WHITEHAVEN COAL

Narrabri Coal Operations Pty Ltd

ABN: 15 129 850 139

Narrabri Coal Mine
Stage 2 Longwall Project

Noise and Vibration Impact Assessment

Prepared by:

Spectrum Acoustics Pty Ltd

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Prepared for:
R.W. Corkery & Co. Pty. Limited
Level 1, 12 Dangar Road
PO Box 239
BROOKLYN NSW 2083

Tel: (02) 9985 8511
Fax: (02) 9985 8208
Email: brooklyn@rwcorkery.com

On behalf of:
Narrabri Coal Operations Pty Ltd
Level 9, 1 York Street
PO Box R1113
SYDNEY NSW 1225

Tel: (02) 8507 9700
Fax: (02) 8507 9701
Email: thaggarty@whitehaven.net.au

Prepared by:
Spectrum Acoustics Pty Ltd
PO Box 374
WALLSEND NSW 2287

Tel: (02) 4954 2276
Fax: (02) 4954 2257
Email: neil@spectrumacoustics.com.au

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CONTENTS

Page

CONTENTS

Page

APPENDICES

TABLES

FIGURES

EXECUTIVE SUMMARY

This report presents a noise and vibration impact assessment of the proposed Narrabri Coal Mine Stage 2 Longwall Project (the Longwall Project) located approximately 10km north-northwest of Baan Baa and 30km south-southeast of Narrabri, NSW within Mining Lease (ML) 1609 (the Mine Site). The Mine Site covers an area of approximately 5 210ha, with most surface activities restricted to a Pit Top Area of 475ha. Mining by the longwall method would be undertaken over area of 3 630ha (the Mining Area) to produce up to 8 million tonnes per annum (8Mtpa), an increase from the currently approved 2.5Mtpa. All coal would continue to be transported by rail to Port Newcastle.

The Mine Site is located in a generally quiet rural area and a total of 14 non-project related surrounding residences have been identified and included in the noise assessment. Minimum background and transport (Kamilaroi Highway / North Western Branch Railway Line) noise levels were assumed for the approved Stage 1 project, resulting in the lowest construction and operational noise criteria achievable under the DECC *NSW Industrial Noise Policy* (INP) and *Environmental Noise Control Manual* (ENCM).

Earthworks and fabrication activities would be required to construct additional surface facilities to accommodate the increased production rate. Noise emissions from these activities, and ongoing operations, are assessed against the existing operational noise criterion of 35dB(A),$L_{eq(15\ minute)}$ at all receivers at all times.

Noise modelling using the DECC recognised *Environmental Noise Model* (ENM) has predicted noise criterion exceedances during the establishment period of the Stage 2 operations (which would include various earthworks and construction activities associated with the establishment of the Stage 2 infrastructure) at some residential locations under noise-enhancing atmospheric conditions. In order to minimise noise impacts, the following recommendation has been made.

> ***Noise Control Recommendation 1:***
>
> *No more than two scrapers are to operate under temperature inversion conditions (unless noise monitoring confirms acceptable levels with more scrapers operating). This generally coincides with the morning period up to 8:30am on calm winter mornings. Monthly attended noise monitoring should be conducted during the period of surface earthworks to quantify received noise levels at surrounding residences.*

Following the establishment period of the Stage 2 operations, the coal preparation and handling facilities, incorporating a rotary breaker, coal preparation plant (CPP), various conveyors and mobile plant to handle coal during processing and train loading would commence operating 24 hours per day, 7 days per week.

Modelling results show noise criterion exceedances at several non-project-related residential locations under noise-enhancing atmospheric conditions during various stages of the project.

The noise modelling also found that noise emissions from the proposed rotary breaker and coal preparation plant could be excessive. Consequently, the following recommendation was made:

> ***Noise Control Recommendation 2:***
>
> *The rotary breaker should by fully enclosed by a shed clad with tilt-up aerated concrete panels, or similar. Also, the CPP should be fully clad with steel sheeting with an acoustic profile (Costom Orb or similar) and 50% of the internal surface lined with acoustic insulation.*

The following additional recommendations have been made to reduce the noise impact of the project proposal as far as reasonably and feasibly possible:

> ***Noise Control Recommendation 3:***
>
> *Use of a bulldozer on the Reject Emplacement Area should not occur under temperature inversion conditions. Coal reject material from the Coal Processing Plant may continue to be trucked to the emplacement at a rate of 1 truck per 15 minutes under inversion conditions.*

> ***Noise Control Recommendation 4:***
>
> *Drills operating above the northern ends of Longwall Panels 1-4 or at the southern ends of Longwall Panels 24-26 must have temporary noise screens positioned so as to achieve a sound power level of 109 dB(A) in the direction of the nearest residences, if these drills are to operate under inversion conditions.*

With the above noise mitigation strategy in place, there are expected to be residual criterion exceedances at four residences as summarised in **Table S1**.

Table S1
Summary of Noise Impacted Residential Receivers

Noise Management Zone (exceedances of 1-4 dB)		**Noise Affectation Zone (exceedances of 5dB or more)**	
Receiver	**Noise source**	**Receiver**	**Noise source**
R1 “Bow Hills” R3 “Naroo” R15 “Greylands”	General surface plant	R11 “Kurrajong”	Drilling above Longwall Panels 24-26

The residences within the noise management zone would be impacted during the early stages of the project life, whereas R11 “Kurrajong” is predicted to receive excessive noise levels late in the project life when the final longwall panels are being developed.

It is recommended that the quarterly operational noise monitoring program should continue until at least the end of the first 12-month period of Longwall Project operations so that several noise-enhancing meteorological conditions are encountered. Noise monitoring locations would be determined in consultation with DECCW but would include at least those receivers listed in

Table S1. R13 “Newhaven” should also be included as a monitoring location when surface preparation works are occurring above Longwall Panels 1-4. Since there are receivers in a noise management zone, a Noise Management Plan (NMP) should be developed to specifically address these receivers.

The NMP would detail all aspects of noise management from a noise monitoring program, communication with local residents (site contact details and complaints register), possible noise mitigation options should exceedances occur and allow for agreements to be negotiated with affected landowners.

No exceedances of noise limits for projected-generated road traffic or rail transport of coal have been predicted.

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1 INTRODUCTION

1.1 Background

Narrabri Coal Operations Pty Ltd (NCOPL, the "Proponent") proposes to convert the approved Narrabri Coal Mine from a continuous miner operation with an approved annual production rate of 2.5Mtpa to a longwall mining operation with a maximum annual production rate of 8Mtpa. **Figure 1** identifies the critical surface and underground components of the proposed longwall mining operation. **Figure 1** differentiates between those activities or infrastructure already approved for the Stage 1 operations and those proposed for the Stage 2, longwall operations.

The Longwall Project is considered a Major Project under *State Environmental Planning Policy (Major Projects 2005)* and therefore the Minister for Planning is the consent authority. Accordingly, a Noise and Vibration Impact Assessment (NVIA) has been conducted in accordance with relevant Department of Environment, Climate Change and Water (DECCW) guidelines for reference in the *Environmental Assessment* (EA) for the Longwall Project.

1.2 Project Description

Longwall mining would involve the sequential development of dual heading gate roads approximately 305m apart oriented north-south from the main headings ("West Mains") and developed for the full distance to the northern and southern boundaries of ML 1609 (up to 4.115km). Once each set of roadways are fully developed, the longwall equipment would be installed and the coal recovered as the longwall unit retreats back towards the West Mains between the two sets of roadways. All coal would be conveyed back to the Pit Bottom Area for transfer to the surface via the approved conveyor drift.

Pre-drainage of the coal seam would be undertaken to reduce gas content to less than 5.0m^3/t would be undertaken for the management of outbursts and rib emission prior to the development of each longwall panel (LW). Pre-drainage would be undertaken using surface to in-seam drilling and / or conventional underground holes.

As the three mine drifts, gate road headings and longwall panels are developed, a ventilation system would be progressively upgraded to prevent gas build-up within the underground workings, thereby providing for safe working conditions and minimising the risk of outburst or spontaneous combustion.

As the longwall unit retreats, and the remaining coal of the seam collapses into the mine void, the gas accumulating in the goaf would also be drained. Goaf gas drainage would be completed either by re-using the surface to in-seam system used for pre-draining the gas from the panel to be developed, or by the development of additional bores from surface into the collapsed panel, with the gas drawn out the goaf by the installation and operation of vacuum plant at the top of each bore.

In order to manage the quantity of groundwater predicted to flow into the underground mine, the groundwater would be pumped to the surface, treated to reduce the salinity of the water through a water conditioning plant with the treated water either stored on the Mine Site in one of the water storage dams or discharged to the Namoi River. A series of brine storage ponds would be constructed to hold the saline by-product of the water treatment process (reverse osmosis). **Figure 1** shows the maximum footprint of the brine storage ponds which would be

constructed progressively as smaller ponds of between 10ha and 15ha in area. The noise associated with the construction of the brine storage ponds has been included in the noise modelling for the Longwall Project.

Transportation of the mined coal to the ROM coal pad would continue to be via the conveyor drift from the Pit Bottom Area to the box cut within the Pit Top Area. From the box cut, the ROM coal would be transported to the ROM coal pad by conveyor from where it would be sent to the Coal Preparation Plant (CPP) via one of two reclaim valves and tunnels from where it would be fed to a rotary breaker for size reduction. The broken coal would then be transferred to a dry screen with the <16mm coal transferred directly to the product coal storage pad and the remainder transferred to a jig washery for removal of fine material and screening of the coarse reject. The <50mm coal would be transferred to the product coal storage pad with the coarse reject and dewatered and thickened fine reject sent to the Reject Emplacement Area.

The product coal would be drawn from storage pad via three reclaim valves and tunnels and conveyed to the train load-out bin. The loading of product coal via the drawdown valves and trains load-out bin would be fully automated with batches of 5 400t to 6300t drawn from the stockpiles and loaded to trains on the Narrabri Coal Rail Siding.

At an anticipated maximum mining rate of 8Mtpa and an initial train capacity of 5 400t, an average of five trains would be loaded and despatched each day of the week[1]. However, the rate of despatch would vary to meet shipping arrival schedules at Port Newcastle.

In addition, a small number of blasts may be necessary during the construction of ventilation shafts (through the harder volcanic units such as the dolerite (basalt) Sill and Garrawilla Volcanics). These blasts would typically undertaken between the hours of 9:00am to 5:00pm Monday to Saturday, although may be undertaken outside these hours in the event an unforeseen obstruction within the shaft is encountered.

2 DESCRIPTION OF TERMS

2.1 Scope

This section aims to convey an understanding of several commonly used acoustical terms. Various terms are explained in plain language and the effects of certain atmospheric phenomena on noise propagation are discussed. Noise level percentiles are explained with the aid of a diagram of a hypothetical noise signal.

The descriptions in this section are not formal definitions of the terms. Formal definitions may be found in AS1633-1985 “Acoustics – Glossary of terms and related symbols”.

[1] This accounts for coal rail unavailability for periods during the year.

