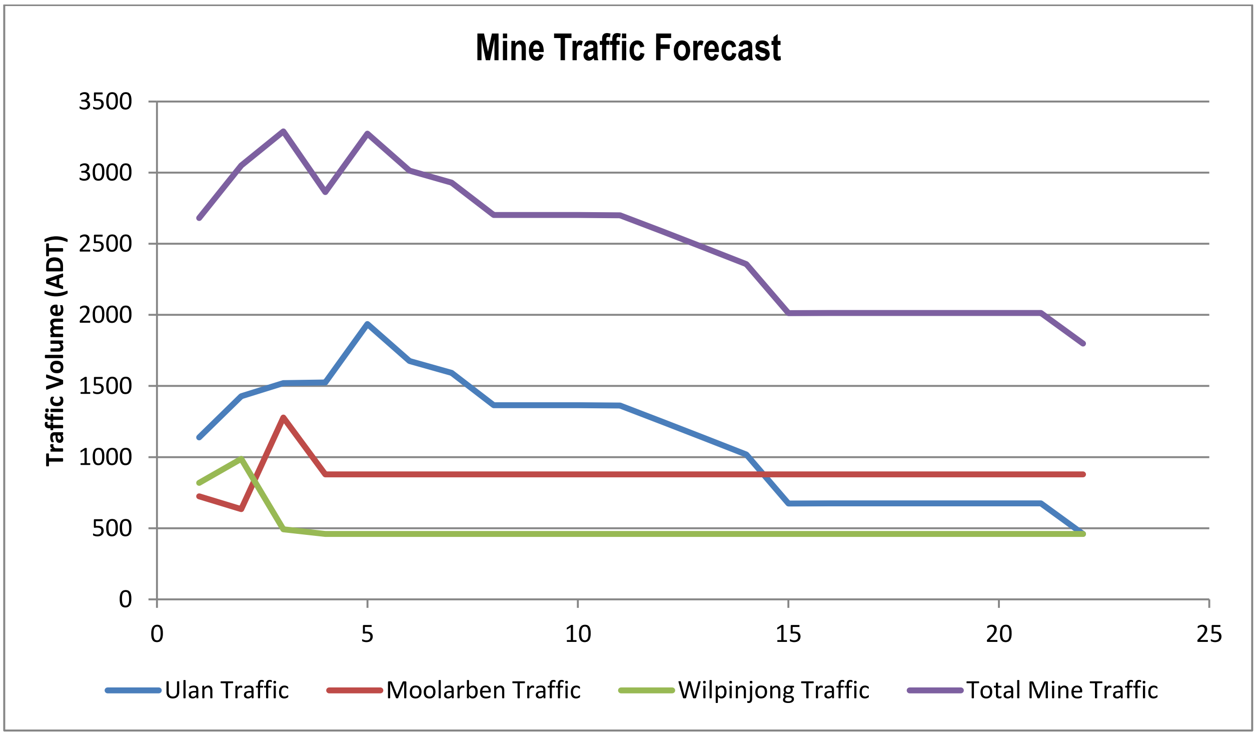


Figure 6.2: Forecast of mine related traffic - three mines

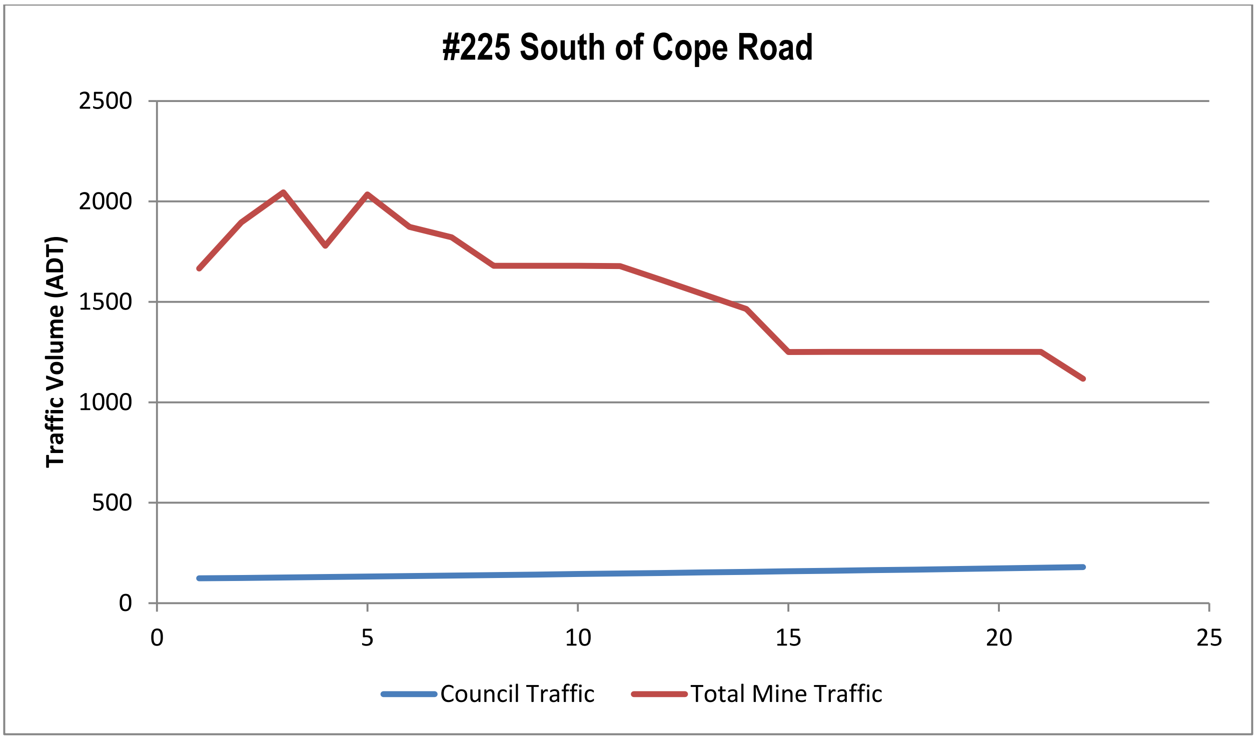


Figure 6.3: Forecast of traffic on Ulan Road, south of Cope Road intersection

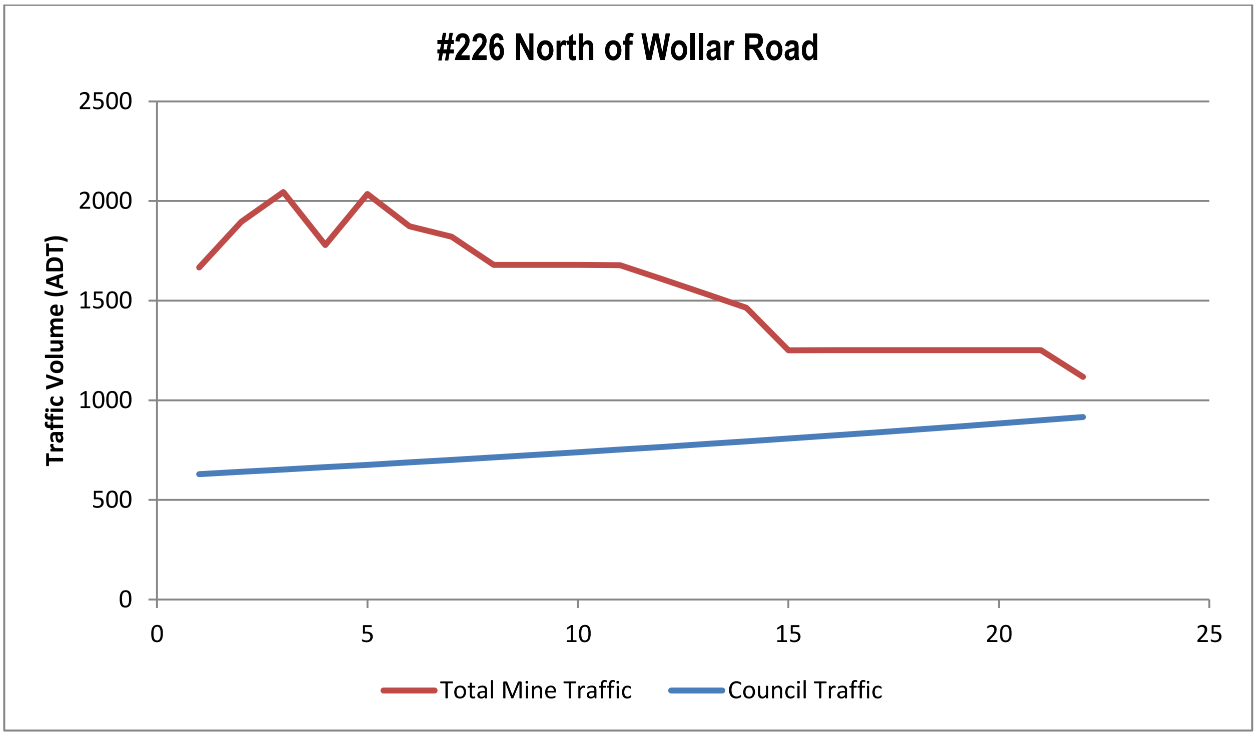


Figure 6.4: Forecast of traffic on Ulan Road, north of Wollar Road intersection

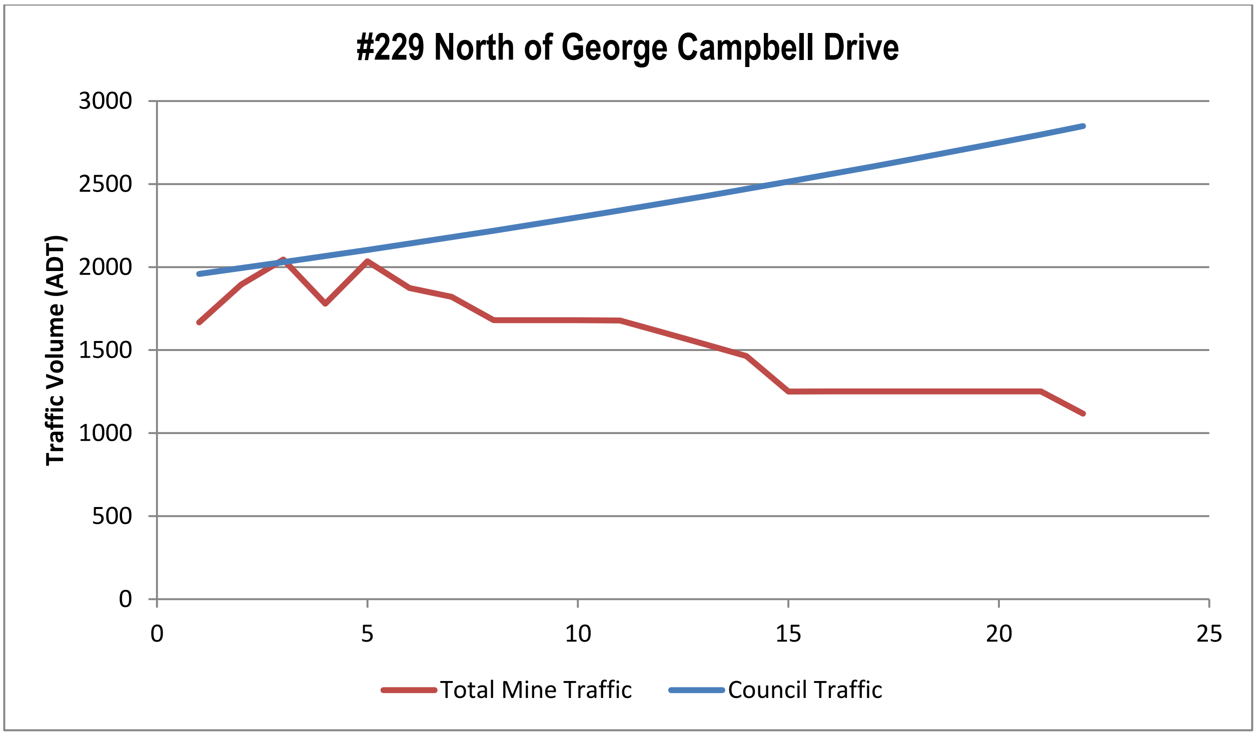


Figure 6.5: Forecast of traffic on Ulan Road, north of George Campbell Drive intersection

The whole-of-life traffic generated for mine and non-mine related activities formed the basis for the apportioning of the cost of certain works to the mines and to MWRC.

The whole-of-life approach is considered to be the more equitable method for assessing traffic impacts over a peak traffic demand approach for the following reasons:

- the mine proposals identify a finite operational life of 21 years
- traffic generated by the mine operations peak within the first five years and then decline for the remaining life of the mine operations.

The proportion of mine versus general community traffic for each section of Ulan Road is presented in Table 6.3. It should be noted that sections 2, 3 and 4 have multiple traffic proportion figures. These reflect the availability of additional traffic count data and the change in traffic volumes along the length of Ulan Road.

Table 6.3: Whole-of-life proportion of traffic by section

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Description	Mine (%)	MWRC (%)
1	0.000	3.785	3.785	Short Street to George Campbell Drive (south), Mudgee Airport turn-off	18.2	81.8
2	3.785	9.574	5.789	George Campbell Drive (south), Mudgee Airport turn-off to Wollar Road (MR208)	39.6 50.6	60.4 49.4
3	9.574	38.655	29.081	Wollar Road (MR208) to Cope Road (MR512)	67.0 79.3 79.0 91.1	33.0 20.7 21.0 8.9
4	38.655	45.236	6.581	Cope Road (MR512) to UCML Admin entrance	92.4 5.6	7.6 94.4

6.2 Managing traffic demand

Part F of condition 50 of the project approval requires consideration of measures that could be applied to reduce the traffic generated by the mine operations. The measures considered in preparing this strategy include:

- Car-pool and car-share
- Bus transport
- Cycling
- Restricting the hours of access to the mines for heavy vehicle movements

Although removed from surrounding towns, the mines are not isolated and the majority of staff and contractors commute each day to and from the mine sites. It is therefore reasonable to consider what action can be taken to reduce the reliance of mine-related staff and contractors on individual vehicle journeys and thus reduce the requirement to expand road infrastructure provision.

To assist understanding the potential for traffic issues, the mines identified the start and finish times for each shift. This information also assists to identify the potential conflict between mine commuting traffic and other general traffic flow.

The road environment and distance between Mudgee and the mines makes cycling impractical to consider. The cost to provide a cycleway for the length of Ulan Road would be prohibitive and require significant widening and loss of roadside verge area.

Advice from the mine representatives is that through active encouragement and incentive and through staff co-operation, there is already a degree of carpooling/car-sharing that occurs amongst staff. There is no firm data that identifies the degree of take up of these initiatives, since it is largely an informal and voluntary process.

Discussion with the mine representatives indicate that consideration can be given to more promotion of sharing commuting trips, however, the take up amongst most staff is complicated by the shift and overtime arrangements.

Bus transport as an option has previously been considered by the mine operators as a means of reducing traffic and improving safety for staff and motorists. Like car-pooling and car-sharing options, arranging bus transport is complicated by the shift and overtime arrangements for the majority of the workforce.

A bus arrangement would involve extended journey times between Mudgee and the mines. Depending on the pick-up/drop-off arrangements this option would also require a large area of land for secured parking of private vehicles at the bus interchange area. Mine representatives indicated that previous consideration of this option would not have a high patronage rate and thus for the expenditure it is unlikely to offer any significant reduction in vehicles on Ulan Road.

Adopting any or all of these options would not guarantee any noticeable impact on the number of vehicles on Ulan Road. Without a significant decrease in mine related traffic, there is no change in the desirable design formation width and hence funding for reducing traffic demand offers no saving in capital or maintenance costs to MWRC or the mines.

In terms of potential safety conflict between school bus and general traffic along Ulan Road, it is suggested that consideration be given to restricting travel time for mine related heavy vehicle traffic. Arrangements between each of the mines and their respective contractors making deliveries etc. could incorporate periods in the morning and afternoon peak traffic times when access to the sites would not be available. Such an arrangement can be a standing contractual arrangement and would effectively remove mine related heavy vehicles from Ulan Road during specified times.

Enforcement could only be via the mines since there is not any specific time restriction available that could be applied by MWRC under the NSW Roads Act.

Therefore, in terms of reducing the amount of mine related traffic on Ulan Road, it is suggested mines actively encourage car-pooling/sharing amongst all staff and in consultation with suppliers, adopt restricted delivery times for heavy vehicle traffic.

6.3 Road safety analysis

Road safety is an important performance measure of the adequacy of a road to cater for current and projected traffic. The analysis of crash data combined with a road safety audit review provide valuable input to the preparation of a road strategy that is considered in conjunction with other analysis such as a traditional assessment of road capacity.

Identifying specific locations or highlighting general infrastructure deficiencies that may contribute to the cause of road crashes can assist to determine an appropriate standard for road and intersection design and can help establish a program of road works.

Analysis of the available crash data and a review of a road safety audit undertaken by SKM have been included in a road safety analysis of the subject length of Ulan Road.

6.3.1 Crash data analysis

Crash data for Ulan Road for the five-year period May 2005 – March 2010 was provided by MWRC. This crash data is plotted in Figure 6.6 and identifies 53 crashes for this period.

The most common crash type recorded is road user movement (RUM) code 71 – Left-off carriageway into object (on a straight) and RUM code 32 rear-end crash into a right turning vehicle with 7 crashes (13.2%) each.

Loss of control type crashes, i.e. off-path on a straight or curve (RUM codes 70 to 88) account for 26 (49.1%) crashes recorded over this period.

All RUM codes considered to be typically related to intersection movements account for 17 crashes (32.1%) along Ulan Road.

A more detailed review of the data was undertaken to identify intersections along Ulan Road where multiple crashes may have been recorded (note: crashes that are located within a 100 metre radius of the intersection were considered to be related to the configuration and traffic movement occurring at an intersection).

Intersections along Ulan Road found to have multiple crashes recorded over the subject period include:

- Henry Lawson Drive (3 crashes, RUM13, 36, 81)
- Moggs Lane (3 crashes, RUM 21, 32, 74)
- George Campbell Drive (2 crashes, RUM 32, 33)
- Mud Hut Creek Road (4 crashes, RUM 20, 32, 80, 83)
- Main Street (2 crashes, RUM 10, 32)

In addition to the crash data supplied by MWRC, a summary crash history analysis for the five-year period January 2006 – December 2010 was provided by RMS. Table 6.4 provides an overview of the summary crash history analysis by RMS. Since this data covers a slightly different period to that provided by MWRC, the results are not able to be directly compared.

Utilising the RMS summary analysis, Figure 6.7 and Figure 6.8 chart the frequency of crashes by time of day and day of week, respectively.

The hour period with the highest number of crashes recorded is between 5.00 and 6.00 pm, with 8 crashes (12.9%). There are two one hour periods with the second highest number of crashes recorded - between 6.00 and 7.00 am and 3.00 and 4.00 pm, with 5 crashes (8.1%) each.

Friday, with 14 crashes (22.6%) and Sunday, with 12 crashes (19.4%) are the days of the week with the highest and second highest number of crashes recorded, respectively.

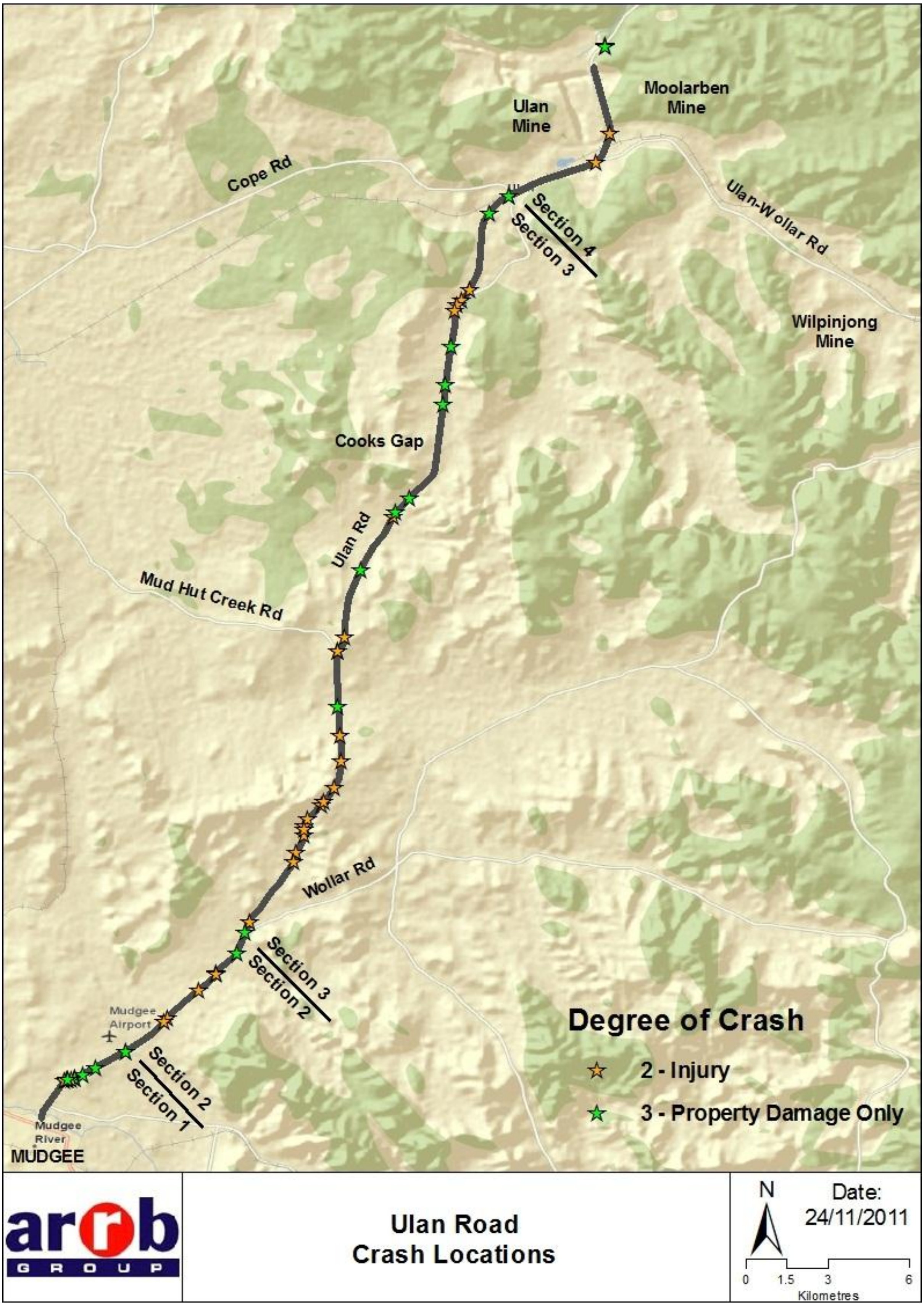


Figure 6.6: Crash map for Ulan Road and intersections

Table 6.4: RMS summary analysis of five-year crash data (2006 – 2010) – Ulan Road

Description	No. of crashes	% of crashes
Number of crashes	62	100
Casualty		
No. of fatal crashes (# killed)	0 (0)	0
No. injury crashes (# injured)	37 (48)	59.7
No. non-casualty crashes	25	40.3
Vehicles involvement		
Car	47	75.8
Light truck (i.e. utility, 4WD etc.)	22	35.5
Motorcycle	7	11.3
Truck (i.e. rigid, articulated)	1	1.6
Location		
Intersection	18	29.0
Non-intersection (i.e. midblock)	44	71.0
Collision type		
Single vehicle	35	56.5
Multiple vehicles	27	43.5
Crash movement type		
Off-carriageway on straight (RUM 70 – 73)	16	25.8
Off-carriageway on curve (RUM 80 – 87)	12	19.4
Rear-end collision (RUM 30 – 32)	12	19.4
Intersection, adjacent approaches	3	4.8
Hit animal (RUM 67)	3	4.8
Other crash type	16	25.8
Road surface condition		
Wet	11	17.7
Dry	51	82.3
Natural lighting conditions		
Dawn	3	4.8
Daylight	39	62.9
Dusk	5	8.1
Darkness	15	24.2
Weather		
Fine	48	77.4
Rain	3	4.8
Overcast	7	11.3
Fog/mist	4	6.5

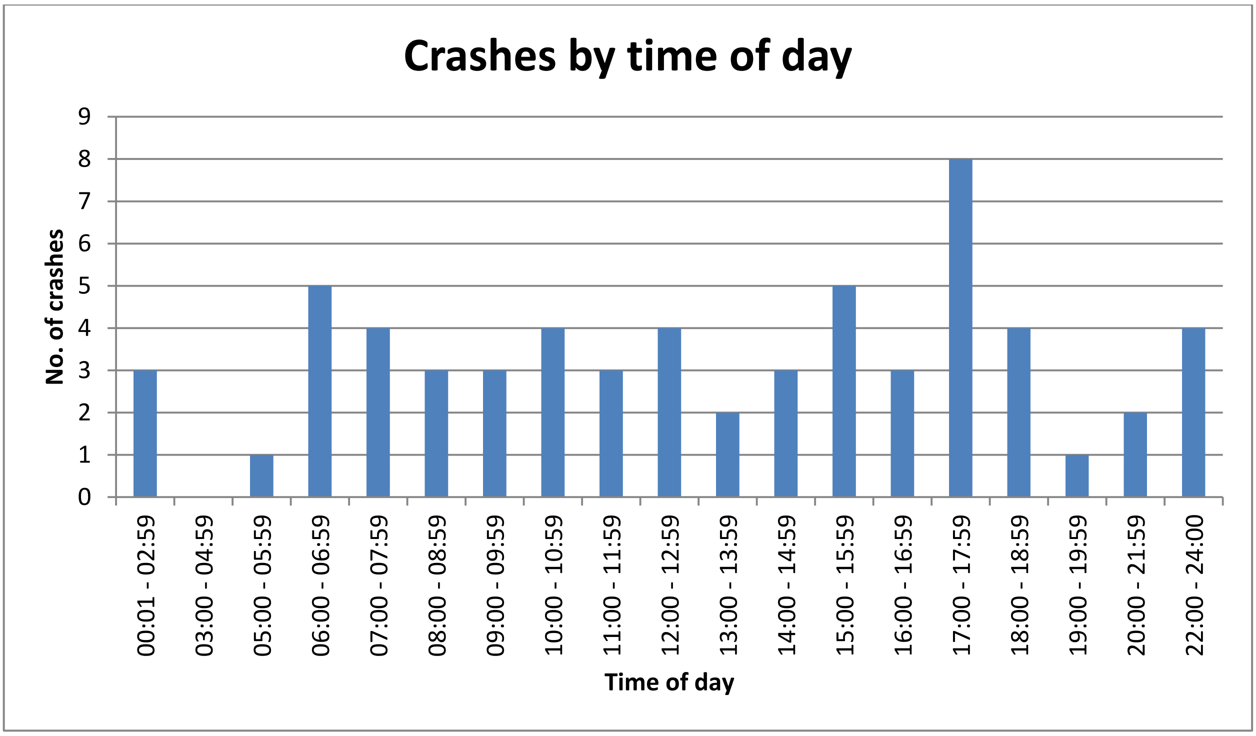


Figure 6.7: No. of crashes by time of day – Ulan Road

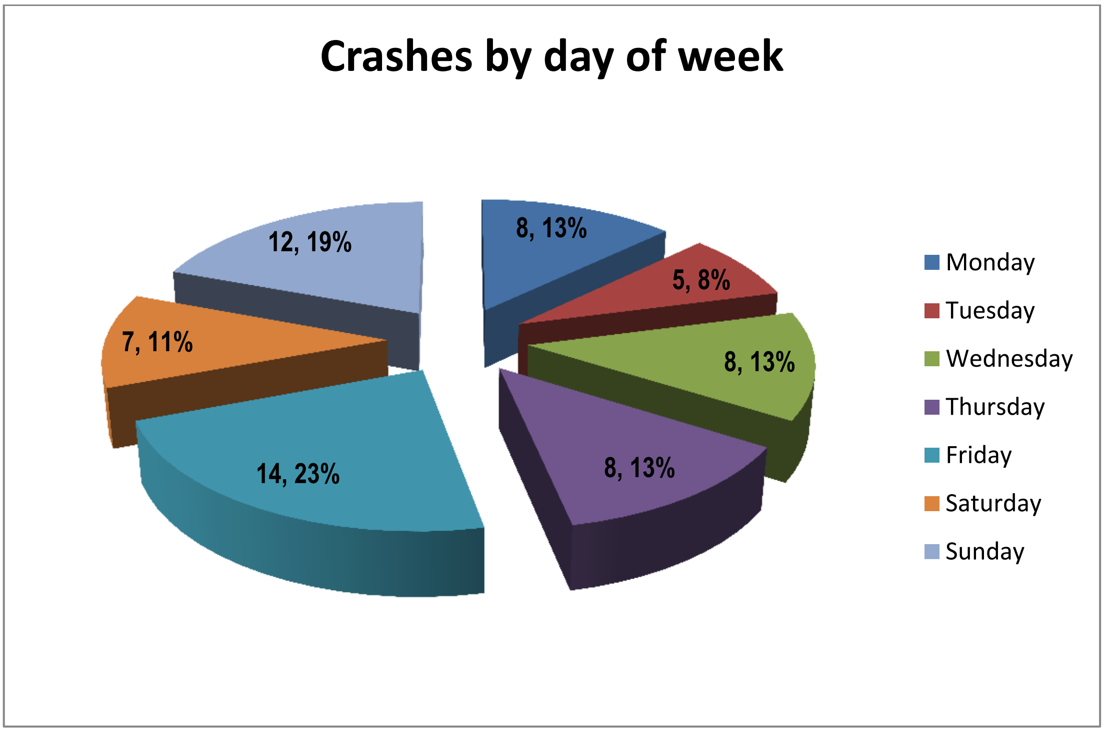


Figure 6.8: Crashes by day of week – Ulan Road

6.3.2 Crash and casualty rates

An indicator of the scale of a crash problem is the crash rate for a road or length of road under investigation. Assessment of the road environment can be used to assist identifying contributing factors to the cause of crashes and remedial works identified to address the road safety issues.

The casualty rate is another indicator for road safety analysis since it can assist to identify the severity of crashes that are occurring on a road or section of road. Under the Safe System approach to road safety adopted in Australia and NSW, a key objective is reducing the severity of crashes, in addition to the occurrence of crashes.

Central to managing crash severity is managing vehicle speeds, particularly the speed of impact during a crash.

The crash and casualty rate for each section of Ulan Road is calculated using the data presented in Table 6.5, noting that traffic volumes used are those that best represent the location where the crashes occurred.

Table 6.5: Crash rate calculation by Ulan Road section

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Description	No. crashes	AADT	Crash rate (100 mvkm)	No. casualties	Casualty rate (cas./km/year)
1	0	3.785	3.785	Short Street to George Campbell Drive (south), Mudgee Airport turn-off	12	3625	47.92	7	0.370
2	3.785	9.574	5.789	George Campbell Drive (south), Mudgee Airport turn-off to Wollar Road (MR208)	6	2919	19.46	5	0.173
3	9.574	38.655	29.081	Wollar Road (MR208) to Cope Road (MR512)	33	2006	31.00	28	0.193
4	38.655	45.236	6.581	Cope Road (MR512) to UCML Admin entrance	2	1010	16.49	2	0.061
Total	0	45.236	45.236	Mudgee to UCML Admin entrance	53	2400	26.75	42	0.186

1. AADT used is that considered most representative of the road section
2. The AADT for the length of Ulan Road is an average and provides an indication only

Section 1 and section 3 may be considered to have crash and casualty rates higher than may be typically expected for the type of road, traffic mix and speed environment present and consideration of remedial action is warranted.

For section 1, there is a cluster of 8 crashes within a 300 metre length between the Henry Lawson Drive and Moggs Lane intersections. It should be noted that 8 of the 12 crashes in section 1 relate to intersection movements. Therefore, the crash rate for section 1 requires caution when comparing it with typical rates for rural road environments and even with the rates for other sections for Ulan Road.

The crash rate for the whole of section 3 is 31 crashes per 100 mvkm. The crash rate south of Mud Hut Creek Road 47.32 per 100 mvkm (19 crashes recorded over the 11 km length). North of Mud Hut Creek Road the crash rate is 21.25 per 100 mvkm (14 crashes recorded over the 18 km length).

6.3.3 *Road safety audit findings*

The SKM report for the MCO included a road safety audit of Ulan Road.

The Transport and Urban Planning report referenced the SKM road safety audit and endorsed the findings and recommendations.

While the Halcrow report also referenced the SKM report, it did not discuss the road safety audit report or the recommendations of SKM.

The SKM road safety audit identified the following areas of deficiency requiring attention:

- poor line marking and delineation
- narrow road pavement, often with no sealed shoulders
- narrow and poor condition of road shoulders.

With reference to the crash data analysis, it is a reasonable conclusion that the current condition of the road pavement, particularly the width of seal and the poor condition of the road shoulders is a safety problem.

A visual assessment of Ulan Road was undertaken as a part of this Strategy to supplement the results of the pavement testing undertaken. The results and consequences of this assessment and testing are discussed in Section 7.

6.4 Road traffic noise assessment

Analysis of the noise generated by existing traffic flows and modelling of the effect of additional traffic loading to generate noise has been undertaken to identify residences that may experience an increase in the noise levels from Ulan Road. Detailed noise calculations and analysis were carried out by consultants Wilkinson Murray for two different scenarios – i.e. the existing and highest traffic volume cases. All calculations and modelling have been based on the existing and forecast traffic volumes discussed elsewhere in this strategy.

The following factors were considered during the assessment process:

- Traffic volume and likely proportions of heavy vehicles
- Topographical information along and surrounding the entire project corridor
- Land use surrounding the project
- Vehicle speed
- Different noise emission levels and source heights
- Location of the noise sources on the motorway
- Road surface types
- Road gradient
- Attenuation from noise barriers (both natural and purpose built for the project).

The Wilkinson Murray report is included in the strategy as Appendix G. Full details of the analysis, discussion of the results and outline of noise treatment options is provided in the report.

In summary, Wilkinson Murray have identified that under existing conditions up to 8 residences are experiencing noise levels the exceed benchmark levels for night time periods. Of these 8 residences, 5 are at risk of experiencing noise that exceeds benchmark levels for day time periods.

During the peak traffic year of the operational life of the mines, up to18 properties are potentially at risk of experiencing noise that exceeds benchmark levels for night time periods. Of these 18 residences, 6 are at risk of experiencing noise that exceeds benchmark levels for day time periods.

6.5 Conclusions for traffic and road safety performance

More than three-quarters of crashes involve a passenger car; the majority of crashes occur on dry roads in fine weather and during the day.

Over half the recorded crashes involve a single vehicle; just over 45% are loss of control type crashes, less than one-third are at intersections.

Analysis of the road and crash data indicates that Ulan Road has higher calculated crash and casualty rates than may be expected for this class of road, the traffic type/mix and the prevailing speed limit.

A road safety audit undertaken as part of a separate study identified that the current condition of the road, particularly the relatively narrow seal and shoulders (or lack thereof) combined with poor delineation contribute to the risk for road users of Ulan Road.

There is an increase in the number of properties that are at risk of experiencing noise levels that exceed benchmark levels for day and night time periods.

7 ROAD CONDITION ASSESSMENT

The existing condition of Ulan Road was assessed utilising the following techniques:

- Pavement condition survey – utilising ARRB's proprietary Hawkeye NSV the condition of the pavement texture, roughness and rutting was analysed. Additional road geometry data such as crossfall and road gradients is also available.
- Falling weight deflectometer (FWD) testing – this testing provides assessment of the structural integrity of the road pavement by measuring deflections under a known impact load. Testing was undertaken at 200 m intervals along Ulan Road in both north and south travel lanes with a 100 metre offset.
- Video assessment – using the digital camera array on the NSV, the road width, line marking, delineation and surface condition was assessed so an overall road condition could be determined.

The condition assessment of Ulan Road was done in accordance with the condition criteria as listed in the appendices of the Austroads *Guide to Pavement Technology Part 5: Guide to Project Evaluation and Treatment Design* (Austroads 2009i). The results of each of these techniques provide a comprehensive view of the existing road condition.

To assist interpreting the results of the data analysis, basic descriptive performance measures that indicate the condition of the road have been used. These are:

- Good
- Fair
- Poor

The range for each condition relate to the parameters assessed for each technique. These are outlined in Table 7.1. It should be noted that not all condition parameters are applicable to each of the descriptive performance measures.

Table 7.1: Condition assessment performance measures

Condition assessment technique	Good (Very strong/strong)	Fair (Moderate)	Poor (Weak)
Pavement surface condition			
▪ Texture	Texture depth in wheel path > 0.6 mm	N/A	Texture depth in wheel path < 0.6 mm
▪ Roughness (ride quality, RQ)	Isolated: < 5.3 m/km (IRI) 500 m section: < 4.2 m/km	N/A	Isolated: > 5.3 m/km (IRI) 500 m section: > 4.2 m/km
▪ Rutting	< 10% road length > 20 mm rut depth	N/A	10% road length > 20 mm rut depth
Falling weight deflectometer	800 – 1050 µm	1050 – 1550 µm	>1550 µm
Video assessment	▪ ≥ 3.2 m sealed lane ▪ ≥ 0.5 m sealed shoulder ▪ No serious pavement damaged ▪ Edge and centreline marking present	▪ 3.1 – 3.2 m sealed lane ▪ Minimal sealed shoulder ▪ No evidence of edge breaks ▪ Centreline present, not likely to have edgelines	▪ < 3.1 m sealed lane ▪ No sealed shoulder ▪ Minimal unsealed shoulder ▪ Edge breaks evident ▪ Centreline but no edgelines

A brief overview of the road condition based on the parameters in the above table is provided in the next sections. A more detailed analysis with supporting data is provided in Appendix D.

7.1 Pavement surface condition

The Hawkeye NSV provides data for pavement texture, roughness and rutting analysis. For Ulan Road this data was collected for each main traffic lane, i.e. both the north and southbound travel lanes. The result, analysed against the performance criteria established by Austroads, is mapped in Figure 7.1, Figure 7.2 and Figure 7.3 for texture, roughness and rutting, respectively.

Table 7.2 indicates the proportion of the length of each section determined to be in good or in poor condition.

