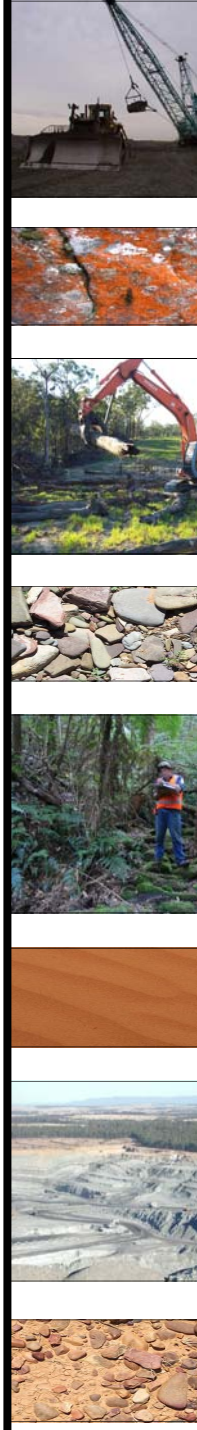
Noise Impact Assessment
(SLR, 2011)



APPENDIX 5

global environmental solutions

Ventilation Air Methane Abatement Demonstration Project

Mandalong Mine

Noise Impact Assessment

Report Number 30-2517

23 May 2011

Centennial Mandalong Pty Limited
c/- GSSE
Level 1, 241 Denison Street
Broadmeadow NSW 2292

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Ventilation Air Methane Abatement Demonstration Project

Mandalong Mine

Noise Impact Assessment

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Level 1, 14 Watt Street Newcastle NSW 2300 Australia

(PO Box 1768 Newcastle NSW 2300 Australia)
T: 61 2 4908 4500 F: 61 2 4908 4501
E: newcastle@slrconsulting.com www.slrconsulting.com

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EXECUTIVE SUMMARY

Centennial Mandalong Pty Limited (Centennial Mandalong) seeks to reduce the greenhouse gas emissions from Mandalong Mine (Mandalong) by reducing the amount of methane being ventilated to the atmosphere through the installation of additional infrastructure to capture and abate approximately 10 cubic metres per second (m^3/s) of ventilation air methane (VAM). Centennial Mandalong is therefore seeking to modify the current Development Consent (DA 97/800) under Section 75W of the EP&A Act to allow for the installation and operation of the ventilation air methane abatement plant.

SLR Consulting Australia Pty Ltd (SLR Consulting) has undertaken a noise impact assessment for Phase 1 of the proposed ventilation air methane abatement plant at Centennial's Mandalong Mine Surface Facilities Area, involving the installation and operation of a single ventilation air methane regenerative afterburner (the Project).

Noise Criteria

Project Specific Noise Criteria for the Project were adopted from *Mandalong Mine Modification to Development Consent Noise and Vibration Impact Assessment* by Bridges Acoustics (May 2008). Measurements have been conducted by SLR Consulting in the vicinity of Mandalong Mine over the past three (3) years in accordance with the approved Noise Monitoring Program. The Project Specific Noise Criteria determined by Bridges have been reconsidered with reference to the recent SLR Consulting monitoring data. The Project Specific Noise Criteria determined by Bridges are still considered relevant at this time.

Construction noise criteria were also established with reference to Schedule 2 Condition 43 of the current Development Consent (DA 97/800 Mod 4, July 2009).

Meteorological Data

Weather data was obtained, for a period of 12 months (2006), from the automatic weather station located at the Mandalong Mine. This calendar year of weather data was chosen for consistency with the current SLR Consulting and previous Holmes Air Quality assessments and because it appears to provide the most representative data. Mandalong weather data for more recent years contain unusually high percentage of calm conditions. Furthermore, similar trends are also evident in data obtained from the Cooranbong and Newstan weather stations.

Prevailing winds (from the south-west) were identified as a feature of the area. Noise modelling under prevailing wind was therefore conducted as part of this investigation.

Meteorological data was not available to allow the determination of the percentage occurrence of temperature inversions during winter nights. A worst case analysis was therefore undertaken and the occurrence of temperature inversions during the night-time period has been considered as part of this noise assessment.

EXECUTIVE SUMMARY

Noise Modelling and Assessment

A computer model was used to predict noise emissions from the Project. The noise modelling was undertaken using the Concawe algorithms within SoundPLAN v7.0 software, developed by Braunstein and Berndt Gmbh in Germany. Topographic contours and operational information were supplied by Centennial for the purpose of modelling noise from the subject site. The model used this information, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Prediction of noise emission levels was carried out under calm and prevailing atmospheric conditions.

Sound power levels of relevant existing and approved plant and equipment were obtained from measurements of plant already operating at the site or have been sourced from a SLR Consulting database of similar equipment. The sound power level of the proposed VAM-RAB unit has been estimated at 97 dBA based on measurements conducted of a similar unit and information provided by the manufacturer.

Noise modelling results under all considered meteorological conditions indicate that the addition of the proposed VAM-RAB is predicted to increase noise levels by less than 1 dBA at the nearest assessed residential locations.

Furthermore, noise emission levels from Mandalong Mine, including the proposed VAM-RAB, are predicted to meet the relevant Project Specific Noise Criteria for all considered meteorological conditions at all assessed residential locations.

Results of current noise modelling (refer to **Sections 7.1.2** and **7.1.3** of this report) indicate that current mine noise emission levels are predicted to be up to 8 dBA above the current consent conditions. This is due to the fact that the current Mandalong Mine Consent conditions relevant to noise were established based on predicted noise emissions provided in *Mandalong Modification to Development Consent Environmental Assessment - Appendix D* (Bridges Acoustics, May 2008). Bridges' predictions differ from the current noise modelling primarily due to the different meteorological scenarios considered.