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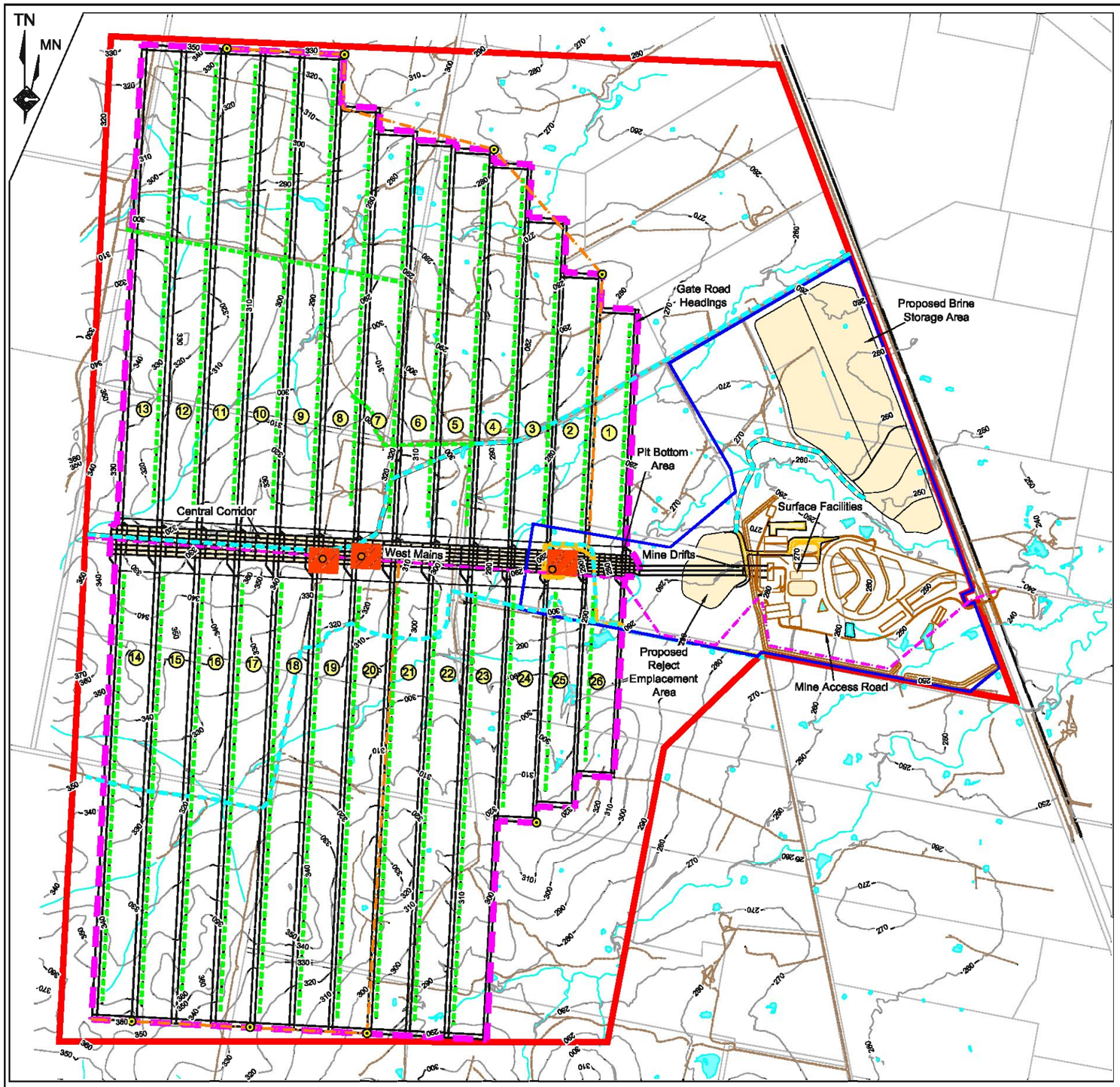

REFERENCE
- Mine Site Boundary
- Pit Top Area Boundary
- Limit of Longwall Mining Area
- Longwall Panel No.
- Underground Gate Road
- Cadastral Boundary
- Contour (m AHD)(Interval = 10m)
- Creek / Drainage Line
- Approved Disturbance within the Pit Top Area
- Area of Proposed Stage 2 Surface Disturbance
- Proposed All Weather Unsealed Access Road
- Proposed Stage 2 Access for Goaf Drainage
- Proposed Power Line
- Proposed Power Line Advancing with Mine
- Ventilation Shaft Area
- Proposed Ventilation Shaft Location
- Proposed Rear of Panel Ventilation Shaft

Figure 1
INDICATIVE MINE SITE LAYOUT

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2.2 General Terms

Sound Power Level

The amount of acoustic energy (per second) emitted by a noise source. Usually written as "Lw" or "SWL", the Sound Power Level is expressed in decibels (dB) and cannot be directly measured. Lw is usually calculated from a measured sound pressure level.

Sound Pressure Level

The "noise level", in decibels (dB), heard by our ears and/or measured with a sound level meter. Written as "SPL", the sound pressure level generally decreases with increasing distance from a source. Noise levels are often written as dB(A) rather than dB. The "A-weighting" is a correction applied to the measured noise signal to account for the ear's ability to hear sound differently at different frequencies. For example, 40dB at 500Hz (speech frequency) is clearly audible but 40dB at 50Hz (very low bass) would be far less audible. The A-weighted sound pressure level therefore represents the measured (or predicted) noise level as it would be heard by the typical human ear.

Temperature Inversion

An atmospheric state in which the air temperature increases with altitude. Sound travels faster in warmer air than in cold air, so that during an inversion the top of a "sound wave" would move faster than the bottom. This bends (refracts) sound back towards the ground just as light bends upon entering and exiting a glass prism. The result is a "trapping" of sound energy near the ground and an increase in noise levels.

Wind Shear

A moving air mass would experience a "friction drag" at the ground in much the same way as a lava flow would flow quickly on top and "roll over" the lava beneath which must drag along the ground. This increasing wind speed with altitude is called "wind shear".

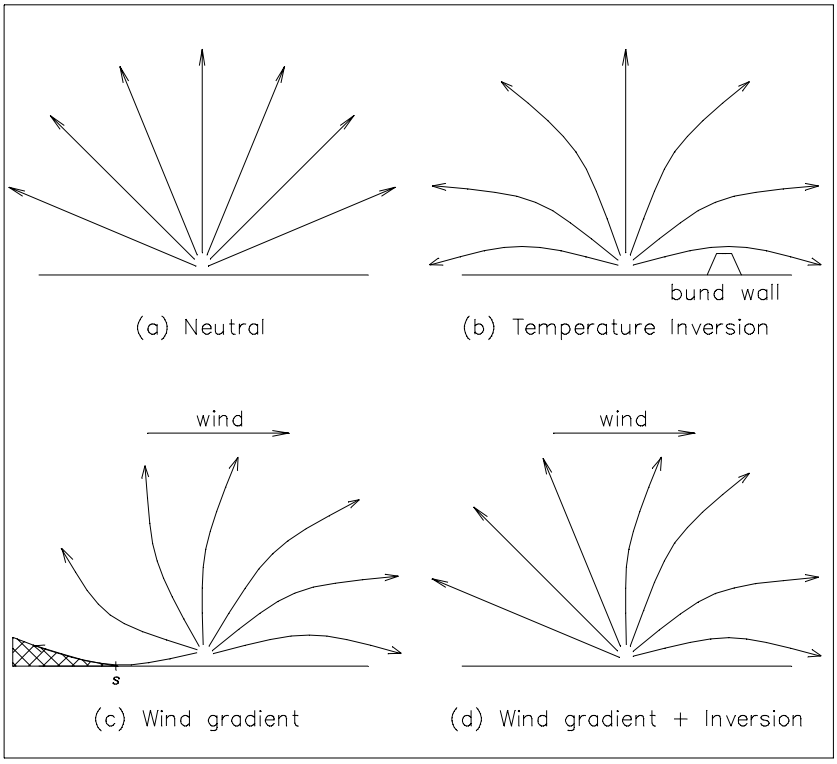
For a sound wave travelling down wind, the top of the wave moves faster than the bottom and the wave bends towards the ground. However, for a wave travelling into the wind the top of the wave is slowed down more than the bottom is and the wave bends upwards. **Figure 2** shows several examples of how atmospheric effects can bend sound waves.

Figure 2 shows that sound rays can be refracted over a barrier (usually a bund wall or small hill) during a temperature inversion, increasing noise levels in the 'shadow zone'.

Neutral Atmospheric Conditions

An atmosphere that is at a temperature of approximately 23°C from ground level to an altitude of 200m or more. There are no fluctuations in density or humidity and no wind. Such conditions rarely occur, as temperature would usually vary with altitude and there is always movement in various directions in different layers of the atmosphere.

Figure 2
Sound refraction under temperature and wind gradients.



Prevailing Atmospheric Conditions

Atmospheric conditions (with regards to potential effects on noise propagation) which are characteristic of the study area. These would typically include seasonal wind directions and velocities. Temperature inversions would be included as prevailing if they occur, on average, for more than 2 nights per week in winter.

Adverse Atmospheric Conditions

Adverse conditions would include simultaneous winds and temperature inversions, even if the inversions occur for less than 2 nights per week in winter. This represents the worst case scenario for potential noise enhancement due to atmospheric effects.

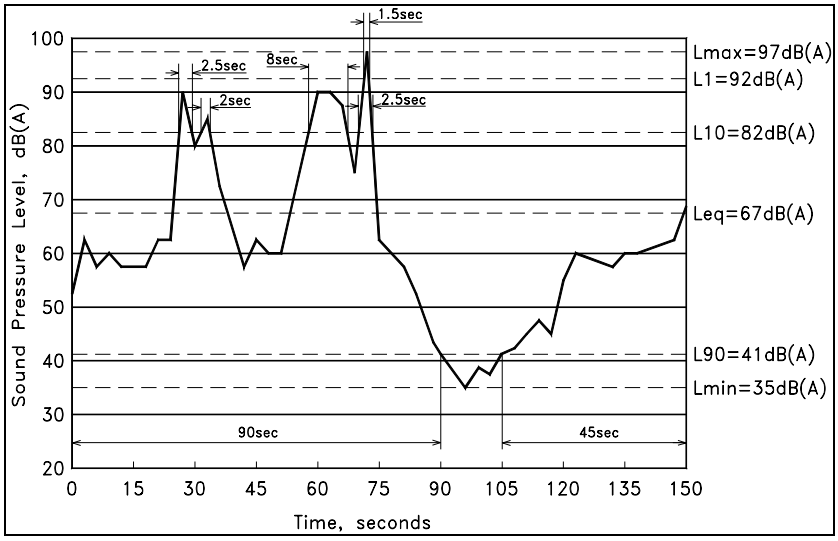
2.3 Noise Levels Percentiles

A noise level percentile (L_n) is the noise level (SPL) in decibels which is exceeded for "n" % of a given monitoring period. Several important L_n percentiles would be explained by considering the hypothetical time signal in **Figure 3**.

The signal in **Figure 3** has a duration of 2.5 minutes (ie. 150 seconds) with noises occurring as follows.

- The person holding the instrument is standing beside a road and hears crickets in nearby grass at a level of around 60dB (A).
- At about the 30 second mark a motorcycle passes on the road, followed by a car.

Figure 3
Hypothetical time-trace of 150-second sound signal.



- At 60 seconds a truck passes.
- After the truck passes it sounds its air horn at the 73 second mark.
- The crickets are frightened into silence and the truck fades into the distance.
- All is quiet until 105 seconds when the crickets slowly start to make noise, reaching full pitch by 120 seconds.
- The measurement stops at 150 seconds, just when an approaching car starts to become audible.

L_1 Noise Level

Near the top of **Figure 3**, there is a dashed line at 92dB(A). A small spike of 1.5 seconds duration extends above this line at around 73 seconds. Since 1.5 seconds is 1% of the signal duration (150 seconds), the L_1 (or L_{A1} to signify A-weighting) noise level of this sample is 92dB(A). The L_1 percentile is often called the *average peak noise level* and is used by the NSW Department of Environment and Conservation[2] (DEC) as a measure of potential disturbance to sleep.