Table 7.2: Pavement surface condition performance (%)

Criteria	Condition	Section			
		1	2	3	4
Texture	Good	64.5	81.9	87.3	80.3
	Poor	35.5	18.1	12.7	19.7
Roughness	Good	98.7	100	99.3	99.2
	Poor	1.3	0.0	0.7	0.8
Rutting	Good	97.4	91.4	85.7	97.0
	Poor	2.6	8.6	14.3	3.0

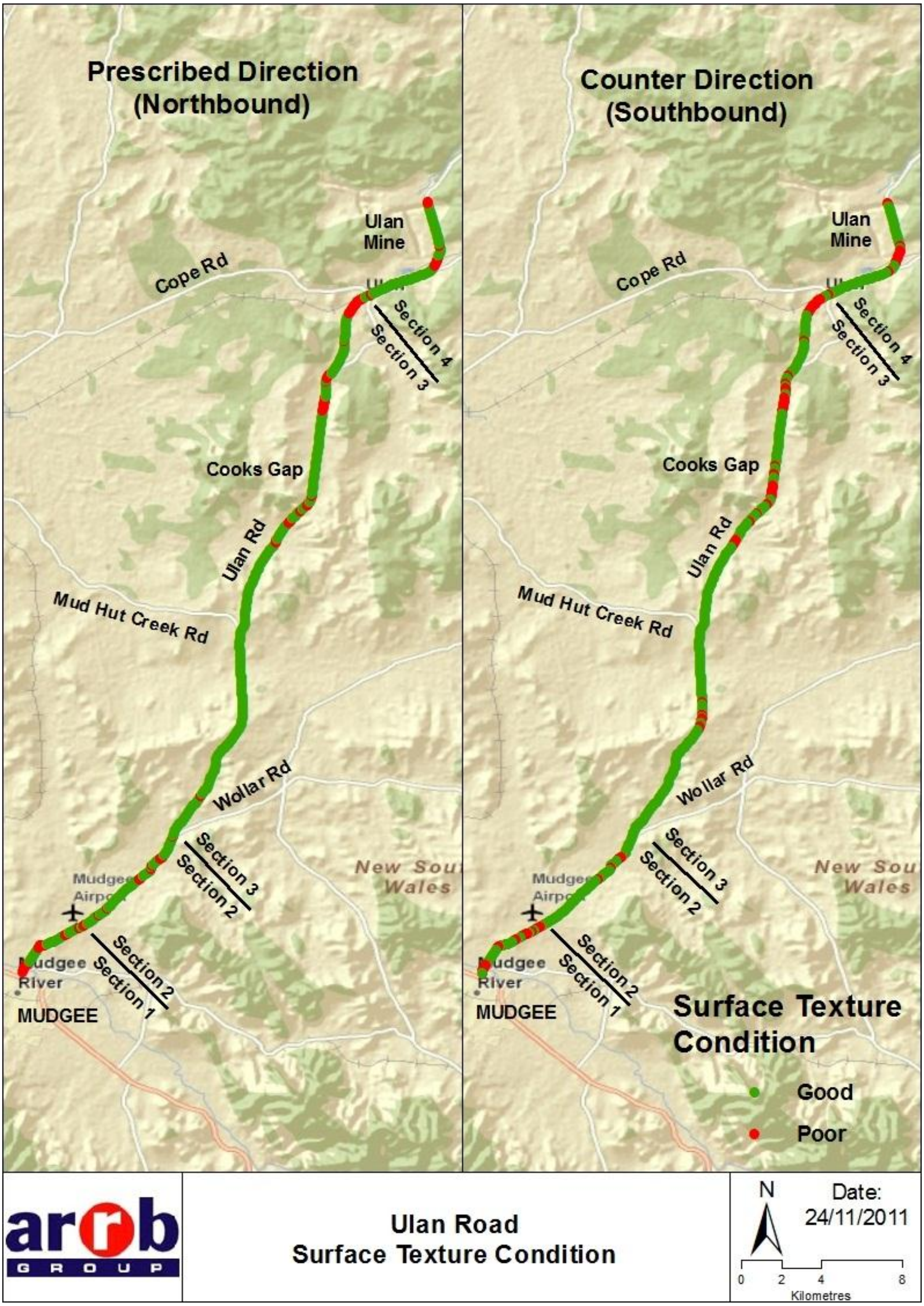


Figure 7.1: Pavement surface texture condition map

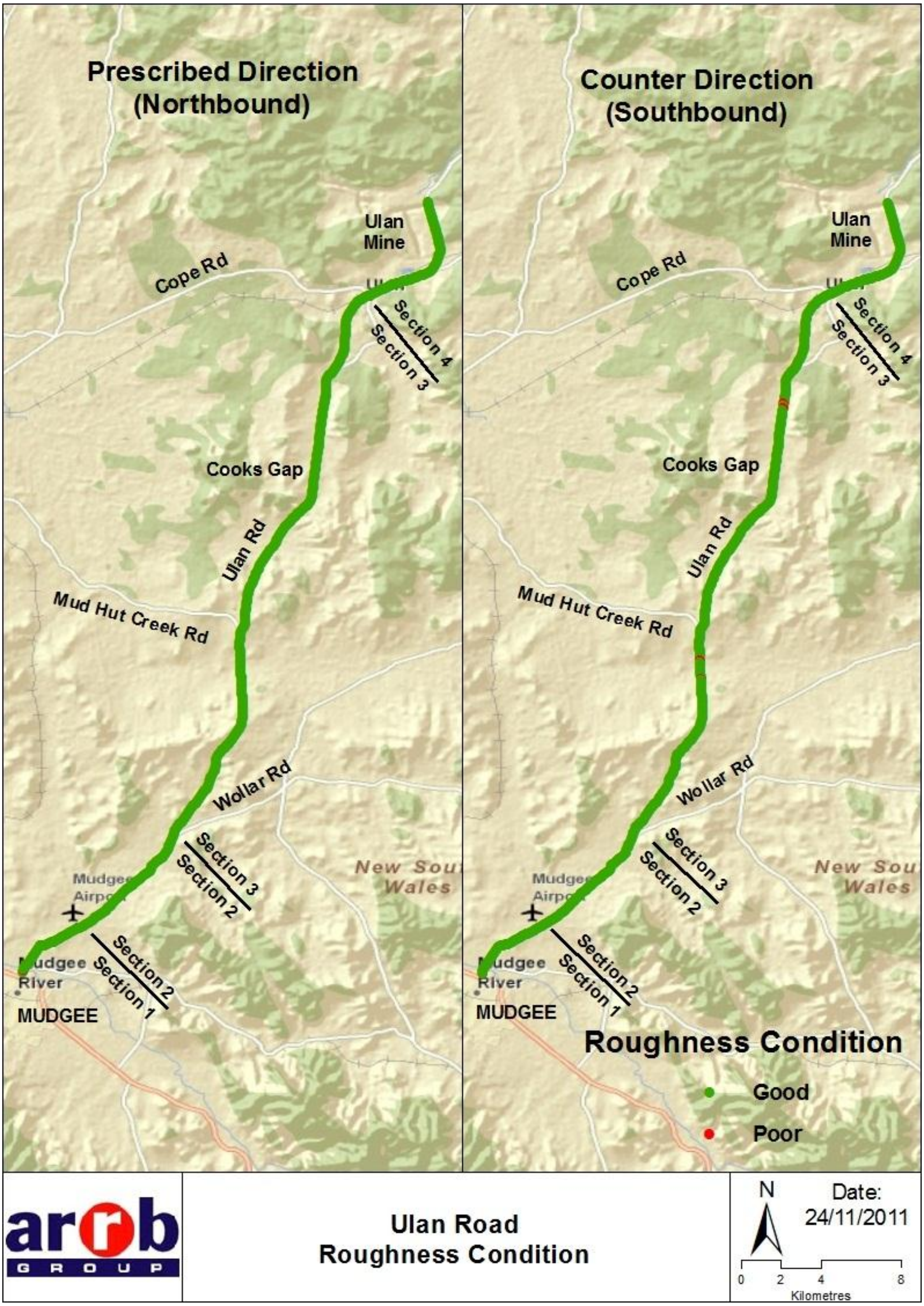


Figure 7.2: Pavement roughness condition map

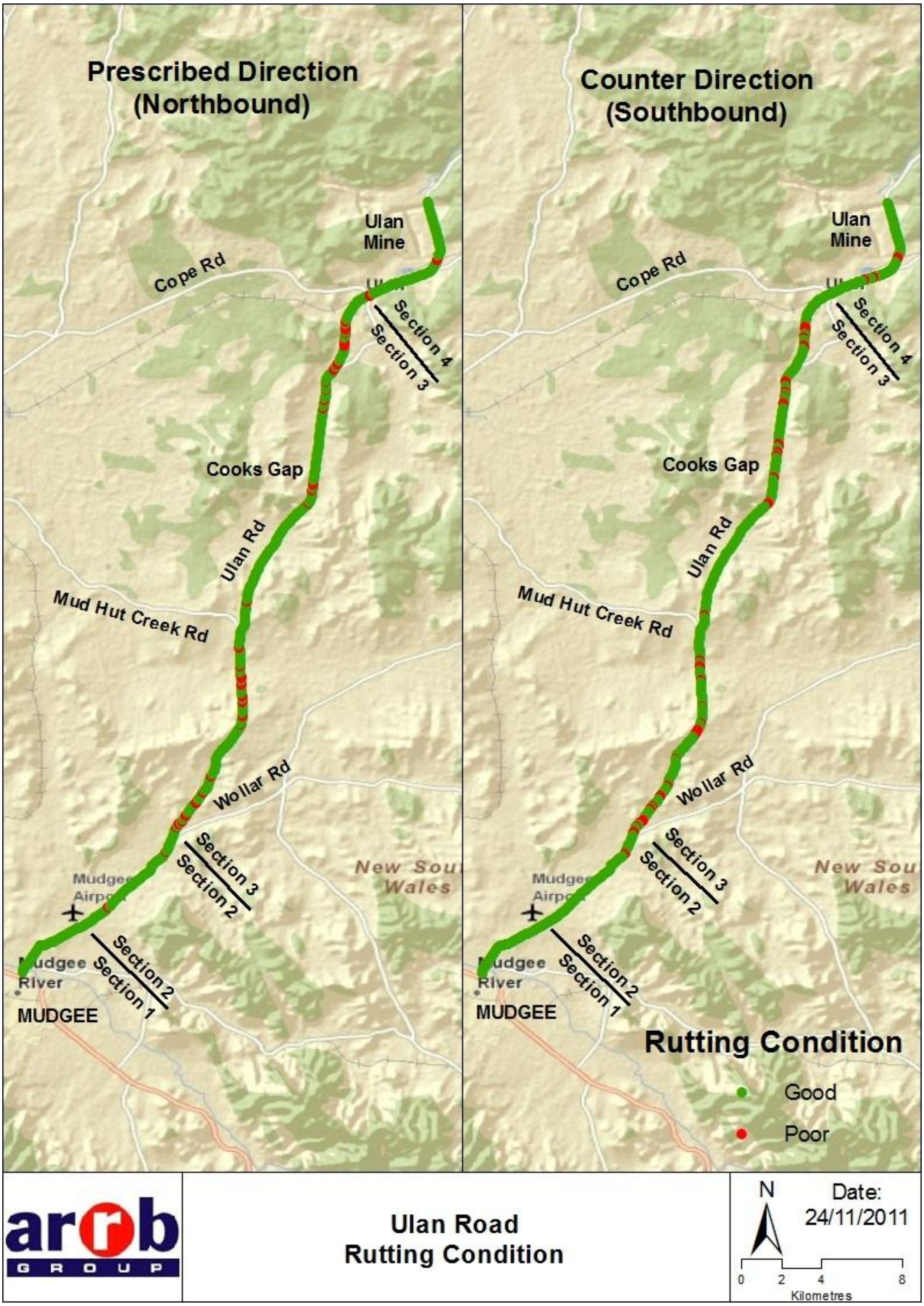


Figure 7.3: Pavement rutting condition map

7.2 Pavement strength and condition

The strength of the existing pavement was tested using a falling weight deflectometer (FWD). This method of testing allows the deflection of a pavement to be measured at set distances from the impact point of a known mass. Based on the measured deflections, the structural condition of the pavement can be determined and the performance over time under a given traffic loading can be estimated.

The FWD test results indicate that the lowest deflections were measured along the older sections of pavement, while larger deflections were measured along recently constructed pavement. Pavement strength results based on the parameters in Table 7.1 are plotted in Figure 7.4 and summarised in Table 7.3.

Table 7.3: Indicative pavement strength by chainage

Section	Chainage	Length (km)	Indicative Strength
1	0.0 – 9.0	9.0	Strong
2	9.0 – 15.7	6.7	Moderate
3	15.7 – 18.7	3.0	Very strong
3	18.7 – 19.5	0.8	Weak
3	19.5 – 26.1	6.6	Moderate
3	26.1 – 31.1	5.0	Strong
3	31.1 – 32.7	1.6	Very Strong
3	32.7 – 38.5	5.8	Moderate
4	38.5 – 45.1	6.6	Moderate

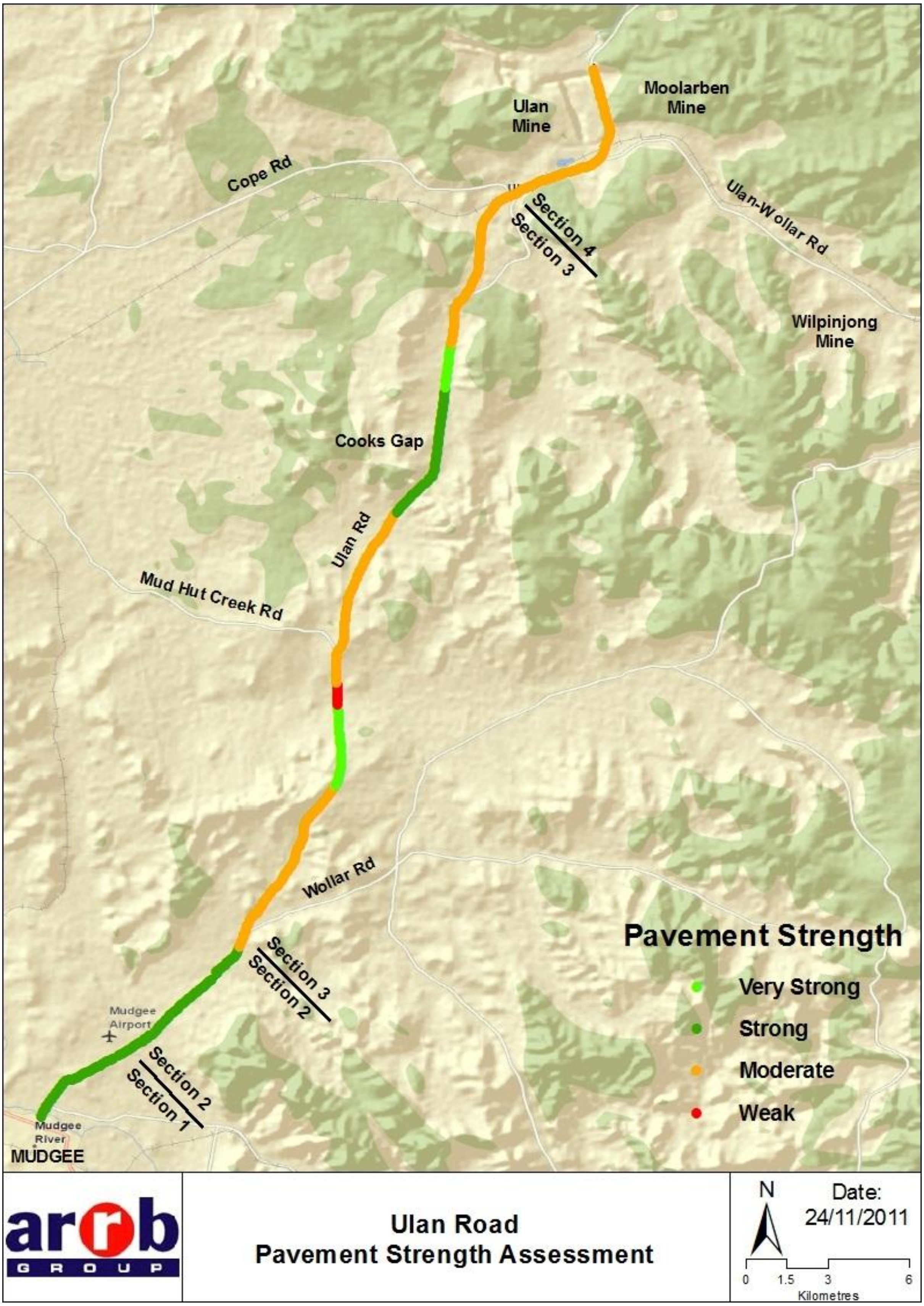


Figure 7.4: Pavement strength (FWD) map

7.3 Visual pavement condition

The visual condition of the pavement was assessed by viewing the digital images in the Hawkeye Toolkit software and is based on the criteria presented in Table 7.1. This considers the width of sealed travel lane, presence of linemarking – centreline and edgelines – and the presence and condition of the sealed and unsealed road shoulders.

The assessment of the width of the marked travel lane was aligned with the desirable design width that was specified in Section 5.3 and Table 5.3.

The result of mapping traffic lane width is present in Figure 7.5. The overall pavement visual assessment rating result is presented in Figure 7.6.

The older pavements of Ulan Road tended to be assessed as being in a poor condition, due to the narrowness of the seal and lack of edgeline marking to define a sealed road shoulder. A length of road identified as poor would require upgrade (widening) to meet the adopted desirable design criteria. This is not necessarily an outcome that describes the condition of the central pavement in terms of the other condition performance criteria. For instance, comparing Figure 7.4 and Figure 7.6 shows that some of the stronger pavement is also some of the poorer performing in terms of visual rating criteria.

The typical width of sealed pavement for each section of Ulan Road is outlined in Table 7.4.

Table 7.4: Typical measured (video) pavement widths

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Description	Traffic lanes (m)	Sealed Shoulder (m)	Unsealed Shoulder (m)
1	0	3.785	3.785	Short Street to George Campbell Drive (south), Mudgee Airport turn-off	2x3.3	2x0.9	0
2	3.785	9.574	5.789	George Campbell Drive (south), Mudgee Airport turn-off to Wollar Road (MR208)	2x3.1	2x0.9	0
3	9.574	38.655	29.081	Wollar Road (MR208) to Cope Road (MR512)	2x3	0	0
4	38.655	45.236	6.581	Cope Road (MR512) to UCML Admin entrance	2x3.2	2x0.7	0

Upgrade of the narrow pavements will ideally involve widening and rehabilitation. This will ensure the construction of a single consolidated pavement that will have superior performance over the longer term as compared to a shoulder widening approach.

It is evident that widening the sealed pavement by adding width to the existing central pavement has been attempted along Ulan Road in the past. This form of upgrade creates a joint between the existing and new pavement that is vulnerable to failure from traffic loading and water ingress. It is clear from the visual assessment that failure along this joint line has created ongoing maintenance and road condition problems.

Figure 7.5: Sealed traffic lane width map

Figure 7.6: Pavement visual condition assessment map

7.4 Conclusions of condition assessment

Various condition measures were assessed and are reported in the foregoing sections. Lengths of road with generally uniform condition ratings were identified and have been plotted on maps of Ulan Road.

From the road condition survey and analysis three distinct road formations have been identified along Ulan Road. These are:

- adequate (existing)
- adequate (new)
- inadequate.

Approximately 24.651 km of Ulan Road is considered to be either adequate (existing) or adequate (new) condition as measured against the three assessment areas surface condition, pavement strength and visual condition.

Sections of adequate (existing) pavement typically have a sealed width in excess of 6.6 m, with marked edgelines and sealed shoulders in the order of 0.3 to 0.5 m wide. While less than the desirable design formation, it is considered un-necessary to reconstruct and/or widen these sections. The existing width is considered adequate for the current and projected traffic loading under the mine development scenarios considered in this strategy.

Recently reconstructed and widened sections typically have a sealed width in the order of 9.0 m and are in very good/new condition and form the second distinct road formation, i.e. adequate (new). Pavement strength testing of this new pavement indicates that these sections exhibit larger deflections than should be expected for a new pavement. The effect of this will be over the long term and regular monitoring of these sections is recommended to ensure timely action to address any failures that arise under traffic loading. This will improve the longevity of the pavement and minimise costly reconstruction in the future.

The remaining length of Ulan Road that is under review totals 20.585 km and is considered to be inadequate and warrants upgrading. Failure of the underlying pavement is evident in sections, particularly along the road edge and the road shoulders area. This is particularly notable along sections where the central pavement was widened with a relatively narrow, approximately 1.0 m, strip of pavement.

This 20.585 km length of pavement fails to meet the requirements of the minimum design width. With reference to Table 5.3, the existing sealed formation fails to meet the design formation for the next lower class of road formation, that for roads servicing 150 – 500 AADT, which requires a total carriageway formation of 9.2 m. On the basis of this assessment this 20.585 km of Ulan Road is not considered adequate for a local road servicing non-mine related (local) traffic.

Upgrading of the inadequate sections of pavement should involve rehabilitation of the central pavement and widening to the desirable design formation width. This will then provide a single pavement of appropriate width for current and projected future traffic.

8 FUTURE WORKS AND MAINTENANCE

The extent of upgrade works required along Ulan Road was identified by:

- comparing the existing road against the adopted design standard for the given traffic demand
- reviewing the conclusions and recommendations of the traffic impact assessment reports undertaken for each mine as a part of their respective environmental impact assessments
- reviewing the road safety performance along the road, particularly at intersections.

The consultant traffic impact assessments for each of the three mine proposals concluded that the level of service for the current intersections along Ulan Road is within acceptable parameters for the existing and future road traffic environment.

In these reports upgrade works were identified along the length of Ulan Road to provide a wider sealed pavement. These reports also identified that upgrade works would be necessary at two intersection locations – Cope Road/Ulan Road and Wollar Road/Ulan Road. The studies indicated that these works were required primarily for reasons of safety and not capacity.

In preparing this strategy, each road intersection along the length of Ulan Road was reviewed against the warrants in Austroads to determine the appropriate intersection type and an estimate of the works necessary to meet that design type was made.

The outcome of this is discussed in more detail below.

8.1 Capital works

8.1.1 Intersections

Forty-three road intersections and larger scale property entrances were identified along the subject length of Ulan Road. There is generally minimal development serviced by the majority of the side roads, although some intersections do provide access to traffic generating businesses such as local quarries.

The existing and recommended configuration for each intersection was assessed following consideration of the design warrants outlined in the Austroads Guide to Road Design Part 4A. In the case of 24 intersections upgrade to either BAR/BAL or CHR/CHL type configurations are recommended.

Intersections that are recommended for upgrade are listed in Table 8.1. The timing of the upgrades, i.e. whether it can be incorporated into road widening works are it is a standalone project, is also indicated in Table 8.1.

Upgrade works to provide a BAR/BAL configuration are considered to be relatively minor works and the opportunity exists to incorporate these upgrades into the widening of the road formation at minimal additional cost. Where a more significant upgrade is required, the works may still be incorporated into the upgrade of the road width formation, however the cost has been adjusted to reflect the additional work.

In several instances an intersection upgrade is considered to be a standalone improvement, since the formation width of Ulan Road may be currently adequate and not require widening. In these instances the higher cost of intersection works is also reflected in the estimates in Table 8.1.

Table 8.1: Summary of intersection upgrades

Section	Chainage (km)	Location/description	Intersection type		Upgrade type
			Existing	Recommended	
1	0.352	Pitts Lane (Grandstand construction)	BAR/BAR	CHR(s)/AUL	Intersection
2	3.785	George Campbell Drive (Airport entrance)	AUR/AUL	CHR(s)/AUL	Intersection
	6.652	Buckaroo Lane	-	CHR(s)	Intersection
	9.574	Wollar Road	BAR/BAL	CHR(s)/AUL	Intersection
3	9.885	Church Lane	-	BAR/BAL	Road
	11.539	Box's Lane	-	BAR/BAL	Road
	14.010	Spring View Lane	-	BAR/BAL	Intersection
	15.754	Hadabob Road	-	BAR/BAL	Road
	17.644	Frog Rock Road	-	CHR(s)/AUL(s)	Road
	19.999	Linburn Lane	-	BAR/BAL	Road
	20.691	Mud Hut Creek Road	-	CHR(S)/AUL	Intersection
	24.435	Wattlegrove Lane	-	BAR/BAL	Intersection
	26.129	Wyaldra Lane	-	BAR/BAL	Road
	27.783	Quarry and RFS Shed entry	-	BAR/BAL	Intersection
	28.771	Moolarben/Ridge Road	-	CHR(S)/AUL	Intersection
	29.252	Nimoola Road	-	BAR/BAL	Road
	30.515	Winchester Crescent	-	BAR/BAL	Road
	33.166	Winchester Crescent	-	BAR/BAL	Road
	34.369	Ridge Road	-	BAR/BAL	Road
	35.442	Lagoons Road	-	BAR/BAL	Road
	37.306	Toole Road (developer funding)	-	CHR/CHL	Intersection
4	38.645	Cope Road	AUR/AUL	CHR/CHL	Intersection
	39.527	UCML Surface Operations entrance	AUR/AUL	CHR/CHL	Intersection
	43.822	Un-named side road	-	BAR/BAL	Road
	44.123	Un-named side road	-	BAR/BAL	Road
	45.236	UCML Mine Administration entrance	AUR/AUL	CHR(S)/AUL	Intersection

8.1.2 Cross-section

The length of Ulan Road can be grouped into one of three formation widths:

- desirable design formation (adopted)
- minimum design formation
- substandard design formation.

With reference to Table 5.3, the adopted desirable design formation for Ulan Road is the road cross-section that should be provided along Ulan Road, where practical to do so. This formation has been applied to one short section of Ulan Road that has been reconstructed during the last 12 months and is comprised of:

2 x 3.5 m sealed lanes + 2 x 1.0 m sealed shoulders + 2 x 1.0 m unsealed shoulders.

Almost half the length of the existing carriageway formation of Ulan Road fails to comply with this desirable design standard. However, a significant proportion of it satisfies the minimum design formation, being:

2 x 3.2 m sealed lanes + 2 x < 0.5 m sealed shoulders + 2 x < 0.5 m unsealed shoulders.

On sections with this formation, there is line marking, a sealed shoulder and the pavement is considered to be in generally good condition; analysis of the pavement test results indicates a reasonable remaining life. These sections are considered adequate for the existing and projected traffic demand and it is not recommended that widening upgrade works be done at this time.

The remaining length of Ulan Road is considered to be a substandard design formation for existing and projected traffic loading and generally has a poor visual condition rating. The location where upgrading is required is identified in Table 8.2 and totals 20.585 km in length.

Table 8.2: Road (midblock) upgrade sections

Section	Start chainage (km)	End chainage (km)	Length to upgrade (km)
3	9.734	13.478	3.744
	14.912	22.215	7.303
	26.039	27.432	1.393
	28.039	31.106	3.067
	32.329	37.407	5.078
	Total		**20.585**

Note: The upgrade width is to the desirable design formation

These sections of Ulan Road are recommended for upgrade works as a capital works priority since they are considered inadequate even for a local traffic road, based on the lack of sealed formation width.

8.1.3 Safety

Upgrade of the nominated intersections and widening of the identified road sections will address the many of the safety issues identified through the crash history analysis and the road safety audit undertaken by SKM.

As discussed in Section 6.3.2, the crash and casualty rates for parts of Ulan Road are higher than expected for this class of road and traffic mix. Under a Safe System approach to managing Ulan Road, there are additional safety measures that could be applied to further address risk and improve safety for road users. These additional measures include ensuring adequate clear zones and/or providing road safety barriers to reduce the risk from and severity of roadside hazards, reducing the sign posted speed limits to reduce the severity of crashes if they do occur, enhanced road delineation and guidance, particularly of restricted curve alignments. The location and application of these types of additional safety measures are outlined in Table 8.3.

Table 8.3: Specific safety measures

Section	Start chainage (km)	End chainage (km)	Length (m)	Safety measure/treatment
1	0.321	2.176	1.855	Lower the existing speed limit: suggest 80 km/h be reduced to 70 km/h to the reduce risk posed by roadside development, i.e. frequent intersections and entrances.
1/2	2.176	4.600	2.424	Lower the existing speed limit: suggest 100 km/h be reduced to 70 km/h to the reduce risk posed by roadside development, i.e. frequent intersections and entrances.
2/3/4	4.600	45.236	40.636	Lower the existing speed limit: suggest 100 km/h be reduced to 90 km/h to the reduce risk posed by roadside hazards, e.g. vegetation, utility poles, culverts and other non-frangible objects.
1/2/3/4	0.321	45.236	-	Enhanced delineation (e.g. CAMs, rrpms) at selected locations, particularly isolated curves, road narrowing (e.g. bridges).
3	26.6	26.84	240(w)	Road safety barrier (e.g. WRSB, steel guardrail)
3	26.67	26.88	210 (e)	Road safety barrier (e.g. WRSB, steel guardrail)
3	27.1	27.45	350 (e)	Road safety barrier (e.g. WRSB, steel guardrail)

8.1.4 Traffic noise

The Wilkinson Murray report (Appendix G) discusses options for noise mitigation for residential properties which exceed the base criteria. The noise mitigation options that could be considered are:

- roadside noise barriers.
- reduction in speed limit.
- low noise road pavement.
- architectural treatment of exposed residences.

Wilkinson Murray discuss the feasibility of these noise mitigation options in the context of this Ulan Road Strategy and the properties identified as at risk.

It is clear that roadside noise barriers, while effective are considered inappropriate for the rural environment and due to the nature of the topography of the land.

Low noise road pavement, while also effective, is considered to be cost prohibitive over the length that requires treatment in terms of initial capital and long term maintenance. With regard to maintenance, noise levels tend to increase over time as the pavement undergoes wear and tear from the traffic loading.

The remaining two treatment options – reduction in speed limit and architectural treatment of the at risk residences – offer sustainable and affordable solutions.

With regard to lowering the speed limit, Wilkinson Murray identifies the reduction in noise that can be achieved for a speed limit of 80 km/h. The cost for this treatment is negligible in terms of expenditure, amounting to a few thousands of dollars for sign changes and pavement markings. Other impacts often associated with lowering speed limits include enforcement activity to gain compliance and community costs – real and perceived - such as increased travel time.

An additional benefit of a lower speed limit is that it compliments an improvement in road safety, as has been discussed elsewhere in this report.

Wilkinson Murray identify that architectural treatments offer a more certain level of noise mitigation that targets identified properties. Since a detailed examination of each residence is required and discussion with the property owners and residents is necessary, it is not possible to define a precise works program for treating road traffic noise in this strategy. Consequently, it is not possible to determine the cost of a noise treatment program, however, indication of the range of costs typically allowed for is between $10 000 and $20 000 per treated.

It is recommended that the owners and residents of properties identified by the noise modelling as at risk from increased road noise are contacted to discuss the opportunities for noise attenuation treatments.

8.1.5 Capital works program and priorities

Priority for the programming works is based on the following considerations:

- pavement condition
- crash history
- traffic volume
- timing with other, nearby, works

Where possible, the upgrade of intersections has been linked to road (midblock) upgrades as means of reducing the traffic disruptions and reducing the cost of works. Where the road condition and/or safety performance is a concern, then works have been programmed as soon as practicable.

An indicative program for all capital works is presented in Table 8.4. An indicative program for intersections detailed in Table 8.5.

Table 8.4: Indicative capital works program

Section	Start Chainage (km)	End Chainage (km)	Year						
			0	1	2	3	4	5	6
1	0	3.785		**I**					
2	3.785	6.652			**I**				
2/3	6.652	9.734			**I**				
3	9.734	17.644			**I**		**I, M**		
3	17.644	22.215		**I**	**I, M**				
3	22.215	26.039						**I**	
3	26.039	37.407		**I, M**	**I, M**	**I, M**		**I**	
3/4	37.407	45.236		**I**					

Notes:
I = Intersection upgrades
M = Road (midblock) upgrades

Table 8.5: Indicative program for intersection upgrades

Section	**Chainage (km)**	**Location/description**	**Intersection type**		**Upgrade with…**	**Year**
			Existing	**Recommended**		
Section 1	0.352	Pitts Lane (Grandstand construction)	BAR/BAR	CHR(S)/AUL	Intersection	1
Section 3	19.999	Linburn Lane	-	BAR/BAL	Road	1
Section 3	33.166	Winchester Crescent	-	BAR/BAL	Road	1
Section 3	34.369	Ridge Road	-	BAR/BAL	Road	1
Section 3	35.442	Lagoons Road	-	BAR/BAL	Road	1
Section 4	39.527	UCML Surface Operations entrance	AUR/AUL	CHR/CHL	Intersection	1
Section 4	45.236	UCML Mine Administration entrance	AUR/AUL	CHR(S)/AUL	Intersection	1
Section 4	38.645	Cope Road	AUR/AUL	CHR/CHL	Intersection	1
Section 3	20.691	Mud Hut Creek Road	-	CHR(S)/AUL	Intersection	1
Section 3	15.754	Hadabob Road	-	BAR/BAL	Road	2
Section 3	26.129	Wyaldra Lane	-	BAR/BAL	Road	2
Section 3	14.01	Spring View Lane	-	BAR/BAL	Intersection	2
Section 2	3.785	George Campbell Drive (Airport entrance)	AUR/AUL	CHR(s)/AUL	Intersection	2
Section 2	6.652	Buckaroo Lane	-	CHR(s)	Intersection	2
Section 3	17.644	Frog Rock Road	-	CHR(s)/AUL(s)	Road	2
Section 2	9.574	Wollar Road	BAR/BAL	CHR(S)/AUL	Intersection	2
Section 3	29.252	Nimoola Road	-	BAR/BAL	Road	3
Section 3	30.515	Winchester Crescent	-	BAR/BAL	Road	3
Section 3	27.783	Quarry and RFS Shed entry	-	BAR/BAL	Intersection	3
Section 3	28.771	Moolarben/Ridge Road	-	CHR(S)/AUL	Intersection	3
Section 3	9.885	Church Lane	-	BAR/BAL	Road	4
Section 3	11.539	Box's Lane	-	BAR/BAL	Road	4
Section 3	37.306	Toole Road (developer funding)	-	CHR/CHL	Intersection	5
Section 3	24.435	Wattlegrove Lane	-	BAR/BAL	Intersection	5

8.2 Scheduled maintenance works

It is recommended that a Responsive Pavement Maintenance Model be set up for the management of future scheduled maintenance works along Ulan Road.

This approach requires regular condition assessments be undertaken for both the surface/functional condition of the road and structural condition of the underlying pavement.

Considering the road class for Ulan Road, it is recommended that the surfacing/functional assessments operate on a three-year cycle, i.e. assessment of the condition of Ulan Road should be undertaken every three years. Assessment of the structural condition should be included in every second cycle, i.e. every six years.

Policies for service levels should be agreed between the stakeholders and intervention criteria should be set up based on these policies. The intervention criteria will then form input for the identification of required works on Ulan Road.

As mentioned previously, this approach to asset management has been proven to be the most efficient mechanism for determining intervention maintenance works. It permits the whole life-cycle costs to be considered and interventions identified in order to satisfy different, and typically conflicting, requirements of stakeholders.

8.2.1 Scheduled maintenance

To facilitate planning and cost apportionment, a whole-of-life scheduled maintenance program has been projected over the operating life of the mines. Based on standard practice for road maintenance the timing of reseal and pavement rehabilitation works has been prepared and is presented in Table 8.6.

While suitable as an indication of the timing and scope of these scheduled maintenance works, the program is indicative only and should be considered with caution since it provides a forward projection based on estimates of traffic flows over the next 20 years. It is for this reason that it is recommended that a regular inspection and testing regime for Ulan Road be established.

Based on the results of the condition testing, either or both the scope and timing of the scheduled maintenance may be deferred, due to better performance by the pavement, or may be brought forward, due to an unexpected rate of deterioration. as a result of factors such as increased traffic, adverse weather or site conditions etc.

Table 8.6: Whole-of-life estimate road maintenance program

Section	Start Chainage (km)	End Chainage (km)	Length (km)	Year 3		Year 5		Year 10		Year 13		Year 15		Year 20	
				Rehab.	Reseal	Rehab.	Reseal	Rehab.	Reseal	Rehab.	Reseal	Rehab.	Reseal	Rehab.	Reseal
1 / 2	0	3.785	3.785	-	-	-	✓	-	-	-	-	✓	-	-	-
2	3.785	6.652	2.867	-	-	-	✓	-	-	-	-	✓	-	-	-
	6.652	9.734	3.082	-	-	-	✓	-	-	-	-	✓	-	-	-
3	9.734	17.644	7.91	-	-	-	-	-	✓	-	-		-	-	✓
	17.644	22.215	4.571	-	-	-	-	-	✓	-	-		-	-	✓
	22.215	26.039	3.824	-	-	-	✓	-	-	-	-	✓	-	-	
	26.039	37.407	11.368	-	-	-		-	✓	-	-	-	-	-	✓
3/4	37.407	45.236	7.829	✓	-	-		-	-	-	✓	-	-	-	

Notes: Incorporated into the scope and timing in this table are a number of assumptions. These include:

- The scheduled maintenance program cover the entire length of Ulan Road
- The timing of the nominated works (i.e. reseal and rehabilitation) are based on a cycle of 10 years reseal and 20 years pavement life, with 2011 being adopted as the base year.
- Traffic loading in ESAs is based on the projection of traffic over the operating life of the mines, being 21 years. A change in traffic loading will require a review of the scheduled maintenance program.

9 COST APPORTIONMENT

A key objective of this Strategy is to determine the cost apportionment for improvements along Ulan Road in order to manage the impact of traffic associated with the Ulan, Moolarben and Wilpinjong mines.

It is appropriate that costs associated with works to manage the impact of mine related traffic are apportioned to each of the mines. Equally, it is appropriate that costs associated with works required to manage non-mine related traffic are apportioned to MWRC.

The manner of calculating costs and apportioning these across the three mines and MWRC is outlined in this section of the report.

9.1 Intersections

9.1.1 Apportionment method

The method adopted for apportioning costs associated with intersection upgrades considers the proportion of turning and through traffic movements attributable to the mines and to the general traffic flow, i.e. MWRC. This apportionment method is described in Figure 9.1 and Table 9.1.

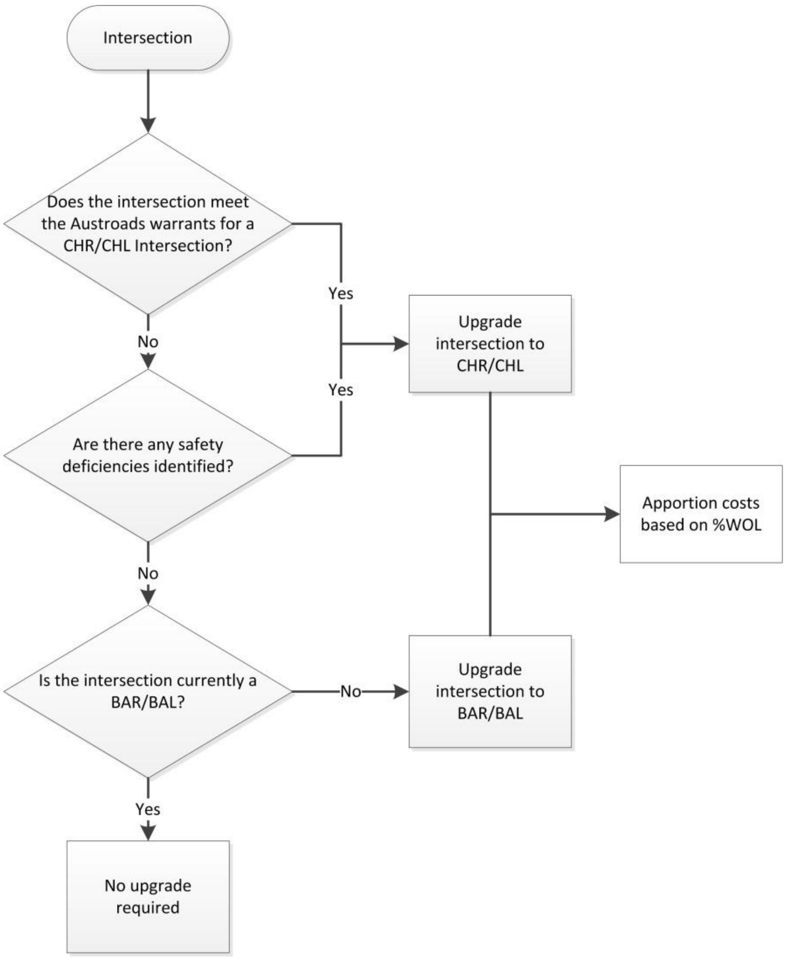


Figure 9.1: Intersection apportionment model

Table 9.1: Intersection apportionment model

Turning traffic[1] (contribute 50% of need for improvement)		Through traffic[2] (contribute 50% of need for improvement)	
% mines	% council (non-mine)	% mines	% council (non-mine)

Notes

1: The assumptions of previous consulting traffic studies are adopted, i.e. the proportion of mine related traffic travels to/from Mudgee.

2: The proportion of mine vs. council traffic varies across Ulan Road sections 1, 2, 3 and 4.

The proportion of turning and through traffic was estimated based on the findings of previous traffic studies prepared as a part of the environmental assessment process for each mine. These studies identify that mine related traffic predominately travels between Mudgee and the mine sites, since Mudgee will provide the largest residential areas and access to support services for the mine staff and mine operations.

The traffic studies also identified that some 28% of staff will turn off Ulan Road at the Cope Road intersection to travel to Gulgong, which offers alternate residential accommodation and services.

A minor proportion of traffic was distributed to the north of Ulan mine, and is removed from the traffic impact estimation since the strategy only covers Ulan Road between the UCML administration and underground facility and Mudgee.

These travel patterns were used in the estimation of traffic impacts along Ulan Road using the apportioning method in Table 9.1.

The resulting apportioning of traffic at intersections that require upgrade work is presented in Table 9.2.