The meteorological scenarios considered as part of the current noise impact assessment represent acoustically worst-case conditions at the nearest potentially affected residential receivers and, thus, are considered appropriate for assessment purposes. Therefore, Centennial Mandalong will seek a modification to its current consent conditions to have the noise criteria modified to be consistent with the Project Specific Noise Criteria.

It is understood by SLR Consulting that the nature of the noise generated by the VAM-RAB unit is that of constant fan-type noise. Hence, no additional impacts in terms of potential for sleep disturbance are expected from operation of the VAM-RAB.

It is predicted that construction noise levels will be below the relevant noise goal for the daytime period at all assessed residential locations under calm and prevailing weather conditions.

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1 INTRODUCTION

Centennial Mandalong Pty Limited (Centennial Mandalong) seeks to reduce the greenhouse gas emissions from Mandalong Mine (Mandalong) by reducing the amount of methane being ventilated to the atmosphere through the installation of additional infrastructure to capture and abate approximately 10 cubic metres per second (m^3/s) of ventilation air methane (VAM). Centennial Mandalong is therefore seeking to modify the current Development Consent (DA 97/800) under Section 75W of the EP&A Act to allow for the installation and operation of the ventilation air methane abatement demonstration plant.

SLR Consulting Australia Pty Ltd (SLR Consulting) has been commissioned by GSS Environmental (GSSE) on behalf of Centennial Mandalong (the Proponent) to undertake noise and air quality impact assessments for Phase 1 of the proposed greenhouse gas abatement plant at Centennial's Mandalong Mine Surface Facilities Area.

This report presents the Noise Impact Assessment (NIA) for the proposed ventilation air methane abatement demonstration plant at Centennial's Mandalong Mine.

1.1 NSW Department of Planning and Infrastructure Requirements

Director-General's Requirements were not issued by the Department for this project.
Notwithstanding this, the Department indicated that the Environmental Assessment must address the following with regard to noise:

> *Noise – including an assessment of noise impacts to determine the level of cumulative impacts of the existing, approved and proposed equipment and plant on-site for near-by residential receivers.*

This noise impact assessment considers the cumulative impact of the existing, approved and proposed equipment and plant on-site at the nearest potentially affected residential receivers and thus satisfies the requirement of the Department.

2 PROJECT OVERVIEW

Greenhouse gas emissions from the Mandalong Mine are relatively high, with 1 Mt of carbon dioxide equivalent (direct emissions) produced each year. Methane has a global warming potential 21 times that of carbon dioxide if released unabated into the atmosphere. Methane released from the coal seam consists of high purity methane drainage gas (32%) and high flow rate ventilation air methane (VAM). The greenhouse gas emission for the high purity methane can be reduced by gas flares (burning) and gas engines (power generation) and installation of both alternatives has already been approved. The reduction of greenhouse gas emission for the high purity methane is outlined in the Modification to Development Consent (Holmes Air Sciences, 2008).

The VAM is more difficult to utilise. Methane is only flammable in air when the temperature is above 595ºC and the concentration exceeds 5%. The methane concentration in VAM is however only 1%, making it more difficult to mitigate than the high purity methane. Different alternatives are currently being researched by the industry. One abatement technique is to oxidise the methane in a ventilation air methane regenerative afterburner (VAM-RAB) unit where the VAM is progressively heated to 700ºC through a series of chequer bricks until it reaches the combustion chamber with a temperature of 1,000ºC. The high temperature oxidises 99.9% of the methane to carbon dioxide. The heat from the air is then transferred back to the chequer bricks before the air is emitted. The Proponent is seeking approval for a single VAM-RAB unit without heat recovery or generation capability, as a demonstration project to prove the technology. An indicative layout of the proposal is shown in **Figure 1**.

Figure 1 Indicative Layout of Proposed VAM-RAB

It is anticipated that the majority of the VAM-RAB unit will be constructed off-site. Construction activity associated with the project on-site will be minor and primarily consist of civil earthworks and foundations. The proposed VAM-RAB location will require filling to achieve the appropriate levels. The top 200 mm of topsoil at the site will be trimmed and then approximately 700-1200 mm compacted fill shall be placed. Preliminary geotechnical information shows that the RAB tower and conditioning duct can be supported with shallow footings. It is anticipated that there would be minimal (if any) further excavation into natural soil.