L_{10} Noise Level

The dashed line at 82dB(A) is exceeded for four periods of duration 2.5 seconds, 2 seconds, 8 seconds and 2.5 seconds, respectively. The total of these is 15 seconds, which is 10% of the total sample period. Therefore, the L_{A10} noise level of this sample is 82dB(A). The L_{10} percentile is called the *average maximum noise level* and has been widely used as an indicator of annoyance caused by noise.

[2] Formerly Environment Protection Authority, EPA.

L_{90} Noise Level

In similar fashion to L_1 and L_{10}, **Figure 3** shows that the noise level of 41dB(A) is exceeded for 135 seconds (90 + 45 =135). As this is 90% of the total sample period, the L_{A90} noise level of this sample is 41dB(A). The L_{90} percentile is called the *background noise level*.

L_{eq} Noise Level

Equivalent continuous noise level. As the name suggests, the L_{eq} of a fluctuating signal is the continuous noise level which, if occurring for the duration of the signal, would deliver equivalent acoustic energy to the actual signal. L_{eq} can be thought of as a kind of 'average' noise level. Recent research suggests that L_{eq} is the best indicator of annoyance caused by industrial noise and the DEC *NSW Industrial Noise Policy* takes this into consideration.

L_{max} and L_{min} Noise Levels

These are the maximum and minimum SPL values occurring during the sample. Reference to **Figure 3** shows these values to be 97dB(A) and 35dB(A), respectively.

3 THE EXISTING ENVIRONMENT

3.1 Introduction

The existing meteorological and acoustic environments were reviewed as part of the Stage 1 Noise and Vibration Assessment (Spectrum Acoustics, 2007). This information was used to establish noise criteria for the Longwall Project and to determine prevailing weather conditions under which these noise criteria apply. Additional noise monitoring and modelling was conducted for Longwall Project to determine the appropriate temperature inversion for modelling noise emissions from Longwall Project. A summary of the relevant information is included in this section.

3.2 Meteorology

The following data are the most significant with respect to noise propagation within and surrounding the Mine Site.

- Relative humidity (RH) varies around an average value of 70% under calm daytime conditions at 20^0C. Higher RH is experienced when the temperature drops and values of 80-95% RH were adopted for modelling under inversion conditions.
- Temperature inversions are assumed to be a feature of the area and modelling of noise emission scenarios during winter 2008 indicated that an inversion strength of up to 6^0C/100m may have occurred. This value has been adopted as a worst case. Mild and moderate inversions strengths of 2^0C/100m and 4^0C/100m have also been considered.

- Winds in the 0-3 m/s range are predominantly southeasterly throughout the year with stronger (>5.5m/s) winds prevailing from the north to northwest. For the purposes of this NVIA, only the winds up to 3m/s are to be considered under the INP. A wind speed of 3m/s (at 10m above ground level) was modelled to determine the noise impacts under the prevailing southeasterly wind.

Typical calm daytime conditions of no wind, 70% RH and -1^{o}C/100m vertical temperature gradient (ie. dry adiabatic lapse rate, DALR) was also modelled to represent typical daytime noise levels.

3.3 Surrounding Residences

Table 1 lists each of the non-project related residences within a 5km radius of the Pit Top Area together with the name of the property owner and the numbering used in this NVIA to locate the residence in relation to the Mine Site (see **Figure 4**).

Table 1
Non-Project-related Residences Surrounding the Mine Site

Property Ref.	Property Name	Property Owner
R1	“Bow Hills”	J. & R. Steiger
R2	“Ardmona”	P. C. Webb
R3	“Naroo”	M. W. Foster
R4	“Oakleigh”	C. Towns
R5	“Pineview”	C. & D. Kirkby
R6	“Matilda”	W. Chapman
R7	“Haylin View”	W. Chapman
R10	“Merrilong”	R & S Chappel
R11	”Kurrajong”	M. Lennox
R13	“Newhaven”	K. & J. Scott
R15	“Greylands”	M. & D. White
R16	“Belah Park”	G. & C. Sevill
R17	“Bungaree”	J. & M. Bish
R18	“Merulana”	P. Smart

4 NOISE AND VIBRATION CRITERIA

4.1 Introduction

This section summarises the noise and vibration criteria for potentially affected non-project related residences. As there have been no significant non-mine related changes to the acoustic environment surrounding the site, previous noise and vibration criteria (prior to the commencement of the Stage 1 development) will continue to apply.

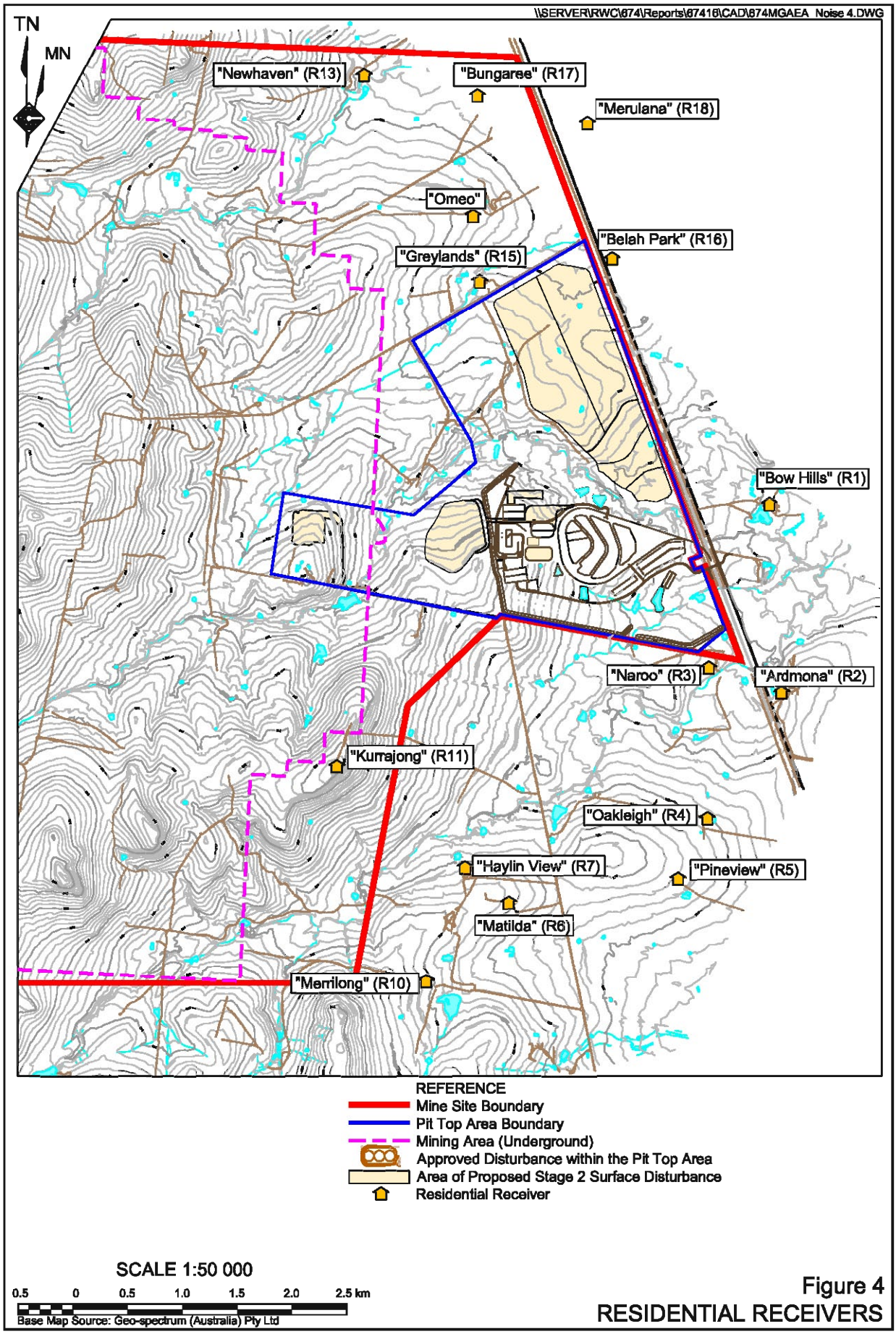


Figure 4
RESIDENTIAL RECEIVERS

4.2 Site Establishment / Construction Noise Criteria

The project is a continuation and expansion of the approved and commenced Narrabri Coal Mine operation. Accordingly, both DECCW and DoP consider the activities to be part of the ongoing mine operation and the existing operational noise criteria, as discussed in the following section, are applicable.

4.3 Operational Noise Criteria

The INP specifies two noise criteria:

- an *intrusiveness criterion* which limits L_{Aeq} noise levels from the industrial source to a value of 'background plus 5dB';and
- an *amenity criterion* which aims to protect against excessive noise levels where an area is becoming increasingly developed.

Since there is no existing major industry dominating noise levels at any residences near the Mine Site, and road traffic noise is not continuous, only the intrusiveness criteria were considered in setting the existing project-specific operational noise limit of **35dB(A),$L_{eq(15\text{-}minute)}$** (day, evening and night) at all non-project related residences. This is the lowest intrusiveness criterion that can be established under the INP.

4.4 Blasting Criteria

4.4.1 Annoyance Criteria

Noise and vibration levels from blasting are assessable against criteria proposed by the Australian and New Zealand Environment and Conservation Council (ANZECC) in their publication *"Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration – September 1990"*.

These criteria are summarised as follows.

- The recommended maximum overpressure level for blasting is 115dB linear.
- The level of 115dB linear may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 120dB at any time.
- The recommended maximum vibration velocity for blasting is 5mm/s Peak Vector Sum (PVS).
- The PVS level of 5mm/s may be exceeded for up to 5% of the total number of blasts over a 12-month period, but should not exceed 10mm/s at any time.
- Blasting should generally only be permitted during the hours of 9am to 5pm Monday to Saturday, and should not take place on Sundays and Public Holidays.
- Blasting should generally take place no more than once per day.

These criteria are typically adopted by the DECC when issuing Environment Protection Licences for projects involving blasting.

4.4.2 Building Damage Criteria

Building damage assessment criteria are nominated in AS 2187.2-1993 *"Explosives – Storage, Transport and Use Part 2: Use of Explosives"* and summarised in **Table 2.**

Table 2
Blasting Criteria to Limit Damage to Buildings (AS 2187)

Building Type	Vibration Level (mm/s)	Airblast Level (dB re 20 μPa)
Sensitive (and Heritage)	5	133
Residential	10	133
Commercial/Industrial	25	133

The annoyance (ANZECC) criteria are more stringent than the building damage criteria (**Table 2**) and would be taken as the governing criteria for the Longwall Project. The annoyance criteria for blasting presented in Section 4.7.1.

4.5 Sleep Disturbance Criteria

To help protect against people waking from their sleep, the DECC recommends that 1-minute L_{A1} noise levels (effectively, the maximum noise level from impacts, etc) should not exceed the background level by more than 15dB when measured/computed at a building facade. The "sleep disturbance" criterion is only applicable to night-time noise emissions.

The sleep disturbance criterion applicable for this project at each non-project-related residence is equal to the intrusiveness criterion plus 10dB(A), that is, **45dB(A),$L_{1(1\text{-minute})}$**.

4.6 Road Traffic Noise Criteria

In NSW, noise from vehicle movements associated with an industrial source is assessed in terms of the INP if the vehicles are on the industrial site (the Mine Site in this case). If the vehicles are on a public road, the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN) applies. The Longwall Project would produce additional traffic on the Kamilaroi Highway (an arterial road) due to employee and delivery vehicles.