Table 9.2: Intersection apportionment for turning and through traffic

Section	Chainage (km)	Location/description	Turning traffic[1] (contribute 50% of need for improvement)		Through traffic[2] (contribute 50% of need for improvement)	
			% mines	% council (non-mine)	% mines	% council (non-mine)
1	0.352	Pitts Lane	0.0	100.0	18.2	81.8
2	3.785	George Campbell Drive (Airport entrance)	0.0	100.0	39.6	60.4
	6.652	Buckaroo Lane	0.0	100.0	39.6	60.4
	9.574	Wollar Road	0.0	100.0	50.6	49.4
3	9.885	Church Lane	0.0	100.0	67.0	33.0
	11.539	Box's Lane	0.0	100.0	67.0	33.0
	14.01	Spring View Lane	0.0	100.0	79.3	20.7
	15.754	Hadabob Road	0.0	100.0	79.3	20.7
	17.644	Frog Rock Road	0.0	100.0	79.3	20.7
	19.999	Linburn Lane	0.0	100.0	79.3	20.7
	20.691	Mud Hut Creek Road	0.0	100.0	79.0	21.0
	24.435	Wattlegrove Lane	0.0	100.0	79.0	21.0
	26.129	Wyaldra Lane	0.0	100.0	79.0	21.0

Section	Chainage (km)	Location/description	Turning traffic[1] (contribute 50% of need for improvement)		Through traffic[2] (contribute 50% of need for improvement)	
	27.783	Quarry and RFS Shed entry	0.0	100.0	91.1	8.9
	28.771	Moolarben/Ridge Road	0.0	100.0	91.1	8.9
	29.252	Nimoola Road	0.0	100.0	91.1	8.9
	30.515	Winchester Crescent	0.0	100.0	91.1	8.9
	33.166	Winchester Crescent	0.0	100.0	91.1	8.9
	34.369	Ridge Road	0.0	100.0	91.1	8.9
	35.442	Lagoons Road	0.0	100.0	91.1	8.9
	37.306	Toole Road	0.0	100.0	91.1	8.9
4	38.645	Cope Road	60.4	39.6	65.7	34.3
	39.527	UCML Surface Operations entrance	100.0	0.0	97.0	3.0
	45.236	UCML Mine Administration entrance	100.0	0.0	5.6	94.4

Note: Mine related turning traffic is expected to be minimal except at the Cope Road intersection and subsequently for the purposes of apportioning costs mine related traffic is assumed as 0%.

9.1.2 Cost estimation

A typical cost for the scope of work for each Austroads intersection type was prepared based on MWRC estimates. These applied where capacity and safety issues were identified and warranted intersection upgrade works.

The cost estimates for each intersection are presented in Table 9.3. The cost allowance depends on the type of existing intersection, the condition of the roadside verge area and the type of upgrade necessary.

Also, some intersections may be upgraded at the time of road works to upgrade the road midblock sections. In these instances the cost of intersection works has been discounted, particularly for BAR/BAL type intersections, since there is relatively minor additional widening and sealing involved. Other intersections require upgrade where the existing road formation is considered adequate. In these instances the unit cost to undertake widening and remarking of the intersections will be higher since site specific establishment etc. needs to be factored into the cost.

Whether intersection works can be undertaken at the time of road section upgrades is identified in Table 9.3 in column six headed ‘Upgrade with…’.

A total of $1 780 000 is identified for intersection upgrades. Actual costs may vary once a detailed design is prepared and quantities can be confirmed. Therefore the figures in Table 9.3 may require adjustment to reflect a revision of cost estimates.

Table 9.3: Intersection upgrade cost estimates

Section	Chainage (km)	Location/description	Intersection type		Upgrade with…	Estimated cost ($)
			Existing	Recommended		
1	0.352	Pitts Lane (Grandstand construction)	BAR/BAR	CHR(s)/AUL	Intersection	$ 10,000
2	3.785	George Campbell Drive (Airport entrance)	AUR/AUL	CHR(s)/AUL	Intersection	$ 150,000
	6.652	Buckaroo Lane	-	CHR(s)	Intersection	$ 250,000
	9.574	Wollar Road	BAR/BAL	CHR(s)/AUL	Intersection	$ 300,000

Section	Chainage (km)	Location/description	Intersection type		Upgrade with...	Estimated cost ($)
			Existing	Recommended		
3	9.885	Church Lane	-	BAR/BAL	Road	$ 10,000
	11.539	Box's Lane	-	BAR/BAL	Road	$ 10,000
	14.01	Spring View Lane	-	BAR/BAL	Intersection	$ 25,000
	15.754	Hadabob Road	-	BAR/BAL	Road	$ 10,000
	17.644	Frog Rock Road	-	CHR(s)/AUL(s)	Road	$ 250,000
	19.999	Linburn Lane	-	BAR/BAL	Road	$ 10,000
	20.691	Mud Hut Creek Road	-	CHR(S)/AUL	Intersection	$ 250,000
	24.435	Wattlegrove Lane	-	BAR/BAL	Intersection	$ 25,000
	26.129	Wyaldra Lane	-	BAR/BAL	Road	$ 10,000
	27.783	Quarry and RFS Shed entry	-	BAR/BAL	Intersection	$ 20,000
	28.771	Moolarben/Ridge Road	-	CHR(S)/AUL	Intersection	$ 250,000
	29.252	Nimoola Road	-	BAR/BAL	Road	$ 10,000
	30.515	Winchester Crescent	-	BAR/BAL	Road	$ 10,000
	33.166	Winchester Crescent	-	BAR/BAL	Road	$ 10,000
	34.369	Ridge Road	-	BAR/BAL	Road	$ 10,000
	35.442	Lagoons Road	-	BAR/BAL	Road	$ 10,000
	37.306	Toole Road (developer funding)	-	CHR/CHL	Intersection	$ 25,000
4	38.645	Cope Road	AUR/AUL	CHR/CHL	Intersection	$ 100,000
	39.527	UCML Surface Operations entrance	AUR/AUL	CHR/CHL	Intersection	$ 10,000
	45.236	UCML Mine Administration entrance	AUR/AUL	CHR(S)/AUL	Intersection	$ 30,000
					Total	$ 1,780,000

9.1.3 *Cost apportionment*

The intersection apportionment model described in Section 9.1.1 was applied to the intersections requiring an upgrade.

Table 9.4 outlines the breakdown of the cost apportioned for each intersection requiring upgrade and is summarised Table 9.5.

Table 9.4: Intersection upgrade cost apportionment – detail

Section	Chainage (km)	Location/description	Intersection type		Upgrade with...	Apportioned costs ($)	
			Existing	Recommended		Mines	Council
1	0.352	Pitts Lane		BAR/BAR	Intersection	$ 908	$ 9,092
2	3.785	George Campbell Drive (Airport entrance)	AUR/AUL	CHR(s)/AUL	Intersection	$ 29,685	$ 120,315
	6.652	Buckaroo Lane	-	CHR(s)	Intersection	$ 49,475	$ 200,525
	9.574	Wollar Road	BAR/BAL	CHR(s)/AUL	Intersection	$ 75,884	$ 224,116
3	9.885	Church Lane	-	BAR/BAL	Road	$ 3,352	$ 6,648
	11.539	Box's Lane	-	BAR/BAL	Road	$ 3,352	$ 6,648
	14.01	Spring View Lane	-	BAR/BAL	Intersection	$ 9,913	$ 15,087
	15.754	Hadabob Road	-	BAR/BAL	Road	$ 3,965	$ 6,035

Section	Chainage (km)	Location/description	Intersection type		Upgrade with...	Apportioned costs ($)	
			Existing	Recommended		Mines	Council
	17.644	Frog Rock Road	-	CHR(s)/AUL(s)	Road	$ 99,129	$ 150,871
	19.999	Linburn Lane	-	BAR/BAL	Road	$ 4,556	$ 5,444
	20.691	Mud Hut Creek Road	-	CHR(S)/AUL	Intersection	$ 98,763	$ 151,237
	24.435	Wattlegrove Lane	-	BAR/BAL	Intersection	$ 9,876	$ 15,124
	26.129	Wyaldra Lane	-	BAR/BAL	Road	$ 3,951	$ 6,049
	27.783	Quarry and RFS Shed entry	-	BAR/BAL	Intersection	$ 9,112	$ 10,888
	28.771	Moolarben/Ridge Road	-	CHR(S)/AUL	Intersection	$ 113,903	$ 136,097
	29.252	Nimoola Road	-	BAR/BAL	Road	$ 4,556	$ 5,444
	30.515	Winchester Crescent	-	BAR/BAL	Road	$ 4,556	$ 5,444
	33.166	Winchester Crescent	-	BAR/BAL	Road	$ 4,556	$ 5,444
	34.369	Ridge Road	-	BAR/BAL	Road	$ 4,556	$ 5,444
	35.442	Lagoons Road	-	BAR/BAL	Road	$ 4,556	$ 5,444
	37.306	Toole Road	-	BAR/BAR	Intersection	$ 4,556	$ 5,444
4	38.645	Cope Road	AUR/AUL	CHR/CHL	Intersection	$ 63,085	$ 36,915
	39.527	UCML Surface Operations entrance	AUR/AUL	CHR/CHL	Intersection	$ 9,850	$ 150
	45.236	UCML Mine Administration entrance	AUR/AUL	CHR(S)/AUL	Intersection	$ 15,843	$ 14,157
				Apportionment totals		$ 631,939	$ 1,148,061
				Total		$1,780,000	

Table 9.5: Intersection upgrade cost apportionment – summary

Intersection upgrade cost	Total	$1,780,000
Intersection upgrade cost apportionment - three mines vs. MWRC	MWRC	$1,148,061
	Mines	$ 631,939
Intersection upgrade cost apportionment - three mines	UCML	$ 284,477
	MCO	$ 221,111
	WCP	$ 126,351

9.2 Road (midblock) upgrades

The method adopted for apportioning costs for road (midblock) upgrades is by examining the nexus between the upgrade of the road and the traffic demand that is requiring the upgrade works.

9.2.1 Design formation elements

Different construction elements for the desirable and minimum design formation have been identified as follows:

- central pavement (existing)
- additional lane width (new) – to minimum design
- additional lane width (new) – to desirable design
- sealed shoulder (new)

- unsealed shoulder (new)

These elements are illustrated and compared for the desirable and minimum design formations in Figure 9.2.

It should be noted, as discussed in Section 7.4, only those lengths of Ulan Road that are considered inadequate, i.e. the formation width fails to meet the minimum design formation specifications outlined in Table 5.3, require capital upgrading. Therefore the capital upgrading is only required on Ulan Road between the Wollar Road and Cope Road intersections, i.e. the 20.585 km length contained within section 3.

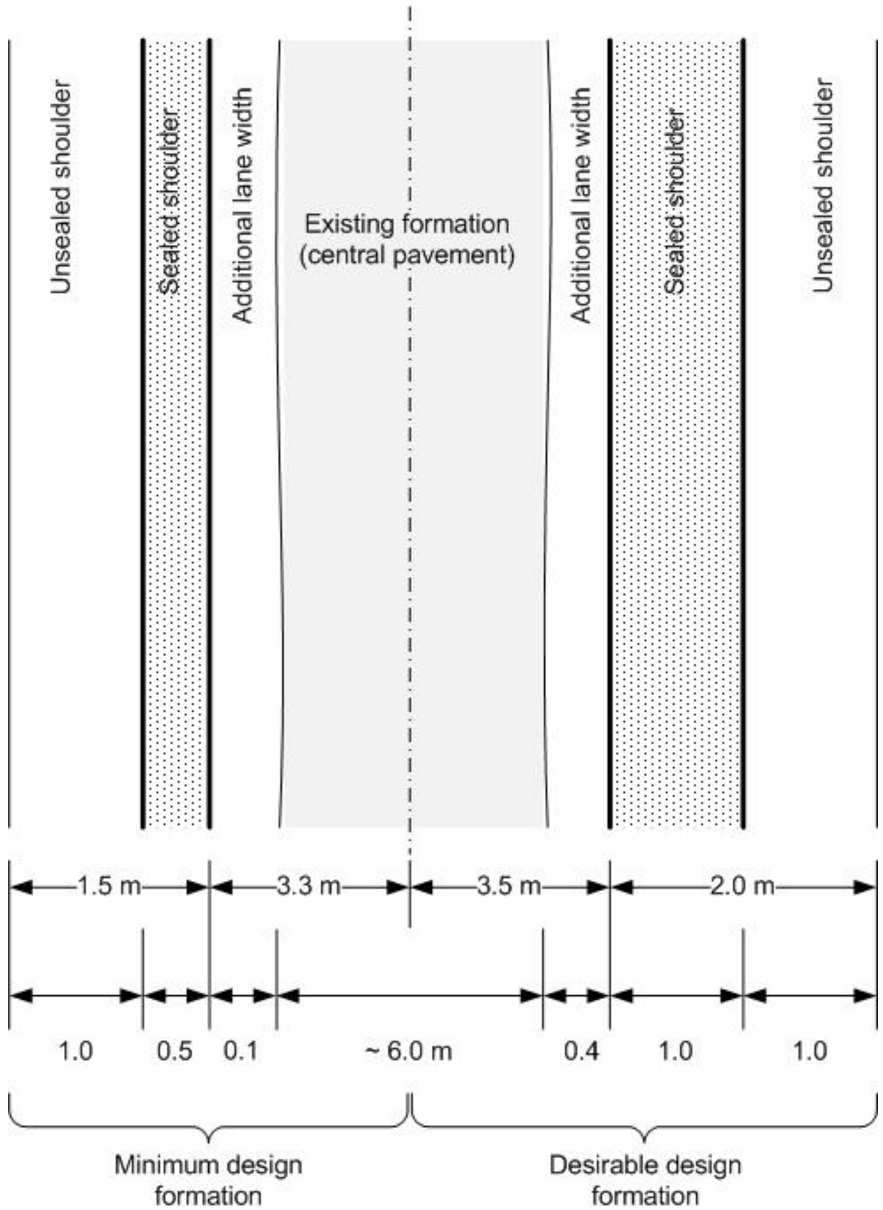


Figure 9.2: Minimum and desirable design formation upgrades

Note: The minimum and desirable design formations are shown as half road for comparison purposes only. The actual constructed road would comprise one or the other desirable or minimum design formation.

9.2.2 Apportionment method

The apportioning of costs for road upgrade works is based on two key considerations:

1. The nexus between the mine development and the upgrade elements (i.e. central pavement, desirable and minimum design formations).
2. The proportion of traffic along Ulan Road generated by the mines and by the general community (i.e. MWRC) over the operating life of the mines.

The apportionment model adopted for determining the scope of works and apportioning of costs between the mines and MWRC for road upgrade works is identified in Figure 9.3 and Table 9.6.

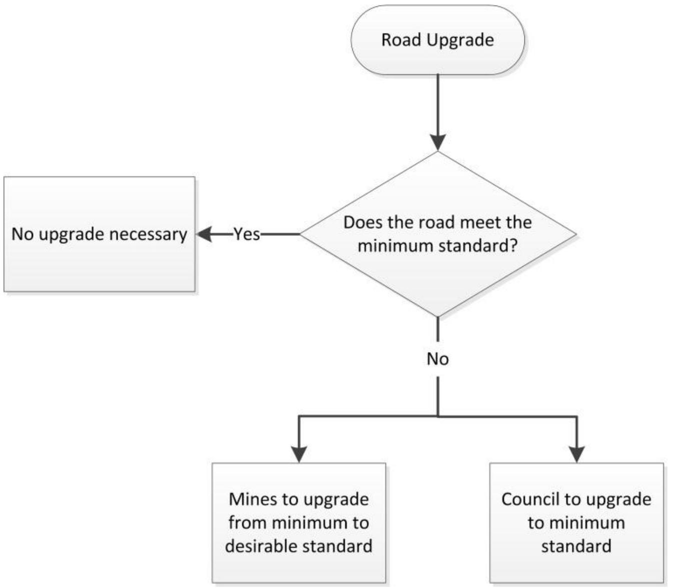


Figure 9.3: Apportionment model for road (midblock) upgrades

Table 9.6: Apportionment models for road (midblock) upgrades

Cost apportioned to mines		Cost apportioned to MWRC	
▪ The difference in the cost to upgrade Ulan Road from the minimum to the desirable design formation	100%	▪ The cost to upgrade Ulan Road to the minimum design formation	100%
		▪ The cost to rehabilitate the central pavement (i.e. existing formation)	100%

A breakdown of the apportioning of each upgrade element is outlined in Table 9.7.

Table 9.7: Mine and MWRC contribution to road (midblock) upgrade elements

Element	Mine contribution		MWRC contribution	
	Minimum	Desirable	Minimum	Desirable
Unsealed shoulders	-	-	2 x 1.0 m x 100 %	-
Sealed shoulders	-	2 x 0.5 m x 100 %	2 x 0.5 m x 100 %	-

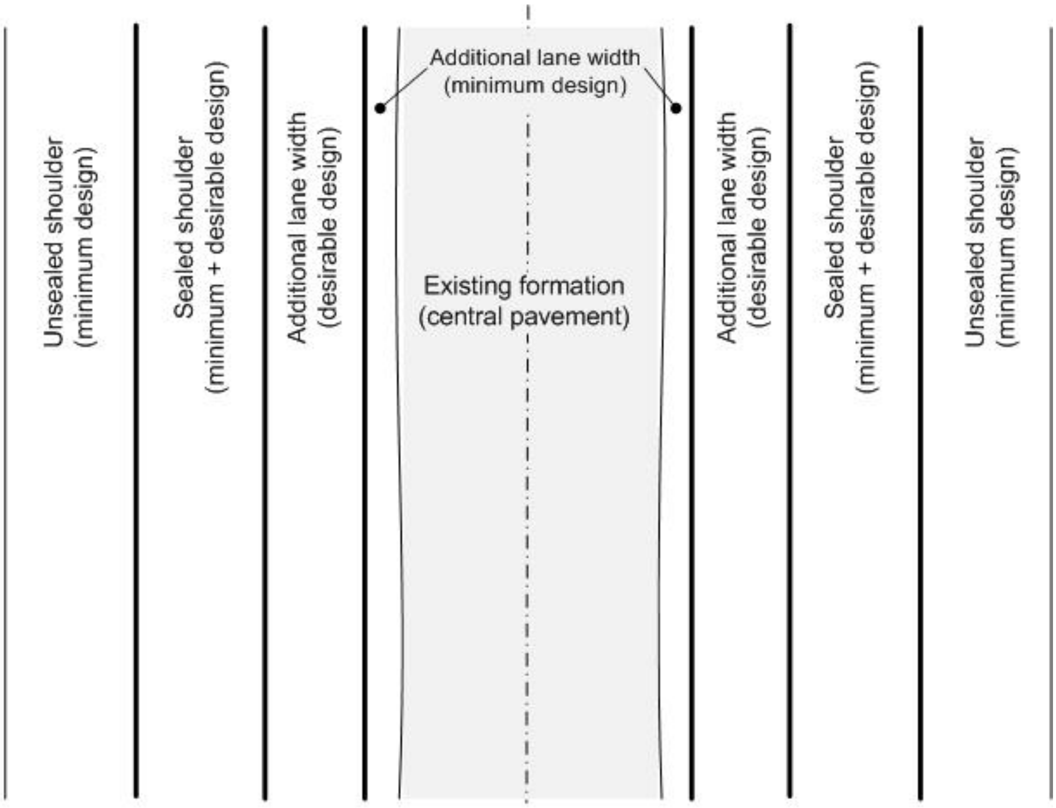
Element	Mine contribution		MWRC contribution	
	Minimum	Desirable	Minimum	Desirable
Pavement	-	2 x 0.4 m x 100 %	2 x 0.1 m x 100 % + 6.0 m x 100 %	-

1. WoL = Whole-of-life traffic generation.
2. The central pavement is typically 6.0 m wide. Where additional width is identified, this is the minimum required to ensure the minimum/desirable width.

In illustrated form, the above contributions table may be represented by Figure 9.4.

This approach to apportioning of road (midblock) upgrade works and costs considers the adequacy of the subject 20.585 km of road requiring capital upgrade to service the existing and projected traffic. It is considered that this length of Ulan Road is currently inadequate existing traffic and, with reference to Table 5.3 (150 – 500 design AADT), would still be inadequate for local traffic demand if all mine-related traffic were removed.

The nexus for the road (midblock) upgrade to the mine related traffic impact is to provide the road design elements to meet the desirable design formation over and above the road that is otherwise required for local traffic. Provision of a road for local traffic requirements is the responsibility of MWRC.



Apportionment rates

Road upgrade (Mines)	0%	50%	100%	0%	0%	0%	100%	50%	0%
Road upgrade (MWRC)	100%	50%	0%	100%	100%	100%	0%	50%	100%

Figure 9.4: Mine and MWRC contributions to road (midblock) upgrade elements

9.2.3 Cost estimation

It is recommended that the full desirable design formation width be provided where the road requires upgrading. Based on the Hawkeye NSV video survey of Ulan Road, a scope of work and schedule of quantities has been prepared for the road upgrade to this meet this design.

Only Section 3, i.e. between Wollar Road and Cope Road intersections, was identified as requiring road upgrade works to cater for the current and projected traffic demand. Section 3 is 29.081 km in length overall; 20.585 km, or 70.8%, of this length requires widening and rehabilitation of the central pavement.

The cost estimate for each length of upgrade in Section 3 is presented in Table 9.8.

MWRC has advised a rate for road reconstruction in the order of \$350 000 to \$400 000/km, although a rate of \$750 000/km is indicated in a works program prepared by MWRC for Ulan Road.

A typical unit rate for widening and rehabilitation works for rural roads obtained from independent sources indicates a range of \$650 000 to \$797 000/km.

It is clear that a rate for works needs to be agreed between stakeholders to more accurately define the cost of all works identified in this strategy.

For the purposes of estimating costs a rate of $750 000/km has been adopted for widening and rehabilitation works. This is considered a reasonable rate for budget estimate purposes and includes standard works associated with widening and rehabilitation of road pavements, e.g. site establishment, pavement rehabilitation, widening, surfacing and linemarking. Using this rate also permits a comparison of the cost of this Strategy against the scope of works indicated by MWRC.

It is important to realise that actual costs may vary once a detailed design is prepared and quantities can be confirmed. The figures in Table 9.8 may require adjustment to reflect a revision of cost estimates based on a detailed design and therefore it is important that work begin to prepare the necessary detailed survey and design of the upgrade works.

Additional works such as specific culvert widening and batter excavation/filling, special pavement stabilisation or added pavement are not included in this typical unit rate.

It is recognised that these additional works may be required when upgrading and widening the necessary sections of Ulan Road. However, without detailed site survey and at least preliminary design, it is not feasible to estimate the costs of these works with any degree of reliability.

Table 9.8: Road upgrade cost estimates

Section	Start chainage (km)	End chainage (km)	Length (km)	Cost estimate ($)
Section 1	No road upgrade works were identified			
Section 2	No road upgrade works were identified			
Section 3	9.734	13.478	3.744	$ 2,808,000
	14.912	22.215	7.303	$ 5,477,250
	26.039	27.432	1.393	$ 1,044,750
	28.039	31.106	3.067	$ 2,300,250
	32.329	37.407	5.078	$ 3,808,500
Section 4	No road upgrade works were identified			
Total				$ 15,438,750

1. Unit rate for widening and rehabilitation = $750 000 per kilometre
2. Significant drainage works are not included in the typical unit rate
3. Linemarking and signing is included in the typical unit rate

9.2.4 Cost apportionment

The road upgrade apportionment model was applied to the nominated works to apportion costs based on the adopted rate. The result of this for each upgrade section is presented in Table 9.9.

Table 9.9: Road upgrade cost apportionment

Section	Start chainage (km)	End chainage (km)	Length (km)	Cost estimate ($)	Apportioned costs ($)	
					Mines	Council
Section 1	No upgrade works identified					

Section 2	No upgrade works identified					
Section 3	9.734	13.478	3.744	$ 2,808,000	$ 471,744	$ 2,336,256
	14.912	22.215	7.303	$ 5,477,250	$ 920,178	$ 4,557,072
	26.039	27.432	1.393	$ 1,044,750	$ 175,518	$ 869,232
	28.039	31.106	3.067	$ 2,300,250	$ 386,442	$ 1,913,808
	32.329	37.407	5.078	$ 3,808,500	$ 639,828	$ 3,168,672
Section 4	No upgrade works identified					
Road upgrade cost apportionment - total for mines and council				$ 15,438,750	$ 2,593,710	$ 12,845,040

Notes: Costs are based on a rate of $750 000/km for widening and rehabilitation to the desirable design formation

9.3 Road safety measures

Previous road safety assessments and the analysis of the crash data and review of Ulan Road as a part of this strategy has identified works specifically designed to address road safety. These works were listed in Table 8.3.

The apportioning of costs for these road safety measures uses the proportion of the whole-of-life traffic generated for mine and non-mine related activity. The result of the apportioning the road safety measures is outlined in Table 9.10 .

Table 9.10: Cost apportionment for road safety measures

Section	Start chainage (km)	End chainage (km)	Length (m)	Safety measure/treatment	Cost ($)	MWRC ($)	UCML ($)	MCO ($)	WCO ($)
1/2/3/4	0.321	45.236	44.915	Lower the existing speed limits	$10 000	$2 670	$3 299	$2 566	$1 466
1/2/3/4	0.321	45.236	44.915	Enhanced delineation (e.g. CAMs, rrpms) at selected locations, particularly isolated curves, road narrowing (e.g. bridges)	$157 200	$41 968	$51 854	$40 331	$23 046
3	26.6	26.84	240(w)	Road safety barrier (e.g. WRSB, steel guardrail)	$168 000	$14 915	$68 888	$53 580	$30 617
3	26.67	26.88	210 (e)	Road safety barrier (e.g. WRSB, steel guardrail)					
3	27.1	27.45	350 (e)	Road safety barrier (e.g. WRSB, steel guardrail)					

9.4 Noise mitigation treatments

The conclusion of the noise modelling indicates that the additional traffic on Ulan Road will place certain residences at risk of noise in excess of benchmark levels. Therefore it is concluded that cost of noise mitigation treatments for the affected properties should be apportioned to the mines.

For budgetary purposes the rate of $20 000 per dwelling has been adopted. The actual cost for noise mitigation treatments requires a detail assessment of each dwelling and discussion with the affected property owners. Based on the above adopted rate, the total cost for noise mitigation apportioned to the mines is estimated to be $360 000.

The contribution for each mine is based on the proportion of the whole-of-life traffic generated by the mine operations as outlined in Table 9.11.

Table 9.11: Noise mitigation treatment apportionment

Description	%	Cost
Total noise mitigation cost	100	$360 000
UCML	45	$162 000
MCP	35	$126 000
WCP	20	$ 72 000

Note: Cost estimates are based on an indicative rate of $20 000 per affected residence.

9.5 Maintenance

9.5.1 Apportionment method

The manner of apportioning the cost of maintenance over the operating life of the mines is based on the proportion of the whole-of-life traffic generated, as presented in Figure 9.5 .

The rate of wear and deterioration of the Ulan Road pavement is directly related to the traffic loading. For this reason the proportion of the whole-of-life traffic is the most equitable and appropriate method for apportioning maintenance costs. Factors such as the percentage of heavy vehicles associated with mine and non-mine related activities are managed in this approach by considering the equivalent standard axles rather than each vehicle as a single equivalent unit.

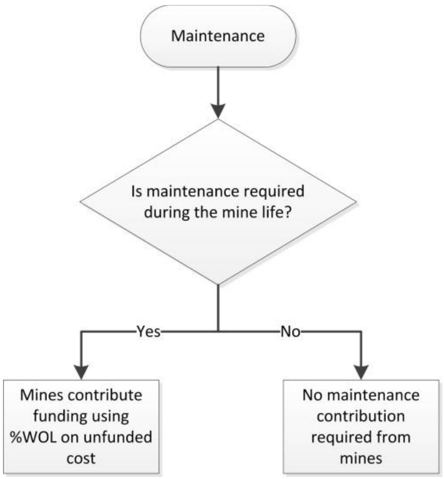


Figure 9.5: Cost apportionment maintenance works

9.5.2 Cost and maintenance program

Maintenance of the existing road includes pavement rehabilitation and resurfacing works. For the purpose of estimating costs for the identified scheduled maintenance works, the following unit rates have been used:

- Resurfacing - $47 700 per km
- Light rehabilitation - $351 000 per km
- Heavy rehabilitation - $597 600 per km

Based on the projected maintenance program presented in Table 8.6, and using the above typical rates, an estimate of cost and an indicative timing for maintenance works is provided in Table 9.12. It should be noted this only covers the operational life of the mines.

Incorporated into the scope, timing and cost of these works are the following assumptions:

- Costs are in current, 2011, dollar values.
- The rates used for rehabilitation are typical rates only and have not been based on site subgrade and pavement material testing.
- The timing of the nominated works (i.e. reseal and rehabilitation) is based on a cycle of 10 years for reseals and 20 years for pavement life, with 2011 being adopted as the base year.
- Traffic loading in ESAs is based on the projection of traffic over the operating life of the mines, this being 21 years. A change in traffic loading will require a review of the scheduled maintenance program.
- The pavement rehabilitation for year 3 is costed as a ‘heavy rehabilitation’ since it is required for the operating life of the mines. For the works identified in year 15 the rehabilitation incorporates a ‘light rehabilitation’ only since the operating life of the mines is expected to end at year 21.

The apportioning of costs for the projected maintenance program is based on the proportion of the whole-of-life traffic generated along Ulan Road, as discussed in Section 6.1.2.

Table 9.12: Whole-of-life estimate of road maintenance costs

Start Chainage (km)	End Chainage (km)	Length (km)	Year 3		Year 5		Year 10		Year 13		Year 15		Year 20		Total
			Rehab	Reseal	Rehab	Reseal	Rehab	Reseal	Rehab	Reseal	Rehab	Reseal	Rehab	Reseal	
0	3.785	3.785	-	-	-	$ 180,545	-	-	-	-	$ 1,328,535	-	-	-	$ 1,509,080
3.785	6.652	2.867	-	-	-	$ 136,756	-	-	-	-	$ 1,006,317	-	-	-	$ 1,143,073
6.652	9.734	3.082	-	-	-	$ 147,011	-	-	-	-	$ 1,081,782	-	-	-	$ 1,228,793
9.734	17.644	7.91	-	-	-	-	-	$ 377,307	-	-		-	-	$ 377,307	$ 756,614
17.644	22.215	4.571	-	-	-	-	-	$ 218,037	-	-		-	-	$ 218,037	$ 436,073
22.215	26.039	3.824	-	-	-	$ 182,405	-	-	-	-	$ 1,342,224	-	-		$ 1,524,629
26.039	37.407	11.368	-	-	-		-	$ 542,254	-	-	-	-	-	$ 542,254	$ 1,084,507
37.407	45.236	7.829	$ 4,678,610	-	-		-	-	-	$ 373,443	-	-	-		$ 5,052,054
Total		45.236	$ 4,678,610	$ -	$ -	$ 646,717	$ -	$ 1,137,597	$ -	$ 373,443	$ 4,758,858	$ -	$ -	$ 1,137,597	$ 12,732,823

Notes: Incorporated into the scope, timing and cost figures in this table are a number of assumptions. These include:

- Costs are in current, 2011 dollar values
- The rates for rehabilitation are typical rates only and have not been based on site subgrade and pavement material testing
- The timing of the nominated works (i.e. reseal and rehabilitation) is based on a cycle of 10 years for reseals and 20 years for pavement life, with 2011 being adopted as the base year.
- Traffic loading in ESAs is based on the projection of traffic over the operating life of the mines, being 21 years. A change in traffic loading will require a review of the scheduled maintenance program.
- The pavement rehabilitation for year 3 is costed as a 'heavy rehabilitation' since it is required for the operating life of the mines. For year 15 the rehabilitation incorporates a 'light rehabilitation' only since the operating life of the mines is expected to end at year 21.

10 WORKS COST APPORTIONMENT SUMMARY

In summary, the works identified as being necessary to provide a road suitable to cater for the projected traffic demand arising from both mine and non-mine related activities cover:

- intersection upgrades
- road (midblock) upgrades
- specific road safety improvements
- road rehabilitation and resurfacing
- noise attenuation treatments to nominated residences

The apportioning of the costs associated with these works are summarised in Table 10.1.

Table 10.1: Summary of cost apportionment for works along Ulan Road

Works	Total Cost	MWRC	RMS	Mines		
				UCML	MCM	WCM
Intersection upgrades	$ 1,780,000	$ 1,148,061	$ -	$ 284,477	$ 221,111	$ 126,351
Road upgrades	$ 15,438,750	$ 12,845,040	$ -	$ 1,167,600	$ 907,520	$ 518,590
Maintenance	$ 12,732,823	$ 2,028,349	$ 5,699,736	$ 2,252,962	$ 1,751,121	$ 1,000,654
Road works subtotal	*$ 29,951,573*	*$ 16,021,451*	*$ 5,699,736*	*$ 3,705,039*	*$ 2,879,753*	*$ 1,645,594*
Road safety	$ 335,200	$ 59,553	$ -	$ 124,041	$ 96,476	$ 55,129
Noise attenuation	$ 360,000	$ -	$ -	$ 160,000	$ 126,000	$ 72,000
Total	$ 30,646,773	$ 16,081,004	$ 5,699,736	$ 3,989,080	$ 3,102,229	$ 1,772,723

A suggested program for implementing the works along Ulan Road is presented in Table 10.2.

Table 10.2: Indicative works program – upgrades and maintenance

Section	Start Chainage (km)	End Chainage (km)	Year																					
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	3.785		I				R										L						
2	3.785	6.652			I			R										L						
2/3	6.652	9.734			I			R										L						
3	9.734	17.644			I		I, M						R										R	
3	17.644	22.215		I	I, M								R										R	
3	22.215	26.039						R, I										L					R	
3	26.039	37.407		I, M	I, M	I, M		I					R											
3/4	37.407	45.236		I		H										R								

Notes:

I = Intersection

M = Road (midblock) upgrade

R = Resurfacing

H = Heavy rehabilitation

L = Light rehabilitation

REFERENCES

Austroads 2009a Guide to Traffic Management Part 1 Introduction to Traffic Management AGTM01/09

Austroads 2009b Guide to Traffic Management Part 4 Network Management AGTM04/09

Austroads, 2009c Guide to Traffic Management Part 13 Road Environment Safety AGTM13/09

Austroads, 2009d Guide to Road Design Part 3 Geometric Design, AGRD03/09

Austroads 2009e Guide to Traffic Management Part 5 Road Management AGTM05/09

Austroads 2009f Guide to Road Design Part 4A Intersections and junctions AGRD04/09

Austroads 2009g Guide to Asset Management Part 1 Introduction to Asset Management AGAM01/09

Austroads 2009h Guide to Pavement Technology Part2 Pavement Structural Design AGPT02/09

Austroads 2009i Guide to Pavement Technology Part 5 Pavement Evaluation and Treatment Design AGPT05/09

APPENDIX A NSW PLANNING AND INFRASTRUCTURE ENDORSEMENT

NSW GOVERNMENT | Planning & Infrastructure

Major Development Assessment
Mining & Industry

Phone: (02) 9228 6583
Fax: (02) 9228 6466
Email: sara.wilson@planning.nsw.gov.au

Room 305
23-33 Bridge Street
GPO Box 39
SYDNEY NSW 2001

Our ref: S04/01722

Jamie Lees
Environment & community Manager
Ulan Coal Mines Limited
Private Mail Bag 3006
MUDGEE NSW 2850

Dear Mr Lees

Ulan Coal Mine
Ulan Road Strategy – Approval of Qualified & Experienced Persons

I refer to your correspondence dated 16 August 2011 seeking the Director-General's endorsement of a team of suitably qualified and experienced persons to prepare the Ulan Road Strategy required under Schedule 3 condition 50 of the Minister's approval for the Ulan Continued Operations Project (08_0184).

The Department is satisfied that the nominated specialists from ARRB Group are suitably qualified and experienced to prepare the plan and approves this appointment on the basis set out in your correspondence.

Please feel free to call Sara Wilson on (02) 9228 6583 if you have any enquiries in relation to this matter.

Yours sincerely

DKitto 18/8/11

David Kitto
Director
Mining & Industry
As delegate for the Director-General

APPENDIX B STAKEHOLDER CONSULTATION MEETINGS

B.1 Stakeholder Inception Meeting 28 September 2011

4.00 pm, Ulan Coal Mine, Administration Offices

Attendees:

- Jamie Lees, Ulan Coal Mine Limited (client project manager)
- Luke Morris, Barnson (client consultant)
- Arjan Rensen, ARRB Group
- David McTiernan, ARRB Group
- David Stone, General Manager (UCML)
- Sean Cleary, Environment Manager, Wilpinjong Coal Operations (WCO)
- Frank Fulham, General Manager, Moorlarben Coal Operations (MCO)
- Ian Livingstone-Blevins, General Manager, Wilpinjong Coal Operations (MCO)
- Des Kennedy, Mayor MWRC
- Warwick Bennett, General Manager, MWRC
- Brad Cam, Manager Operations, MWRC
- Sally Mullinger, Business Manager Works, MWRC

General Business

1. ARRB Group provided a summary of the project scope and the method to be employed to address the issues identified by the conditions of consent for the Ulan Mine major project approval.

2. The project timeline, key tasks and deliverables, including an outlined of the additional stakeholder meetings proposed for November and December was provided.

   2.1. Dates for the meetings are:

   Stakeholder Meeting 1: 9 November 2011

   Stakeholder Meeting 2: 30 November 2011

Action: Stakeholders are to confirm availability for the nominated dates for the proposed stakeholder meetings.

(It has since been identified that key representatives are not available for a meeting on 9 November 2011. An alternate date is to be submitted for consideration)

3. ARRB Group provided information about the project method, data collection techniques and type of analysis to be undertaken. A copy of the slides presented at the meeting is attached for information.

4. Road design formation, traffic management and safety matters:

   4.1. The RTA indicated the following design formation width for the upgraded sections of Ulan Road should be considered:

   - 2 x 3.5 m lanes + 2 x 2.0 m sealed shoulders + 1.0 m unsealed shoulders

4.2. Council indicated the following formation preference for the upgraded sections of Ulan Road:

- 2 x 3.5 m lanes + 2 x 1.0 m sealed shoulders

4.3. Council has safety and amenity concerns for the road junctions along Ulan Road due to the increase in traffic associated with the mine upgrades.

4.4. The proposed speed limit along the length of Ulan Road (to be confirmed with Council) was identified as:

- 50 km/h from Mudgee to north at Lue Road
- 70 km/h to the AREC site
- 100 km/h from the AREC site

4.5. Regional road block grants received by Council are untied

4.6. The condition of the linemarking along the length of Ulan Road requires renewal. One quote received by Council is $130 000 to $140 000 for edge and centreline markings (only). Council sought support from the mines for funding assistance towards this linemarking renewal, which Council believes will benefit mine employees and contractors through improved safety.

UCML agreed to contribute towards linemarking renewal along Ulan Road

4.7. Additional improvement to safety could include an embargo on heavy vehicle access at certain times, such as morning peak time.

Action: Council will investigate the opportunities for establishing a heavy vehicle restriction along Ulan Road at certain times.

5. Council identified the following works along Ulan Road:

- Roundabout construction to commence in January 2012 and will last approximately 7 weeks.
- The section known as Winchester Crescent (and north) has planned rehabilitation works for October 2011.

Action: Council to provide the mines with at least one week notice of proposed works and traffic disruptions.

Meeting closed: 5.05 pm

B.2 Stakeholder Progress Meeting 8 November 2011

8.00 am, Council Chambers, MWRC

Attendees:

- Jamie Lees, Ulan Coal Mine Limited (client project manager)
- David McTiernan, ARRB Group
- Noha Elazar, ARRB Group
- David Stone, General Manager (UCML)
- Frank Fulham, General Manager, Moorlarben Coal Operations (MCO)
- Des Kennedy, Mayor MWRC
- Warwick Bennett, General Manager, MWRC
- Brad Cam, Manager Operations, MWRC
- Sally Mullinger, Business Manager Works, MWRC
- Catherine Van Laeren, Manager Development Services, MWRC

Apologies:

- Ian Livingston Blevins, Wilpinjong Coal Operations
- Sean Cleary, Wilpinjong Coal Operations
- Tony Hendry, RTA
- Jacqui Anderson, RTA

General Business

1. ARRB Group presented a summary of findings to date which will form part of the draft report. These included road conditions and road standard required by council for the different traffic volumes.

2. Part of the findings presented showed that the pavement on the older road sections is stronger than the newer sections of road, which can be put down to a build of traffic permitting a consolidation of the pavement over time. Newer pavements have not had this consolidation by traffic loading and hence suffer high deflections in testing.

3. The road assessment work identified that the new section of Ulan Road upgraded by MWRC during 2011 do not totally comply with the agreed upgrade standard in accordance with Austroads guidelines.