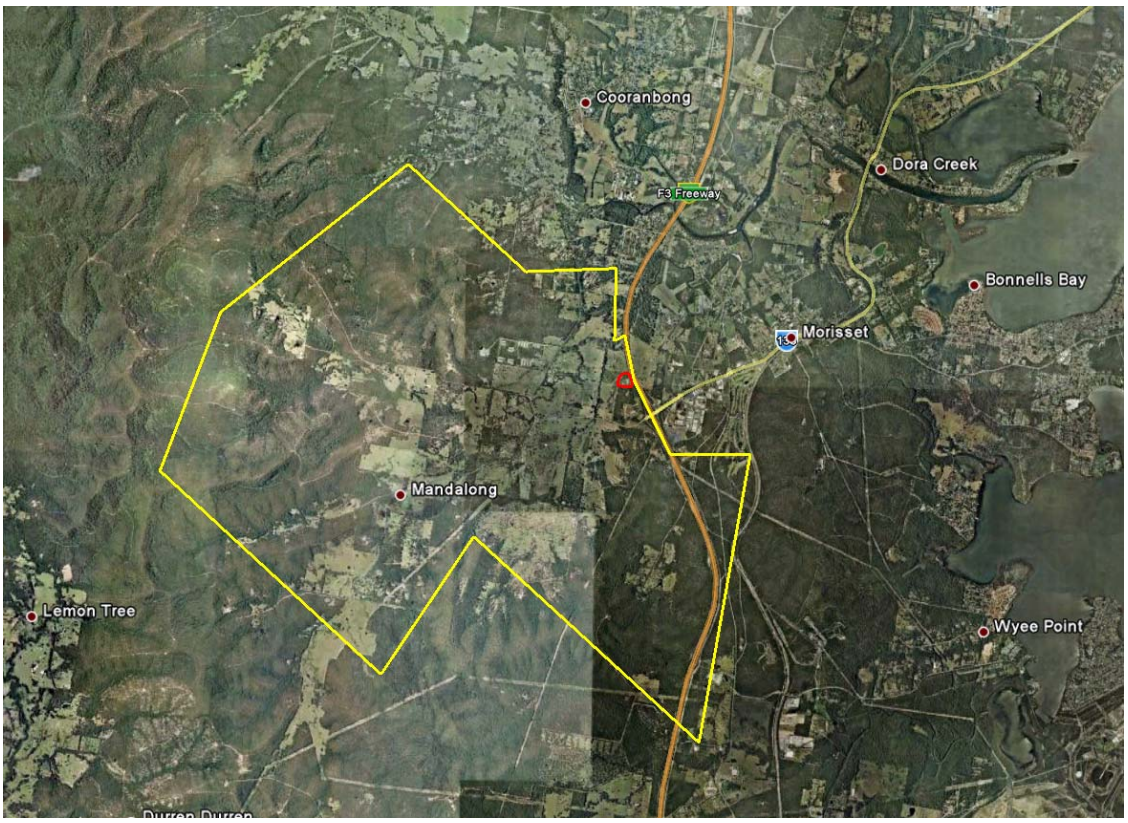
Foundations and civil works will take approximately four (4) weeks. During this time, the following machinery/equipment will be used:

- Sheepsfoot roller;
- Truck and trailer (for transporting fill);
- Small excavator;
- Concrete truck;
- Concrete pump;
- Concrete vibrator; and
- Hand held tools.

3 PROJECT SETTING

The Mandalong Mine site is located near Morisset, approximately 5 km west of Lake Macquarie, in the Newcastle Coalfield of New South Wales. The Project Site is bounded by the F3 Sydney–Newcastle Freeway to the east and Mandalong Road to the south. **Figure 2** illustrates the local setting of the Project Site.

Figure 2 Local Setting of Centennial's Mandalong Mine

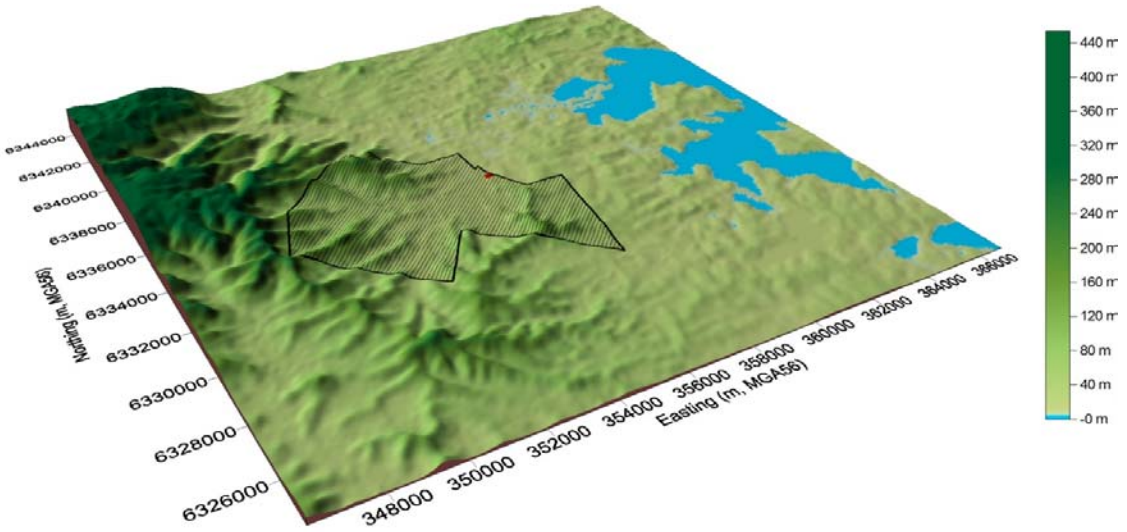


Source: Google Earth 2011

The Project Site and surrounding residences are located in undulating terrain, with elevated terrain located south and west of the site. The Project Site is situated at an approximate elevation of 10 m Australian Height Datum (AHD), with a ridge running in a north-southerly direction located just south of the site. The land levels out to the east of the site towards Lake Macquarie.

The topography of the local region surrounding the Project Site is presented in **Figure 3**.