It is recognised that the additional noise generated by the Longwall Project would be concentrated in short periods of time around shift changes, whereas the criteria for arterial roads are for the entire day/night periods due to the relatively constant nature of traffic of major freeways. It will therefore be assumed that the Kamilaroi Highway is a collector road due to its more intermittent traffic.

Table 3 shows ECRTN traffic noise criteria for the case where a development creates additional traffic on a collector road.

Table 3
Road Traffic Noise Criteria

Type of Development	Recommended Criteria – dB(A)	
	Day (7.00am to 10.00pm)	**Night (10.00pm to 7.00am)**
11. Land use developments with potential to create additional traffic on existing collector roads.	$L_{Aeq(1hr)}60$	$L_{Aeq(1hr)}55$

4.7 Rail Traffic Criteria

4.7.1 Train Noise Level Criteria

The Longwall Project would result in an average of five return train movements per day on the North Western Branch and Main Northern Railway Lines between the Mine Site and Port Newcastle and there would be a corresponding increase in noise exposure at residences adjacent to the train line. Chapter 163 of the DECC *Environmental Noise Control Manual* (ENCM) recommends limits on train noise levels presented in **Table 4.**

Table 4
ENCM Recommended Train Noise Levels

Descriptor	Planning Levels	Maximum Levels
$L_{eq,\ 24\ hour}$	55dB(A)	60dB(A)
L_{max}	80dB(A)	85dB(A)

The Australian Rail Track Corporation (ARTC) operates the North Western Branch Railway Line and Main Northern Railway Lines which are included under Environment Protection Licence (EPL) 3142. The EPL does not contain environmental noise limits but states the objective of progressive reduction of noise levels from rail lines through Pollution Reduction Programs (PRPs).

While the North Western Branch Railway Line and Main Northern Railway Lines are not currently subject to a PRP, Section U1.1 of EPL 3142 provides the goals presented in **Table 5** to work towards in developing a PRP.

Table 5
EPL3142 Pollution Reduction Program Goals

Descriptor	Design Goal
$L_{eq,\ (15\ hour)}$, day	65dB(A)
$L_{eq,\ (9\ hour)}$, night	60dB(A)
$L_{max\ (24\ hour)}$	85dB(A)

These criteria would be applicable if ARTC was required to assess train noise levels on the North Western Branch Railway Line and Main Northern railway line.

4.7.2 Train Vibration Level Criteria

Various authorities have set maximum limits on allowable ground and building vibration in different situations. In this Report, vibration criteria were obtained from the DECC publication *"Assessing Vibration: A Technical Guideline"* (AVTG).

DECC limits are for vibration in buildings, and relate to personal comfort and not structural integrity of the building. Based on procedures set out in Appendix B of the AVTG, a maximum allowable vibration velocity of 2.82mm/s applies to train-induced ground vibration, which is typically at frequencies greater than 10Hz.

5 ASSESSMENT METHODOLOGY

5.1 Operational Noise

5.1.1 Introduction

Assessment of operational noise was conducted using the ENM software. The noise sources were modelled at their known (for stationary sources such as the rotary breaker and CPP) or most exposed (for mobile sources such as personnel carriers and trains) positions and noise contours and/or point calculations were generated for the surrounding area. Operational scenarios with brine storage cells being constructed in the southeastern and northern corners of the allocated Brine Storage Area were considered separately.

5.1.2 Noise Sources

Sound power levels of operational noise sources are shown in **Appendix A**. Preliminary modelling showed excessive noise levels from the rotary breaker and CPP, when modelled as unattenuated sources. These sources would require acoustic treatment as follows:

- Rotary breaker – contain within shed clad with tilt-up aerated concrete panels;
- CPP – fully clad with steel sheeting and 50% internally lined with insulation.

These noise controls have been included in model results presented later in the report.

5.1.3 Modelled Scenarios

Three operational scenarios were modelled with sources placed as illustrated in **Figures 5** to **7.** These scenarios are generally described as:

Scenario 1: Establishment of additional surface facilities, roadworks, main ventilation shaft and pre-drainage above Longwall Panel (LW) 1.

Scenario 2a: All surface plant and train loading activities occurring. Goaf drainage pumps above LW 1 and pre-drainage construction above LW 2 and LW 3.

Scenario 2b: As for Scenario 2a with brine storage pond construction in the northern corner of the allocated area.

Scenario 3a: All surface plant and train loading activities occurring. Goaf drainage pumps above LW 24 and pre-drainage construction above LW 25 and LW 26.

Scenario 3b: As for Scenario 3a with brine storage pond construction in the southeastern corner of the allocated area.

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TN
MN

R13 R17 R18 R16 R15 R1 R2 R3 R4 R5 R6 R7 R10 R11

Gate Road Headings
Brine Storage Area
Pit Bottom Area
Reject Emplacement Area
Surface Facilities
West Mains
Mine Drifts
Mine Access Road

REFERENCE
- Mine Site Boundary
- Pit Top Area Boundary
- Cadastral Boundary
- Contour (m AHD)(Interval = 2m)
- Creek / Drainage Line
- Approved Disturbance within the Pit Top Area
- Area of Proposed Stage 2 Surface Disturbance
- Proposed Stage 2 All Weather Unsealed Access Road
- Proposed Stage 2 Power Line
- Proposed Stage 2 Power Line Advancing with Mine
- Proposed Stage 2 Access for Goaf Drainage
- Proposed Stage 2 Rear of Panel Ventilation Intake or Exhaust Shaft
- Proposed Ventilation Shaft Location
- Longwall Panel No.
- Ventilation Shaft Area
- Noise Generating Activity Reference
- R1 Residential Receiver

Noise Activity Areas

1. **Longwall Unit Assembly Area** : Crane (x3), Scraper (x2), Excavator (35t) & Water cart.
2. **ROM Coal Pad Extension** : Cranes (x2), Scraper (x2), Excavator (45t), Bulldozer (D8), Grader (14G Cat) & Water cart.
3. **Coal Preparation Plant** : Cranes (x3) & Excavator.
4. **Reject Emplacement Area Construction** : Scraper (x2), 50t articulated haul truck & Water cart.
5. **General Road Construction** : Grader (14G Cat), Gravel truck (x2) & Water cart
6. **Ventilation Shaft Construction** : Drill Rig, Bulldozer (D8), Gravel truck & Water cart
7. **Coal Seam Pre-Drainage Activities:** Various pumps and generators
8. **Pre-Drainage Site Preparation:** Dril rig, Bulldozer (D8), Gravel truck & Water Cart*.
9. **Rear of Panel Exhaust Ventilation (Construction)** : Drill Rig, Bulldozer (D8), Gravel truck & Water Cart*.
10. **Rail Load-out**: Rail loading from bin to Wagons, idling locomotives on Rail Loop & shunting wagons on Rail Loop.

***Note:** Bulldozer and Drill Rig would not operate simultaneously

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Figure 5
MINE SITE SCENARIO 1
OPERATIONAL ACTIVITIES
AND RESIDENTIAL RECEIVERS

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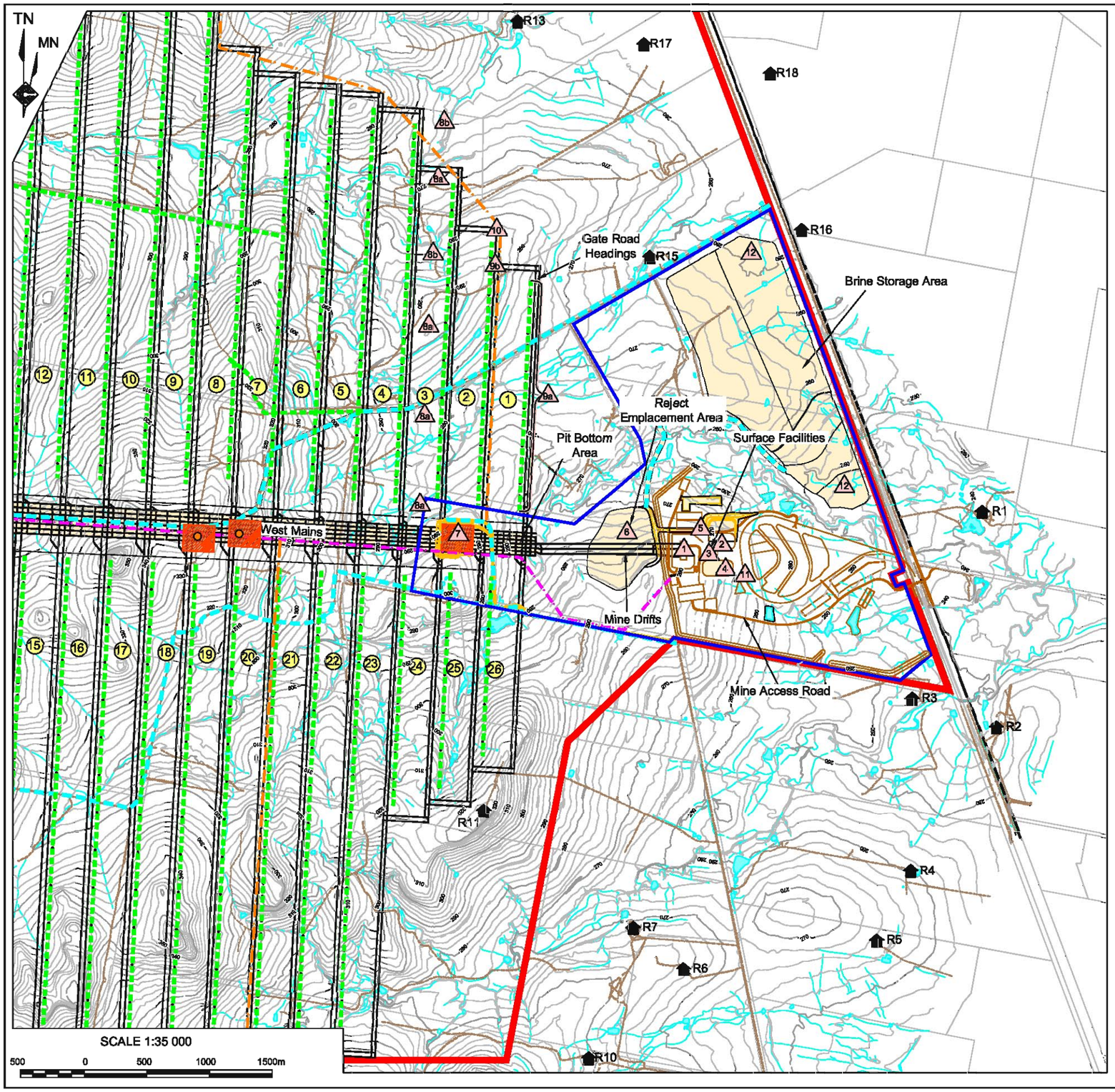

REFERENCE
- Mine Site Boundary
- Pit Top Area Boundary
- Cadastral Boundary
- Contour (m AHD)(Interval = 2m)
- Creek / Drainage Line
- Approved Disturbance within the Pit Top Area
- Area of Proposed Stage 2 Surface Disturbance
- Proposed Stage 2 All Weather Unsealed Access Road
- Proposed Stage 2 Power Line
- Proposed Stage 2 Power Line Advancing with Mine
- Proposed Stage 2 Access for Goaf Drainage
- Proposed Stage 2 Rear of Panel Ventilation Intake or Exhaust Shaft
- Proposed Ventilation Shaft Location
- Longwall Panel No.
- Ventilation Shaft Area
- Noise Generating Activity Reference
- R1 Residential Receiver

Noise Activity Areas

1. **Box Cut and Mine Portals** : Drift Conveyor (x1), Underground Transports (x7).
2. **ROM Coal Pad** : ROM skyline conveyor and tipper (x1), Bulldozer (D10)(x2), Rotary breaker (x1), Dry screen (x1), Water cart (x1).
3. **Coal Preparation Plant** : Jig Washing Plant (24hours/7 days), Tertiary Screen, Cyclones & Thickener.
4. **Product Coal Pad** : Product skyline conveyor and tripper (24hours/7days), Bulldozer (D10)(x2), & Water cart (x1).
5. **Reject Stockpile Area** : Conveyor (x1) & Front-end loader (x1).
6. **Reject Emplacement Area** : Haul Truck (50t)(x1), Bulldozer (D8)(x1), & Water cart (x1).
7. **Ventilation Shaft Area** : Ventilation fan & Support vehicle.