4. Council confirmed that the strength of the newer pavement has not been up to the required standard. However the latest section, north of Cooks Gap has been constructed to a higher standard and this shows in the results ARRB presented.

5. Council has a priority program for constructing certain sections, Council is to send the program of the timing for the section upgrades.

6. Council's cost rate for re-construction of rural roads are between $330,000/km to $400,000/km.
7. All the traffic assessments undertaken by the mines have only identified 2 major intersections being required for upgrading, these are Cope Road and Wollar Road. These upgrades are required based on safety reasons and not capacity concerns.
8. The upgrade of Mud Hut Creek Road intersection is a priority for Council based on crashes. Linburn Lane intersection would be the next priority.
9. Council confirmed that Regional Road Block Grant funding is $6,000 (RTA) and $6,000 (Council)
10. The delivery of a draft Strategy is on-track for presentation on 30/11/2011. The process for Council to consider and endorse the Strategy was discussed. MWRC Council meetings for the rest of 2011 are on 7/12/2011 and 21/12/2011 and this will need to be considered when the draft Strategy is submitted.

Meeting closed: 10.00 am

B.4 Stakeholder Meeting 5 December 2011

3.00 pm, Council chambers MWRC

Attendees:

- Jamie Lees, Ulan Coal Mine Limited (client project manager)
- Mark Klasen, (UCML)
- Des Kennedy, Mayor (MWRC)
- Warwick Bennett, General Manager, (MWRC)
- Catherine Van Laeren, Manager Development Services , (MWRC)
- Sally Mullinger, Business Manager Works (MWRC)
- Brad Cam, Manager Operations, (MWRC)
- Ian Livingston-Blevins, (WCO)
- Sean Cleary, (WCO)
- Frank Fulham, (MCO)
- Tony Hendry, Roads and Maritime Services (RMS)
- David McTiernan, ARRB Group
- Noha Elazar, ARRB Group

Apologies:

- David Stone, General Manager (UCML)

General Business

1. ARRB Group presented the details of the executive summary, which was distributed earlier to the stakeholders. It was explained that the presentation along with the executive summary covers most of the contents of the final report.
2. Questions and Comments were invited.

MWRC

- Council disagrees with the logic and will be objecting to the apportionment but did not offer any alternative.
- Council disagree with the total cost for the upgrade.
- The local traffic on Ulan Rd is also partly due to the mines existence.
- 5.7 is the multiplier effect that the mines use and that should be used on the local traffic.
- Council need to see the full report before we make a decision. Why were these particular intersections chosen and not others?
- It is council’s opinion that the road in its current condition is suitable for local traffic. Council has 300km of regional roads to look after and Ulan Rd has had its fair share of spending and council will not spend any more in the next 3 years. Council does not have the funds available to spend an additional $21M on Ulan Road.
- The 26 intersections are dangerous because of the mine traffic. If the mines were not there then the intersections would not be dangerous.
- The only contribution made to Council for local roads is by MCO, no other mine has paid. An agreement with WCO for $600,000 is in progress.
- Council is disappointed that there is no final report and that no mention is made regarding state government funding.
- Last Council meeting for the year is on 21/12/11.

UCML

- UCML used a multiplier factor of 1.8 for the Social and Economic Impact Assessment not 5.7.
- UCML has consulted with the stakeholders throughout the development of the strategy. It is regrettable that the delivery of the final report has been delayed, however MWRC and other stakeholders have been provided information regarding all the key outcomes of the strategy in the form of the executive summary and the progress presentation. UCML committed to providing the presentation to MWRC and RMS after the meeting.

MCO

- Condition 50 is for the increase in mine traffic not for the people who live in the town because of the mines.
- You need to look at and understand what is asked from condition 50. The report is to answer the conditions.
- The intersections are a very small amount compared to the total cost.

RMS

- It is a valid statement to make to review the speed limit. 70 and 90 are still legal speed limits but require chief executive to approve. It is a recognised means to reduce crashes.
- The RMS went out with MWRC and looked at all the intersections. Austroads is a guide and that the RMS was comfortable with the standards and advice given to Council regarding the upgrade required.
- Apportionment is simplistic but RMS would have also gone down that track. Need to see the full report.
- Looking at condition 50, then the mines pay for the mine related additional traffic.
- There are 60 crashes in 5 years on Ulan Road. A fatality costs the community $6M and a Casualty $700,000. The accidents on this road have cost the community $42M. The $21M to make the road more safe looks like a good investment compared to the costs of the accidents. This is to bring into perspective why the road needs to be fixed.
- An AUR is not used in NSW, we use CHR.

ARRB

- The intersections chosen were assessed against Austroads warrants. Some intersections in Councils works list are not warranted.
- The contributions from the mines have not been used. They are only listed in accordance with condition 50.
- The rates used were construction rates and Council rates. Designs are required for exact costs. CHRs costs can only be done when exact designs are known, (clearing of trees, acquisition of land, etc.) Some works are included in future maintenance works instead of capital works. That explains the difference in between the ARRB estimate and the MWRC estimate.
- 70km/h and 90km/h are still in for selected use. Council should look at reducing the speed to improve safety.
- If this is a simplistic approach for the apportionment then what else can be done?
- The report will be finalised by the end of next week (16/12/11).

Final Comments:

- The report will be finalised and sent to UCML by 16/12/11.
- The mines will lodge report by 31/12/11 which satisfies the condition of consent.

Meeting closed 4.45pm

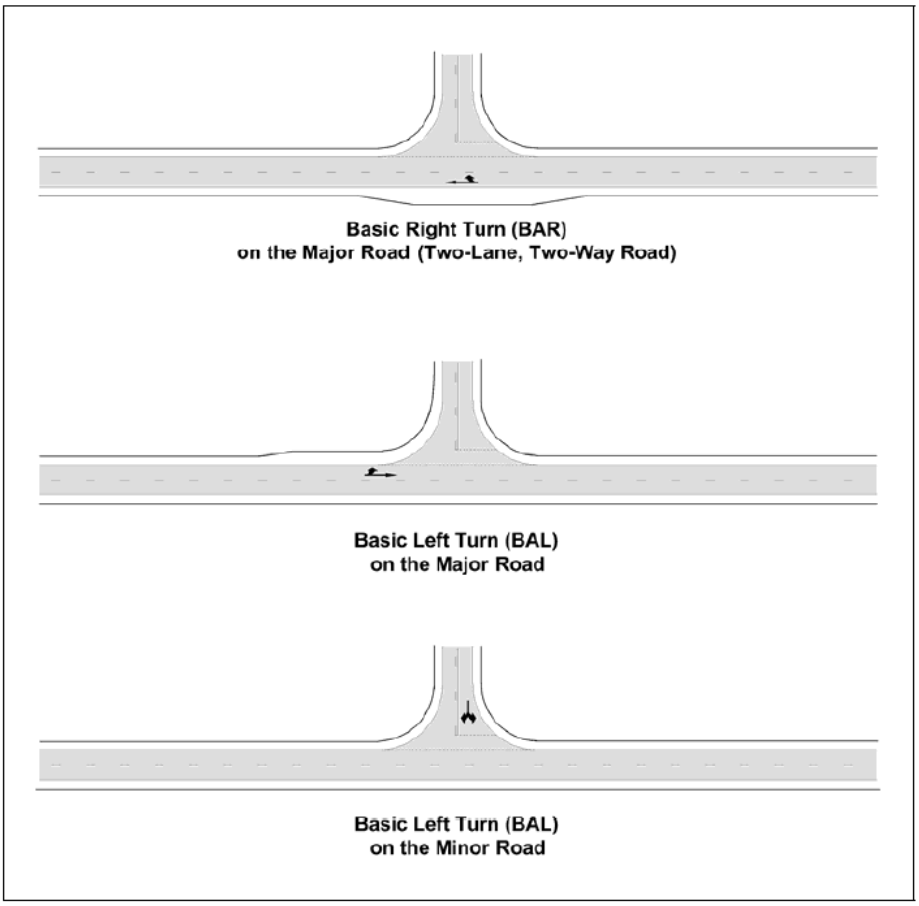
APPENDIX C ROAD DESIGN

C.1 Intersections

The Austroads Guide to Road Design *Part 4A: Unsignalised and Signalised Intersections* provide typical diagrams of the three levels of unsignalised intersection treatment suitable for rural roads, being:

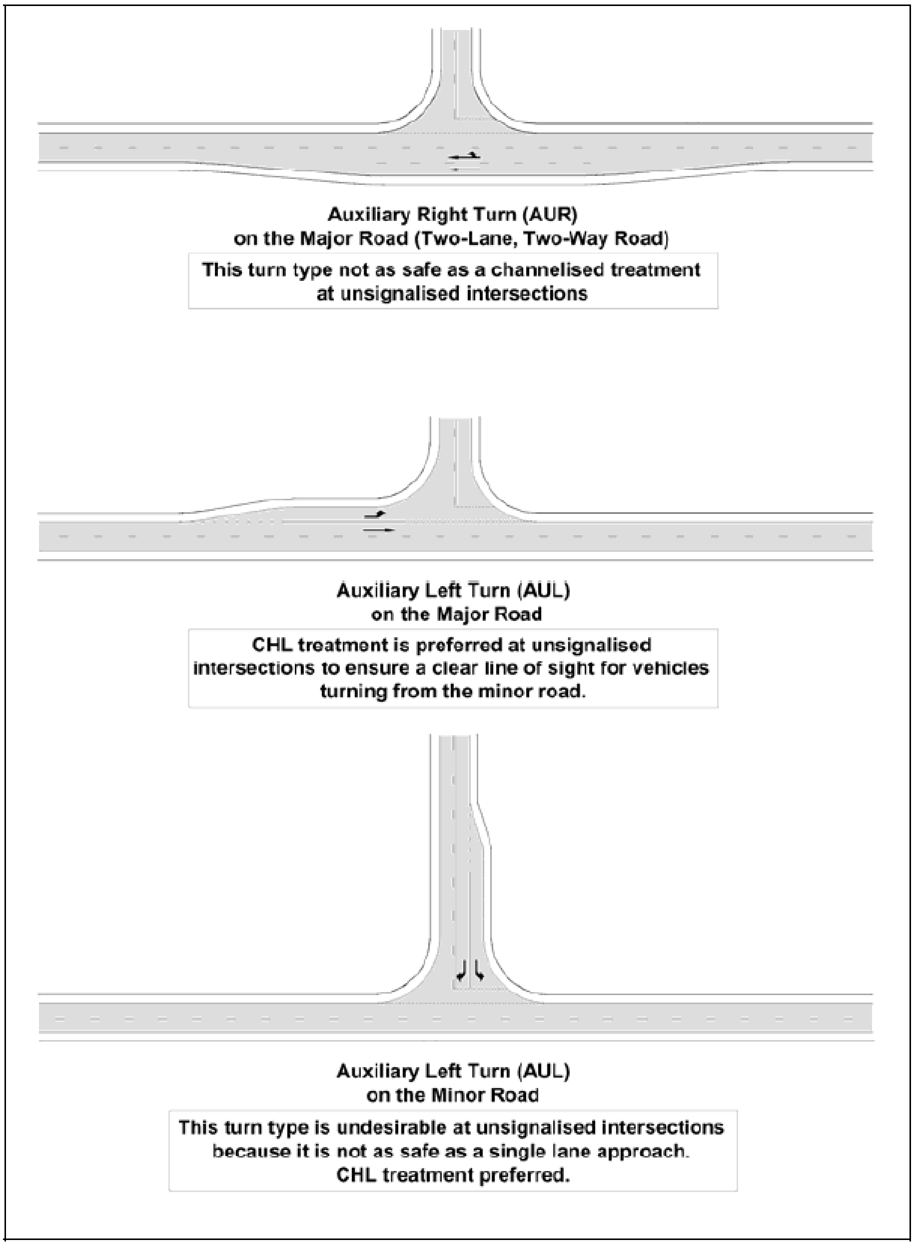
- BAR/BAL
- AUR/AUL
- CHR and CHL.

The Guide outlines the process and provides the warrants for determining the type of intersection that should be considered at a particular location for given traffic flows. This information is outlined below.



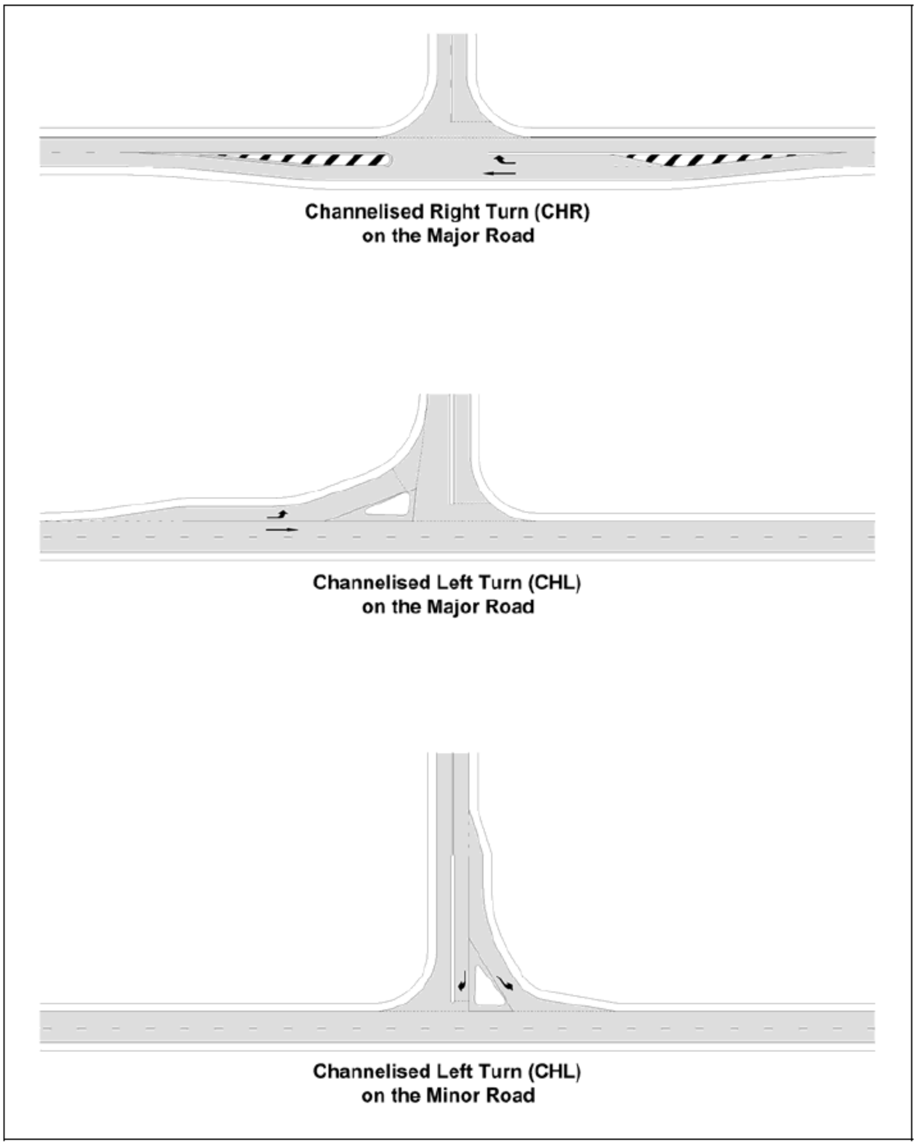
Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections

Figure C 1: BAR/BAL type intersections



Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections

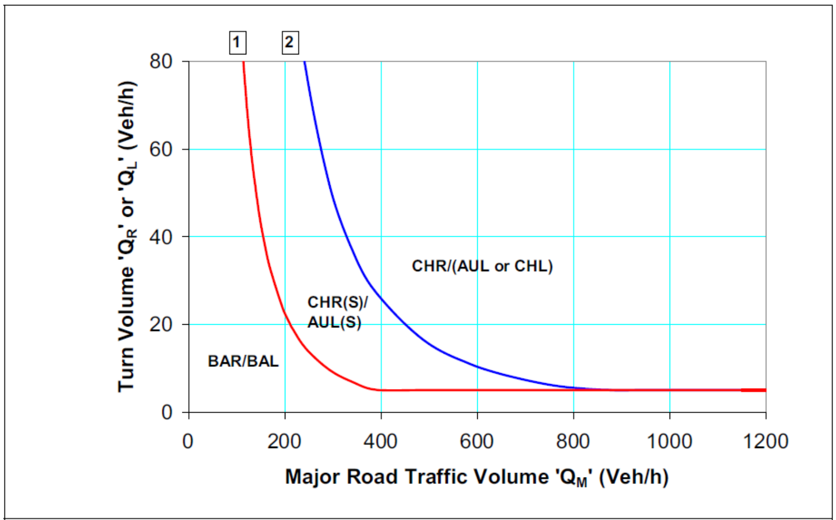
Figure C 2: AUR/AUL BAL type intersections



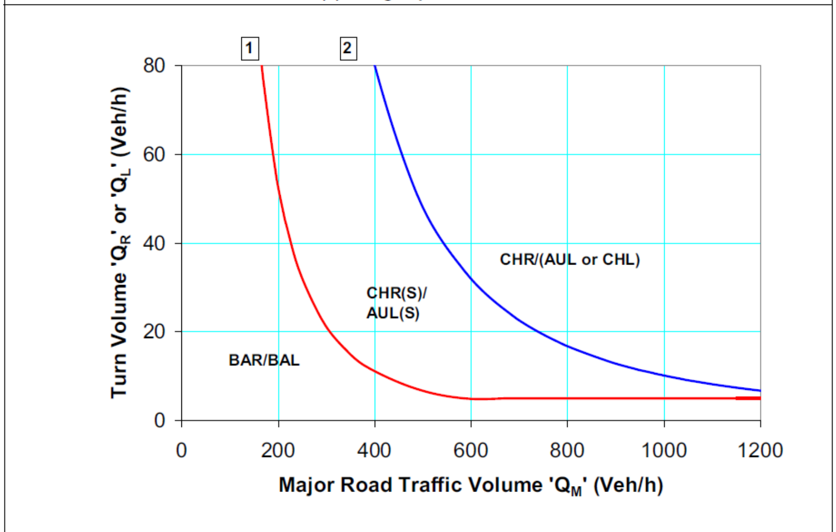
Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections

Figure C 3: CHR/CHL type intersections

Examples of each of these types of intersections present on Ulan Road are illustrated in Appendix F.



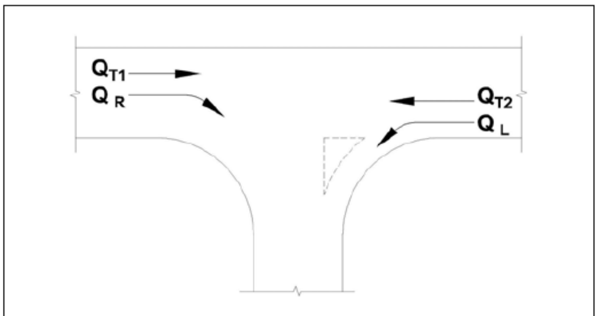
(a) Design speed ≥100 km/h



(b) Design speed < 100 km/h

Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections

Figure C 4: Warrants for turn treatments on the major road at unsignalised intersections



Turn type	Splitter island	Q_M (veh/h)
Right	No	$= Q_{T1} + Q_{T2} + Q_L$
Right	Yes	$= Q_{T1} + Q_{T2}$
Left	No/Yes	$= Q_{T2}$

Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections

Figure C 5: Calculation of the major road traffic volume parameter QM

APPENDIX D ROAD CONDITION DATA

D.1 Pavement condition

The following provide more detailed information and analysis to the information outlined in the report.

D.2 Base Material Quality

Based on data received from Mid-Western Regional Council for the rehabilitation design for upgrade of 900m section, the material does not meet the specification for both Base and Subbase pavement.

The graphs indicate that the material contains too much fine material and is not well-graded as is required for a high quality base material. (RMS Specification 3051 for Granular Base and Sub-base for surfaced road pavements.)

Information from the material investigation also suggests that the current subbase and subgrade material have high clay content (Plasticity Index (PI)), and require treatment with lime to reduce the PI.

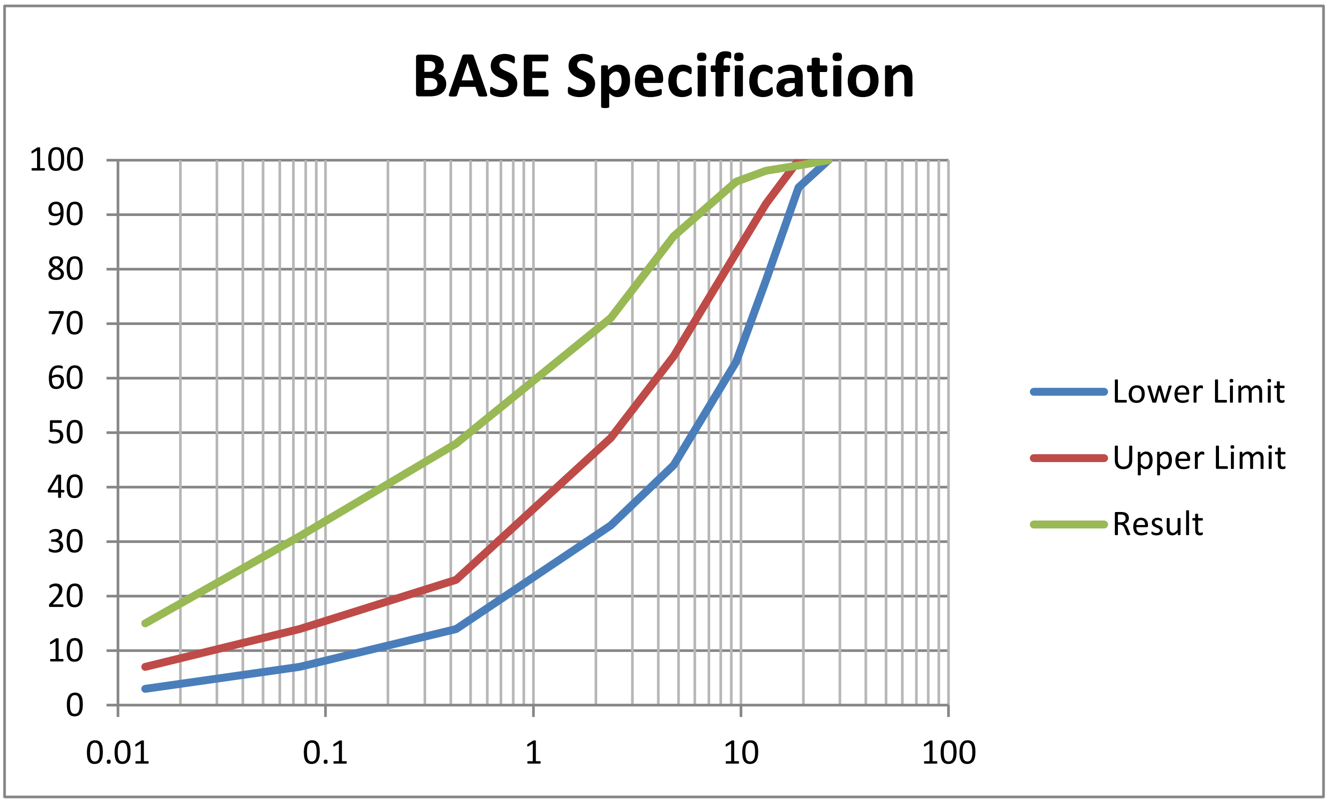


Figure D 1: Pavement rehabilitation design

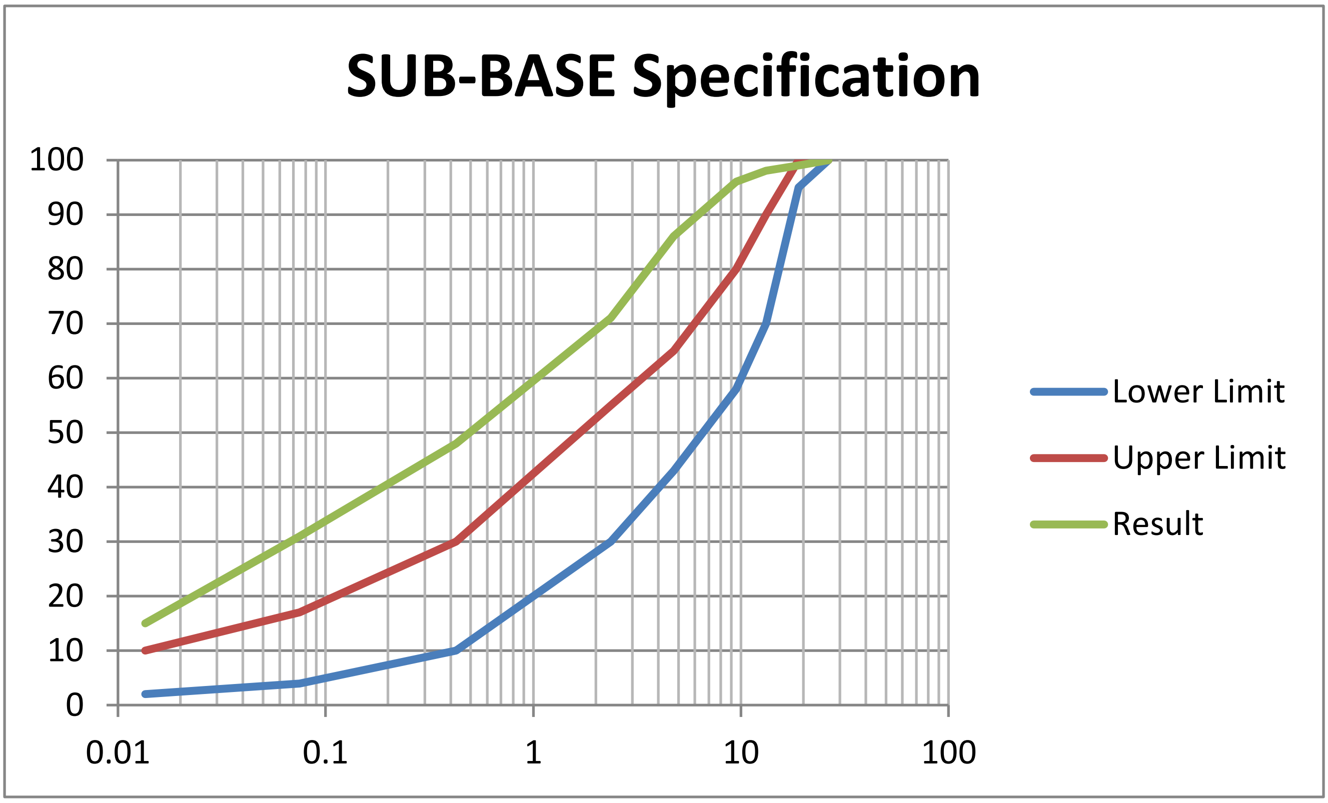


Figure D 2: Pavement rehabilitation design

D.3 Functional Condition – Riding Quality

Uniform riding quality sections were identified using the Cumulative Sum of Differences (CUSUM) method. These are shown in the figures below. Also shown in the figures are the investigation limits for sections longer than 500m. It may be noted that the riding quality of the road is in general good, with some sections, i.e. those projecting above the investigation limit, requiring attention to improve riding quality.

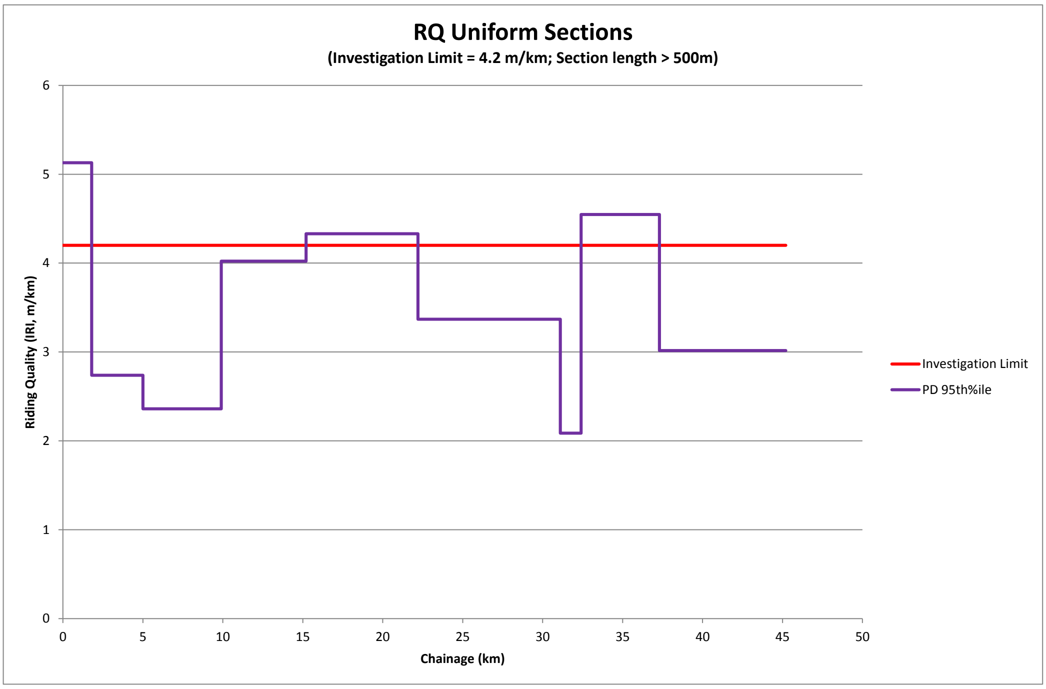


Figure D 1: Plot of ride quality, prescribed direction

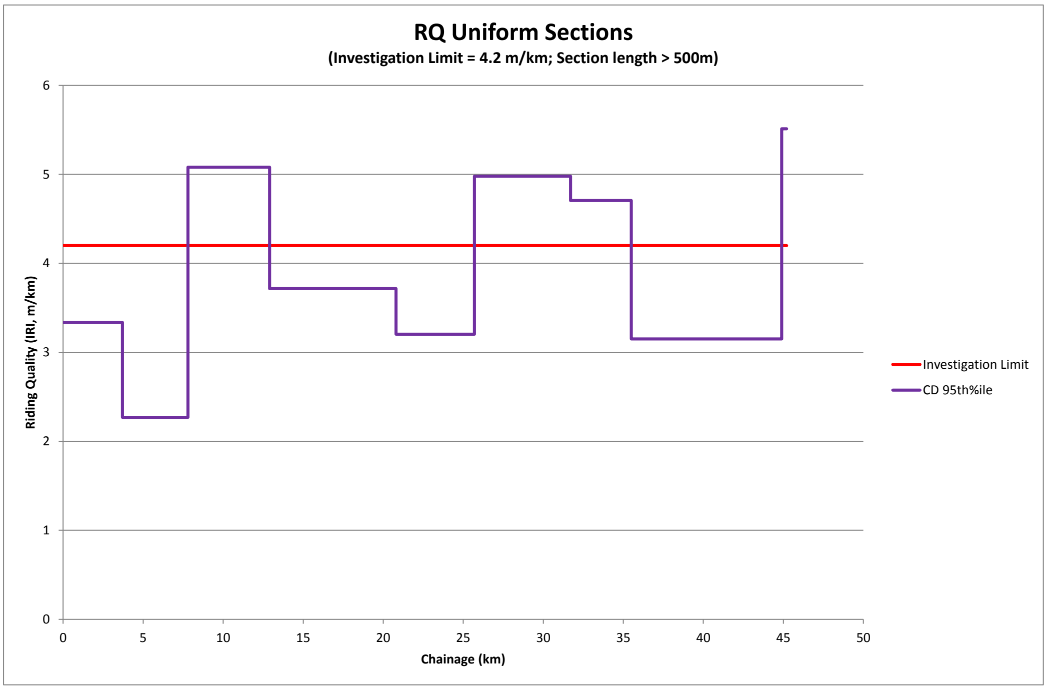


Figure D 2: Plot of ride quality, counter direction

D.4 Existing Structural Capacity

The traffic data obtained from the recent counts (April to May 2011) along the road was used for the calculation of the Design Traffic. Information from previous reports regarding traffic impact of proposed mine expansion works were also used in the calculations.

Table D 1: Traffic data for pavement structural capacity

Site	AADT 2010	Traffic Split		Design Traffic (N_{DT})			Design Traffic %	
		% LV	% HV	Base Line	Additional	Total	Base Line	Additional
Site 4	3563	93.10%	6.80%	2,920,570	302,618	3,223,187	90.6	9.4
Site 5	1972	90.20%	9.90%	2,352,972	443,196	2,796,168	84.1	15.9
Site 6	2447	89.80%	10.20%	3,007,985	185,126	3,193,111	94.2	5.8

The Design Equivalent Standard Axles (ESAs) required (the structural capacity required) calculated from the above is 2.3 million ESA, using urban parameters. The Design Equivalent Standard Axles required using rural parameters is 3.25 million ESA.

The FWD data may be used to identify sections of the road where the structural capacity is deficient with regard to the required Design Traffic. Uniform sections were identified using the cumulative sum of squares (CUSUM) method. This procedure described in Austroads Contract Report AT1613 and is used to identify sections where the existing structural capacity of the road is deficient.

Figure D 3 indicates that a large portion of the road is deficient with regard to the required structural capacity – the red line should plot within the area indicated by green and yellow blocks identified to the left of the chart.

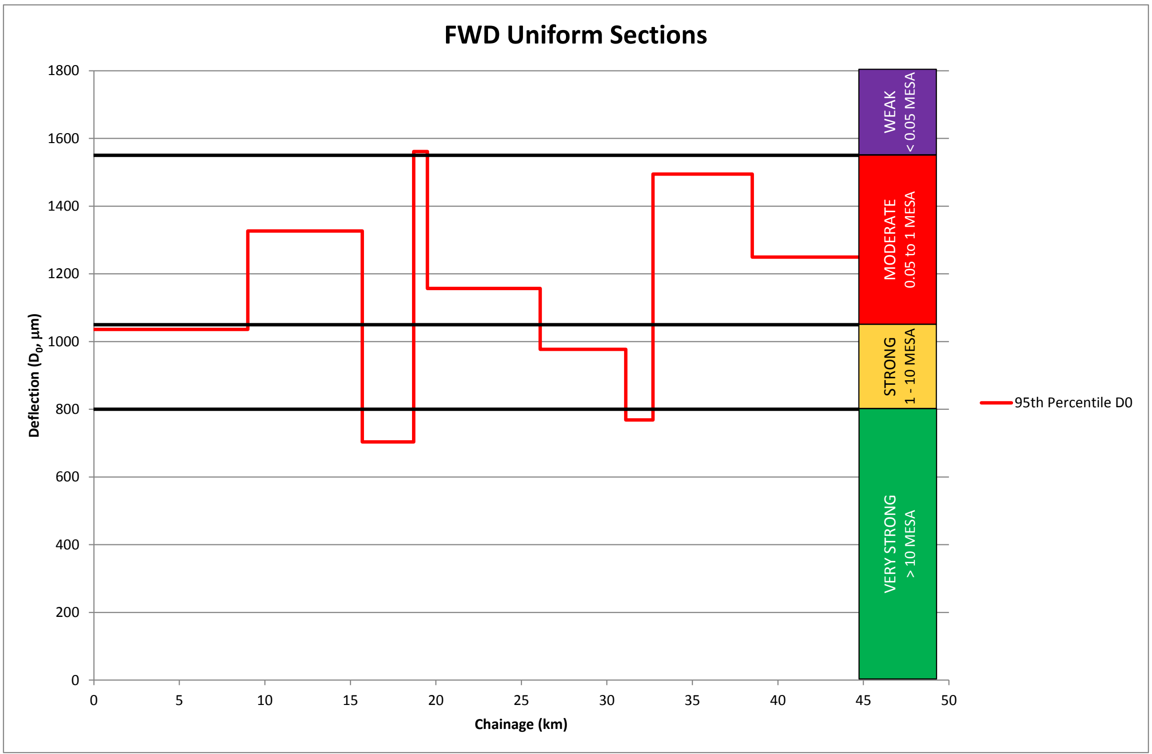


Figure D 3: Pavement deflection by chainage

D.5 Combined road condition results

The results of the surface condition (texture, roughness, rutting), structural capacity (FWD) and visual condition assessments were combined into a single plot to assist determining sections requiring pavement upgrades and projecting a maintenance schedule.

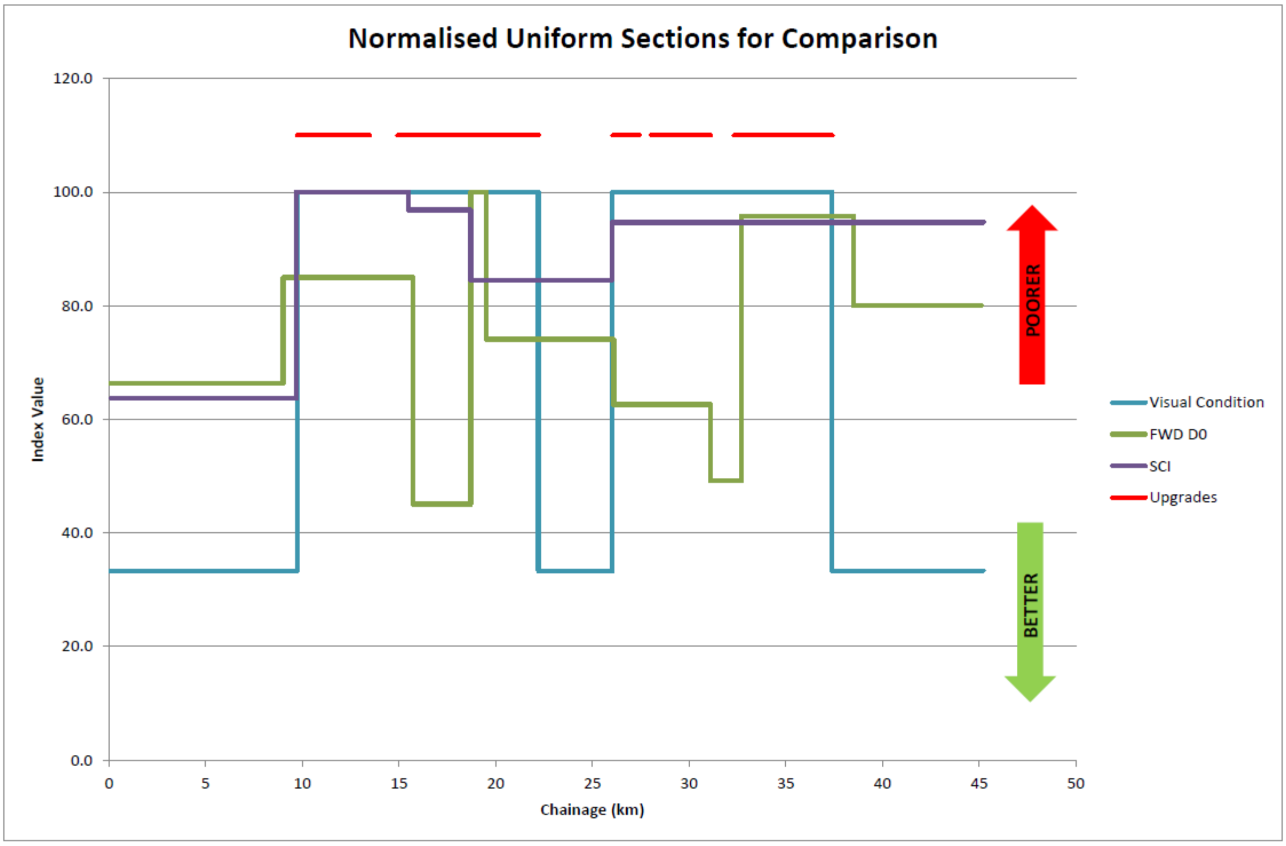


Figure D 4: Pavement condition assessment (combined)

D.6 Preliminary Rehabilitation Design

The empirical design method described in Austroads Guide to Pavement Technology Part 2 was used to obtain indicative pavements for the rehabilitation of deficient sections. The method is based on the concept of depth to cover, i.e. the total thickness of material required to protect the subgrade from permanent deformation is calculated. The subgrade strength (quality) is an input to the calculation; this data was not available. Thus, the results for a range of subgrade strengths are shown in the tables below.