Figure 3 Local Topography



3.1 Sensitive Receptors

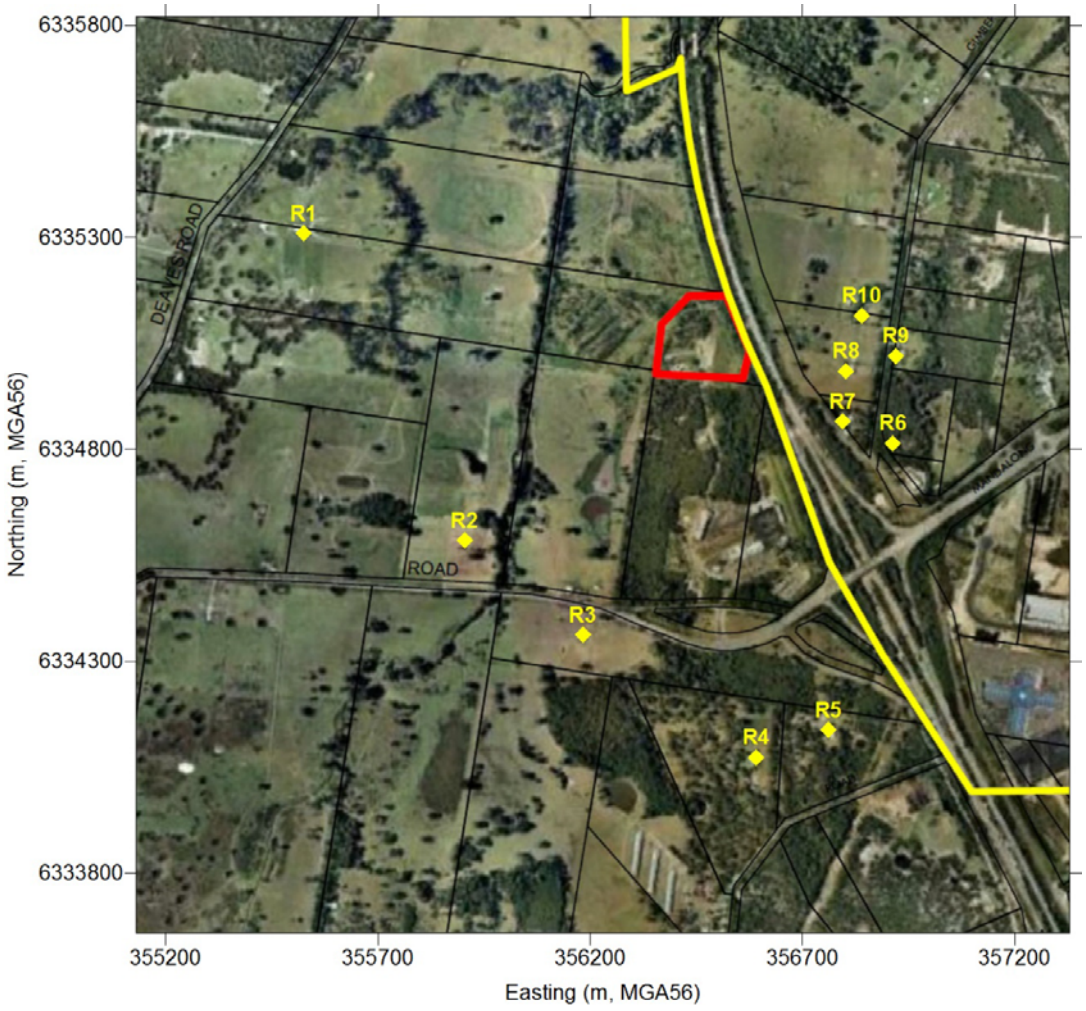
A number of residences are located in the area surrounding the Project Site. The nearest non-project related residences have been identified as sensitive receptor locations to be considered as part of the Noise Impact Assessment. A list of the nearest sensitive receptors in the immediate vicinity of the Project Site (R1 to R10) and their respective distances from the Project Site boundary are presented in **Table 1** and **Figure 4.**

Table 1 Nearest Sensitive Receptors

Receptor ID*	Location	Ownership	Location (m, MGA56)		Distance (m) / Direction From Site Boundary	Elevation (m, AHD)
			Easting	Northing		
R1 (64)	61//9632	Private	355,525	6,335,309	850 / WNW	9
R2 (82)	2//557230	Private	355,904	6,334,585	560 / SW	9
R3 (97)	10//261891	Private	356,183	6,334,363	610 / SSW	14
R4 (109)	4//555891	Private	356,591	6,334,074	870 / S	37
R5 (110)	3//13318	Private	356,761	6,334,138	840 / SSE	25
R6 (86)	1//262159	Private	356,913	6,334,814	400 / ESE	23
R7 (85)	4//262159	Private	356,795	6,334,866	270 / ESE	19
R8 (72)	7//262159	Private	356,803	6,334,985	250 / E	16
R9 (73)	3//10720	Private	356,920	6,335,020	380 / E	18
R10 (66)	9//262159	Private	356,839	6,335,116	310 / E	14

*The receptor ID number provided in brackets is with reference to Schedule 6 (Noise Receiver Locations) of the Modified Project Approval (DA97/800 MOD 4, July 2009).

Figure 4 Sensitive Receptors Surrounding the Project Site



4 SUMMARY OF PREVIOUS NOISE ASSESSMENTS AND MONITORING

4.1 Mandalong Mine Statement of Environmental Effects (SKM, October 2004)

The Mandalong Mine SoEE (SKM, October 2004) included a noise impact assessment which evaluated potential noise impacts from both construction and operation of the (then proposed) methane drainage plant.

This assessment concluded that noise from both construction and operational activities would have negligible impact on the surrounding noise-sensitive receivers.

4.2 Mandalong Modification to Development Consent Environmental Assessment– Appendix D (Bridges Acoustics, May 2008)

The *Mandalong Mine Modification to Development Consent Noise and Vibration Impact Assessment* by Bridges Acoustics (May 2008) provided an assessment of potential noise impacts as a result of the (then proposed) modifications in accordance with the Industrial Noise Policy (INP). The (then proposed) additions and alterations to Mandalong Mine were as follows:

- A 2 Mtpa increase in capacity, allowing for up to 6 Mtpa of ROM coal to be mined.
- The construction and operation of multiple gas engines with a total power of 12 MW, fuelled by the methane gas captured by the existing methane drainage plant.
- Relocation of the approved ballast borehole.