8a. **Pre-Drainage Sites** : Dewatering pump, Vacuum pump & Generator.

8b. **Pre-Drainage Site Preparation:** Dril rig or Bulldozer (D8), Gravel truck & Water Cart*.

9a. **Goaf Gas Drainage** : Vacuum pump & Generator (x2) (multiple locations).

9b. **Goaf Gas Drainage Site Preparation:** Dril rig, Bulldozer (D8), Gravel truck & Water Cart*.

10. **Rear of Panel Exhaust Ventilation** : Ventilation fan & Support vehicle.
11. **Rail Load-out** : Rail loading from bin to Wagons, idling locomotives on Rail Loop & shunting wagons on Rail Loop.
12. **Brine Storage Area Construction:** Haul Truck (50t)(x1), Bulldozer (D8)(x1) & Water cart (x1) .

*Note: Bulldozer and Drill Rig would not operate simultaneously

Figure 6
MINE SITE SCENARIO 2 (A and B)
OPERATIONAL ACTIVITIES
AND RESIDENTIAL RECEIVERS

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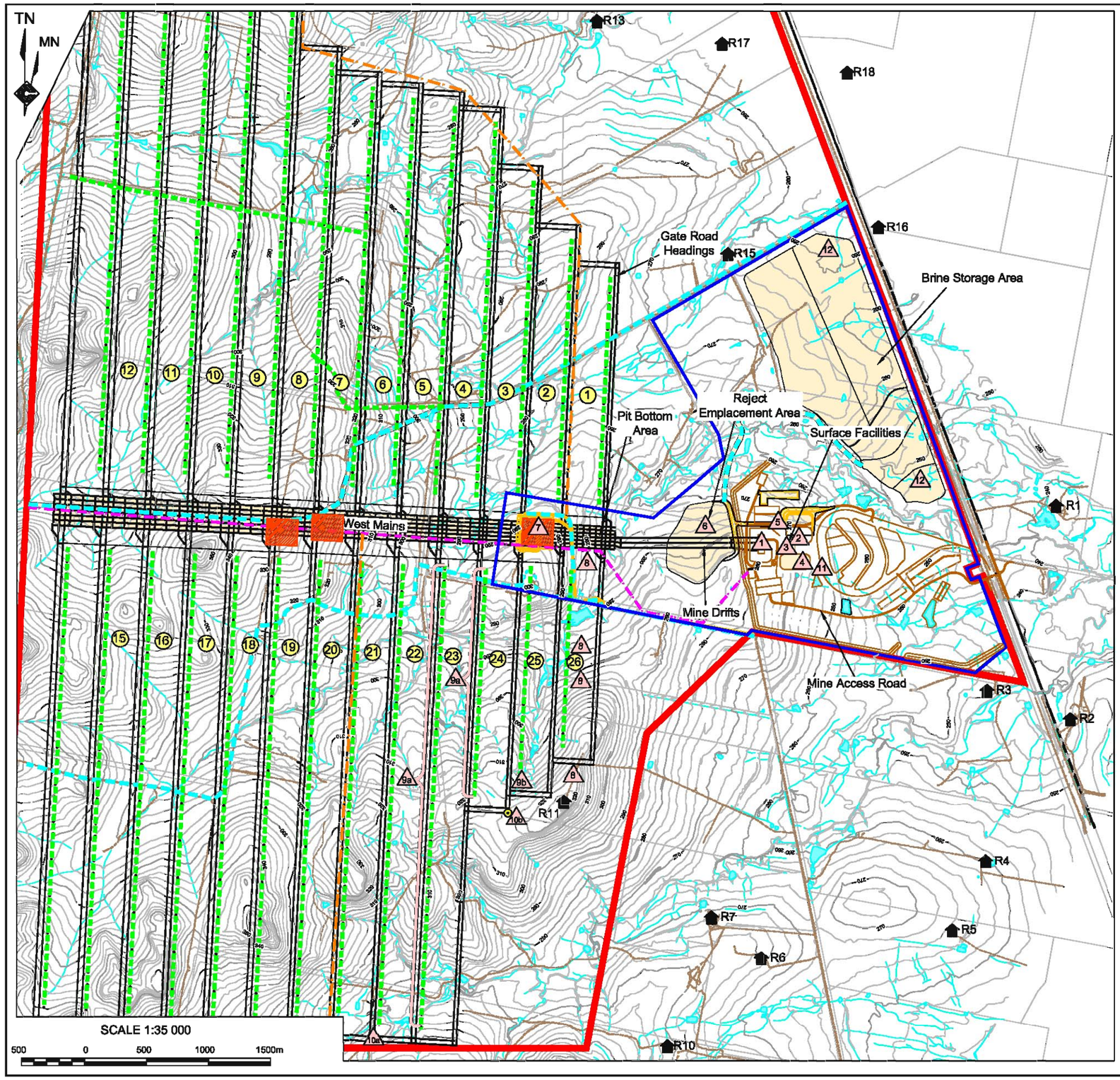

REFERENCE
- Mine Site Boundary
- Pit Top Area Boundary
- Cadastral Boundary
- Contour (m AHD)(Interval = 2m)
- Creek / Drainage Line
- Approved Disturbance within the Pit Top Area
- Area of Proposed Stage 2 Surface Disturbance
- Proposed Stage 2 All Weather Unsealed Access Road
- Proposed Stage 2 Power Line
- Proposed Stage 2 Power Line Advancing with Mine
- Proposed Stage 2 Access for Goaf Drainage
- Proposed Stage 2 Rear of Panel Ventilation Intake or Exhaust Shaft
- Proposed Ventilation Shaft Location
- Longwall Panel No.
- Ventilation Shaft Area
- Noise Generating Activity Reference
- R1 Residential Receiver

Noise Activity Areas

1. **Box Cut and Mine Portals :** Drift Conveyor (x1), Underground Transports (x7).
2. **ROM Coal Pad :** ROM skyline conveyor and tipper (x1), Bulldozer (D10)(x2), Rotary breaker (x1), Dry screen (x1), Water cart (x1).
3. **Coal Preparation Plant :** Jig Washing Plant (24hours/7 days), Tertiary Screen, Cyclones & Thickener.
4. **Product Coal Pad :** Product skyline conveyor and tripper (24hours/7days), Bulldozer (D10)(x2), & Water cart (x1).
5. **Reject Stockpile Area :** Conveyor (x1) & Front-end loader (x1).
6. **Reject Emplacement Area :** Haul Truck (50t)(x1), Bulldozer (D8)(x1), & Water cart (x1).
7. **Ventilation Shaft Area :** Ventilation fan & Support vehicle.
8. **Pre-Drainage Sites :** Dewatering pump, Vacuum pump & Generator.

9a. **Goaf Gas Drainage :** Vacuum pump & Generator (x2) (multiple locations).

9b. **Goaf Gas Drainage Site Preparation:** Dril rig or Bulldozer (D8), Gravel truck & Water Cart*.

10a. **Rear of Panel Exhaust Ventilation :** Ventilation fan & Support vehicle.

10b. **Rear of Panel Exhaust Ventilation :** Dril rig or Bulldozer (D8), Gravel truck & Water Cart.

11. **Rail Load-out :** Rail loading from bin to Wagons, idling locomotives on Rail Loop & shunting wagons on Rail Loop.

12. **Brine Storage Area Construction:** Haul Truck (50t)(x1), Bulldozer (D8)(x1) & Water cart (x1) .

*Note: Bulldozer and Drill Rig would not operate simultaneously

Figure 7
MINE SITE SCENARIO 3 (A and B)
OPERATIONAL ACTIVITIES
AND RESIDENTIAL RECEIVERS

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As discussed in Section 3.1, modelling was conducted for the following atmospheric conditions.

- *Daytime lapse:* 20^{0}C, 70% relative humidity (RH), no wind, -1^{o}C/100m vertical temperature gradient (dry adiabatic lapse rate, DALR).
- *Inversion:* 2-10^{0}C, 80-95% R.H., inversion strengths of +2, +4 and +6^{o}C/100m.
- *Prevailing wind* – 20^{0}C, 70% R.H., 3m/s wind from SE.

Wind roses compiled from the on-site meteorological station suggest that northerly winds prevail in most seasons, however only a small percentage of these winds are below 3 m/s and are not required to be assessed under the INP.

5.2 Sleep Disturbance

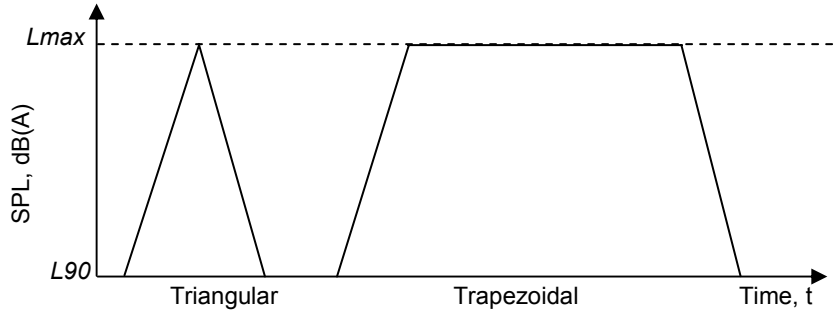
A potential for sleep disturbance would occur during operations within the Pit Top Area due to general impact noise from the rotary breaker, CPP and coal (train) loading operations. Sound power levels of modelled L_{Amax} noise sources (as an estimation of L_{A1} levels) are shown in **Appendix A**. Impact noise was modelled using the ENM program under the noise-enhancing atmospheric conditions discussed in Section 3.2.

5.3 Rail and Road Traffic Noise

Additional rail traffic generated by the Longwall Project will be of an intermittent rather than constant nature. There are many methods available for calculating the cumulative noise impact arising from intermittent signals of various shapes. The methodology employed in this section was sourced from the US Environmental Protection Agency document No. 550/9-74-004 *"Information on Levels of Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974".*

The document refers to 'triangular' and 'trapezoidal' time signals, which are illustrated in **Figure 8**. A triangular time signal rises from the background level to a peak noise level and then immediately begins to subside. A trapezoidal time signal rises from the background level to a maximum level and sustains that level for a period of time before subsiding.

Figure 8
Triangular and trapezoidal time signals



The value of L_{eq},T for a series of identical trapezoidal time patterns having maximum levels of L_{max} is given by **Equation 1**. A trapezoidal time signal is a good approximation to the SPL signal of a train as it passes an observation point.

$$L_{eq},T = 10\log\left[\frac{N\tau}{T}\left(\frac{1}{\frac{(\tau-\xi)\Delta L}{10}+\frac{\xi}{2}}\right)\left\{10^{\frac{Lb}{10}}\left(\frac{(\tau-\xi)}{2.3}\right)\left(10^{\frac{\Delta L}{10}}-1\right)+10^{\frac{L\max}{10}}\left(\frac{\xi}{2}\right)\right\}\right] \quad (1)$$

where,

L_{max} = maximum train noise at residence, dB(A)
L_b = background noise level, dB(A)
ΔL = L_{max} - L_b
T = assessment period (minutes)
τ = duration of noise from each train (minutes)
ξ = duration of Lmax, and
N = number of trains during assessment period.