Table D 2: Pavement design for 2 million ESA

Subgrade (CBR)	Thickness		Base	Sub-base
	Calculated	Design	CBR > 80	CBR > 30
5	422	430	200	230
7	347	350	150	200
10	279	280 *(300)*	150	130*
15	216	220 *(300)*	150	70[1]

1. Impractical thickness - increase to 150mm
2. Minimum Base Thickness = 150mm

Table D 3: Pavement design for 2.8 million ESA

Subgrade (CBR)	Thickness		Base	Sub-base
	Calculated	Design	CBR > 80	CBR > 30
5	436	450	200	250
7	359	370	170	200
10	288	300	150	150
15	223	230 *(300)*	150	80[1]

1. Impractical thickness - increase to 150mm
2. Minimum Base Thickness = 150mm

APPENDIX E TRAFFIC IMPACT DATA

E.1 Mine traffic generation and proportion forecasts

Table E 1: Mine traffic generation and Ulan Road traffic proportion forecasts

Traffic count location	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Whole-of-life traffic generated
	2011A	2012F	2013F	2014F	2015F	2016F	2017F	2018F	2019F	2020F	2021F	2022F	2023F	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F	
Traffic at Mine Entrances																							
Ulan Traffic	1138	1427	1520	1525	1936	1676	1592	1364	1364	1364	1362	1249	1134	1018	674	675	675	675	675	675	675	460	9,071,783
Moolarben Traffic	724	634	1278	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	878	7,051,070
Wilpinjong Traffic	819	988	492	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	4,029,235
Total Mine Traffic	2681	3049	3290	2863	3274	3014	2930	2702	2702	2702	2700	2587	2472	2356	2012	2013	2013	2013	2013	2013	2013	1798	20,152,088
Total Mine Traffic on Ulan Rd	2413	2744	2961	2576	2947	2712	2637	2432	2432	2432	2430	2328	2225	2120	1811	1812	1812	1812	1812	1812	1812	1618	18,136,879
Traffic volumes along Ulan Road																							
#220 (north of UCML entrance)																							
Total Traffic	1010	1037	1061	1066	1095	1106	1123	1135	1154	1174	1194	1211	1228	1246	1258	1280	1302	1324	1347	1370	1394	1412	9,682,481
Council Traffic	938	954	972	989	1007	1025	1044	1062	1081	1101	1121	1141	1161	1182	1204	1225	1247	1270	1293	1316	1340	1364	9,138,374
Council Traffic %	92.8%	92.1%	91.6%	92.8%	91.9%	92.6%	93.0%	93.6%	93.7%	93.8%	93.9%	94.2%	94.6%	94.9%	95.7%	95.8%	95.8%	95.9%	96.0%	96.0%	96.1%	96.6%	94.4%
Total Mine %	7.2%	7.9%	8.4%	7.2%	8.1%	7.4%	7.0%	6.4%	6.3%	6.2%	6.1%	5.8%	5.4%	5.1%	4.3%	4.2%	4.2%	4.1%	4.0%	4.0%	3.9%	3.4%	5.6%
#223 (north of Cope Rd)																							
Total Traffic	2489	2813	3026	2656	3018	2793	2723	2527	2530	2534	2535	2439	2342	2244	1947	1951	1955	1958	1962	1966	1969	1786	19,039,990
Council Traffic	148	151	154	157	159	162	165	168	171	174	177	181	184	187	191	194	198	201	205	208	212	216	1,447.217
Council Traffic %	6.0%	5.4%	5.1%	5.9%	5.3%	5.8%	6.1%	6.7%	6.8%	6.9%	7.0%	7.4%	7.9%	8.3%	9.8%	9.9%	10.1%	10.3%	10.4%	10.6%	10.8%	12.1%	7.6%
Total Mine %	94.0%	94.6%	94.9%	94.1%	94.7%	94.2%	93.9%	93.3%	93.2%	93.1%	93.0%	92.6%	92.1%	91.7%	90.2%	90.1%	89.9%	89.7%	89.6%	89.4%	89.2%	87.9%	92.4%
#224 Cope Rd																							
Total Traffic	1017	1095	1160	1062	1169	1112	1098	1049	1056	1063	1070	1050	1029	1008	932	940	948	957	965	973	982	938	8,401,999
Council Traffic	343	349	355	362	368	375	382	389	396	403	410	417	425	433	440	448	456	465	473	481	490	499	3,323,531
Council Traffic %	33.7%	31.9%	30.7%	34.1%	31.5%	33.7%	34.8%	37.0%	37.5%	37.9%	38.3%	39.8%	41.3%	42.9%	47.2%	47.7%	48.1%	48.6%	49.0%	49.5%	49.9%	53.2%	39.6%
Total Mine %	66.3%	68.1%	69.3%	65.9%	68.5%	66.3%	65.2%	63.0%	62.5%	62.1%	61.7%	60.2%	58.7%	57.1%	52.8%	52.3%	51.9%	51.4%	51.0%	50.5%	50.1%	46.8%	60.4%
#225 (south of Cope Rd)																							
Total Traffic	1790	2021	2173	1910	2168	2008	1959	1820	1822	1825	1826	1758	1690	1620	1409	1413	1416	1419	1422	1425	1428	1297	13,733,715
Council Traffic	124	126	128	130	133	135	138	140	143	145	148	150	153	156	159	161	164	167	170	173	177	180	1,219,268
Council Traffic %	6.9%	6.2%	5.9%	6.8%	6.1%	6.7%	7.0%	7.7%	7.8%	8.0%	8.1%	8.5%	9.1%	9.6%	11.3%	11.4%	11.6%	11.8%	12.0%	12.2%	12.4%	13.9%	8.9%
Total Mine %	93.1%	93.8%	94.1%	93.2%	93.9%	93.3%	93.0%	92.3%	92.2%	92.0%	91.9%	91.5%	90.9%	90.4%	88.7%	88.6%	88.4%	88.2%	88.0%	87.8%	87.6%	86.1%	91.1%
#236																							
Total Traffic	2006	2241	2397	2138	2400	2245	2199	2064	2071	2078	2084	2021	1957	1893	1687	1695	1703	1711	1719	1728	1736	1611	15,838,942
Council Traffic	340	346	352	358	365	371	378	385	392	399	406	413	421	428	436	444	452	460	468	477	485	494	3,324,496
Council Traffic %	16.9%	15.4%	14.7%	16.8%	15.2%	16.5%	17.2%	18.6%	18.9%	19.2%	19.5%	20.4%	21.5%	22.6%	25.8%	26.2%	26.5%	26.9%	27.2%	27.6%	27.9%	30.6%	21%
Total Mine %	83.1%	84.6%	85.3%	83.2%	84.8%	83.5%	82.8%	81.4%	81.1%	80.8%	80.5%	79.6%	78.5%	77.4%	74.2%	73.8%	73.5%	73.1%	72.8%	72.4%	72.1%	69.4%	79%
#232 (south of Linburn Lane)																							
Total Traffic	2000	2235	2391	2131	2393	2238	2192	2058	2064	2071	2077	2014	1950	1885	1679	1687	1695	1703	1711	1719	1728	1603	15,780,464
Council Traffic	334	340	346	352	358	365	371	378	385	392	399	406	413	421	428	436	444	452	460	468	477	485	3,266,017
Council Traffic %	16.7%	15.2%	14.5%	16.5%	15.0%	16.3%	16.9%	18.4%	18.6%	18.9%	19.2%	20.2%	21.2%	22.3%	25.5%	25.8%	26.2%	26.5%	26.9%	27.2%	27.6%	30.3%	20.7%

Traffic count location	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Whole-of-life traffic generated
	2011A	2012F	2013F	2014F	2015F	2016F	2017F	2018F	2019F	2020F	2021F	2022F	2023F	2024F	2025F	2026F	2027F	2028F	2029F	2030F	2031F	2032F	
Total Mine %	83.3%	84.8%	85.5%	83.5%	85.0%	83.7%	83.1%	81.6%	81.4%	81.1%	80.8%	79.8%	78.8%	77.7%	74.5%	74.2%	73.8%	73.5%	73.1%	72.8%	72.4%	69.7%	79.3%
#226 (north of Wollar Road)																							
Total Traffic	2296	2536	2697	2443	2711	2562	2522	2393	2406	2419	2431	2374	2316	2258	2059	2074	2089	2104	2119	2135	2151	2033	18,665,405
Council Traffic	630	641	652	664	676	688	701	713	726	739	753	766	780	794	808	823	838	853	868	884	899	916	6,150,959
Council Traffic %	27.4%	25.3%	24.2%	27.2%	24.9%	26.9%	27.8%	29.8%	30.2%	30.6%	31.0%	32.3%	33.7%	35.2%	39.3%	39.7%	40.1%	40.5%	41.0%	41.4%	41.8%	45.0%	33%
Total Mine %	72.6%	74.7%	75.8%	72.8%	75.1%	73.1%	72.2%	70.2%	69.8%	69.4%	69.0%	67.7%	66.3%	64.8%	60.7%	60.3%	59.9%	59.5%	59.0%	58.6%	58.2%	55.0%	67%
#228 (south of Wollar Road)																							
Total Traffic	2919	3171	3343	3101	3380	3243	3215	3099	3124	3150	3175	3132	3088	3044	2859	2888	2918	2948	2978	3009	3041	2939	24,737,428
Council Traffic	1253	1275	1298	1321	1345	1369	1394	1419	1445	1471	1497	1524	1552	1579	1608	1637	1666	1696	1727	1758	1790	1822	12,222,981
Council Traffic %	42.9%	40.2%	38.8%	42.6%	39.8%	42.2%	43.4%	45.8%	46.2%	46.7%	47.1%	48.7%	50.2%	51.9%	56.2%	56.7%	57.1%	57.6%	58.0%	58.4%	58.9%	62.0%	49.4%
Total Mine %	57.1%	59.8%	61.2%	57.4%	60.2%	57.8%	56.6%	54.2%	53.8%	53.3%	52.9%	51.3%	49.8%	48.1%	43.8%	43.3%	42.9%	42.4%	42.0%	41.6%	41.1%	38.0%	50.6%
#229 (north of George Campbell Drive)																							
Total Traffic	3625	3889	4075	3846	4138	4015	4001	3899	3939	3979	4019	3991	3963	3934	3765	3811	3857	3904	3951	4000	4050	3966	31,618,403
Council Traffic	1959	1994	2030	2066	2103	2141	2180	2219	2259	2300	2341	2383	2426	2470	2514	2559	2606	2652	2700	2749	2798	2849	19,103,957
Council Traffic %	54.0%	51.3%	49.8%	53.7%	50.8%	53.3%	54.5%	56.9%	57.4%	57.8%	58.2%	59.7%	61.2%	62.8%	66.8%	67.2%	67.6%	67.9%	68.3%	68.7%	69.1%	71.8%	60.4%
Total Mine %	46.0%	48.7%	50.2%	46.3%	49.2%	46.7%	45.5%	43.1%	42.6%	42.2%	41.8%	40.3%	38.8%	37.2%	33.2%	32.8%	32.4%	32.1%	31.7%	31.3%	30.9%	28.2%	39.6%
#230 (north of Hollyoak Bridge)																							
Total Traffic	7454	7787	8043	7885	8251	8201	8263	8237	8355	8475	8596	8651	8706	8763	8680	8815	8951	9089	9230	9374	9520	9535	68,937,462
Council Traffic	5788	5892	5998	6106	6216	6328	6441	6557	6675	6796	6918	7042	7169	7298	7430	7563	7699	7838	7979	8123	8269	8418	56,423,016
Council Traffic %	77.6%	75.7%	74.6%	77.4%	75.3%	77.2%	78.0%	79.6%	79.9%	80.2%	80.5%	81.4%	82.4%	83.3%	85.6%	85.8%	86.0%	86.2%	86.4%	86.7%	86.9%	88.3%	81.8%
Total Mine %	22.4%	24.3%	25.4%	22.6%	24.7%	22.8%	22.0%	20.4%	20.1%	19.8%	19.5%	18.6%	17.6%	16.7%	14.4%	14.2%	14.0%	13.8%	13.6%	13.3%	13.1%	11.7%	18.2%

E.2 Forecast mine traffic volumes

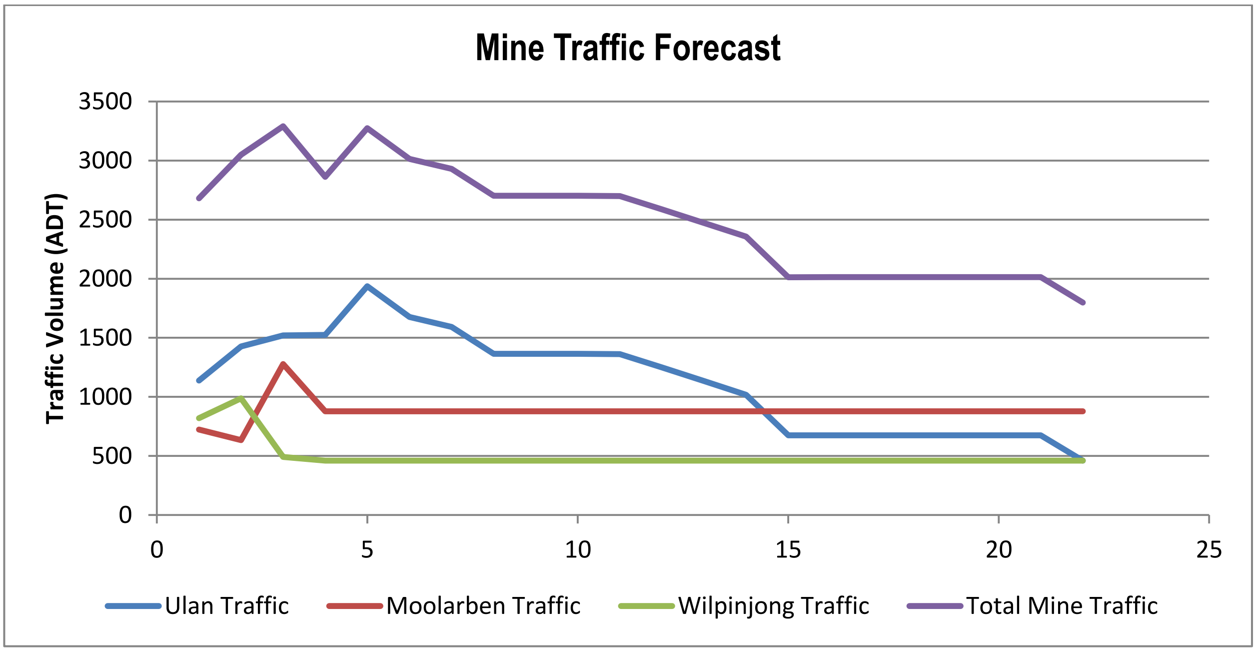


Figure E 1: Forecast of traffic generated from the three mines

E.3 Forecast traffic volumes on Ulan Road

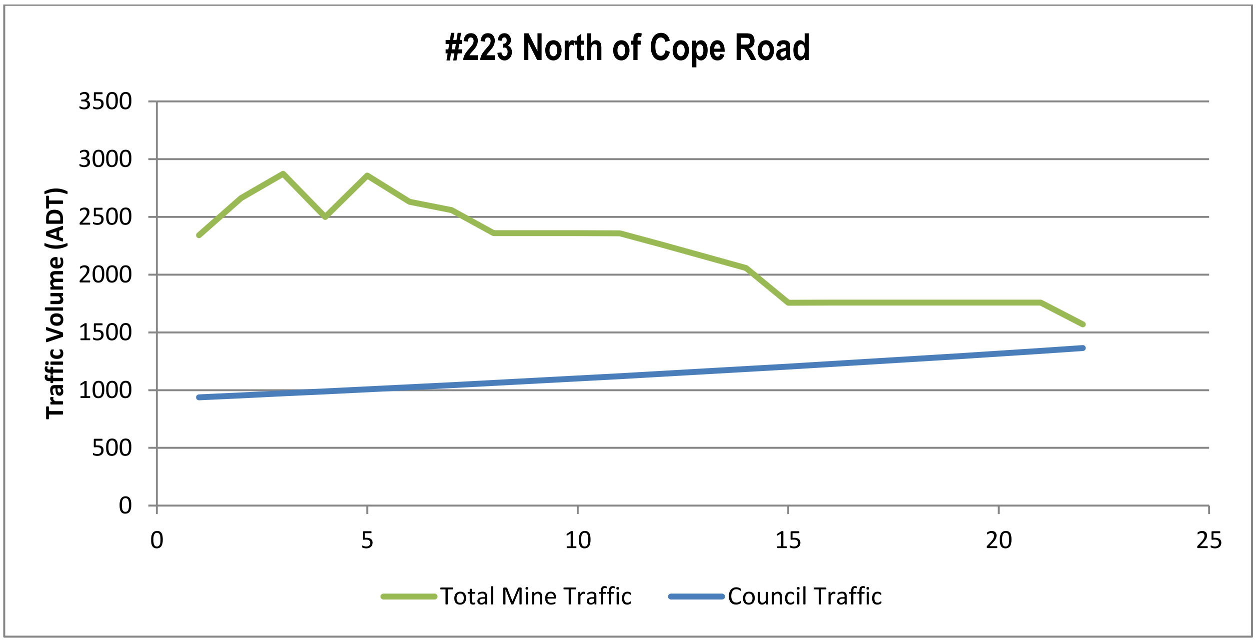


Figure E 2: Forecast of traffic on Ulan Road, north of Cope Road intersection

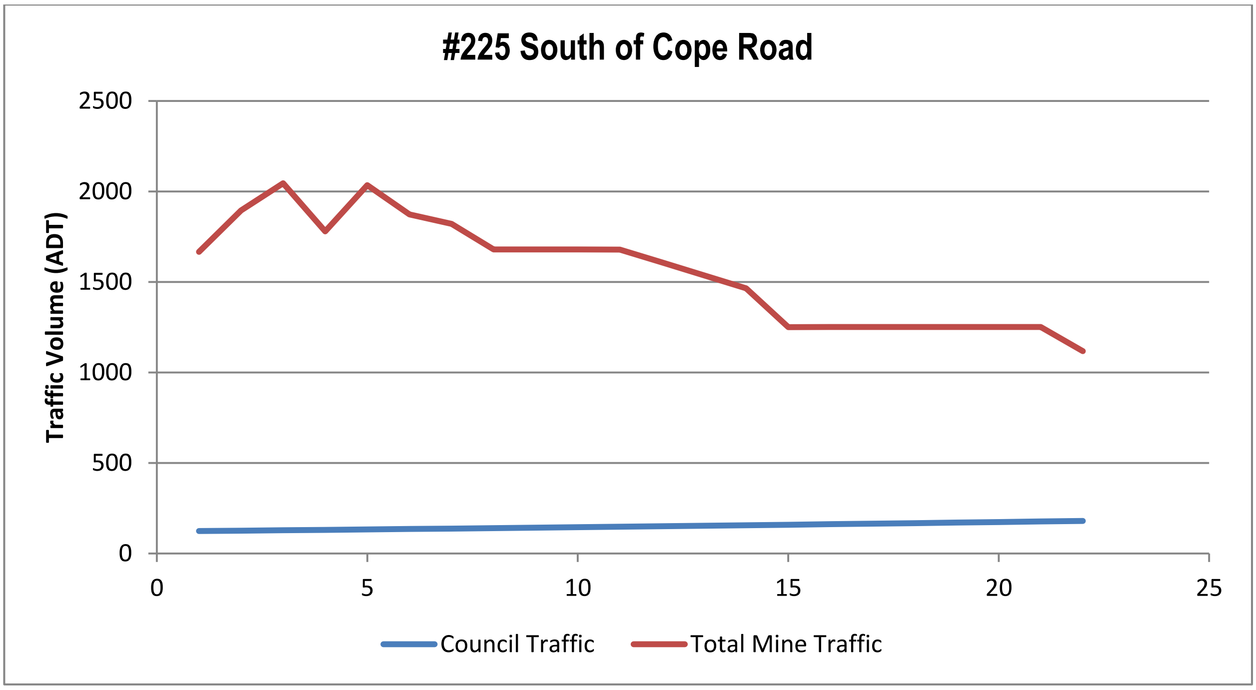


Figure E 3: Forecast of traffic on Ulan Road, north of Mud Hut Creek intersection

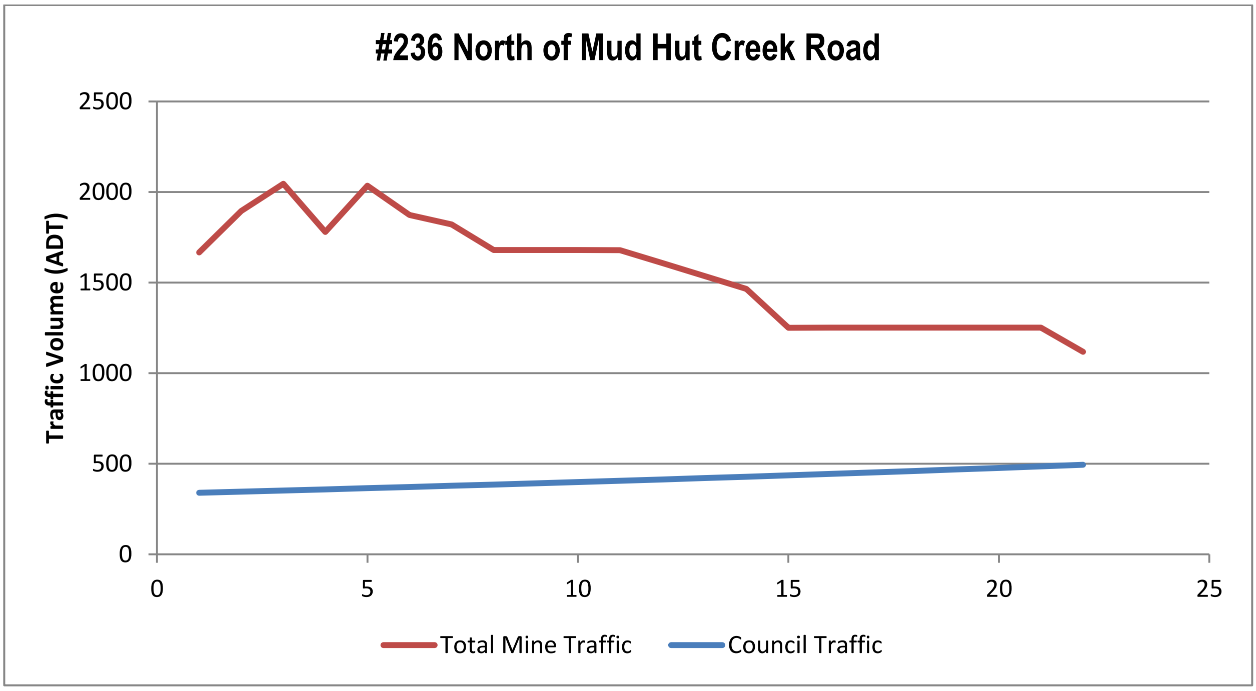


Figure E 4: Forecast of traffic on Ulan Road, north of Mud Hut Creek intersection

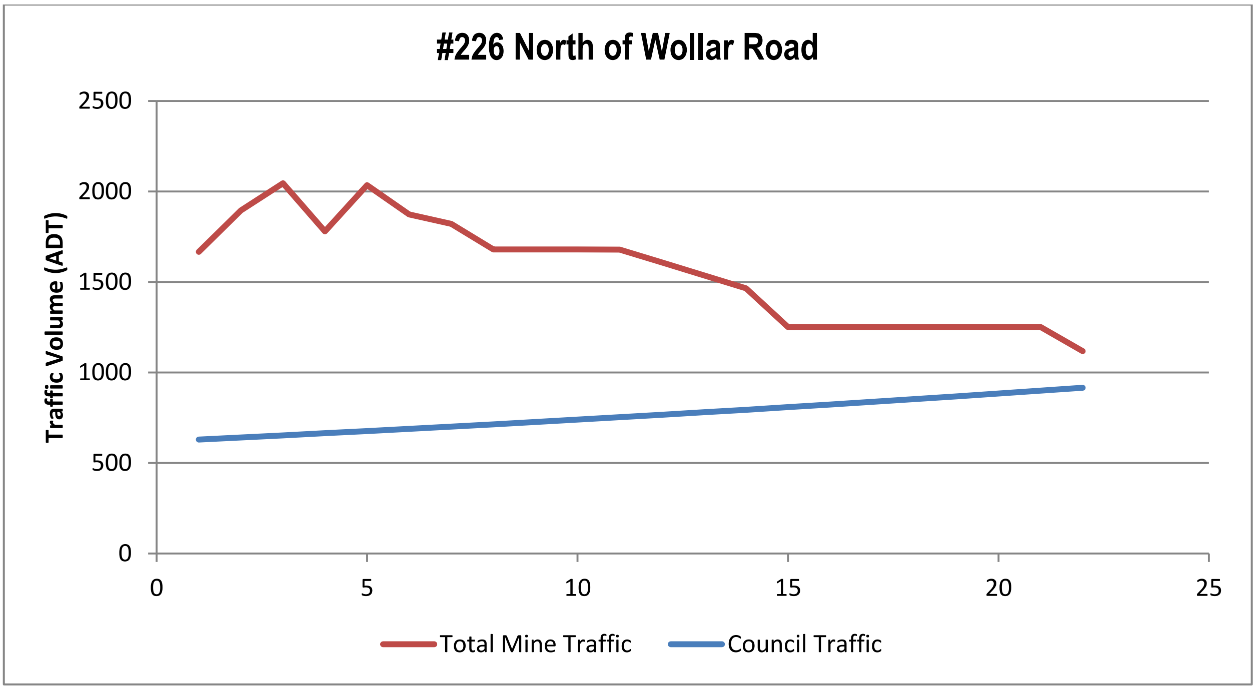


Figure E 5: Forecast of traffic on Ulan Road, north of Wollar Road intersection

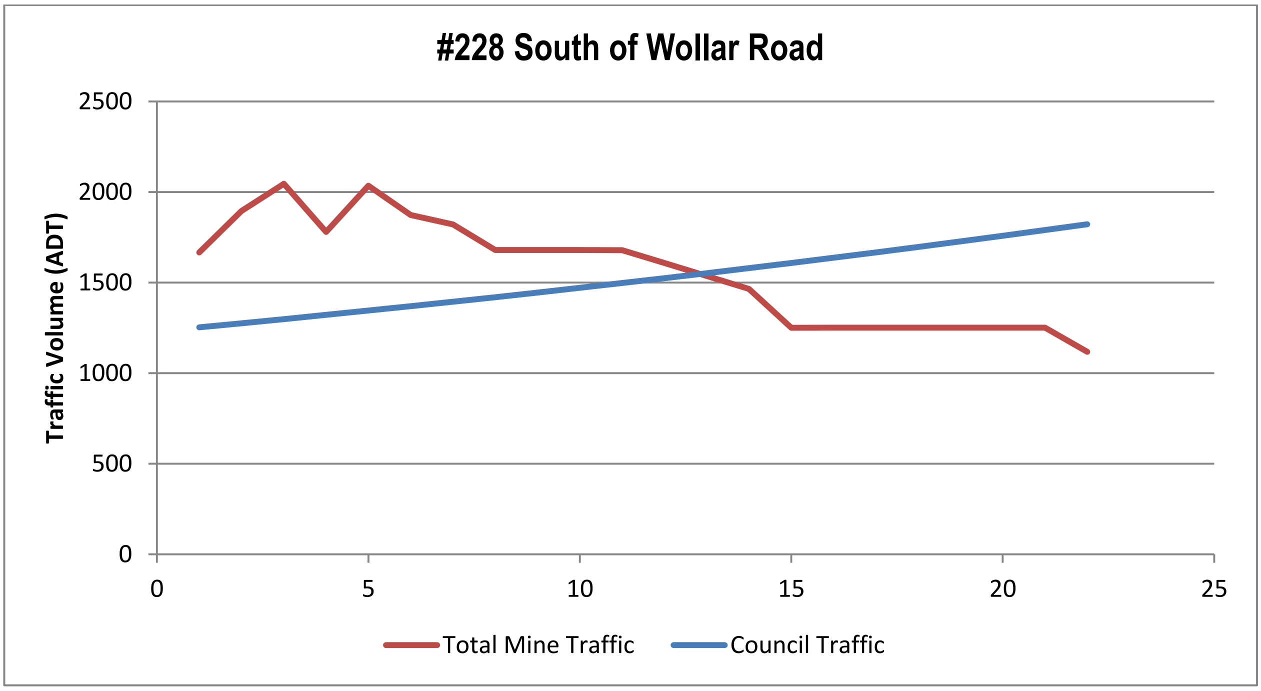


Figure E 6: Forecast of traffic on Ulan Road, south of Wollar Road intersection

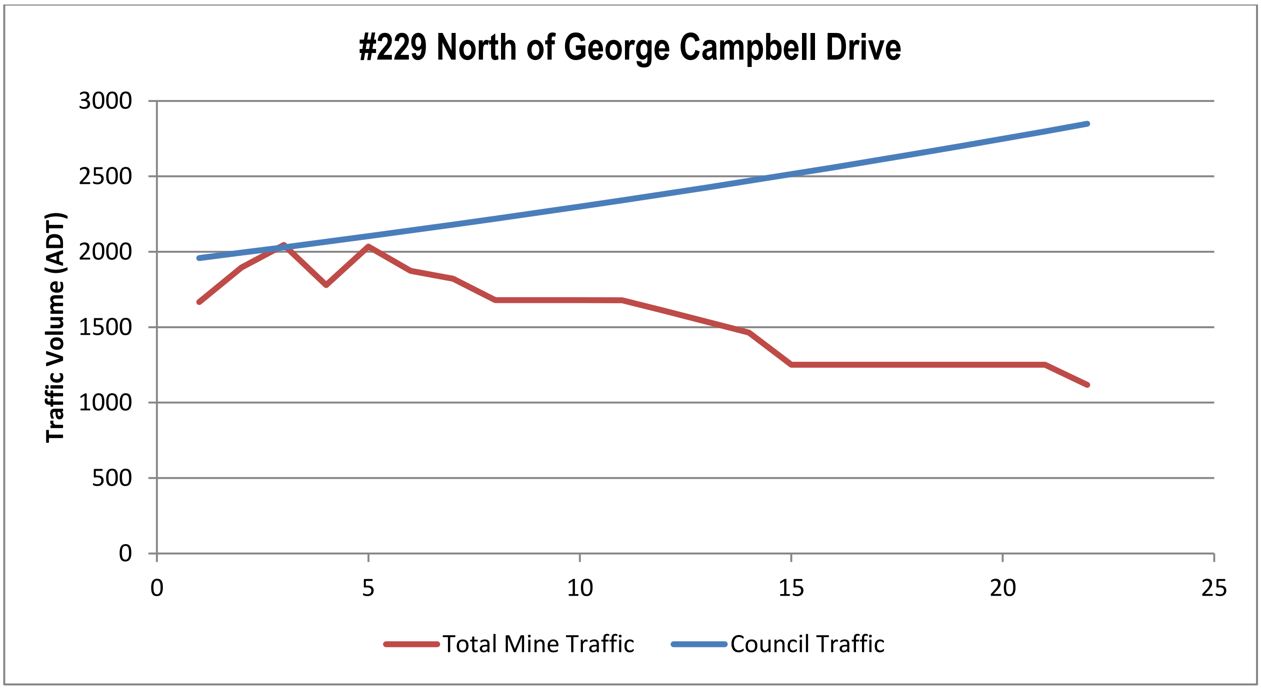


Figure E 7: Forecast of traffic on Ulan Road, north of George Campbell Drive intersection

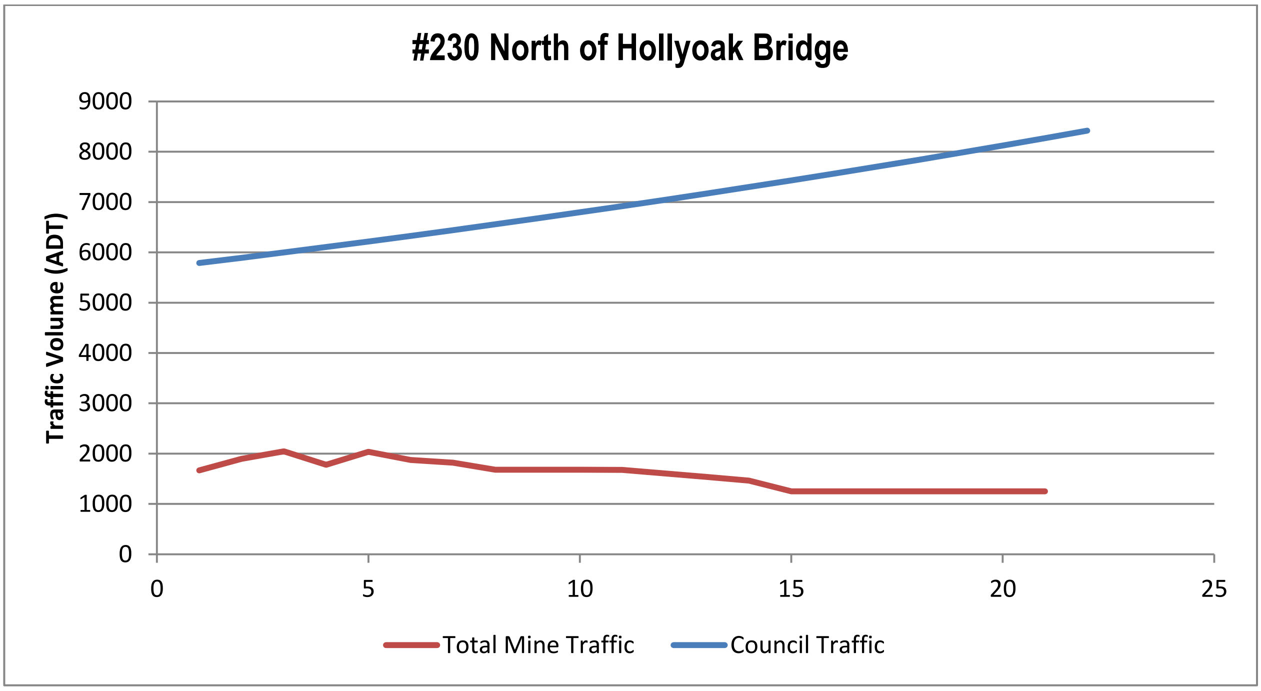


Figure E 8: Forecast of traffic on Ulan Road, north of Hollyoak Bridge

E.4 Existing and recommended intersection configuration

Section	Chainage (km)	Location/description	Intersection type	
			Existing	Recommended
Section 1	0.352	Pitts Lane	BAR/BAR	BAR/BAR
	0.552	Lue Road	AUR	CHR(s)
	1.214	Racecourse entrance	BAR/BAL	BAR/BAL
	1.364	Country Comfort Hotel	CHR/CHL	CHR/CHL
	1.544	Winery and Cheese Factory	CHR	CHR
	1.695	Henry Lawson Drive	CHR/CHL	CHR/CHL
	1.865	Moggs Lane	AUR	CHR(s)
	2.833	AREC entrance	AUR/AUL	AUR/AUL
Section 2	3.785	George Campbell Drive (Airport entrance)	AUR/AUL	CHR(s)/AUL
	4.487	Blue Wren Winery entrance	BAR/BAL	BAR/BAL
	5.068	Thumbprint Winery entrance	BAR/BAL	BAR/BAL
	5.479	Buckaroo Lane/Black Springs Road	BAR/BAL	BAR/BAL
	6.271	Eurunderee Lane	BAR/BAL	BAR/BAL
	6.652	Buckaroo Lane	-	CHR(s)
	6.963	Winery entrance	BAR/BAL	BAR/BAL
	8.331	Pipeclay Lane	AUR	CHR(s)
	8.682	Crowleys Lane	BAR/BAL	BAR/BAL
	9.574	Wollar Road	BAR/BAL	CHR(s)/AUL
Section 3	9.885	Church Lane	-	BAR/BAL
	11.539	Box's Lane	-	BAR/BAL
	12.531	School Lane	BAR/AUL(S)	BAR/AUL(S)
	14.01	Spring View Lane	-	BAR/BAL
	15.754	Hadabob Road	-	BAR/BAL
	17.644	Frog Rock Road	-	CHR(s)/AUL(s)
	19.999	Linburn Lane	-	BAR/BAL
	20.691	Mud Hut Creek Road	-	CHR(S)/AUL
	24.435	Wattlegrove Lane	-	BAR/BAL
	26.129	Wyaldra Lane	-	BAR/BAL
	27.783	Quarry and RFS Shed entry	-	BAR/BAL
	28.771	Moolarben/Ridge Road	-	CHR(S)/AUL
	29.252	Nimoola Road	-	BAR/BAL
	30.515	Winchester Crescent	-	BAR/BAL
	33.166	Winchester Crescent	-	BAR/BAL
	34.369	Ridge Road	-	BAR/BAL
	35.442	Lagoons Road	-	BAR/BAL
	37.306	Toole Road	-	CHR/CHL

Section	Chainage (km)	Location/description	Intersection type	
			Existing	Recommended
Section 4	38.645	Cope Road	AUR/AUL	CHR/CHL
	39.527	UCML Surface Operations entrance	AUR/AUL	CHR/CHL
	41.632	Ulan-Wollar Road	CHR/CHL	CHR/CHL
	42.674	Moolarben Mine Administration entrance	CHR/CHL	CHR/CHL
	43.822	XX side road	-	BAR/BAL
	44.123	YY side road	-	BAR/BAL
	45.236	UCML Mine Administration entrance	AUR/AUL	CHR(S)/AUL

E.5 Existing key intersections

Figure E 1: Ulan/Cope Road intersection (northbound approach)

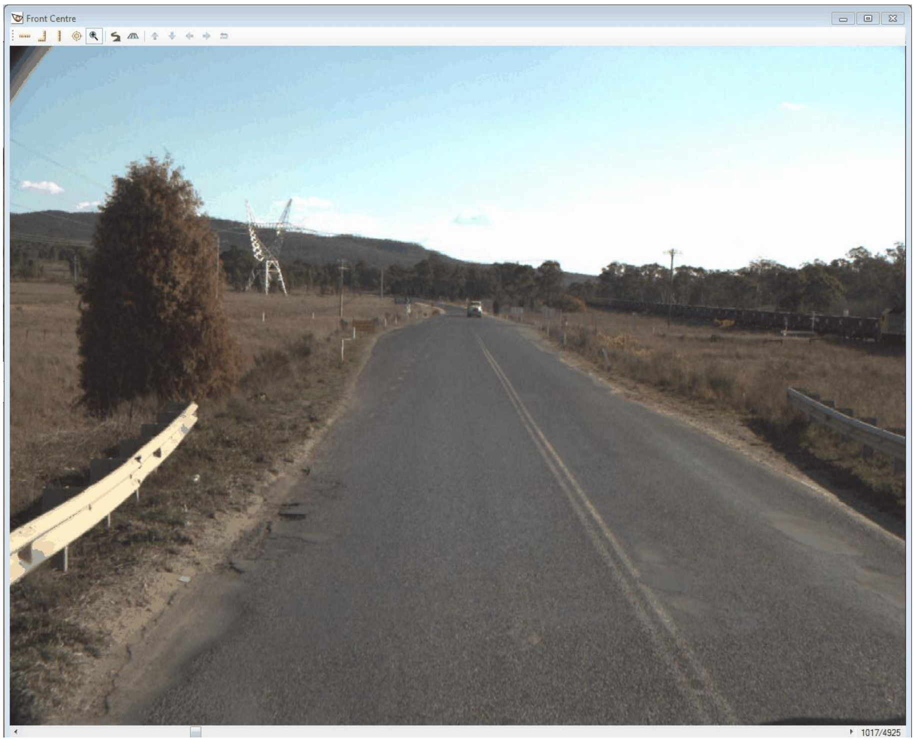


Figure E 2: Ulan/Cope Road intersection (southbound approach)

Figure E 3: Ulan/Wollar Road intersection (northbound approach)

Figure E 4: Ulan/Wollar Road intersection (northbound approach)