The Bridges' assessment included ambient noise monitoring, determination of project specific noise levels, weather data analysis and prediction and assessment of likely noise levels at the nearest potentially affected residential locations. This impact assessment concluded the following with regard to potential noise and vibration impacts associated with the modifications:

> *Predicted noise levels from the proposed ballast borehole are expected to remain within relevant noise criteria provided the hopper at the top of the borehole is constructed with an effective noise damping material such as concrete. Truck movements associated with operation of the borehole during the day are not expected to cause excessive noise to any residence.*
>
> *Existing noise levels from the Mandalong Mine Services Site currently meet relevant noise criteria and are expected to remain within the criteria when the approved coal preparation plant, conveyors, stockpiles and other equipment are constructed and operated.*
>
> *Based on the results of this assessment, environmental noise and vibration levels associated with this Modification are considered acceptable provided the gas engines are designed and constructed to meet the recommended sound power level listed in Table 8 for these units.*

4.3 Ongoing Noise Compliance Measurements

Annual noise monitoring has been conducted to assess operational noise levels with regard to the noise limits in the Mine's consent (Condition 44) in accordance with the approved Noise Monitoring Program (NMP) (Condition 45). SLR Consulting has monitored operational noise emission levels from Mandalong Mine on an annual basis since 2008.

Each round of noise monitoring (2008, 2009 and 2010) determined that noise emission levels from Mandalong Mine were inaudible at most monitoring locations and below the relevant criteria at all monitoring locations.

5 PROJECT NOISE CRITERIA

5.1 Operational Noise Criteria

5.1.1 Mandalong Mine Conditions of Consent (DA 97/800 Mod 4, July 2009)

Mandalong Mine Consent conditions relevant to noise were established based on predicted noise emissions provided in *Mandalong Modification to Development Consent Environmental Assessment - Appendix D* (Bridges Acoustics, May 2008). These predictions were based on the proposed development at that time and on certain meteorological parameters which were, in turn, based on an analysis of weather data available at that time.

Operational noise criteria are outlined in Schedule 2 Condition 44 of the current Development Consent (DA 97/800 Mod 4, July 2009) and have been reproduced as follows.

> *44. The Applicant shall ensure that the noise generated by the development at any residence on privately-owned land, or on more than 25% of any privately-owned land, does not exceed the noise impact assessment criteria in Table 1 for the noise receiver location nearest to that residence or land.*

Table 1: Noise impact assessment criteria (dB(A))

Noise Receiver locations	***Day***	***Evening***	***Night***
	$L_{Aeq\ (15\ minute)}$	$L_{Aeq\ (15\ minute)}$	$L_{Aeq\ (15\ minute)}$
23	*36*	*39*	*39*
72 (Shown as property 313 in schedule 4) *85 (Shown as property 314 in schedule 4)*	*37*	*35*	*38*
26	*35*	*37*	*37*
86(Shown as property 308 in schedule 4) *89(Shown as property 310 in schedule 4)* *110(Shown as property 244 in schedule 4)*	*35*	*35*	*36*
All other privately-owned land	*35*	*35*	*35*

> *Where monitoring levels indicate that the noise level at the boundary or at a residence of an privately-owned property exceeds the noise impact assessment in Table 1, then additional monitoring will be undertaken (with the approval of the Land Owner) across the property to develop noise level contours to establish that not more than 25% of the land, is not impacted.*
>
> *However, if the Applicant has a written negotiated noise agreement with any landowner of land listed in Table 1, and a copy of this agreement has been forwarded to the Department and DECC, then the Applicant may exceed the noise limits in Table 1 at that land in accordance with the negotiated noise agreement.*

Notes:

1. The noise receiver locations are as described in the EA accompanying DA 97/800 MOD 4, and shown in schedule 6.
2. To determine compliance with the $L_{Aeq(15\ minutes)}$ noise limits, noise from the development is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of a dwelling (rural situations) where the dwelling is more than 30 metres from the boundary. Where it can be demonstrated that direct measurement of noise from the development is impractical, the Department may accept alternative means of determining compliance (see chapter 11 of the NSW Industrial Noise Policy). The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.
3. The noise emission limits identified in the above table apply under meteorological conditions of:
   - Wind speeds of up to 3m/s at 10 metres above ground level; or
   - *Temperature inversion conditions of up to 3^0C/100m, plus a 2m/s source-to-receiver component drainage flow wind a 10 metres above ground level for those receivers where applicable in accordance with the NSW Industrial Noise Policy*

5.1.2 Project Specific Noise Criteria

Project Specific Noise Criteria presented in Appendix D of the EA (Bridges, 2008) have been reproduced in **Table 2**.

Table 2 Adopted Mining Noise Criteria at Residences (Table 5, Bridges 2008)

Location	Period	Intrusive Criteria $L_{Aeq(15minute)}$	Amenity Criteria $L_{Aeq(Period)}$
M2 (West of Mine) [R1 - R5]	Day	54 dBA	50 dBA
	Evening	54 dBA	45 dBA
	Night	42 dBA	40 dBA
M3 (East of Mine) [R6 - R10]	Day	60 dBA	54 dBA
	Evening	56 dBA	48 dBA
	Night	48 dBA	47 dBA

Measurements have been conducted by SLR Consulting in the vicinity of Mandalong Mine over the past three (3) years in accordance with the approved Noise Monitoring program. The Project Specific Noise Criteria determined by Bridges have been reconsidered with reference to the recent SLR Consulting monitoring data. The Project Specific Noise Criteria determined by Bridges are still considered relevant at this time.