Similarly, road traffic on the Kamilaroi Highway generated by the Longwall Project would be intermittent rather than constant with each passing vehicle approximated by a triangular time signal (see **Figure 8**). The value of L_{eq},T for a series of triangular time patterns having maximum levels of L_{max} is given by **Equation 2.**

$$L_{eq},T = L_b + 10\log\left[1+\frac{n\tau}{T}\left(\frac{10^{\frac{\Delta L}{10}}-1}{2.3}-\left(\frac{\Delta L}{10}\right)\right)\right] \quad (2)$$

where,

L_{max} = maximum vehicle noise at residence, dB(A)
L_b = ambient equivalent noise level, dB(A)
ΔL = L_{max} - L_b
T = assessment period (minutes)
τ = “10dB-down” duration per vehicle, and
n = number of vehicles during assessment period.

5.4 Rail Vibration

Vibration levels from laden and unladen coal trains have been widely studied in the Hunter Valley. A thorough assessment conducted in 1997 (*Noise and Vibration Assessment, Jerrys Plains Rail Spur, Wilkinson Murray Pty Limited*) found that the ground vibration level from coal trains is well below the criterion of 2.82 mm/s at approximately 20m from the track. Numerous measurements conducted by Spectrum Acoustics at locations 20m from passing coal trains have recorded ground vibration levels no greater than 1 mm/s. Since there are no potentially

affected receivers within 20m of the track on the North Western Branch Railway Line between the Mine Site and the junction with the Main Northern Line, rail vibration will not be considered further in this assessment.

5.5 Blasting

The following sections provide standard equations for predicting blast overpressure and ground vibration levels, sourced from the United States Bureau of Mines.

5.5.1 Blast Overpressure

Unweighted airblast overpressure levels (OP) are predicted from **Equation 1** below.

$$OP = 165 - 24(\log_{10}(D) - 0.3 \log_{10}(Q)), \quad \text{dB} \qquad (1)$$

where *D* is distance from the blast to the assessment point (m) and
Q is the weight of explosive per delay (kg).

Analysis of 12 months blast data for a coal mine in the Hunter Valley has shown Equation 1 to underestimate overpressure levels by up to 3 dB for small blasts (MIC 100-400kg) and overestimate by 1 dB for larger blasts (MIC > 400kg). Given the small MIC values likely to be necessary a 3 dB correction has been applied to Equation 1.

5.5.2 Blast Vibration

The basic equations for calculation of peak particle vibration (PPV) levels from blasting are as follows:

$$\text{PPV} = 1140\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s} \quad \text{(for average ground type)} \qquad (2)$$

$$\text{PPV} = 500\left(\frac{D}{Q^{0.5}}\right)^{-1.6}, \text{ mm/s} \quad \text{(for hard rock)} \qquad (3)$$

where *D* and *Q* are defined as in Equation 1. A conservative assumption of ‘average’ ground type (equation 2) will be applied.

6 IMPACT ASSESSMENT

6.1 Introduction

This section presents predicted noise and vibration levels and provides mitigation recommendations where criterion exceedances are predicted. In all tables of results that follow, any predicted exceedances of the relevant criteria are highlighted in bold type.

6.2 Operational Noise Assessment

6.2.1 Predicted Noise Levels – Scenario 1

Predicted noise levels at non-project related receivers from Stage 2 'construction' activities in the Pit Top Area are shown in **Table 6**, which also includes the "differentials" between the predicted levels (maximum over all meteorological conditions) and the noise criterion. The results are the worst case predicted impacts when all site establishment activities are occurring concurrently. Noise contours are shown in **Appendix B**.

Table 6
Predicted Stage 2 Noise Levels (Scenario 1) – dB(A), $L_{eq(15\ minute)}$

Location		Meteorological Condition						
		Lapse (calm)	Inversion (^{0}C/100m)			SE wind (3m/s)	Criterion dB(A)	Maximum Differential dB(A)*
			2	4	6			
R1	"Bow Hills"	30	**39**	**40**	**42**	29	35	+7
R2	"Ardmona"	25	34	35	**38**	20	35	+3
R3	"Naroo"	31	**40**	**41**	**44**	26	35	+9
R4	"Oakleigh"	25	35	**36**	**38**	20	35	+3
R5	"Pineview"	<20	30	31	33	<20	35	-2
R6	"Matilda"	<20	31	32	34	<20	35	-1
R7	"Haylin View"	20	33	34	**36**	<20	35	+1
R10	"Merrilong"	<20	29	31	32	<20	35	-3
R11	"Kurrajong"	30	**40**	**41**	**43**	28	35	+8
R13	"Newhaven"	32	**39**	**40**	**42**	**38**	35	+7
R15	"Greylands"	35	**42**	**44**	**45**	**39**	35	+10
R16	"Belah Park"	29	**36**	**38**	**40**	32	35	+5
R17	"Bungaree"	28	35	**36**	**39**	30	35	+4
R18	"Merulana"	20	31	33	35	26	35	0
* Differential between the worst-case predicted noise level and the criterion.								
Bold entries refer to noise levels predicted to exceed the nominated criterion								

6.2.2 Noise Control Recommendations – Scenario 1

Table 6 shows potential major (greater than 5dB) noise criterion exceedances at several receivers under inversion conditions. The DoP generally considers receivers to be in a noise 'affectation' (or 'acquisition') zone where there are exceedances greater than 5dB that cannot reasonably or feasibly be reduced to the criterion level, or at least to no more than 5dB above this level. Predicted levels in the range 1 to 4 dB above the criterion place the receiver in a noise 'management' zone.

The dominant noise sources with respect to the 'southern' receivers (R1 to R11) are scrapers operating in three areas simultaneously: the longwall unit assembly area; the ROM coal pad area and the Reject Emplacement Area (with two scrapers in each area). Reducing noise emissions from individual scrapers would be impractical, since they would be hired in from contractors on a campaign basis and are therefore not under the Proponent's control. Supplementary modelling has found that reducing the total number of scrapers from six to two would reduce predicted noise levels in **Table 6** by 4 dB.

It is recommended that use of scrapers be avoided under inversion conditions in order to satisfy the criterion under calm daytime and southeast wind conditions.

In order to determine the timing when scraper use should be avoided, **Table 7** shows a summary of attended noise measurements conducted at the "Claremont" southern boundary on 12 August 2008.

Table 7
Narrabri Coal Mine Noise Monitoring Results – 12 August 2008

Location	Time	dB(A),Leq	Wind speed/ direction	Identified Noise Sources
Kurrajong*	7:39 am	47.1	Calm	**NCM (47)**
Kurrajong*	8:03 am	44.1	Calm	**NCM (42.7)** birds (40),
Kurrajong*	8:18 am	40.7	Calm	**NCM (40.7)**
Kurrajong*	8:31 am	38.6	0.1 m/s, NE	**NCM (38.4)**, Birds (<30),
Kurrajong*	8:53 am	35.3	0.5 m/s, NE	Birds (34), **NCM (27.6)**

NCM = Narrabri Coal Mine
*Kurrajong monitoring location at Claremont southern boundary.

The results in **Table 7** formed part of the study which determined that a 6^0C/100m inversion was the appropriate worst case for assessment of noise emissions from the Longwall Project. The inversion on the morning of 12 August 2008 'burnt off' between approximately 7:30am and 9:00am with noise levels dropping by 20dB. Given the drop of approximately 7dB between 7:30am and 8:30am it is recommended that if conditions are indicative of a temperature inversion during construction activities, scrapers should not be used prior to 8:30am. After 8:30am, all six scrapers may operate as the inversion is likely to have significantly decreased in intensity by this time, resulting in reduced noise emissions.

Noise monitoring should be conducted at R11 "Kurrajong" (if accessible), R1 "Bow Hills" and R3 "Naroo" during the period of surface earthworks. If excessive noise levels are encountered during the construction period then noise management methods in the operational NMP would be implemented and noise levels re-measurement to confirm their effectiveness.

Significant criterion exceedances have also been predicted at most 'northern' receivers (R13-R17). The dominant sources causing exceedances at these receivers are drills operating at the northern ends of LW1 to LW3. Drilling in these areas may be suspended under inversion conditions in order to satisfy the noise criterion. Alternatively, specific noise reduction in the order of 10dB could be applied to each drill if continuous drilling (ie, unable to stop under inversion conditions) is required.

Generally, drills should be oriented so that the quietest side (drills are often quite directional in their noise output) is directed towards the residences and temporary acoustic shielding

employed. Appropriately placed site huts or temporary hoarding could fulfil this purpose. A suitable noise control option should be fully analysed and installed prior to commencement of drilling at the ends of LW1 to LW6 *under inversion conditions* and compliance with the noise criterion demonstrated through attended monitoring.

Receivers R13 "Newhaven" and R15 "Greylands" should be included as noise monitoring locations during the drilling at the northern ends of LW1 to LW4.

6.2.3 Predicted Noise Levels – Scenario 2a

Predicted operational noise levels for Scenario 2a at all assessed receivers are shown in **Table 8** which also includes the "differentials" between the predicted levels (maximum over all meteorological conditions) and the noise criterion. Noise contours are shown in **Appendix B**.

Table 8
Predicted Noise Levels (Scenario 2a – No Brine Cell Construction) – dB(A),$L_{eq(15\text{-}minute)}$

Location		Meteorological Condition						
		Lapse (calm)	Inversion (^{0}C/100m)			SE wind (3m/s)	Criterion dB(A)	Differential dB
			2	4	6			
R1	"Bow Hills"	29	35	**37**	**39**	27	35	**+4**
R2	"Ardmona"	25	31	33	35	20	35	0
R3	"Naroo"	29	35	**37**	**39**	25	35	**+4**
R4	"Oakleigh"	22	30	32	34	<20	35	-1
R5	"Pineview"	<20	27	29	31	<20	35	-4
R6	"Matilda"	<20	28	30	32	<20	35	-3
R7	"Haylin View"	20	30	32	34	<20	35	-1
R10	"Merrilong"	<20	26	27	30	<20	35	-5
R11	"Kurrajong"	23	32	35	**36**	23	35	**+1**
R13	"Newhaven"	29	34	35	**36**	35	35	**+1**
R15	"Greylands"	31	**38**	**40**	**41**	**37**	35	**+6**
R16	"Belah Park"	26	34	35	**37**	31	35	**+2**
R17	"Bungaree"	24	30	32	33	29	35	-2
R18	"Merulana"	21	27	30	31	27	35	-4
Bold entries refer to noise levels predicted to exceed the nominated criterion								

6.2.4 Noise Control Recommendations - Scenario 2a

Noise criterion exceedances ranging from 1 to 6 dB have been predicted at several receivers under adverse conditions. After inclusion of noise attenuation to the rotary breaker and CHPP, the dominant noise source at the southern receivers (R1 to R11) is a bulldozer working on the Reject Emplacement Area. Further modelling was conducted to determine the level of noise impact without a dozer operating and with one truck per 15 minutes transporting coal reject to the Reject Emplacement Area.

The results of this modelling showed that noise levels complied with the criterion at all southern receivers under all conditions except intense (6^0C/100m) inversions where a 2dB exceedance remained at receivers R1"Bow Hills" and R3 "Naroo" placing these receivers in a noise management zone.