APPENDIX F EXAMPLE ROAD CONDITION PHOTOS

F.1 Intersections

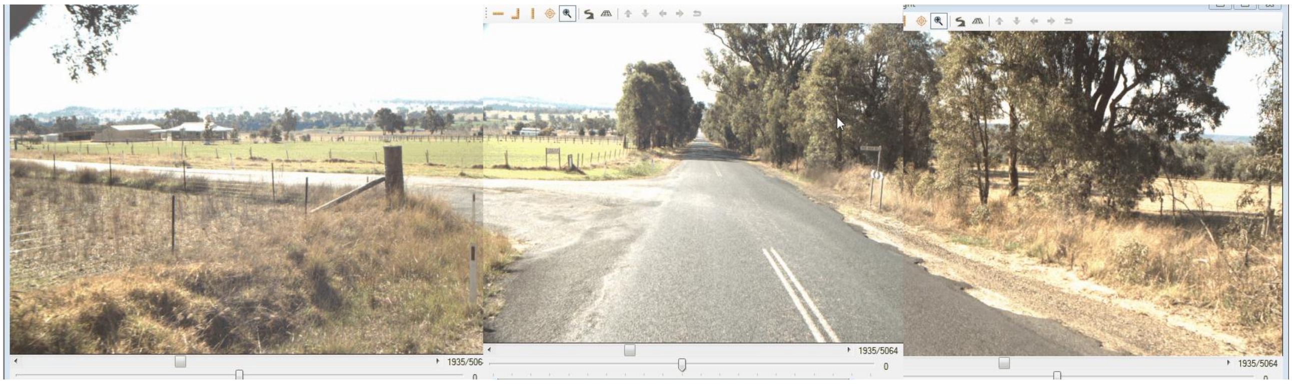


Figure F 1: BAR/BAL treatment (Ch17.609N)

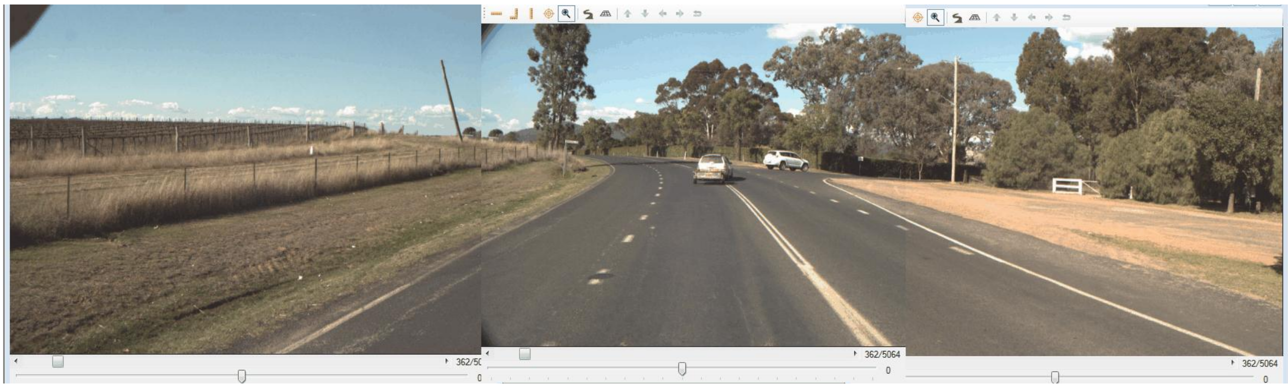


Figure F 2: AUR/AUL treatment (Ch 1.825N)

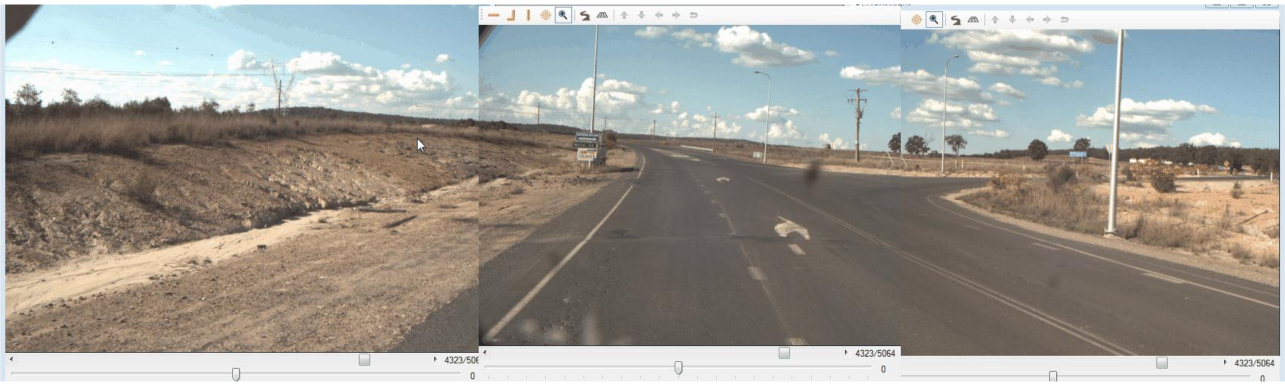


Figure F 3: CHR/CHL treatment (Ch 41.572N)

F.2 Midblock

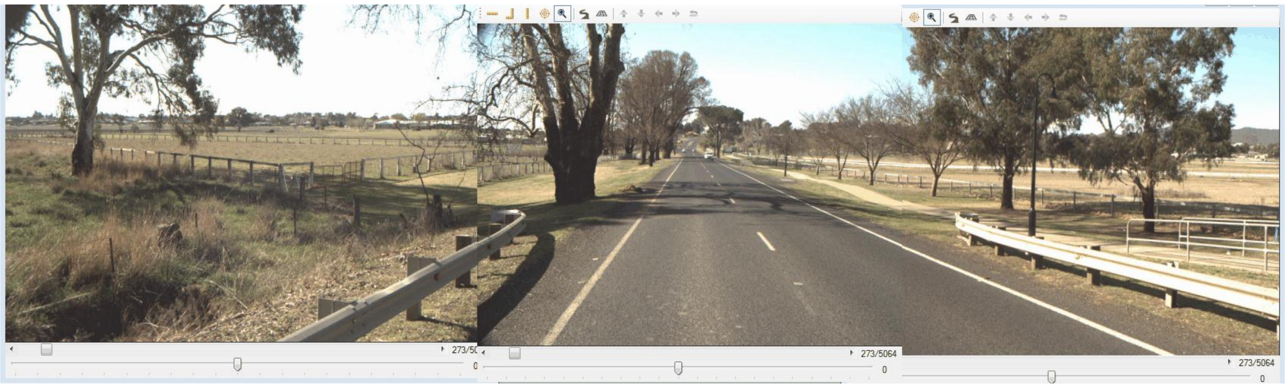


Figure F 4: Good section – width and linemarking (Ch0.933N)

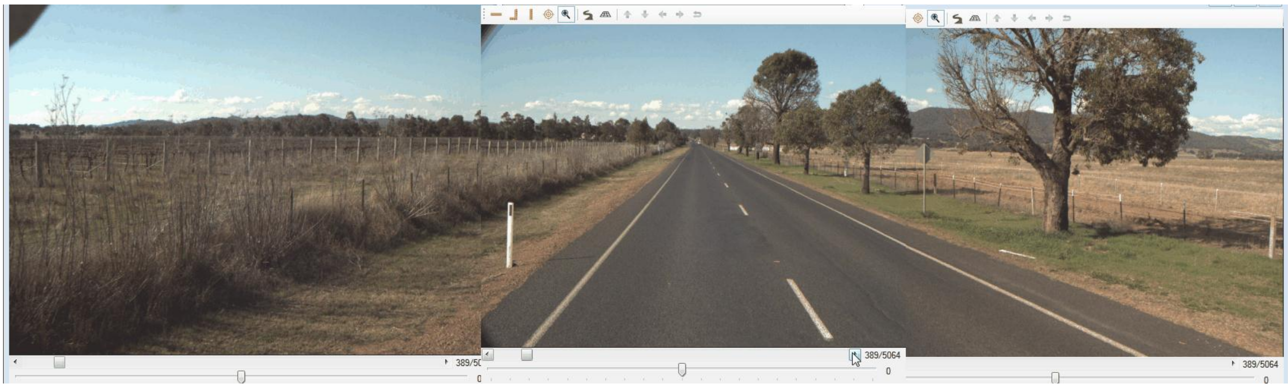


Figure F 5: Good section – width and linemarking (Ch2.096N)

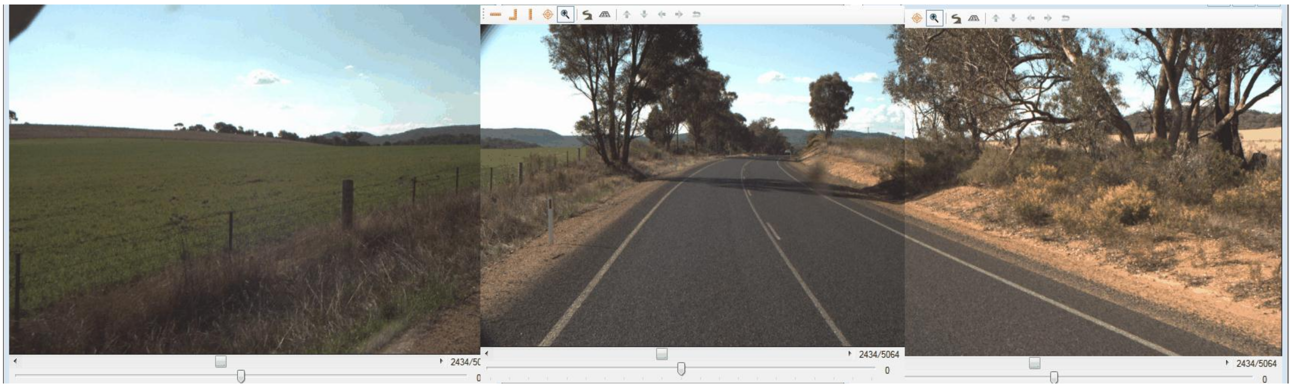


Figure F 6: Good section – width and linemarking curve (Ch22.616N)

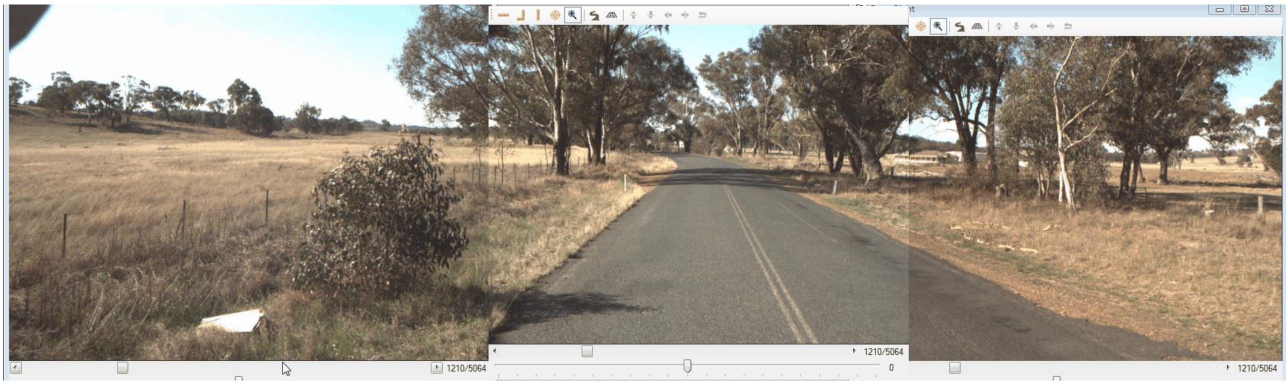


Figure F 7: Poor section – lacks shoulders and adequate width (Ch10.296N)

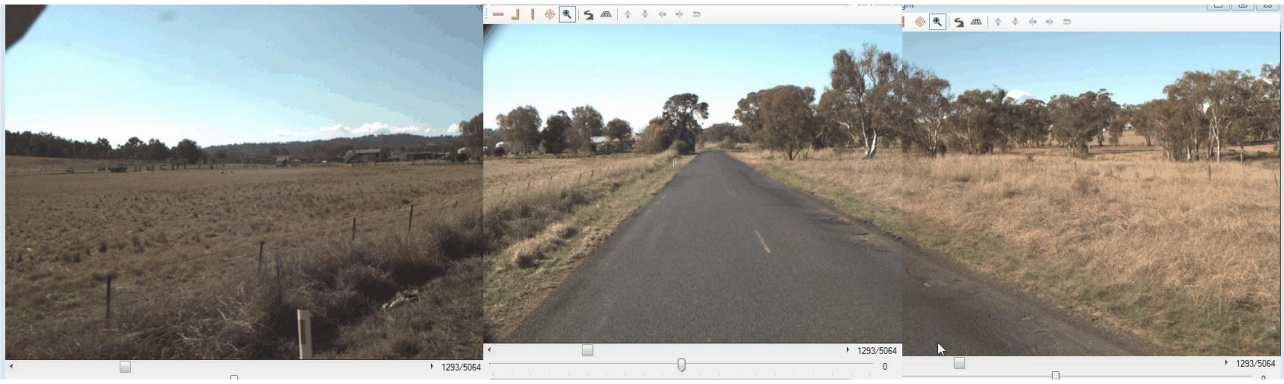


Figure F 8: Poor section – lacks shoulders and adequate width (Ch11.168N)

APPENDIX G WILKINSON MURRAY NOISE MODELLING REPORT

ULAN ROAD

TRAFFIC NOISE ASSESSMENT

REPORT NO. 11297
VERSION B

DECEMBER 2011

PREPARED FOR

ARRB GROUP LTD
GROUND FLOOR 2-14 MOUNTAIN ST
ULTIMO NSW 2007

A C O U S T I C S A N D A I R

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	draft	25-11-2011	Jeffrey Peng	John Wassermann
A	draft	14-11-2011	Jeffrey Peng	John Wassermann
B	Final	15-11-2011	Jeffrey Peng	John Wassermann

Note

All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC

This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

TABLE OF CONTENTS

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

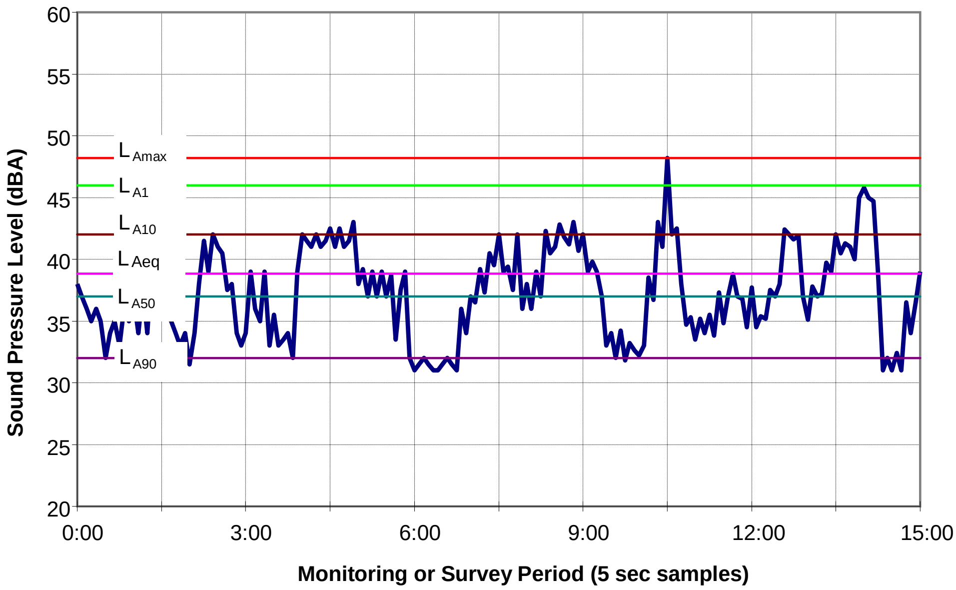
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

Ulan Coal Mine Limited (UCML), in conjunction with Moolarben Coal Project (MCP) and Wilpinjong Coal Mine Limited (WCML) has engaged ARRB Group Ltd to prepare an Ulan Road Strategy as required by Condition 51 of Ulan Coal Mines Department of Planning Approval Application Number 08_0184.

Condition 50 of project approval 08_0184 requires states:

Ulan Road Strategy

Condition 50 *By the end of December 2011, unless the Director-General directs otherwise, the Proponent shall prepare to the satisfaction of the Director-General a strategy for the upgrade and maintenance of Ulan Road between Mudgee and the entrance to the underground surface facilities at the Ulan mine over the next 21 years.*

This strategy must be prepared in conjunction with the owners of both the Moolarben and Wilpinjong mines, and the cost of preparing the strategy should be shared equally between the Proponent and the owners of these mines.

The strategy must:

(a) be prepared by a suitably qualified, experienced and independent person whose appointment has been endorsed by the Director-General;
(b) be prepared in consultation with both the RTA and Council;
(c) determine the design standard of the relevant section of road (and any associated intersections) to the satisfaction of the RTA (based on the relevant road design guideline(s));
(d) identify the works required to upgrade the road to the designated design standard;
(e) estimate the cost of these works and the likely annual costs for maintaining the upgraded road;
(f) identify any measures that could be implemented to reduce the amount of mine traffic on the road, such as providing long-term parking in Mudgee to support increased car pooling, and the likely cost of implementing these measures;
(g) identify any measures that could be implemented to minimise the traffic noise impacts of mine traffic on Ulan Road on adjoining residences, and the likely cost of implementing these measures;
(h) include a detailed program for the proposed upgrade and maintenance of the road, implementation of traffic noise mitigation measures, and implementation of any works to support efforts to reduce the amount of mine traffic on the road;
(i) calculate what each mine and the Council shall contribute towards the implementation of the detailed program outlined in (h) above, including consideration of:
   - *the likely traffic generated by each mine as a proportion of the total traffic on the road;*
   - *any mine contributions that have been made towards the upgrading of the road in recent years; and*
   - *any relevant planning agreements that deal with the funding or maintenance of roads in the Mid-Western LGA; and*

(j) include a detailed contributions plan for the three mines and the Council to support the implementation of the detailed program described in (h) above.

If there is any dispute between the various parties involved in either the preparation or the implementation of the strategy, then any of the parties may refer the matter to the Director-General for resolution.

Wilkinson Murray was commissioned by ARRB Group Ltd to undertake a road traffic noise study to investigate the noise impact on the adjoining residential receivers due to the increased traffic on Ulan Road arising from the expansion of the three coal mine operations, UCML, MCP and WCML.

The scope of this study involves, following:

- Noise measurement surveys along Ulan Road;
- Develop noise criteria consistent with NSW government policy;
- Predict noise levels from road traffic on Ulan Road to adjoining residential receivers; and
- Recommend in principle, noise control measures where applicable.

2 SITE DESCRIPTION

The mine operations at Ulan, Moolarben and Wilpinjong employ a considerable number of local people directly and through the supply of contracted services. As a result, there has been an increasing utilisation of adjoining roads to the mines, principally:

- Ulan Road; and
- Cope Road.

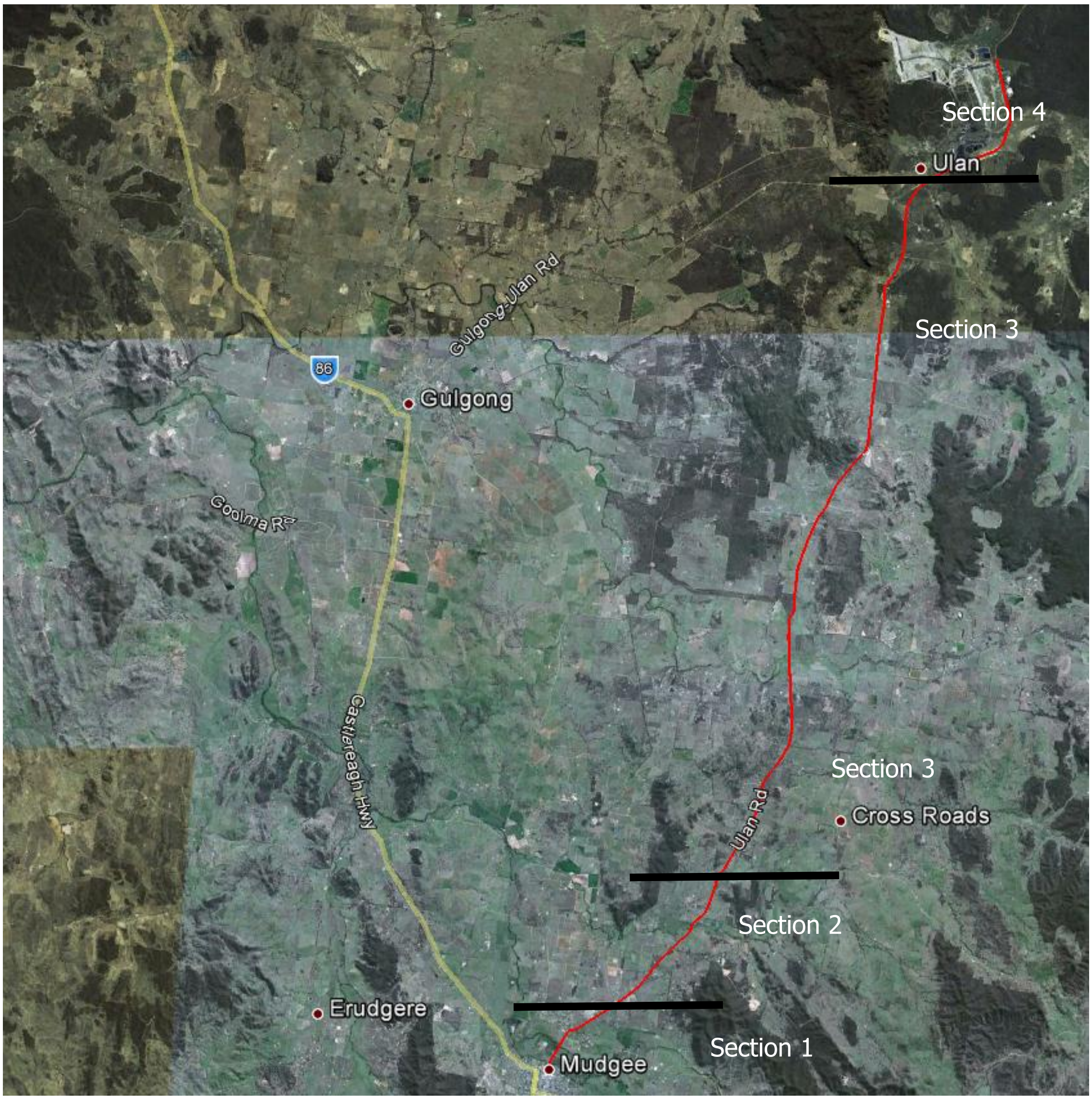
The mining sites are located approximately 45km north-east of the township of Mudgee (via Ulan Road) and 25km north-east of the historic town of Gulgong (via Cope Road / Gulgong-Ulan Road), as shown in **Figure 2-1**.

Ulan Road is a two lane regional road linking the township of Mudgee with Ulan Coal Mine. It is a rural road with a sealed pavement which is between 6.0 metres to 9.0 metres wide with variable shoulder widths, and has a speed limit of 100 km/h for the majority of the road.

Ulan road is gently undulating and straight with intersection crossings. There are four major roads intersecting Ulan Road. These are:

- Lue Road, approximately 0.5 kilometres north of Mudgee;
- Henry Lawson Drive, approximately 1.8 kilometres north of Mudgee which provides alternative access to Gulgong and to the vineyards and rural properties in the area;
- Wollar Road, approximately 9.6 kilometres north of; and
- Cope Road, approximately 40 kilometres north of Mudgee, access to Ulan Village.

Figure 2-1 Site Plan showing Ulan Road.



3 NOISE SENSITIVE RECEIVERS

The existing noise environment surrounding Ulan Road is subject to existing road traffic noise. Residential developments along Ulan Road are sparse rural residential properties. Thirty one rural residential receivers have been identified along Ulan Road regarded as likely locations of impact by noise associated with the increased traffic volume. The 31 receivers are located on both the east and west side of Ulan Road, and the distance from the façade to Ulan Road range from 15m to just over 100m.

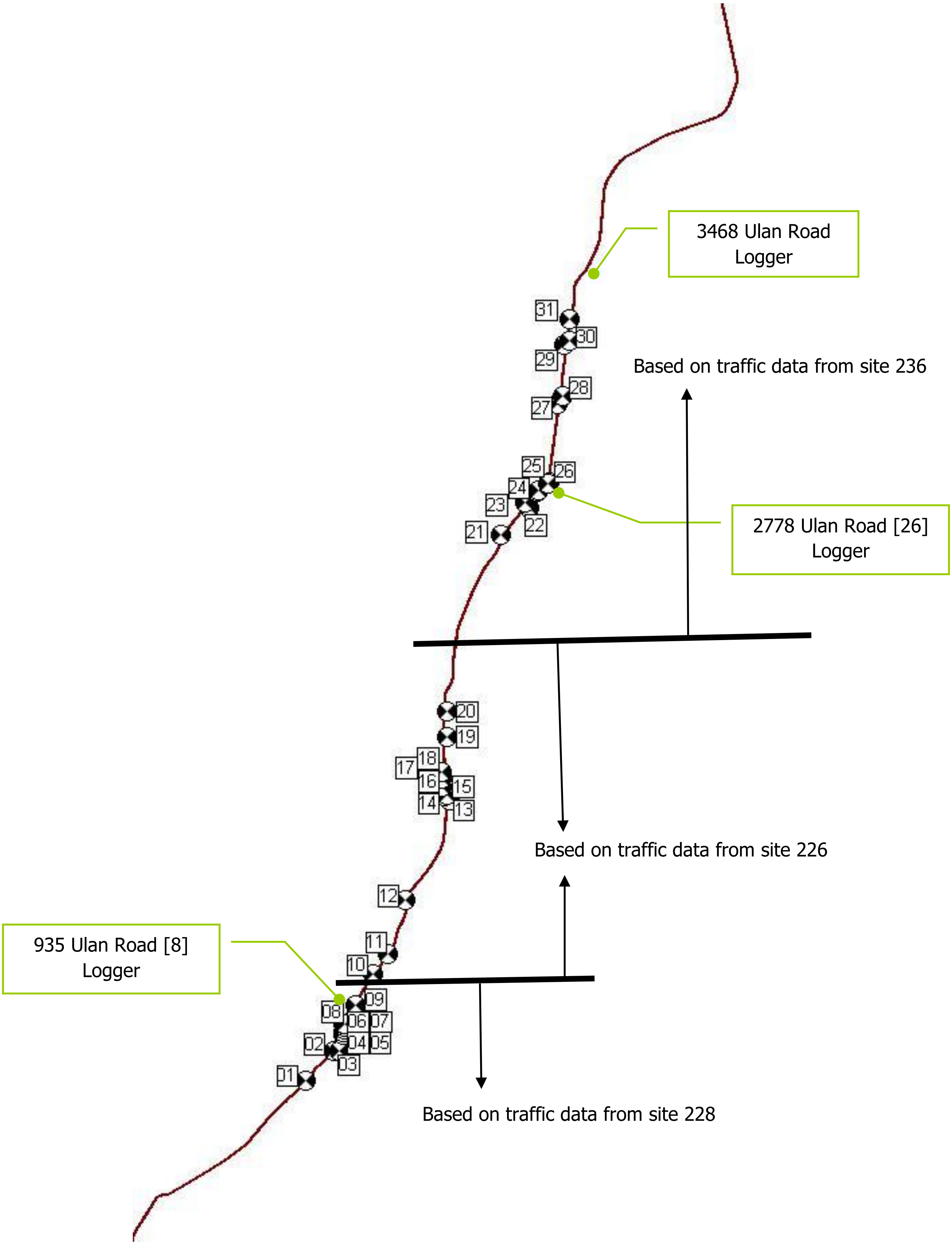
Each residential location has been assigned a unique identification number for ease of reference and its corresponding chainage along Ulan Road in kilometres is shown in Table 3-1.

Table 3-1 Receiver ID Number / Chainage / Distance from Façade

Receiver Number	Section	Chainage (km)	Distance from Façade (m)
01	3	7.303	65
02	3	8.742	20
03	3	8.762	130
04	3	9.263	76
05	3	9.363	64
06	3	9.444	84
07	3	9.494	23
08	3	9.574	15
09	3	10.306	80
10	3	11.388	19
11	3	12.15	19
12	3	13.94	65
13	3	17.328	91
14	3	17.468	56
15	3	17.508	52
16	3	17.794	106
17	3	18.004	94
18	3	18.175	92
19	3	19.247	52
20	3	20.039	62
21	3	25.859	108
22	3	26.891	78
23	3	27.061	106
24	3	27.392	73
25	3	27.613	67
26	3	27.959	28
27	3	30.294	82
28	3	30.655	44
29	3	32.169	81
30	3	32.339	26
31	3	32.946	84

The section along Ulan Road where the receivers are located are shown in Figure 2-1. The receiver locations are shown in Figure 3-1.

Figure 3-1 Receiver Locations



4 TRAFFIC NOISE MEASUREMENTS

Noise measurements of existing traffic were conducted to characterise the existing noise environment and to calibrate the traffic noise model. Environmental noise monitoring was performed at 3 representative locations along the length of Ulan Road.

These locations have been selected based on a detailed inspection of potentially affected areas, giving considerations to other noise sources which may adversely influence the measurements, security issues for the noise monitoring devices and gaining permission for access from the residents or landowner.

Unattended noise monitoring was conducted between 24 September and 5 October 2010 at 3468 Ulan Road, and between 4 November and 11 November 2011 at 935 Ulan Road and 2778 Ulan Road. The location of the noise loggers are shown in Figure 2-1.

The noise monitoring equipment used for the noise measurements consisted of an ARL 215 Noise Logger set to A-weighted, fast response, continuously monitoring each 15-minute period. This equipment is capable of monitoring and storing noise various level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted. The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} of the ambient noise. The most relevant of these descriptors is the L_{Aeq} descriptor which is used to describe intrusive noise from road traffic.

All three loggers were in a free field position with respect to traffic noise. The noise results are presented in graphical form in Appendix A for 935 Ulan Road, 2778 Ulan Road and Blue Pines respectively.

Based on the measured results, the daytime and night time L_{Aeq} noise levels are summarised below in Table 4-1. Any extraneous noise not assumed to be typical of traffic has been excluded.

Table 4-1 Traffic Noise Measurements - dBA

Monitoring Location	Setback Distance to the Road (m)	Day time $L_{Aeq,15hr}$ (dBA)	Night time $L_{Aeq,9hr}$ (dBA)
935 Ulan Road	16	62	60
2778 Ulan Road	17	61	59
3468 Ulan Road	15	60	59

NOTE: Day time period correspond to 7.00am – 10.00pm and night time period correspond to 10.00 – 7.00am.

5 NOISE CRITERIA

Criteria for assessment of road traffic noise are set out in the NSW Government's *Road Noise Policy (RNP)*.

Under the *RNP*, road developments are classified as either "new road" or "redevelopment of an existing road". For all noise-sensitive locations considered in this assessment, the proposal would be classified as an *"Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments"*.

Table 5-1 sets out the assessment criteria for the identified residences.

Table 5-1 Assessment Criteria for Operational Traffic Noise - Residences

Road Category	Type of Project/Land Use	Assessment Criteria	
		daytime (7.00am-10.00pm)	night time (10.00pm-7.00am)
Freeway/arterial/sub-arterial roads	Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,15hour}$ 60dBA (external)	$L_{Aeq,9hour}$ 55dBA (external)

In applying Table 5-1, the noise level criterion applies to the predicted noise level for the design (typically ten years). For this traffic noise assessment, the design year has been considered the year of highest estimated traffic volumes within the next ten years which was established by ARRB Group, with reference to traffic studies by others, to be 2013.

6 ROAD TRAFFIC NOISE MODEL

6.1 Methodology of Assessing Traffic Noise Impact

Detailed noise calculations have been carried out for two different scenarios – Existing and Highest Traffic Volume case. All calculations and modelling are based on the existing and forecast traffic volumes provided by ARRB Group.

The following factors are considered during the assessment process:

- Traffic volume and likely proportions of heavy vehicles;
- Topographical information along and surrounding the entire project corridor;
- Land use surrounding the project;
- Vehicle speed;
- Different noise emission levels and source heights;
- Location of the noise sources on the motorway;
- Road surface types;
- Road gradient; and
- Attenuation from noise barriers (both natural and purpose built for the project).

6.2 Noise Modelling Procedures

Noise levels from both the existing and proposed road designs were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified in the following ways.

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} – 3$. (NSW RTA, 2001);
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representative of typical values for Australian vehicles. Noise from a heavy vehicle exhaust is 8dBA lower than the noise from the engine; and
- Previous research in Australia has established a negative correction to the *CoRTN* predictions of -1.7 dB for façade-corrected levels (Samuels and Saunders, 1982). Corrections for Australian conditions have been included in noise modelling for this project.

The model was implemented using CadnaA software (Version 4.2). Road information was based on data supplied by the ARRB Group.

Traffic counts were conducted at eight locations along Ulan Road as shown in Figure 6-1. The sign posted speed limit is 100km/hr for the length of Ulan Road between Locations 220 and 229, of which, traffic counts at Locations 226, 228 and 236 were used due to the positions of identified residential receivers. The existing and highest traffic volume case AADT data for Locations 226, 228 and 236 are shown in Tables 6-1 and 6-2 respectively, and are traffic volumes used in the modelling and calibration. It should be noted that the worst case traffic volumes for daytime and night time are projections based on the day-to-night time ratio established from existing traffic volumes.

The existing road surface is a "well worn" 14mm chip seal. The corrections for the road surface used by Wilkinson Murray, relative to dense graded asphalt are:

- "well worn" 14mm chip seal is +1dB; and
- new 14mm chip seal +3dB.

(*Tyre/Road Noise Reference Book*, 2002, Ulf Sandberg and Jerzy A Ejsmont)

Figure 6-1 Traffic Count Locations on Ulan Road

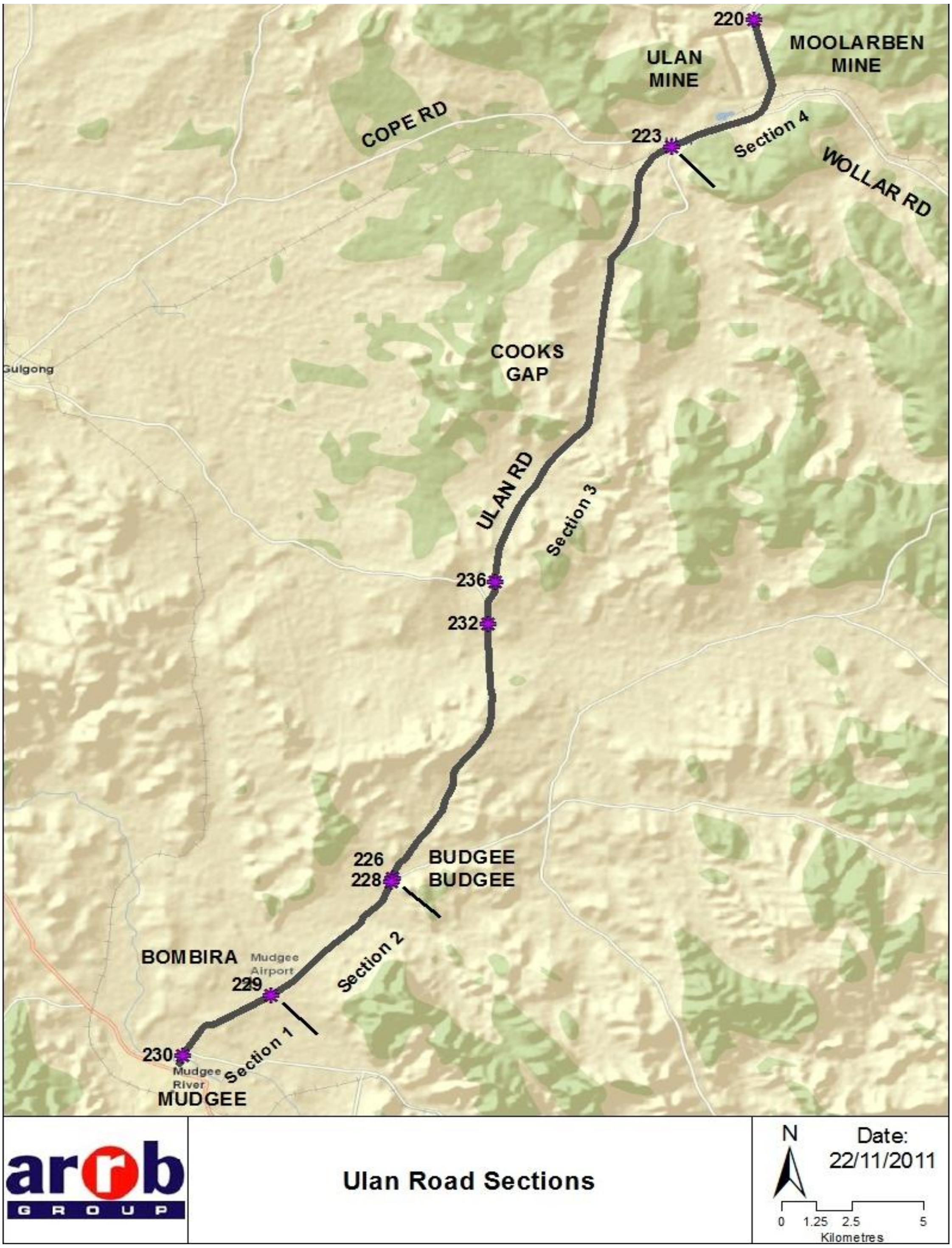


Table 6-1 Existing Traffic Volumes (2011)

Location	AADT	% of Mine Traffic	15hr Daytime (7.00am to 10.00pm)		9hr Night Time (10.00pm to 7.00am)	
			All types of vehicle	% Heavy Vehicles	All types of vehicle	% Heavy Vehicles
226	2296	73	1758	7.2	538	7.2
228	2919	57	2235	7.2	684	7.4
236	2006	83	1413	10.4	593	8

Table 6-2 Highest Traffic Volume Case (2013)

Location	AADT	% of Mine Traffic	15hr Daytime (7.00am to 10.00pm)		9hr Night Time (10.00pm to 7.00am)	
			All types of vehicle	% Heavy Vehicles	All types of vehicle	% Heavy Vehicles
226	2697	76	2065	7.2	632	7.2
228	3343	60	2559	7.2	784	7.4
236	2397	85	1689	10.4	708	8

6.3 Calibration of Noise Model to Measured Results

It is considered the measured noise levels are the most reliable data to calibrate predicted noise levels so the noise model has been established primarily on this basis. The results of traffic noise measurement presented in Section 4 and model calculations for the same period, based on monitored traffic flows, can be found in Table 6-3.

Table 6-3 Predicted Calibrated Traffic volumes

Location	Daytime $L_{Aeq,15hr}$			Night time $L_{Aeq,9hr}$		
	Measured	Predicted	Difference	Measured	Predicted	Difference
935 Ulan Road	61.5	62.2	+0.7	59.6	59.6	0.0
2778 Ulan Road	60.7	61.3	+0.6	58.8	59.5	+0.7
3468 Ulan Road	60.3	62.2	+1.9	58.5	60.4	+1.9

A comparison of the noise levels in Table 6-3 shows that the difference between measured and predicted values range from zero to +1.9 which is within the accepted *CoRTN* modelling tolerance of 2dB. However, the average difference between the predicted and measured level has a positive bias (over predicting) with an average difference of +1dB. It is therefore considered appropriate that a project specific correction of -1dB be used to gain the most accurate modelling results. Assuming the project specific correction of -1dB is used with the remaining assumptions it is considered that the traffic noise model developed for this study will reliably predict traffic noise levels at the noise sensitive receivers.

6.4 Proposed Ulan Road Maintenance

Maintenance works are required to ensure an efficient and sustainable upkeep of Ulan Road under the expected traffic loading.

For maximum benefit to road users, the upgrade works should be implemented as soon as possible. This will ensure the improvements are available for the peak traffic demand identified in the traffic forecasts, which is anticipated to be year 4.

The indicative works program suggested by ARRB is presented in Table 6-4.

Table 6-4 Indicative works program suggested by ARRB to ensure an efficient and sustainable upkeep of Ulan Road

Section	Start Chainage (km)	End Chainage (km)	Year																					
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	3.785		**I**				**R**										**L**						
2	3.785	6.652		**I**	**I**			**R**										**L**						
2/3	6.652	9.734			**I**			**R**										**L**						
3	9.734	17.644			**I**		**I, M**						**R**										**R**	
3	17.644	22.215		**I**	**I, M**								**R**										**R**	
3	22.215	26.039						**R, I**										**L**					**R**	
3	26.039	37.407		**I, M**	**I,M**	**I, M**							**R**											
3/4	37.407	45.236		**I**		**H**		**I**								**R**								

I = Intersection
M = Road upgrade (midblock)
R = Reseal
H = Heavy Rehabilitation
L = Light Rehabilitation

Note that the works identified by M, R, H and L will all involve a resurfacing of the road. Also, it is not necessarily the case that the entire length of the sections indicated will be resealed.