It is considered appropriate to assess the current proposal with reference to the Project Specific Noise Criteria (presented in **Table 2**), rather than the current consent conditions relating to noise, for two main reasons:

1. The current proposed Modification involves the installation of additional plant to that previously assessed (Bridges, 2008).

2. Additional meteorological scenarios are to be considered (refer to **Section 6** of this report).

5.2 Construction Noise Criteria

Construction noise criteria are outlined in Schedule 2 Condition 43 of the current Development Consent (DA 97/800 Mod 4, July 2009) and have been reproduced as follows.

> *43. The Applicant shall ensure that the contributed $L_{A10(15min)}$ noise level due to construction works, when measured or computed at any dwelling not owned by the Applicant shall not exceed the following noise emission levels assessed under prevailing weather conditions:*
> *Daytime (0700 hours to 2200 hours) –*
> *(i) For a cumulative noise exposure period greater than 26 weeks, the $L_{A10(15\ min)}$ noise level should not exceed the $L_{A90(15min)}$ background level by more than 5 dB(A);*
> *(ii) For a cumulative noise exposure period between 4 and 26 weeks, the $L_{A10(15\ min)}$ noise level should not exceed the $L_{A90(15min)}$ background level by more than 10 dB(A);*
> *(i) For a cumulative noise exposure period of up to 4 weeks, the $L_{A10(15\ min)}$ noise level should not exceed the $L_{A90(15min)}$ background level by more than 20 dB(A);*
> *Night-time (2200 hours to 0700 hours)*
> *(iv) For any noise exposure duration, the $L_{A10(15\ min)}$ noise level should not exceed the $L_{A90(15min)}$ background level by more than 5 dB(A).*
>
> *Note: Prevailing weather conditions include calm and windy conditions, but in the absence of temperature inversions. However, if it is established that the frequency of temperature inversions exceed 15% of the time during the night-time in winter as measured in terms of DECC requirements, then temperature inversions shall be considered as prevailing conditions for the purposes of determining if acquisition is required under Condition 48.*

The relevant construction noise goals are contained in **Table 3** and are based on an assumed construction period of up to 4 weeks duration.

Table 3 Construction Noise Goals

Location	Period	Adopted Background Noise Level (RBL)* (dBA)	Noise Goal LA10(15minute) (dBA)
R1 - R5 (West of Mine)	Day	49	69
	Evening	49	69
	Night	37	42
R6 – R10 (East of Mine)	Day	56	76
	Evening	51	71
	Night	43	48

For Monday to Saturday, Daytime 7.00 am - 6.00pm; Evening 6.00pm - 10.00pm; Night-time 10.00pm - 7.00am.
On Sundays and Public Holidays, Daytime 8.00am - 6.00pm; Evening 6.00pm - 10.0 pm; Night-time 10.0 pm - 8.00am.
*Obtained from *Mandalong Mine Modification to Development Consent Noise and Vibration Impact Assessment* by Bridges Acoustics (May 2008).

6 EFFECTS OF METEOROLOGY ON NOISE LEVELS

6.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receiver at speeds up to 3 m/s for more than 30% of the time in any season, then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Weather data was obtained, for a period of 12 months (2006), from the automatic weather station located at the Mandalong Mine. This calendar year of weather data was chosen for consistency with the current SLR Consulting and previous Holmes Air Quality assessments and because it appears to provide the most representative data. Mandalong weather data for more recent years contain unusually high percentage of calm conditions. Furthermore, the same trends (prevailing South West and Southerly winds) are also evident in data obtained from the Cooranbong and Newstan weather stations.

This data was analysed to determine the frequency of occurrence of winds up to speeds of 3 m/s for daytime, evening and night in each season. A summary of the most frequently occurring winds is contained within **Table 4**, **Table 5** and **Table 6**.

Table 4 Seasonal Frequency of Occurrence of Wind Speed Intervals – Daytime

Period	Calm	Wind Direction	0.5 – 2 m/s	2 – 3 m/s	0.5 – 3 m/s
Summer	1.5%	SE±45°	7.1%	12.7%	19.8%
Autumn	12.5%	SW±45°	18.4%	11.6%	30.0%
Winter	20.4%	SW±45°	22.7%	13.0%	35.7%
Spring	9.0%	SSW±45°	7.3%	8.9%	16.2%

Table 5 Seasonal Frequency of Occurrence of Wind Speed Intervals –Evening

Period	Calm	Wind Direction	0.5 – 2 m/s	2 – 3 m/s	0.5 – 3 m/s
Summer	27.0%	SSW±45°	24.1%	2.8%	26.9%
Autumn	55.4%	SW±45°	21.1%	1.5%	22.6%
Winter	64.4%	WSW±45°	19.2%	4.5%	23.6%
Spring	53.8%	SW±45°	23.5%	7.6%	31.0%

Table 6 Seasonal Frequency of Occurrence of Wind Speed Intervals – Night

Period	Calm	Wind Direction	0.5 – 2 m/s	2 – 3 m/s	0.5 – 3 m/s
Summer	49.4%	SW±45°	29.8%	5.5%	35.3%
Autumn	66.7%	WSW±45°	22.6%	1.3%	24.0%
Winter	55.3%	WSW±45°	24.0%	7.7%	31.7%
Spring	43.2%	SW±45°	21.5%	6.7%	28.1%

Seasonal wind records indicate that certain winds (from the south-west and west-south-west) are a feature of the area. The frequency of winds below 3 m/s is above the 30% threshold during several seasons and periods. Modelling under prevailing wind was therefore conducted as part of this investigation.