Apart from the bulldozer, the main contributing noise sources would be the rotary breaker and CPP (with attenuation applied) and there is limited scope to effectively reduce noise emissions further. For this reason, it is recommended that noise monitoring, including monitoring at night, be conducted monthly, rather than quarterly, during the first winter of operations to determine the level of impact at receivers R1 and R3. Criterion exceedances would be mitigated or otherwise addressed through application of the NMP.

Exceedances at three northern receivers R13 "Newhaven", R15 "Greylands" and R16 "Belah Park" are predominantly due to drills at the northern ends of LW1 to LW3 and may be mitigated by drill orientation and temporary shielding as recommended in Section 6.2.2.

6.2.5 Predicted Noise Levels - Scenario 2b

Predicted operational noise levels for Scenario 2b (with brine storage pond construction at the northern end of the Brine Storage Area) at all assessed receivers are shown in **Table 9**, which also includes the "differentials" between the predicted levels (maximum over all meteorological conditions) and the noise criterion. Noise contours are shown in **Appendix B**.

Table 9
Predicted Noise Levels (Scenario 2b – Northern Brine Cell Construction) – dB(A), $L_{eq(15\text{-}minute)}$

Location		Meteorological Condition						
		Lapse (calm)	Inversion (^{0}C/100m)			SE wind (3m/s)	Criterion dB(A)	Differential dB
			2	4	6			
R1	"Bow Hills"	30	36	**38**	**40**	27	35	**+5**
R2	"Ardmona"	25	31	34	35	20	35	0
R3	"Naroo"	30	35	**37**	**39**	25	35	**+4**
R4	"Oakleigh"	23	30	33	35	20	35	0
R5	"Pineview"	<20	27	29	32	<20	35	-3
R6	"Matilda"	<20	28	30	33	<20	35	-2
R7	"Haylin View"	20	30	32	34	<20	35	-1
R10	"Merrilong"	<20	26	28	31	<20	35	-5
R11	"Kurrajong"	26	34	35	**37**	24	35	**+2**
R13	"Newhaven"	30	34	35	**38**	35	35	+3
R15	"Greylands"	35	**39**	**40**	**42**	**40**	35	**+7**
R16	"Belah Park"	34	**38**	**40**	**40**	35	35	**+5**
R17	"Bungaree"	25	30	33	34	29	35	-1
R18	"Merulana"	22	28	31	33	28	35	-2
Bold entries refer to noise levels predicted to exceed the nominated criterion								

6.2.6 Noise Control Recommendations - Scenario 2b

Table 9 shows a similar pattern of criterion exceedances to **Table 8**. Brine storage pond construction should not commence prior to 8:30am on days when temperature inversions are indicated to avoid criterion exceedances at R16 "Belah Park" under these conditions. As recommended in Section 6.3.2 above, the dozer would also not operate on the Reject Emplacement Area prior to 8:30am under inversion conditions.

These noise controls would not, however, alter the predicted noise level at receiver R15 "Greylands" under southeast wind conditions, which would remain in a 'noise management zone' (40dB(A) as shown in **Table 9**). Given the campaign nature of construction activities within the Brine Storage Area, it is recommended that further noise management be negotiated with the owners / residents of the "Greylands" property as part of an updated Noise Management Plan.

6.2.7 Predicted Noise Levels - Scenario 3

Predicted operational noise levels for Scenario 3a (works above southern LW 24 to LW 26) at all assessed receivers are shown in **Table 10**, which also includes the "differentials" between the predicted levels (maximum over all meteorological conditions) and the noise criterion. Results for Scenario 3b (as for Scenario 3a but with brine cell construction at the southern end of the allocated area) are shown in **Table 11**. Noise contours are shown in **Appendix B**.

Table 10
Predicted Noise Levels (Scenario 3a – No Brine Cell Construction) – dB(A), $L_{eq(15\text{-}minute)}$

Location		Meteorological Condition						
		Lapse (calm)	Inversion (^{0}C/100m)			SE wind (3m/s)	Criterion dB(A)	Differential dB
			2	4	6			
R1	"Bow Hills"	30	35	**38**	**39**	27	35	**+4**
R2	"Ardmona"	25	33	34	**36**	21	35	+1
R3	"Naroo"	29	**36**	**38**	**40**	25	35	**+5**
R4	"Oakleigh"	23	33	35	**37**	20	35	+2
R5	"Pineview"	20	32	33	35	<20	35	0
R6	"Matilda"	22	34	**37**	**39**	20	35	+4
R7	"Haylin View"	25	**36**	**40**	**43**	22	35	+8
R10	"Merrilong"	24	**36**	**38**	**40**	20	35	+5
R11	"Kurrajong"	**47**	**50**	**>50**	**>50**	43	35	**>15**
R13	"Newhaven"	21	25	28	29	25	35	-6
R15	"Greylands"	30	**36**	**39**	**40**	**37**	35	**+5**
R16	"Belah Park"	26	34	**35**	**37**	31	35	**+2**
R17	"Bungaree"	20	28	30	31	28	35	-4
R18	"Merulana"	20	27	29	31	27	35	-4
Bold entries refer to noise levels predicted to exceed the nominated criterion								

6.2.8 Noise Control Recommendations - Scenario 3

Suspending works in the southern brine storage area and use of a bulldozer on the Reject Emplacement Area under inversion conditions (as recommended for previous scenarios) reduces noise levels at R1 to R3 and R15 to R16 by 2dB relative to levels presented in **Table 10**, thereby leaving R1 "Bow Hills", R3 "Naroo" and R15 "Greylands" in a noise management zone with 1 to 3dB exceedances under worst case meteorological conditions.

Table 11
Predicted Noise Levels (Scenario 3b – Southeastern Brine Cell Construction) – dB(A),$L_{eq(15\text{-}minute)}$

Location		Meteorological Condition						
		Lapse (calm)	Inversion (^{0}C/100m)			SE wind (3m/s)	Criterion dB(A)	Differential dB
			2	4	6			
R1	"Bow Hills"	30	**36**	**38**	**40**	27	35	**+5**
R2	"Ardmona"	25	33	35	**36**	21	35	**+1**
R3	"Naroo"	30	**36**	**38**	**40**	25	35	**+5**
R4	"Oakleigh"	23	34	35	**37**	20	35	**+2**
R5	"Pineview"	20	32	33	35	<20	35	0
R6	"Matilda"	23	35	**38**	**40**	20	35	**+5**
R7	"Haylin View"	25	**37**	**40**	**43**	22	35	**+8**
R10	"Merrilong"	24	**36**	**38**	**40**	20	35	**+5**
R11	"Kurrajong"	47	**50**	**>50**	**>50**	**46**	35	**>15**
R13	"Newhaven"	20	27	28	30	26	35	-5
R15	"Greylands"	30	**37**	**39**	**40**	**38**	35	**+5**
R16	"Belah Park"	29	35	**36**	**38**	34	35	**+3**
R17	"Bungaree"	22	28	30	31	28	35	-4
R18	"Merulana"	21	28	30	31	27	35	-4
Bold entries refer to noise levels predicted to exceed the nominated criterion								

The main feature of the results in **Tables 10** and **11**, and the associated noise contours in **Appendix B**, is the significant noise impact from drilling at the southern ends of LW 24 to LW 26. If left unmitigated, this noise would place R6 "Matilda", R7 "Haylin View", R10 "Merrilong" and R11 "Kurrajong" in an affectation zone with exceedances of 5dB or more and R4 "Oakleigh" would be included in a noise management zone.

It is estimated that practical upper limit on the noise reduction achievable by appropriately positioning and screening a drill rig is 10 dB. At least 8 dB reduction is required to remove R6, R7 and R10 from the noise affectation and management zones. Based on the modelled sound power level of 117 dB(A), drills operating at the southern ends of LW 24 to LW 26 must achieve an equivalent point-source sound power level of no more than 109 dB(A) in the direction of the affected receivers. Even with this noise reduction in place, R11 "Kurrajong" would remain in a noise affectation zone with a level in excess of 40dB(A).

6.3 Modifying Correction Factors

The INP requires that a +5dB correction factor (effectively a 5 dB penalty) be added to measured or predicted noise levels if the received noise contains certain annoyance characteristics such as distinct tones, low frequency noise or is intermittent in nature. Activities associated with the Longwall Project, as perceived from neighbouring residences, would not be tonal or intermittent in nature but must be assessed for low-frequency content. This is accomplished by comparing the C-weighted (essentially linear over the normal audible frequency range from 50 Hz to 10 kHz) and A-weighted levels at the receiver and adding 5dB to the received A-weighted level if the difference is greater than 15dB. The analysis was conducted for Scenarios 2a and 3a under 4^0C/100m temperature inversion conditions as representative of activities and adverse conditions that would regularly occur. Results are shown in **Tables 12** and **13**.

Table 12
Low-frequency Noise Analysis (Scenario 2a, 4^0C/100m inversion) – dB(A),$L_{eq(15\text{-}minute)}$

Receiver		dB(C) Calculated	dB(A) Calculated	Difference (C-A)	Modifying Factor	dB(A) Final
R1	"Bow Hills"	45	37	8	0	37
R2	"Ardmona"	43	33	10	0	33
R3	"Naroo"	47	37	10	0	37
R4	"Oakleigh"	43	32	11	0	32
R5	"Pineview"	41	29	12	0	29
R6	"Matilda"	41	30	11	0	30
R7	"Haylin View"	44	32	12	0	32
R10	"Merrilong"	40	27	13	0	27
R11	"Kurrajong"	44	35	9	0	35
R13	"Newhaven"	45	35	10	0	35
R15	"Greylands"	46	40	6	0	40
R16	"Belah Park"	42	35	7	0	35
R17	"Bungaree"	40	32	8	0	32
R18	"Merulana"	39	30	9	0	30

Table 13
Low-frequency Noise Analysis (Scenario 3a, 4^0C/100m inversion) – dB(A),$L_{eq(15\text{-}minute)}$

Receiver		dB(C) Calculated	dB(A) Calculated	Difference (C-A)	Modifying Factor	dB(A) Final
R1	"Bow Hills"	48	38	10	0	37
R2	"Ardmona"	44	34	10	0	33
R3	"Naroo"	47	38	9	0	37
R4	"Oakleigh"	42	35	7	0	32
R5	"Pineview"	40	33	7	0	29
R6	"Matilda"	43	37	6	0	30
R7	"Haylin View"	47	40	7	0	32
R10	"Merrilong"	44	38	6	0	27
R11	"Kurrajong"	>50	>50	4	0	35
R13	"Newhaven"	43	28	15	5	33
R15	"Greylands"	46	39	12	0	40
R16	"Belah Park"	42	35	13	0	35
R17	"Bungaree"	41	30	11	0	30
R18	"Merulana"	40	29	11	0	29

Results **Tables 12** and **13** show that (C-A) levels generally become greater at larger separation distance between source and receiver, with values ranging between 6-15dB. A modifying factor of 5dB added to the predicted level of 28 dB(A) at R13 "Newhaven" increases the reportable noise level to 33 dB(A) at this receiver for this scenario.

It is anticipated that measurement and application of all INP modifying correction factors will be required in the Stage 2 noise monitoring program.

6.4 Sleep Disturbance Assessment

Predicted sleep disturbance impact (maximum) noise levels at all non-project related residences are shown in **Table 14** which also includes the "differentials" between the predicted levels (maximum over all meteorological conditions) and the noise criterion. The results reflect the fact that brine cell construction would not occur at night time.