7 PREDICTED NOISE LEVELS AT IDENTIFIED RECEIVERS

For the existing (2011) and highest traffic volume case (2013) scenarios, façade noise levels were calculated at each building facade along Ulan Road. Tables 7-1 and 7-2 presents the predicted noise levels at each identified receiver locations for existing and worst case traffic volumes respectively. The total traffic noise levels have been separated to show the noise level contribution from local and mining traffic. The numbers highlighted in red indicate exceedances over the day time criterion of 60dBA or night time criterion of 55dBA. For the highest traffic volume case in 2013 it was conservatively assumed that Ulan Road is resealed with a 14mm chip seal road surface.

Table 7-1 Predicted L_{Aeq} Noise Levels for Existing Case - dBA

Receiver ID Number	Daytime $L_{Aeq,15hr}$			Night time $L_{Aeq,9hr}$		
	Local	Mine	Total	Local	Mine	Total
1	50.8	52.1	54.5	49.8	51.1	53.5
2	57.6	58.9	61.3	56.6	57.9	60.3
3	46.6	47.9	50.3	45.6	46.9	49.3
4	51.3	52.6	55	50.3	51.6	54
5	51.9	53.2	55.6	50.9	52.2	54.6
6	50.2	51.5	53.9	49.3	50.6	53
7	56.7	58.0	60.4	55.7	57.0	59.4
8	58.8	60.1	62.5	57.8	59.1	61.5
9	49.2	50.5	52.9	48.3	49.6	52
10	55.2	59.5	60.9	54.4	58.7	60.1
11	55.8	60.1	61.5	54.9	59.2	60.6
12	48.1	52.4	53.8	47.2	51.5	52.9
13	46.0	50.3	51.7	45.1	49.4	50.8
14	49.0	53.3	54.7	48.2	52.5	53.9
15	49.5	53.8	55.2	48.6	52.9	54.3
16	45.4	49.7	51.1	44.5	48.8	50.2
17	45.2	49.5	50.9	44.3	48.6	50
18	45.4	49.7	51.1	44.6	48.9	50.3
19	49.3	53.6	55	48.4	52.7	54.1
20	47.8	52.1	53.5	47.6	51.9	53.3
21	41.6	48.5	49.3	41.5	48.4	49.2
22	43.1	50.0	50.8	43.0	49.9	50.7
23	43.0	49.9	50.7	42.9	49.8	50.6
24	44.1	51.0	51.8	44.0	50.9	51.7
25	45.5	52.4	53.2	45.4	52.3	53.1
26	49.0	55.9	56.7	48.9	55.8	56.6
27	44.2	51.1	51.9	44.1	51.0	51.8

28	47.7	54.6	55.4	47.6	54.5	55.3
29	43.2	50.1	50.9	43.1	50.0	50.8
30	50.8	57.7	58.5	50.7	57.6	58.4
31	44.0	50.9	51.7	43.9	50.8	51.6

For the existing case, 8 of the 31 residential receivers exceed the night time criterion of 55dBA, and 5 of the 8 residential receivers also exceed the daytime criterion of 60dBA.

For the highest traffic volume case and assuming a reseal of the road with 14mm chip seal, noise levels have increased due to the increase in traffic volumes and the nosier road surface, 18 of the 31 residential receivers exceed the night time criterion of 55dBA, and 6 of the 18 residential receivers also exceed the daytime criterion of 60dBA.

For the existing case, the noise level contribution from mining traffic has the highest noise contribution when compared to the traffic noise generated by local traffic at the residential receivers. If mining traffic did not exist on the road only 3 residential receivers would exceed the night time criterion of 55dBA, and only 2 residential receivers would exceed the daytime criterion of 60dBA for the existing case.

For the highest traffic volume case the noise level contribution from mining traffic has again the highest noise contribution when compared to the traffic noise generated by local traffic at the residential receivers. If mining traffic did not exist on the road only 5 residential receivers would exceed the night time criterion of 55dBA, and only 2 residential receivers would exceed the daytime criterion of 60dBA for the existing case.

Table 7-2 Predicted L_{Aeq} Noise Levels for Highest Traffic Volume Case - dBA

Receiver ID Number	Daytime $L_{Aeq,15hr}$			Night time $L_{Aeq,9hr}$		
	Local	Mine	Total	Local	Mine	Total
1	53.1	54.9	57.1	51.8	53.6	55.8
2	59.9	61.7	63.9	58.7	60.5	62.7
3	49.0	50.8	53	47.7	49.5	51.7
4	53.6	55.4	57.6	52.4	54.2	56.4
5	54.2	56.0	58.2	53.0	54.8	57
6	52.6	54.4	56.6	51.3	53.1	55.3
7	59.1	60.9	63.1	57.8	59.6	61.8
8	61.2	63.0	65.2	59.9	61.7	63.9
9	51.6	53.4	55.6	50.4	52.2	54.4
10	59.7	61.5	63.7	58.5	60.3	62.5
11	58.0	63.0	64.2	56.8	61.8	63
12	50.4	55.4	56.6	49.1	54.1	55.3
13	48.3	53.3	54.5	47.0	52.0	53.2
14	51.3	56.3	57.5	50.1	55.1	56.3
15	51.7	56.7	57.9	50.5	55.5	56.7
16	47.7	52.7	53.9	46.4	51.4	52.6

17	47.4	52.4	53.6	46.2	51.2	52.4
18	47.7	52.7	53.9	46.5	51.5	52.7
19	51.5	56.5	57.7	50.3	55.3	56.5
20	50.1	55.1	56.3	49.6	54.6	55.8
21	43.8	51.3	52	43.5	51.0	51.7
22	44.4	51.9	52.6	44.9	52.4	53.1
23	45.3	52.8	53.5	44.9	52.4	53.1
24	46.4	53.9	54.6	46.0	53.5	54.2
25	47.8	55.3	56	47.4	54.9	55.6
26	51.3	58.8	59.5	50.9	58.4	59.1
27	46.5	54.0	54.7	46.1	53.6	54.3
28	50.0	57.5	58.2	49.6	57.1	57.8
29	45.5	53.0	53.7	45.1	52.6	53.3
30	53.1	60.6	61.3	52.7	60.2	60.9
31	46.3	53.8	54.5	45.9	53.4	54.1

8 NOISE MITIGATION

Noise mitigation should be considered for all residential receivers which exceed the base criteria. Overall noise mitigation options that could be considered for the project are:

- Roadside noise barriers.
- Reduction in speed limit.
- Low noise road pavement.
- Architectural treatment of exposed residences.

8.1 Noise Barriers

Due to the rural residential receivers being isolated from each other and driveway access arrangements from Ulan Road being required, barriers are not considered a reasonable and feasible option.

8.2 Reduction in Traffic Speed

The speed limit for Ulan Road is currently 100km/hr. If the speed limit was reduced to 80km/hr a reduction in noise level of 2 dB is achievable as can be seen in Table 8-1. . For the highest traffic volume case, assuming a reseal of the road with 14mm chip seal and a reduction in speed to 80km/hr; 8 of the 31 residential receivers exceed the night time criterion of 55dBA, and 5 of the 8 residential receivers exceed the daytime criterion of 60dBA. The noise impacts under this scenario for the future are the same as the existing case.

Table 8-1 Predicted L_{Aeq} Noise Levels for Highest Traffic Volume Case with 80km speed limit – dBA

Receiver ID Number	Daytime $L_{Aeq,15hr}$			Night time $L_{Aeq,9hr}$		
	Local	Mine	Total	Local	Mine	Total
1	51.1	52.9	55.1	49.8	51.6	53.8
2	57.9	59.7	61.9	56.7	58.5	60.7
3	47.0	48.8	51	45.7	47.5	49.7
4	51.6	53.4	55.6	50.4	52.2	54.4
5	52.2	54.0	56.2	51.0	52.8	55
6	50.6	52.4	54.6	49.3	51.1	53.3
7	58.1	59.9	62.1	55.8	57.6	59.8
8	59.2	61.0	63.2	57.9	59.7	61.9
9	49.6	51.4	53.6	48.4	50.2	52.4
10	57.7	59.5	61.7	56.5	58.3	60.5
11	56.0	61.0	62.2	54.8	59.8	61
12	48.4	53.4	54.6	47.1	52.1	53.3
13	46.3	51.3	52.5	45.0	50.0	51.2
14	49.3	54.3	55.5	48.1	53.1	54.3
15	49.7	54.7	55.9	48.5	53.5	54.7

16	45.7	50.7	51.9	44.4	49.4	50.6
17	45.4	50.4	51.6	44.2	49.2	50.4
18	45.7	50.7	51.9	44.5	49.5	50.7
19	49.5	54.5	55.7	48.3	53.3	54.5
20	48.1	53.1	54.3	47.6	52.6	53.8
21	41.8	49.3	50	41.5	49.0	49.7
22	42.4	49.9	50.6	42.9	50.4	51.1
23	43.3	50.8	51.5	42.9	50.4	51.1
24	44.4	51.9	52.6	44.0	51.5	52.2
25	45.8	53.3	54	45.4	52.9	53.6
26	49.3	56.8	57.5	48.9	56.4	57.1
27	44.5	52.0	52.7	44.1	51.6	52.3
28	48.0	55.5	56.2	47.6	55.1	55.8
29	43.5	51.0	51.7	43.1	50.6	51.3
30	51.1	58.6	59.3	50.7	58.2	58.9
31	44.3	51.8	52.5	43.9	51.4	52.1

For the highest traffic volume case, assuming a reseal of the road with 14mm chip seal, the noise level contribution from mining traffic has the highest noise contribution when compared to the traffic noise generated by local traffic at the residential receivers. If mining traffic did not exist on the road only 4 residential receivers would exceed the night time criterion of 55dBA, and only 3 residential receivers would exceed the daytime criterion of 60dBA for the existing case.

8.3 Low Noise Pavement

Low noise pavements such as open graded asphalt could reduce noise levels. The surface corrections for various road surfaces relative to dense graded asphaltic concrete are presented in Table 8-2.

Table 8-2 Road Surface Corrections

Surface type (Regularly Trafficked)	Traffic Noise
14mm chip seal	+3.0
14mm chip seal with 7mm scattered	+2.0
Dense Graded Asphalt	0
Stone mastic asphalt	-1.0 to -3.5
Open graded asphaltic concrete	0 to -4.5

It is understood for maintenance and cost reasons, low noise pavements are not a reasonable and feasible noise mitigation option for Ulan Road.

8.4 Noise Mitigation to Residences

For receivers where noise levels can not be reduced further by barriers, reducing speed limits and low noise pavements remaining noise mitigation is generally limited to acoustic treatment of the building elements and the installation of acoustic screens walls close to dwellings.

Architectural treatments should aim to achieve internal noise levels in habitable rooms 10dBA below the external noise targets. 10dBA is equivalent to the traffic noise reduction that can be achieved for most building structures with the windows sufficiently open to satisfy minimum fresh air requirements.

Building element treatments are more effective when they are applied to masonry structures than light timber frame structures. Caution should be exercised before providing treatments for buildings in a poor state of repair, as they will be less effective in these cases. The acoustic treatments provided would typically be limited to:

- Fresh air ventilation systems that meet Building Code of Australia requirements with the windows and doors shut;
- Upgraded windows and glazing and solid core doors on the exposed facades of structures;
- Upgrading window and door seals; and
- The sealing of wall vents, eaves, roofs.

Typically funding for architectural treatments is between $10,000-$20,000 for individual dwellings. The fresh air ventilation systems which would be required to be installed as part of the architectural treatment can be as simple as the acoustic ventilator shown in Appendix B or as complex as a ducted residential air conditioning system.

For residential receivers, that exceed the day time and night time criterion of 60dBA and 55dBA, that may be considered for architectural treatments are presented in Table 8-3 for the highest traffic volume case assuming a reseal of the road with 14mm chip seal. The table also shows the number of residential receivers impacted if the speed limit on Ulan Road was reduced to 80km/hr.

Table 8-3 Residential receivers that may be considered for architectural noise treatments.

Option	Residential Receivers	Total
The highest traffic volume case, assuming a reseal of the road with 14mm chip seal	1, 2, 4, 5, 6, 7, 8, 1011,12,14,15,19, 20, 25, 26, 28, 30	18
The highest traffic volume case, assuming a reseal of the road with 14mm chip seal and a reduction in the speed limit to 80km/hr	2, 7, 8, 10, 11, 26, 28, 30	8

9 CONCLUSION

Wilkinson Murray was commissioned by ARRB Group Ltd to undertake a road traffic noise study to investigate the noise impact on the adjoining residential receivers due to the increased traffic on Ulan Road arising from the expansion of the three coal mine operations, UCML, MCP and WCML. The noise investigation has found:

- The noise level contribution from mining traffic has the highest noise contribution when compared to the traffic noise generated by local traffic at the residential receivers.
- For the existing case, 8 of the 31 residential receivers exceed the night time criterion of 55dBA, and 5 of the 8 residential receivers also exceed the daytime criterion of 60dBA.
- For the highest traffic volume case and assuming a reseal of the road with 14mm chip seal, noise levels increased due to the increase in traffic volumes and the nosier road surface, 18 of the 31 residential receivers exceed the night time criterion of 55dBA, and 6 of the 18 residential receivers also exceed the daytime criterion of 60dBA.

Options for noise mitigation have been consider for the residential receivers which exceed the base criteria. The two main options considered reasonable and feasible are:

- Reduction in speed limit; and
- Architectural treatment of exposed residences.

The speed limit for Ulan Road is currently 100km/hr. If the speed limit was to reduce to 80km/hr a reduction in noise level of 2 dB is achievable. For the highest traffic volume case, assuming a reseal of the road with 14mm chip seal and a reduction in speed to 80km/hr, 8 of the 31 residential receivers exceed the night time criterion of 55dBA, and 5 of the 8 residential receivers also exceed the daytime criterion of 60dBA.

For receivers where noise levels can not be reduced further by barriers, reducing speed limits and low noise pavements remaining noise mitigation is generally limited to architectural treatments. The residential receivers that exceed the day time and night time criterion of 60dBA and 55dBA , that may be considered for architectural treatments are presented below for the highest traffic volume case assuming a reseal of the road with 14mm chip seal. The table also shows the number of residential receivers requiring architectural treatments if the speed limit of Ulan Road was reduced to 80km/hr.

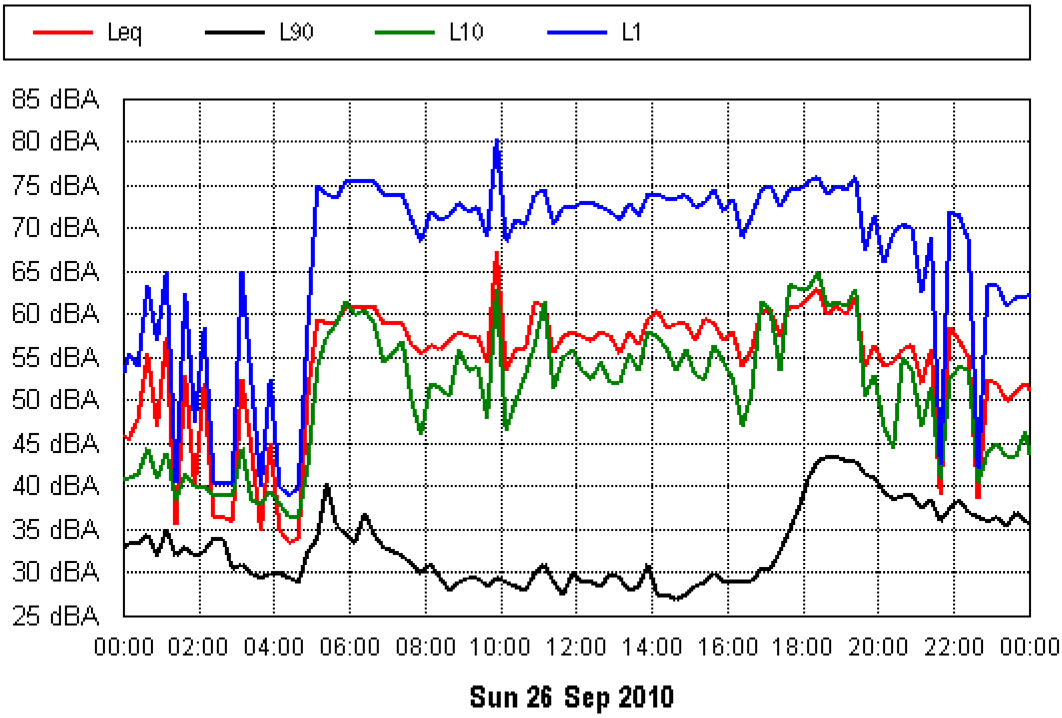
Table 9-1 Residential receivers that may be considered for architectural noise treatments.

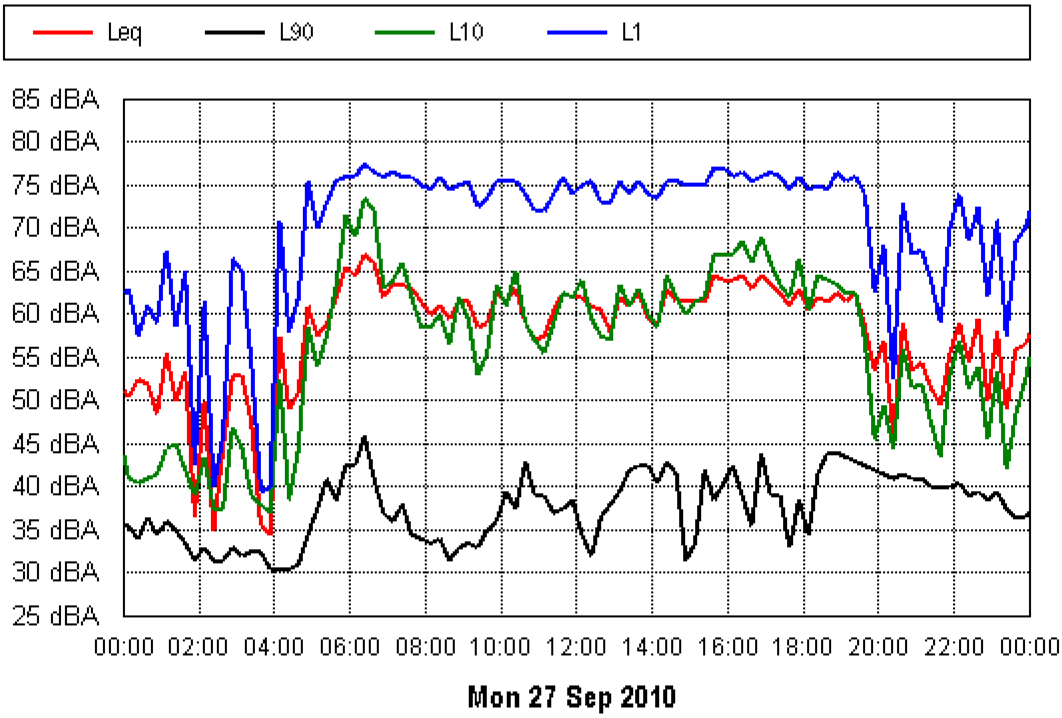
Option	Residential Receivers	Total
The highest traffic volume case, assumin reseal of the road with 14mm chip seal	1, 2, 4, 5, 6, 7, 8, 1011,12,14,15,19, 20, 25, 26, 28, 30	18
The highest traffic volume case, assuming a reseal of the road with 14mm chip seal and a reduction in the speed limit to 80km/hr	2, 7, 8, 10, 11, 26, 28, 30	8

APPENDIX A

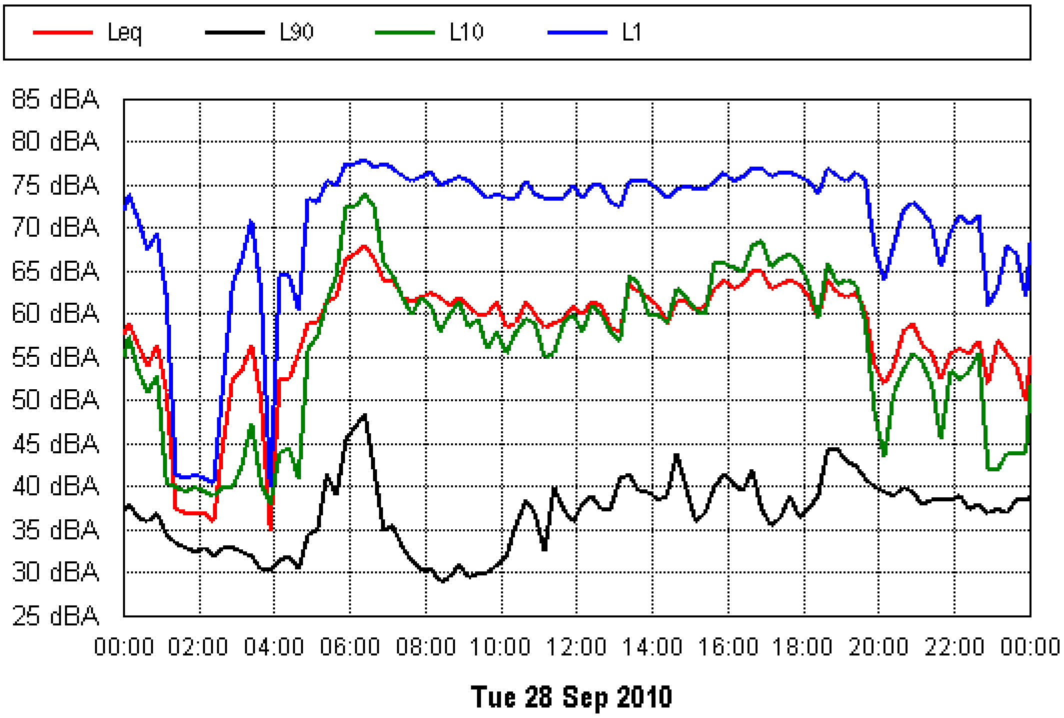
NOISE MEASUREMENT RESULTS

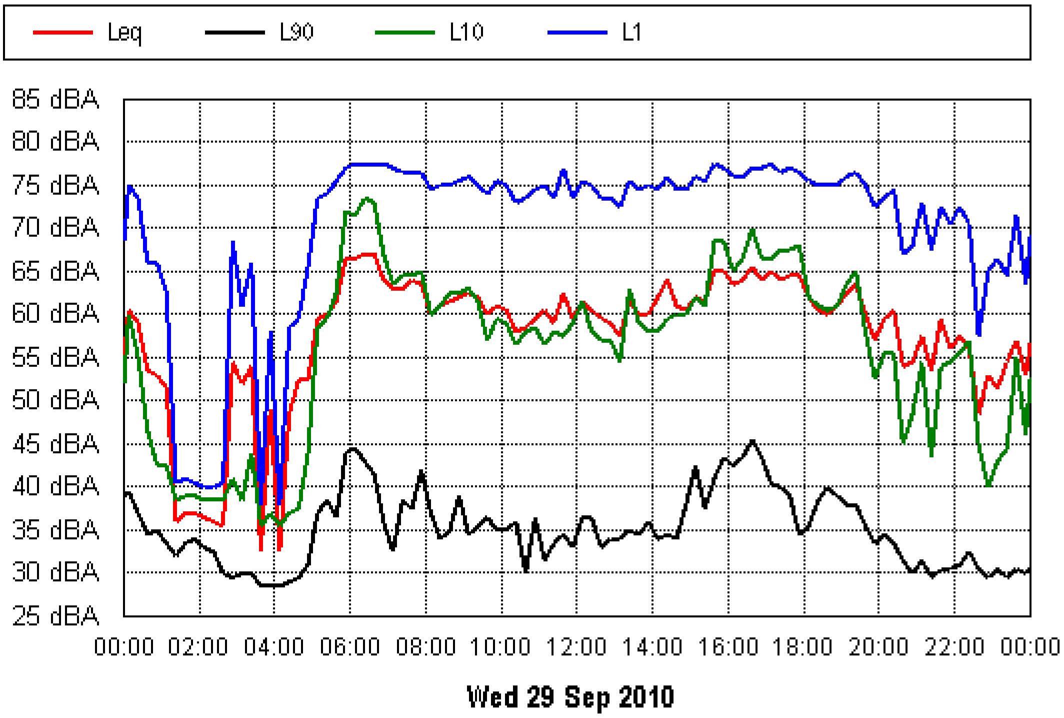
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: 'Blue Pines' Residence – 3468 Ulan Road



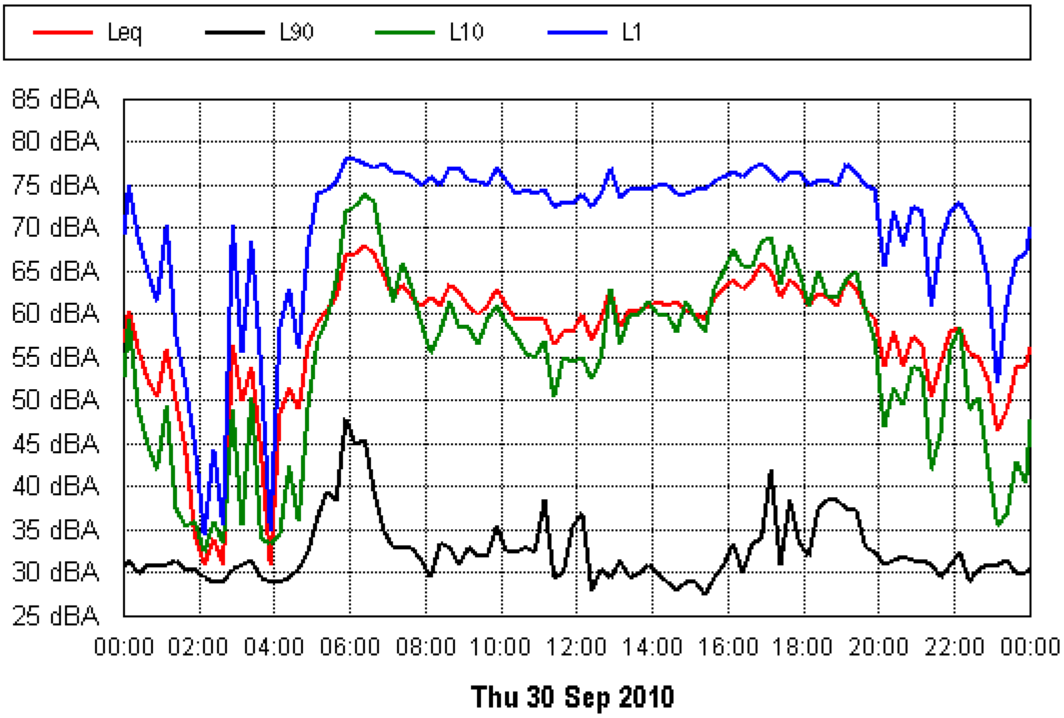


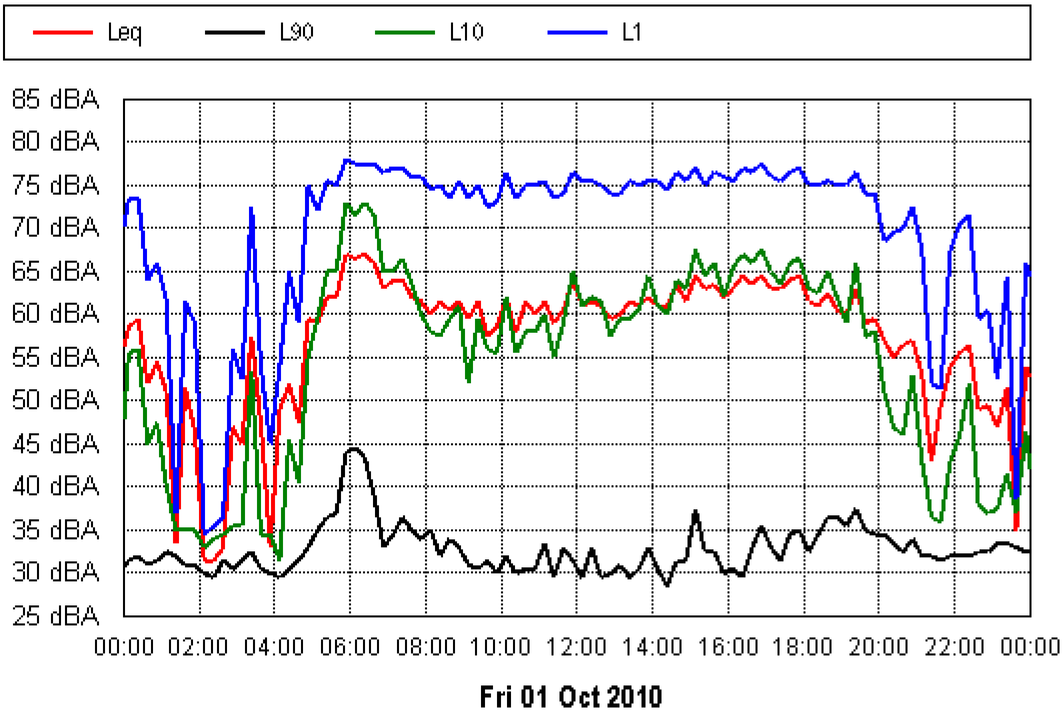
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: 'Blue Pines' Residence – 3468 Ulan Road



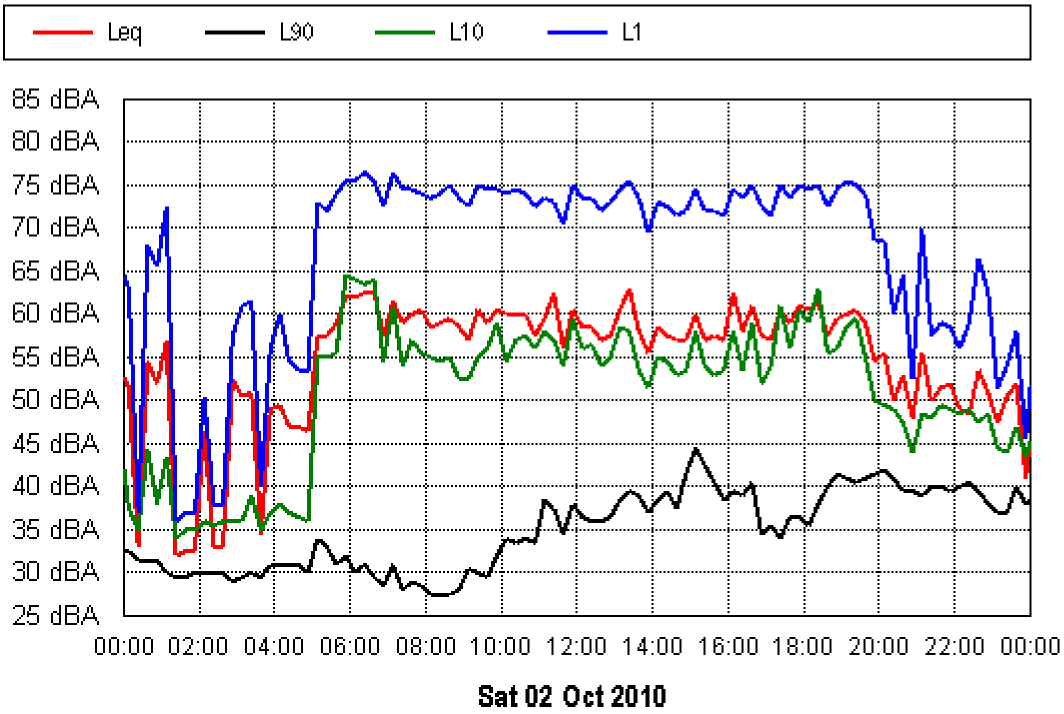


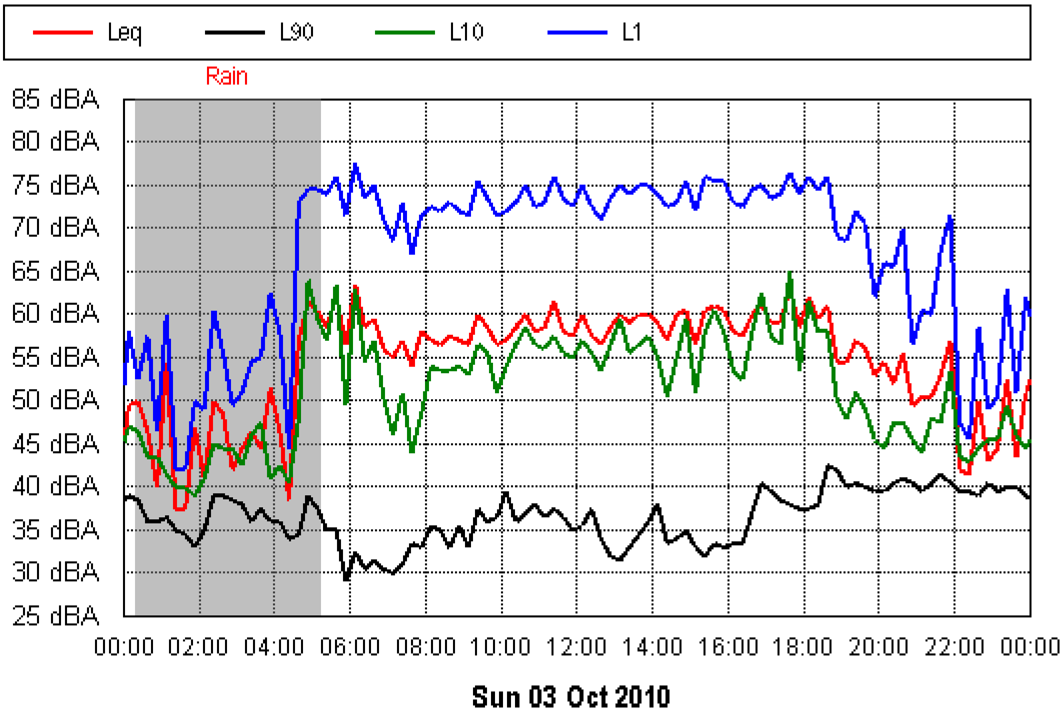
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: 'Blue Pines' Residence – 3468 Ulan Road



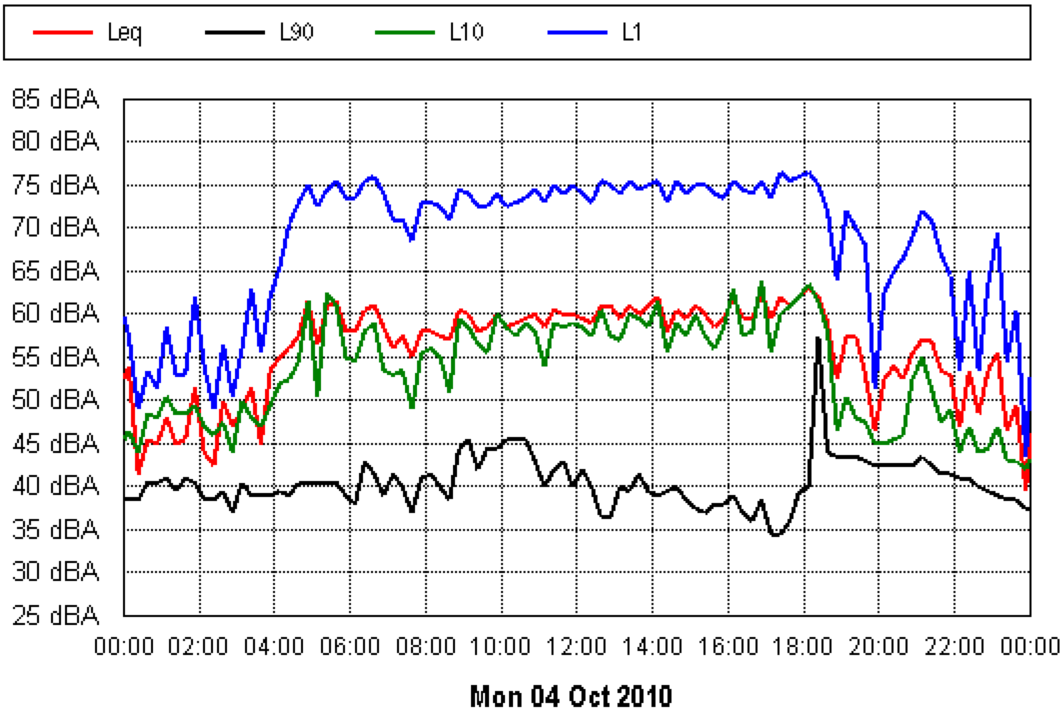


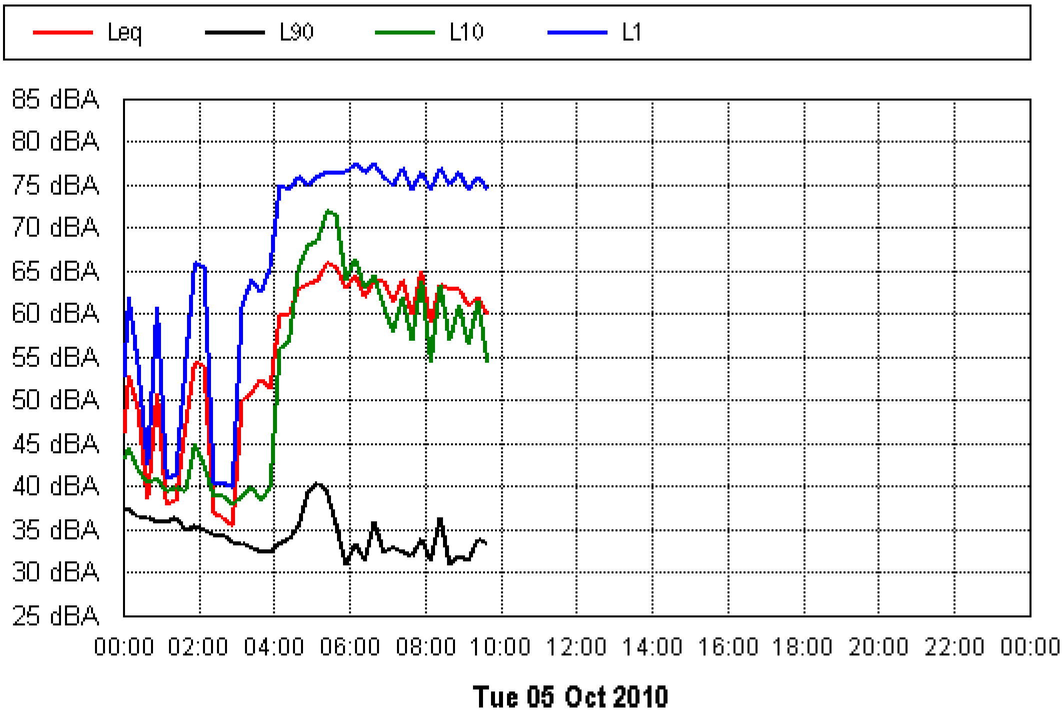
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: 'Blue Pines' Residence – 3468 Ulan Road