6.2 Temperature Inversion

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night-time during winter, or about two nights per week.

Meteorological data was not available to allow the determination of the percentage occurrence of temperature inversions during winter nights. A worst case analysis was therefore undertaken and the occurrence of temperature inversion during the night-time period has been considered as part of this noise assessment. Default temperature inversion values, as defined in the INP, have been assumed. Further details are provided in **Section 7.1.1**.

6.3 Meteorological Conditions – Comparison to Previous Noise Modelling

Mandalong Mine Consent conditions relevant to noise were established based on predicted noise emissions provided in *Mandalong Modification to Development Consent Environmental Assessment - Appendix D* (Bridges Acoustics, May 2008). These predictions considered the following meteorological scenarios:

Table 7 Meteorological Scenarios Considered in Previous Noise Modelling (Bridges, 2008)

Daytime	Evening	Night
• No wind • 20°C average air temperature • 70% relative humidity • -2.0°C/100m lapse representing a warm sunny day.	• 3m/s wind from the east • 15°C average air temperature • 70% relative humidity • No vertical temperature gradient	• No wind • 10°C average air temperature • 80% relative humidity • No vertical temperature gradient

The following is noted with regard to the meteorological conditions considered for the previous noise predictions:

- The easterly wind modelled during the evening period would have the effect of reducing mine noise emission at the nearest residential locations (R7 and R8).
- Temperature inversions were not modelled during the night-time period.

7 ASSESSMENT OF NOISE IMPACTS

7.1 Operational Noise Assessment

7.1.1 Noise Modelling Parameters

A computer model was used to predict noise emissions from operation of the project. The operational noise modelling was undertaken using the Concawe algorithms within SoundPLAN v7.0 software, developed by Braunstein and Berndt Gmbh in Germany. A three-dimensional digital terrain map providing relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

Topographic contours and operational information were supplied by Centennial for the purpose of modelling noise from the subject site. Prediction of noise emission levels was carried out under calm and prevailing atmospheric conditions. Atmospheric parameters under which noise predictions were made are given in **Table 8**.

Table 8 Meteorological Parameters Considered for Noise Predictions

	Temperature	Humidity	Wind Speed	Wind Direction (degrees from north)	Temperature Inversion
Calm (Day/Evening)	20°C	65%	n/a	n/a	n/a
Calm (Night)	10°C	90%	n/a	n/a	n/a
South-west Wind (Day / Evening)	20°C	65%	3 m/s	225	n/a
South-west Wind (Night)*	10°C	90%	3 m/s	247.5	n/a
Inversion (Night only)	10°C	90%	n/a	n/a	3°C/100m

*Modelling was also conducted for a 3m/s WSW wind during the night-time. Predicted noise levels were identical to those under a South-west wind so, for simplicity, only noise levels predicted under the South-west wind during the night-time period have been presented.

Sound power levels of relevant existing and approved plant and equipment have been obtained from measurements of plant already operating at the site or have been sourced from a Heggies database of similar equipment. The sound power level of the proposed VAM-RAB unit has been estimated at 97 dBA based on measurements conducted of a similar unit and information provided by the manufacturer.

The operational scenario modelled during each period together with sound power level information is summarised in **Table 9**. A tick (✓) indicates that the equipment is in operation during the relevant period. A cross (×) indicates that the equipment is not in operation during the relevant period. Where there is a number in brackets following a tick, this represents the number of pieces of the equipment that has been considered in the noise model during the relevant period. The typical operational scenario was confirmed by a Centennial Coal representative.

Table 9 Operational Scenario Considered in Noise Model

Plant and Equipment	Sound Power Level	Day	Evening	Night
Compressors[1]	96 dBA	✓	✓	✓
ForkLift*[1]	102 dBA	✓(1)	✓ (1)	✓ (1)
PJB*[1]	108 dBA	✓(1)	✓ (1)	✓ (1)
Mine Vent Fan[1]	91 dBA	✓	✓	✓
Methane Drainage Plant (discharge)[1]	95 dBA	✓	✓	✓
Gas Engines[2]	102 dBA	✓	✓	✓
Methane Flare & Booster[2]	82 dBA	✓	✓	✓
Proposed VAMRAB[3]	97 dBA	✓	✓	✓

*The sound power level of this equipment has been reduced by 3 dBA in the noise model on the basis that these machines typically operate on the surface for up to 50% of the time at full engine speed in a busy 15 minute period.
1. Existing plant and equipment.
2. Approved, yet to be installed.
3. Currently proposed.

7.1.2 Predicted Operational Noise Levels - Intrusive

Noise emission levels were predicted from the proposed development for the typical operational scenario described in **Table 9**.

Noise from all sources that contribute to the total noise from the site have been examined to identify characteristics that may cause greater annoyance (for example tonality, impulsiveness etc). These characteristics were not identified in any of the sources considered.

Intrusive noise levels predicted at the nearest potentially affected residential locations are provided in **Table 10**, **Table 11** and **Table 12** for calm, SW wind and temperature inversion scenarios, respectively.

Noise contour maps are provided in **Figure 5**, **Figure 6** and **Figure 7** for calm conditions and worst case meteorological conditions (SW wind and temperature inversion), respectively.