Table 14
Predicted Maximum operational Noise Levels – dB(A),$L_{A1(1\text{-}minute)}$

Location		Meteorological Condition						
		Lapse (calm)	Inversion (^{0}C/100m)			SE wind (3m/s)	Criterion dB(A)	Differential dB*
			2	4	6			
R1	"Bow Hills"	32	38	40	43	29	45	-2
R2	"Ardmona"	26	31	34	36	23	45	-9
R3	"Naroo"	31	37	39	41	26	45	-4
R4	"Oakleigh"	25	29	31	35	24	45	-10
R5	"Pineview"	21	24	30	33	23	45	-12
R6	"Matilda"	21	29	32	35	21	45	-10
R7	"Haylin View"	22	31	32	37	23	45	-8
R10	"Merrilong"	22	26	29	33	23	45	-12
R11	"Kurrajong"	27	36	40	41	30	45	-4
R13	"Newhaven"	24	29	31	30	29	45	-15
R15	"Greylands"	31	38	40	42	39	45	-3
R16	"Belah Park"	27	34	36	39	34	45	-6
R17	"Bungaree"	22	30	31	31	29	45	-14
R18	"Merulana"	23	28	30	30	29	45	-15

The predicted maximum noise levels in **Table 14** are all below the sleep disturbance criterion.

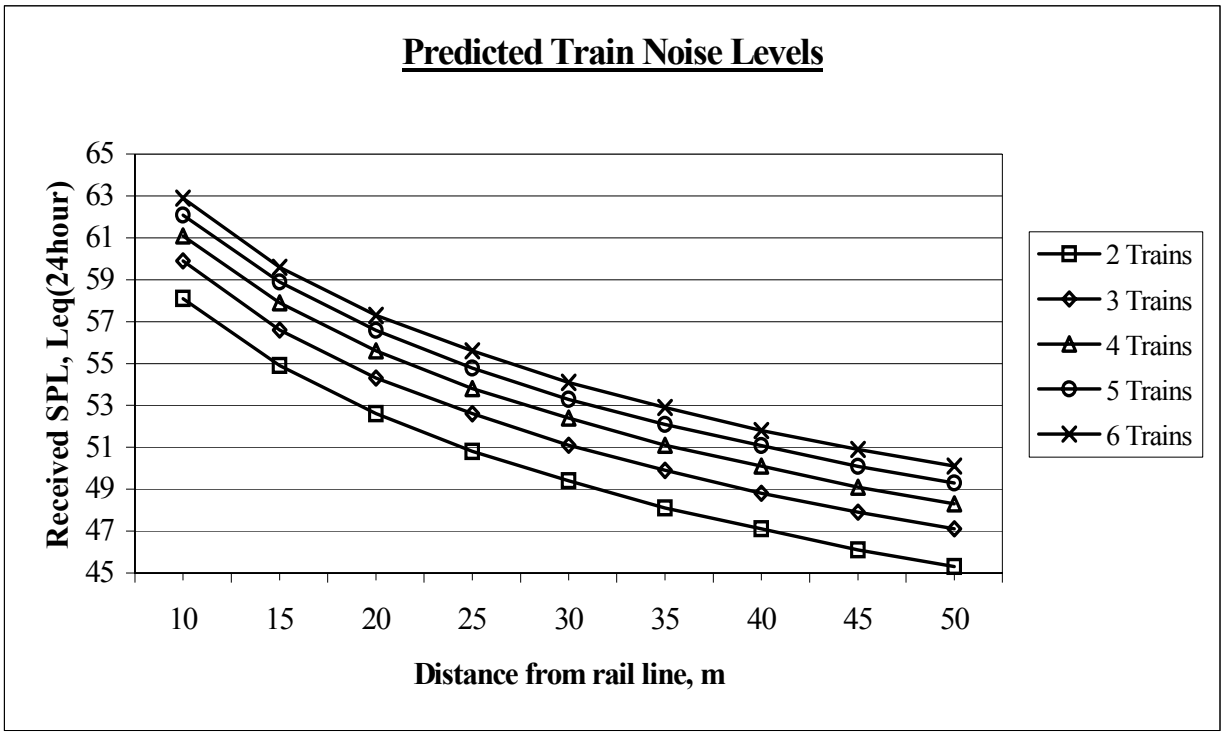
6.5 Rail Noise Assessment

Figure 9 shows predicted train pass-by noise levels out to a distance of 50m from the centre line of a passing coal train based on **Equation 2** and sound power levels provided in **Appendix A** for coal trains in motion. The closest residence to the North Western Branch Railway Line within several kilometres of the Mine Site ("Ardmona") is at a distance of approximately 140m. At this distance, more than 17 coal train movements per 24-hour period could cause the DECC criterion of 55dB(A),$L_{eq(24\ hour)}$ to be exceeded. As the Longwall Project would not produce sufficient coal to require more than 5 trains per day (10 train movements), an actual train noise level of 46dB(A),$L_{eq(24\ hour)}$ is anticipated at "Ardmona".

Trains travelling south from the Mine Site would firstly pass through the village of Baan Baa. A site visit confirmed that the closest residence to the rail line is 60m to the west and approximately 65m from a level crossing which is equipped with lights and warning bells. Train noise levels at this distance are predicted to be 52dB(A),$L_{eq(24\ hour)}$ and 60dB(A),L_{max}. These levels are below the DECC recommended criteria of 55dB(A),$L_{eq(24\ hour)}$ and 80dB(A),L_{max}.

Based on previous measurements near levels crossings, it is anticipated that noise from the warning bells would be approximately 60-70 dB(A),L_{max} at the nearest residence in Baan Baa.

Figure 9
Predicted Train Noise Levels



Further south, in Boggabri, coal trains from the Longwall Project would combine with the maximum 3 trains per day from the approved Boggabri Coal Project. The total of eight trains (ie, 16 movements) would produce a level 57dB(A),$L_{eq(24\ hour)}$ at a distance of 30m from the rail line, if travelling at speed. Since trains are likely to be limited to a speed of 60 km/h in town, noise levels will be approximately 2 to 4dB lower than when travelling at 80 km/h and the 55 dB(A) criterion is likely to be met at a distance of 20m. No residences have been identified within this distance from the rail line.

At a distance of 140m, L_{max} train noise levels are likely to be approximately 54dB(A), based on previous measurements of coal trains. This is well below the DECC recommended maximum level of 80dB(A). Of the residences considered in this study, all are at significantly greater distances from the rail line than "Ardmona" and will receive much lower train noise levels.

A review of the ARTC's *"Standard Working Timetable – Freight and Country Passenger Services from 5 August 2007 – Booker 5 North and North West"*, effective 8 January 2008, suggests that there are over 160 timetabled coal train slots (100+ during the day and 60+ during the night) on the Main Northern Line. This capacity is not filled by the current coal train numbers. Data presented in the EA for Minimbah Third Track by GHD (GHD 2008) suggest an actual maximum volume of 63 coal trains during the day and 35 coal trains at night through the most densely populated areas around Maitland.

The addition of up to 10 additional trains per 24-hour period from the Longwall project would increase existing L_{Aeq} train noise levels by an immeasurable and inaudible amount of approximately 0.4dB, with no increase in L_{Amax} levels. This insignificant increase in noise would not affect any current train noise set-back distances, and further assessment of train noise impacts from the proposal is not considered necessary.

6.6 Road Traffic Noise Assessment

The estimated numbers of vehicle movements generated by the Longwall Project, as provided by the Proponent, is presented in **Table 15**.

The adopted traffic noise criteria apply to 1-hour noise levels rather than daily average levels. Maximum hourly traffic levels occur during shift changes and it is common for 25% of the total daily light vehicle traffic (workforce) to occur during a 1-hour period. It is therefore possible for up to 95 light vehicle movements to occur in an hour at shift change.

As a worst case, considering all these vehicles travelling either north or south of the Mine Site on the Kamilaroi Highway, the greatest potential impact would be at either "Belah Park" or "Ardmona", which are approximately 230m and 140m east of the highway, respectively.

Table 15
Indicative Vehicle Movements During Mining Operations

Activity	Vehicle Type	Estimated Average Daily Vehicle Movements	
		Average	Maximum
Equipment / supplies deliveries	Semi-trailer, rigid truck	8	20
Workforce	Passenger vehicles	218[3]	300
Miscellaneous	Various light vehicles	20	40
TOTAL	Heavy	8	20
	Light	254	380

1. One round trip = 2 movements
2. Assumes 365 days per year operations
3. Assumes 1.7 employees/vehicle

Based on a road speed of 100km/h, **Equation 2** gives a predicted sound pressure level of 42dB(A),$L_{eq(1\ hour)}$ at the nearest receiver "Ardmona", which is considerably below the night time criterion level of 55dB(A),$L_{eq(1\ hour)}$.

Based on a worst case (and unrealistic) assumption that all of the estimated daily total of 20 light and heavy delivery trucks may pass by "Ardmona" in a 1-hour period, the predicted noise level is 44dB(A),$L_{eq(1\ hour)}$. Assuming further that these deliveries arrive during a night-time shift change, the total predicted traffic noise level at these residences is only 47dB(A),Leq(1 hour) and the criterion is easily satisfied.

6.7 Blasting Assessment

Based on the formulae presented in Section 5.6 and a minimum distance from the closest residence to the closest ventilation shaft, approximately 1900m to "Kurrajong", a Maximum Instantaneous Charge of 225kg would result in blasting emissions that would be less than the relevant criterion. In addition, as blast monitoring information is collected, site laws would be developed which would more precisely identify the blasting impacts. Finally, the Proponent would ensure that only qualified and experienced blasting engineers or shot firers would design and implement blasting operations and that these operations would be designed to ensure that blasting impacts of surrounding residences would be less than the relevant criteria.

As a result, blasting-related impacts would not exceed the relevant criteria at surrounding residences.

7 SUMMARY

An assessment has been conducted to determine the noise and vibration impact of the Narrabri Coal Mine Stage 2 Longwall Project. Modelling results show noise criterion exceedances at several non-project-related residential locations under noise-enhancing atmospheric conditions during various stages of the project.

The noise modelling also found that noise emissions from the proposed rotary breaker and coal preparation plant could be excessive. Consequently, it has been recommended that these items be fully enclosed to reduce noise emissions.

The following recommendations have been made to reduce the noise impact of the proposal as far as reasonably and feasibly possible.

- No more than two scrapers are to be used during the earthworks stage under temperature inversion conditions.
- Use of a bulldozer on the Reject Emplacement Area will be suspended under inversion conditions.
- Only one truck per 15 minute period will transport reject to the Reject Emplacement Area under inversion conditions.
- Drills operating at the northern ends of LW1 to LW3 or at the southern ends of LW24 to LW26 must have temporary noise screens positioned so as to achieve a sound power level of 109 dB(A) in the direction of the nearest residences, if these drills are to operate under inversion conditions.

With the above noise mitigation strategy in place, there will be residual criterion exceedances at four residences as summarised in **Table 16**.

Table 16
Summary of noise impacted residential receivers

Noise Management Zone (exceedances of 1-5 dB)		**Noise Affectation Zone (exceedances of 5dB or more)**	
Receiver	**Noise source**	**Receiver**	**Noise source**
R1 “Bow Hills” R3 “Naroo” R15 “Greylands”	General surface plant	R11 “Kurrajong”	Drilling above LW 24 to LW 26

It is recommended that the quarterly operational noise monitoring program should continue until at least the end of the first 12-month period of Longwall Project operations so that several noise-enhancing meteorological conditions are encountered. Noise monitoring locations would be determined in consultation with DECC but would include at least those receivers listed in **Table 16**. R13 “Newhaven” should also be included as a monitoring location when surface preparation works are occurring above LW1 to LW3. Since there are receivers in a noise management zone, a Noise Management Plan (NMP) should be developed to specifically address these receivers.

No exceedances of noise limits for projected-generated road traffic or rail transport of coal have been predicted.