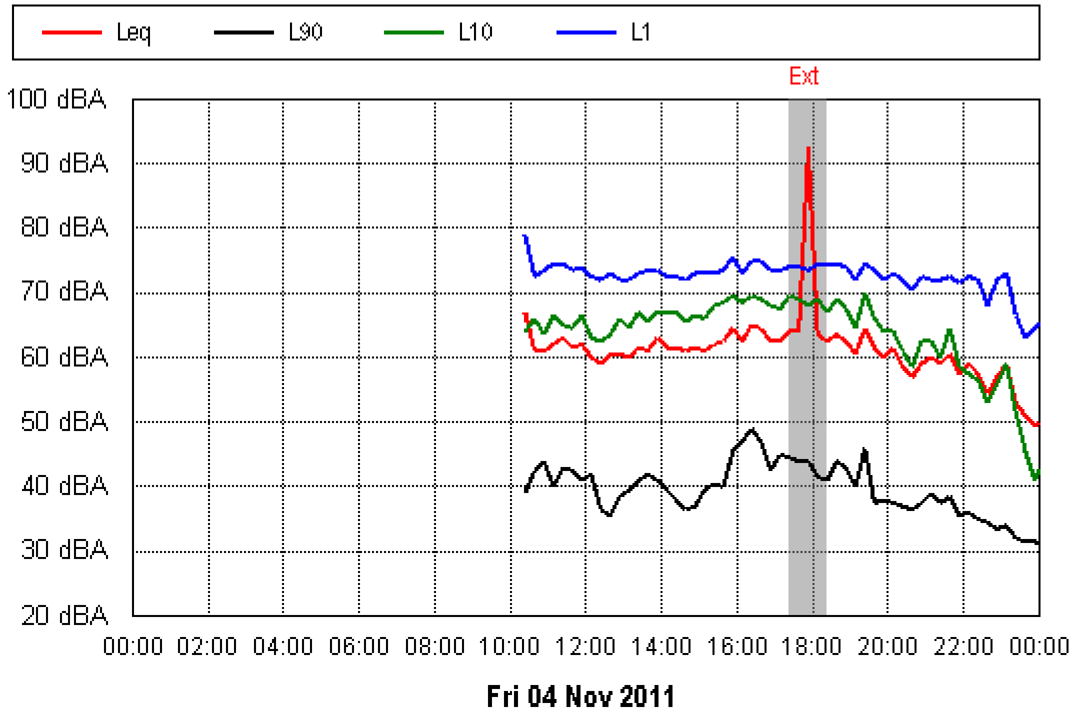


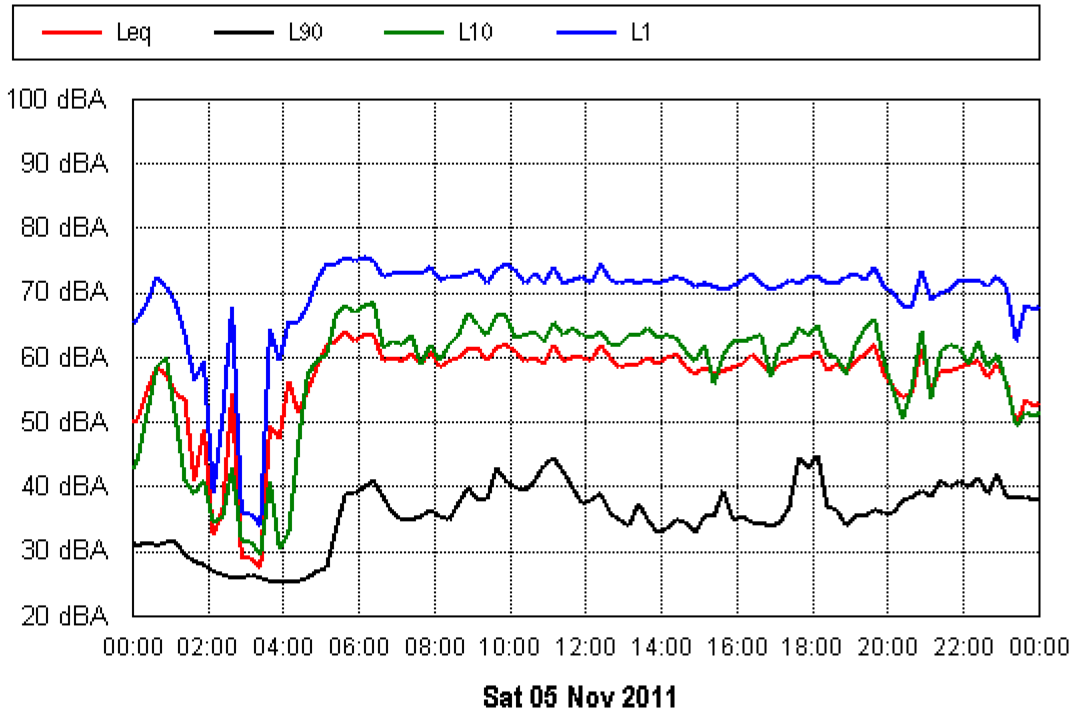
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: 'Blue Pines' Residence – 3468 Ulan Road



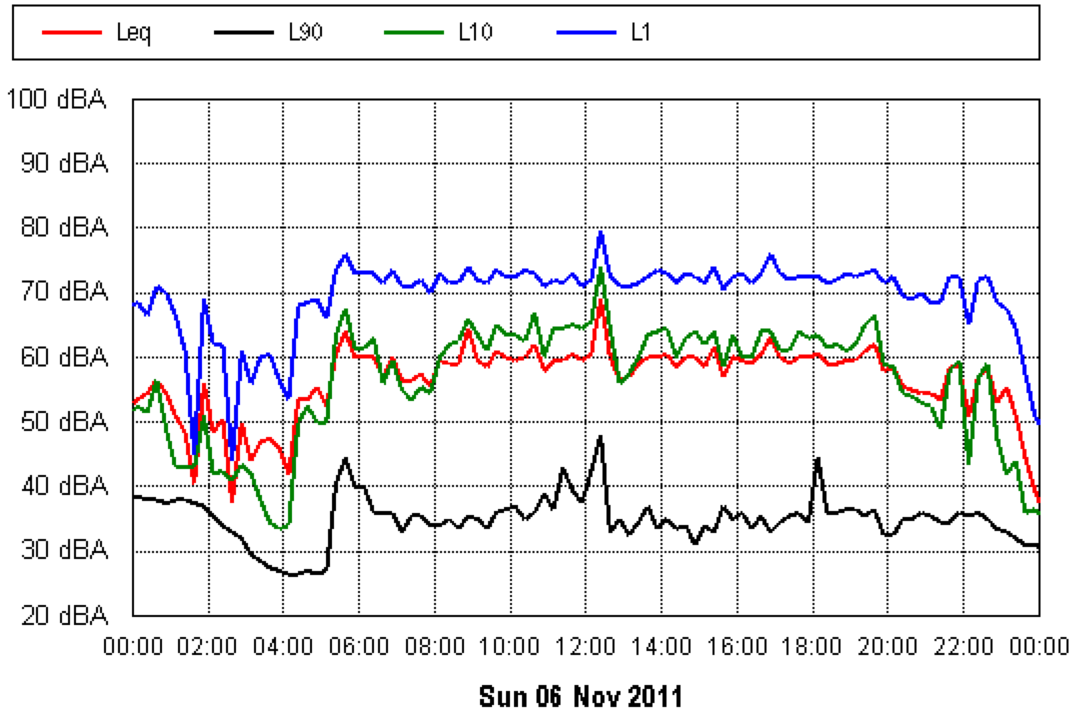


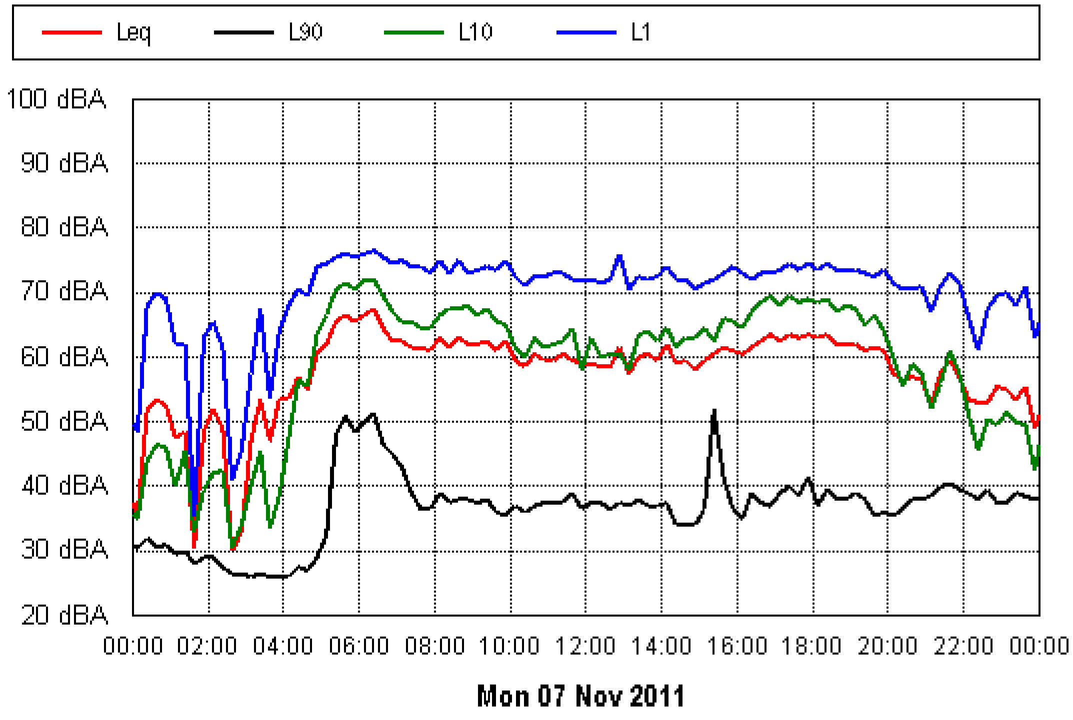
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 935 Ulan Road



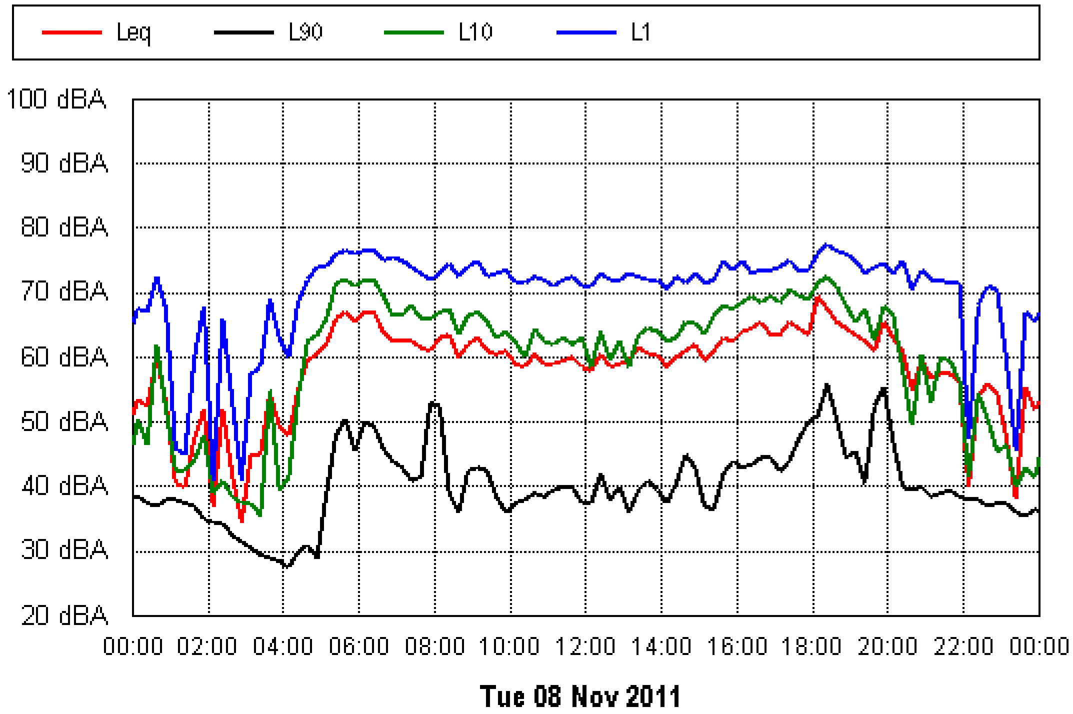


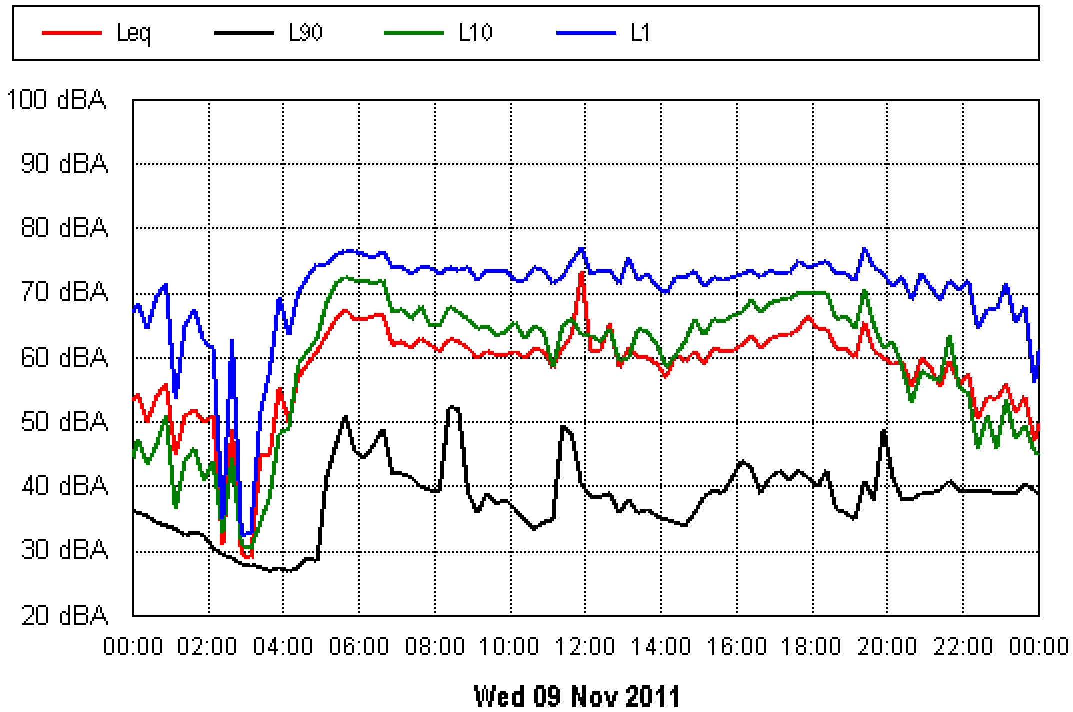
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 935 Ulan Road



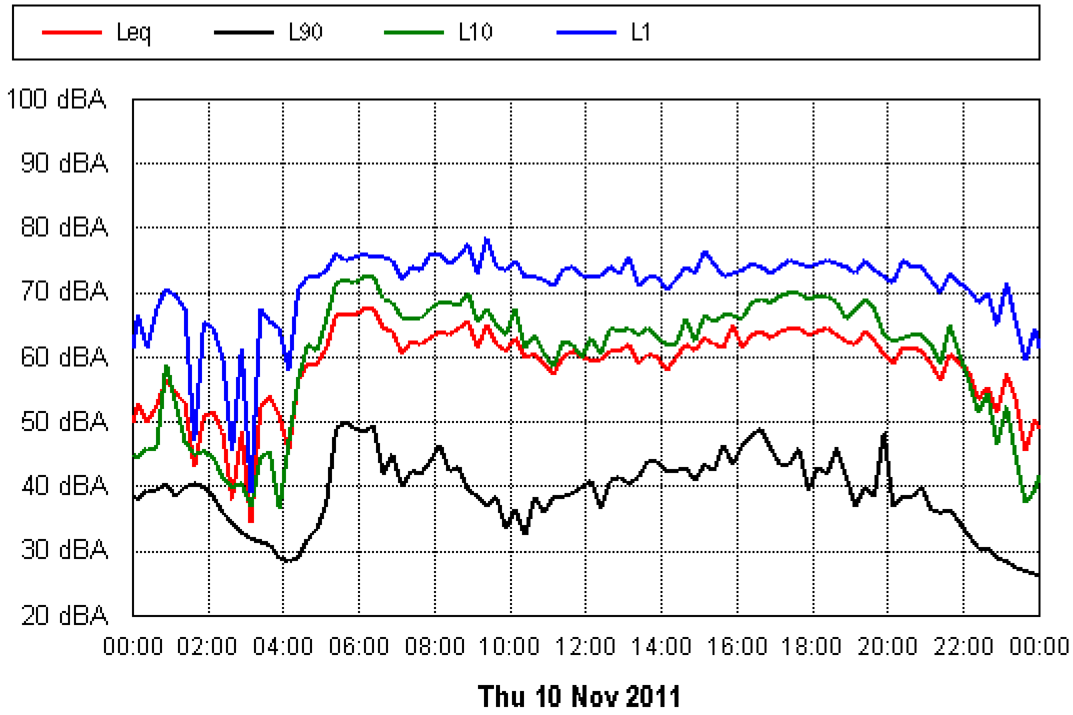


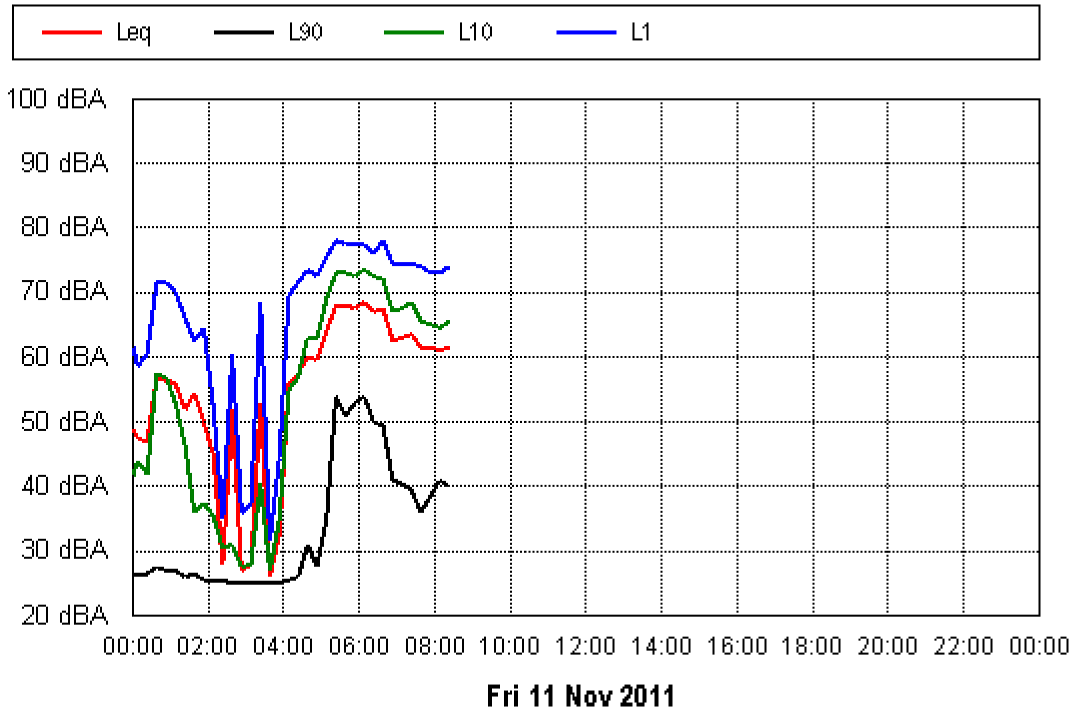
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 935 Ulan Road



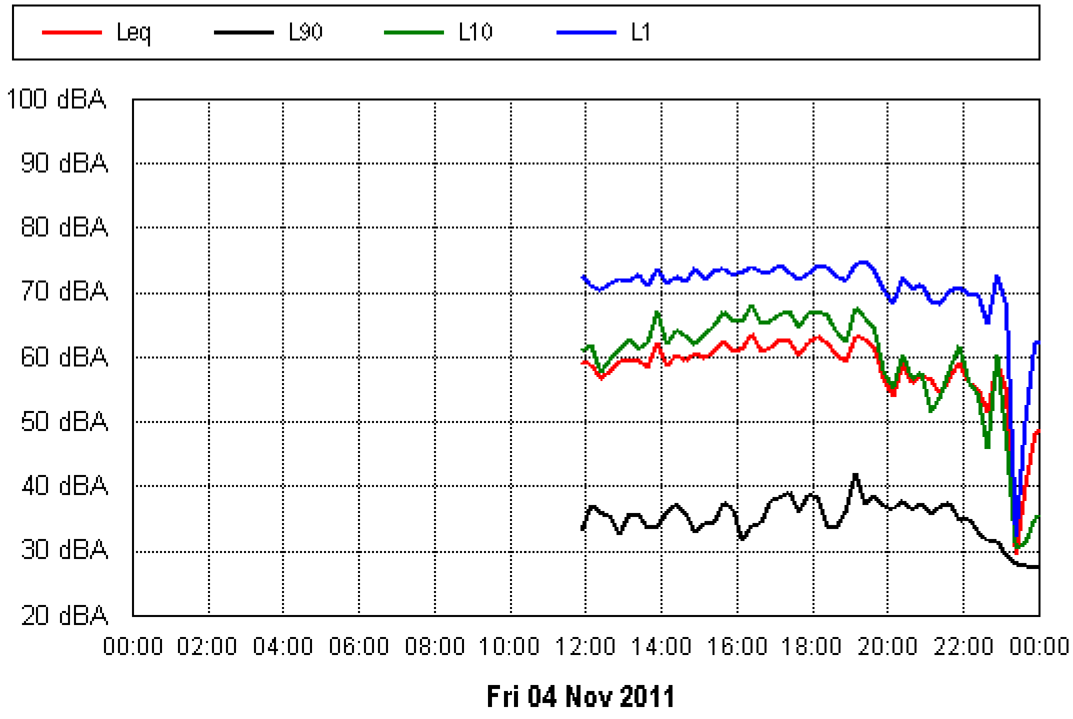


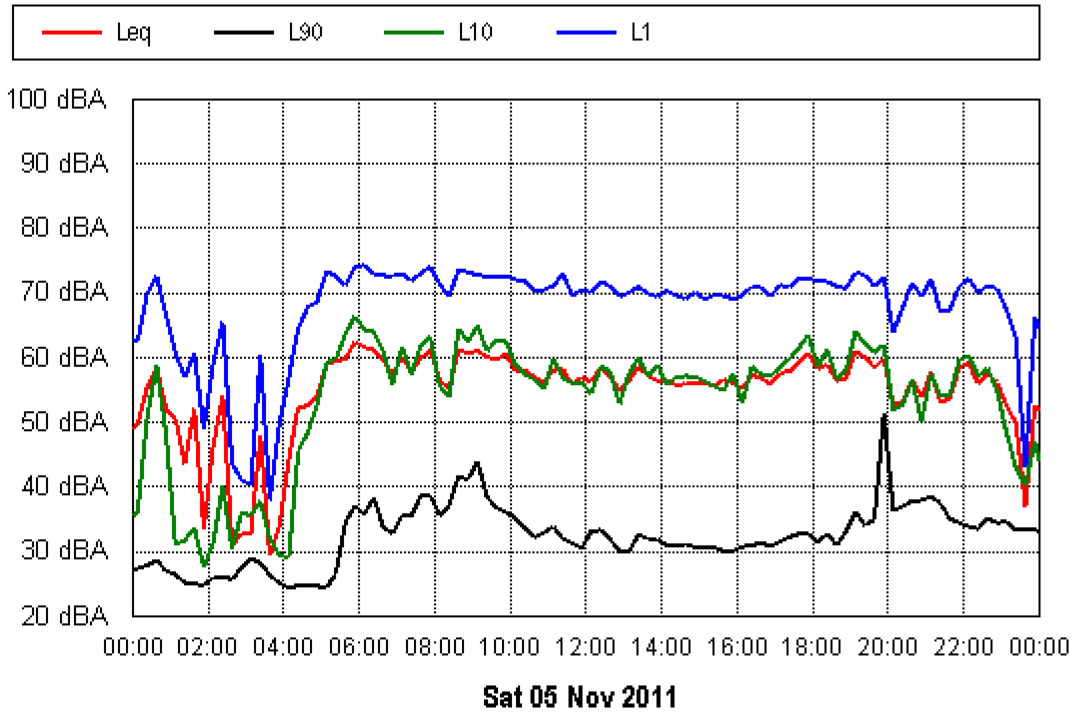
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 935 Ulan Road



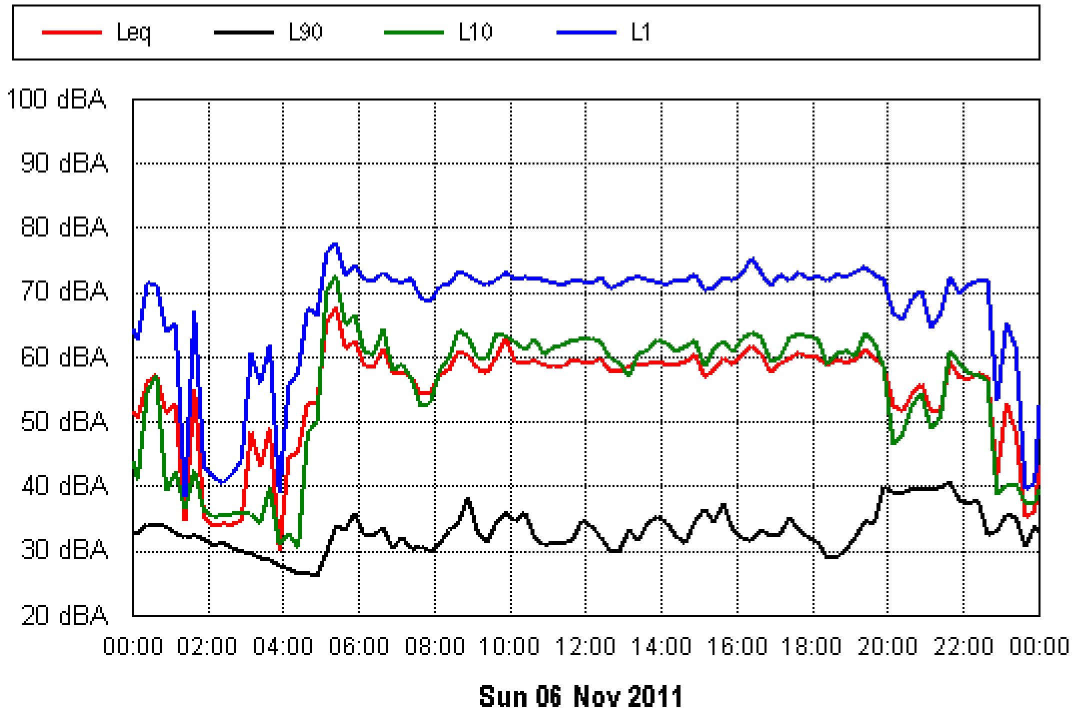


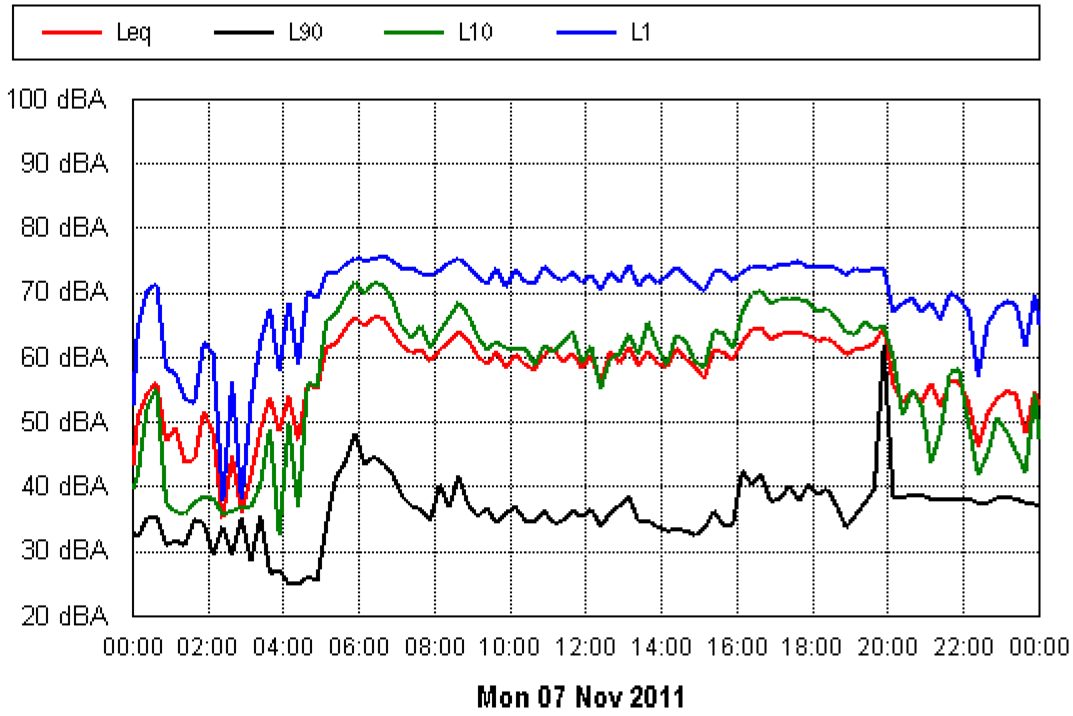
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 2778 Ulan Road



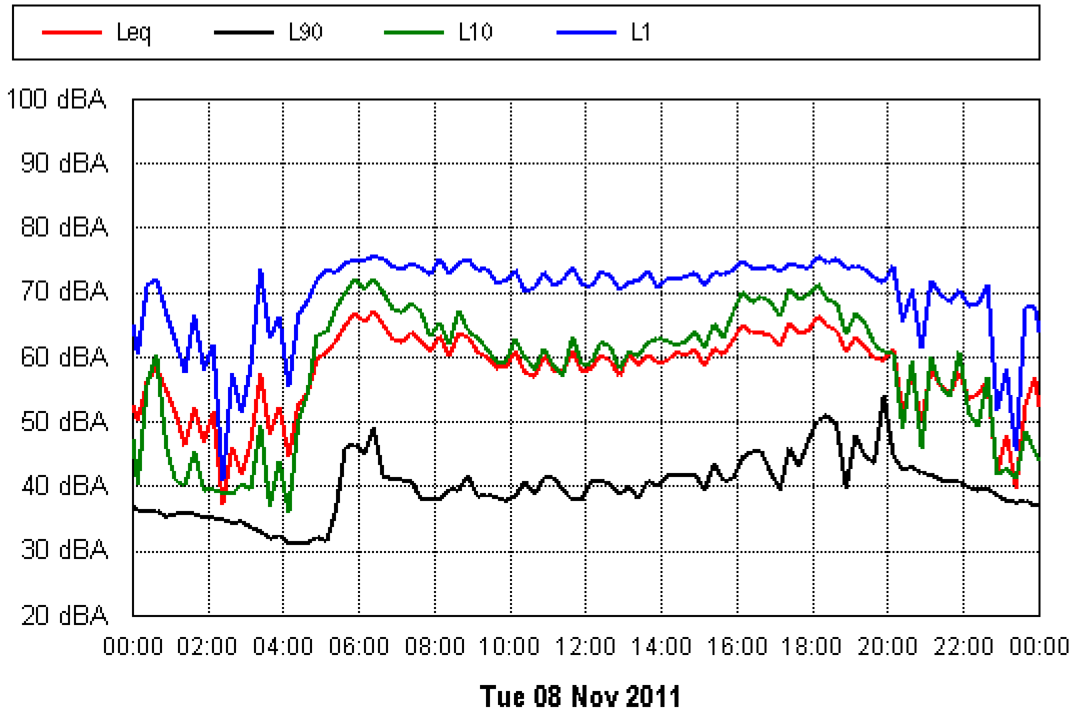


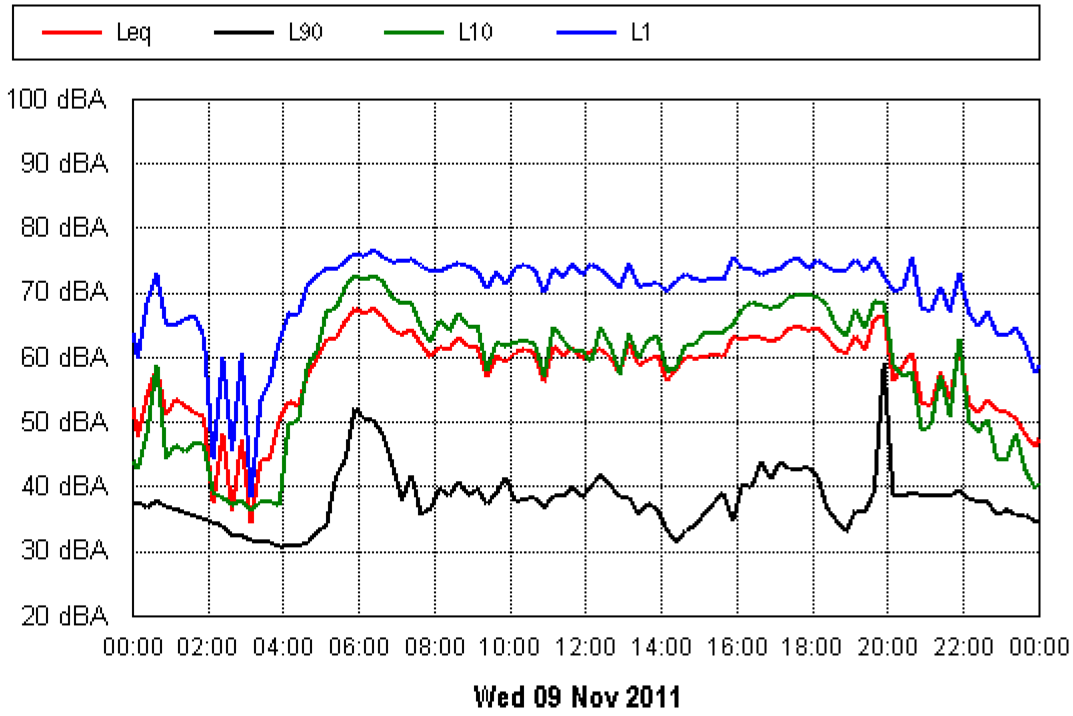
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 2778 Ulan Road



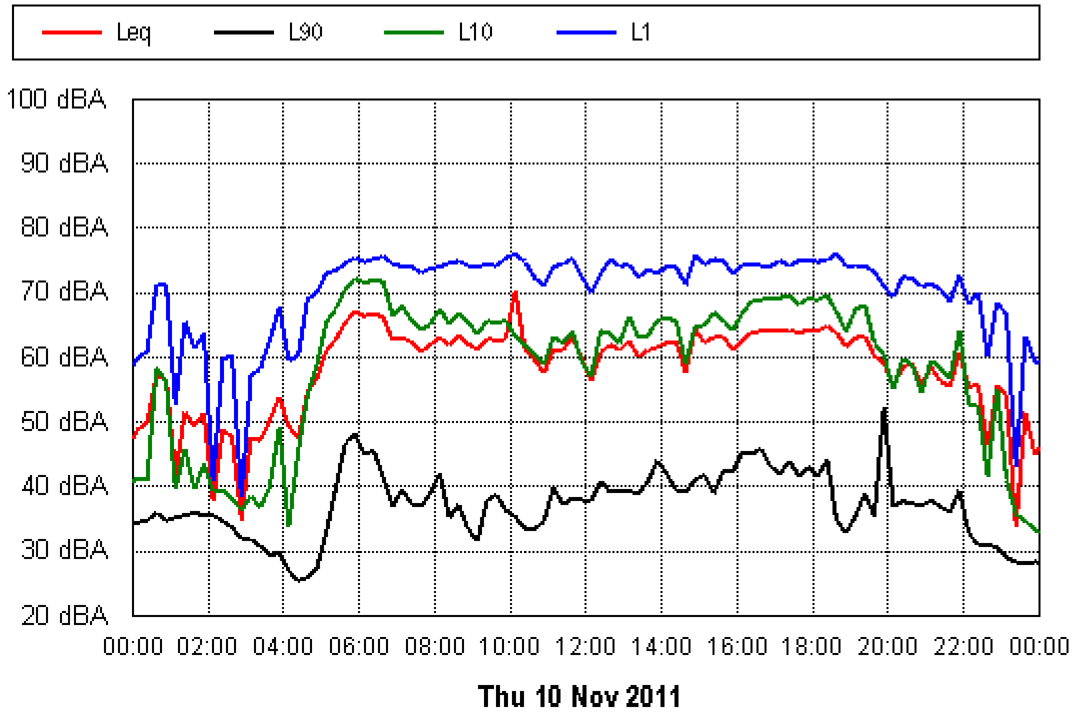


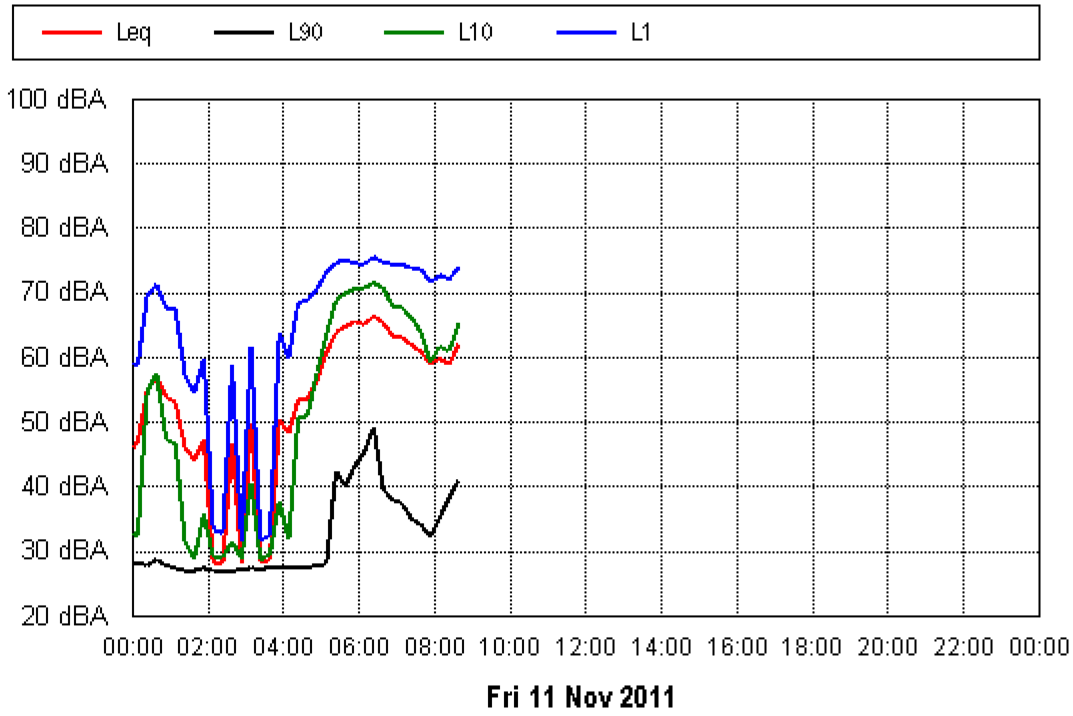
Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 2778 Ulan Road





Project: 11297 Ulan Road - Traffic Noise Assessment
Location: Front Garden - 2778 Ulan Road





APPENDIX B

ACOUSTIC VENTILATOR

AEROPAC™

'Silent & Healthy Ventilation'

Technical Data

Dimensions
Height: 405mm
Width: 250mm
Depth: 115mm

Air Movement
30 - 135 m³/h

Power Consumption
9 Watt - Max. 25 Watt

Operating Noise Level
20 dB(A) - @ max flow 30 dB(A)

Sound Absorption (Vents Open)
R_w - 1.9 = 45 - 47 dB
D_N - W = 52 - 54 dB

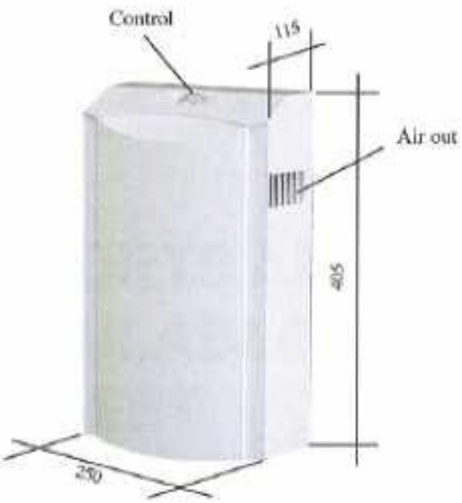
Air Flow
Left / right or in both directions

Power Supply
230V AC, 0.18amps

PVC Tube Dimensions
80mm x 500mm long

Filter Type
Active Carbon filter

Weather Grill



SIMPLE INSTALLATION

- Mark the outside wall opening and fixing points vertically, one above the other, (assembly template is supplied with each ventilation unit). Install close to a convenient power supply, taking care to avoid concealed cables & pipes. Drill the two 8mm wall fixing points.
- Use a powerful drill with 80mm ø cutter for the wall opening.
- Insert the wall plugs and screws so that they protrude approx. 8mm from the wall.
- Fit the AEROPAC to the wall by locating the keyhole slots in the rear face over the screw heads.
- Connect to the power supply & the AEROPAC is ready to work.