Table 10 Predicted Intrusive Noise Levels – Mandalong Mine, Calm

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)			Project Specific Noise Criteria* ($L_{Aeq(15minute)}$)
		Without VAMRAB	VAMRAB Only	Total	
R1 (64)	Day	<30	<30	<30	54 (35)
	Evening	<30	<30	<30	54 (35)
	Night	<30	<30	<30	42 (35)
R2 (82)	Day	33	<30	34	54 (35)
	Evening	33	<30	34	54 (35)
	Night	34	<30	34	42 (35)
R3 (97)	Day	37	<30	37	54 (35)
	Evening	37	<30	37	54 (35)
	Night	37	<30	37	42 (35)
R4 (109)	Day	33	<30	34	54 (35)
	Evening	33	<30	34	54 (35)
	Night	34	<30	34	42 (35)
R5 (110)	Day	36	<30	36	54 (35)
	Evening	36	<30	36	54 (35)
	Night	36	<30	36	42 (36)
R6 (86)	Day	36	<30	36	60 (35)
	Evening	36	<30	36	56 (35)
	Night	36	<30	37	48 (36)
R7 (85)	Day	39	<30	40	60 (37)
	Evening	39	<30	40	56 (35)
	Night	39	<30	40	48 (38)
R8 (72)	Day	39	<30	39	60 (37)
	Evening	39	<30	39	56 (35)
	Night	39	<30	39	48 (38)
R9 (73)	Day	35	<30	35	60 (35)
	Evening	35	<30	35	56 (35)
	Night	35	<30	36	48 (35)
R10 (66)	Day	36	<30	37	60 (35)
	Evening	36	<30	37	56 (35)
	Night	37	<30	37	48 (35)

*The number shown in brackets in this column is the noise limit as per the current Conditions of Consent.

Noise modelling results under calm meteorological conditions indicate that the addition of the proposed VAM-RAB is predicted to increase noise levels by less than 1 dBA at some of the nearest assessed residential locations; namely R2, R4, R6, R7, R9 and R10.

Furthermore, noise emission levels from Mandalong Mine, including the proposed VAM-RAB, are predicted to be significantly below the relevant Project Specific Noise Criteria for calm meteorological conditions at all assessed residential locations.

Figure 5 Mandalong Mine Predicted Noise Contours – Calm Day, including VAM-RAB

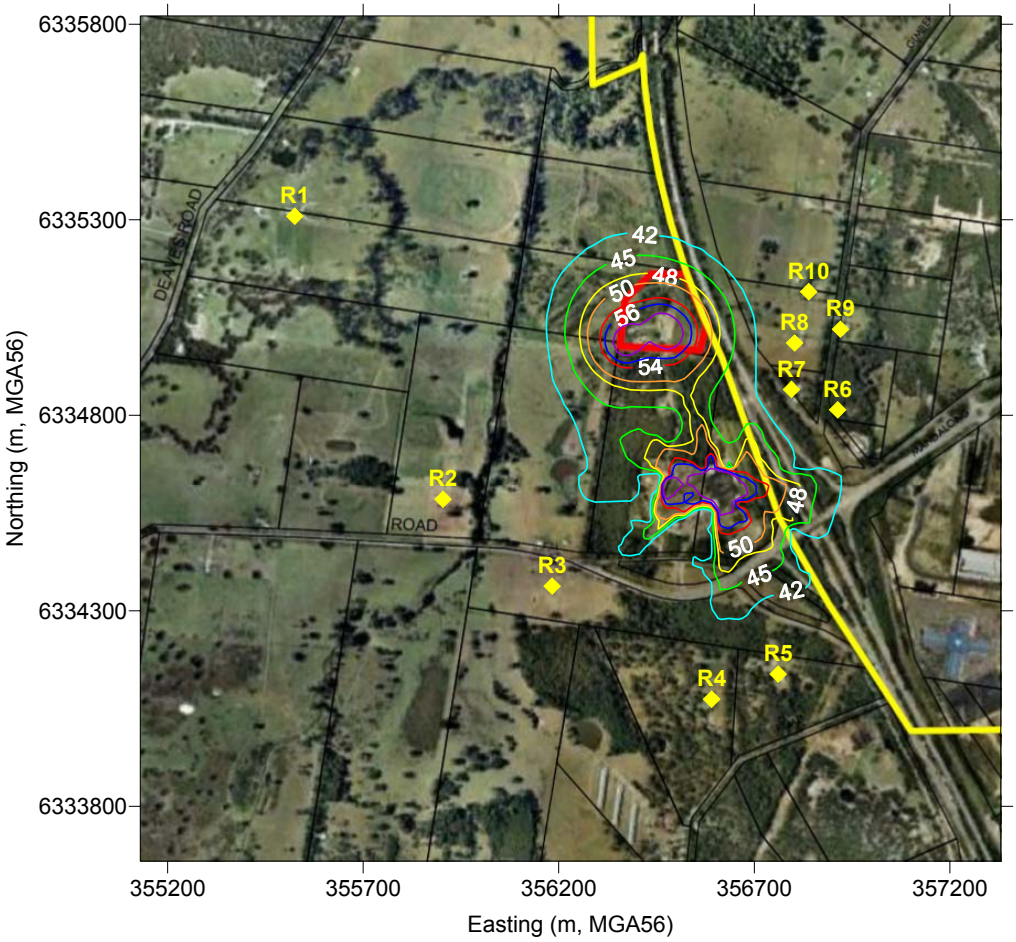


Table 11 Predicted Intrusive Noise Levels – Mandalong Mine, SW Wind

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)			Project Specific Noise Criteria* ($L_{Aeq(15minute)}$)
		Without VAMRAB	VAMRAB Only	Total	
R1 (64)	Day	<30	<30	<30	54 (35)
	Evening	<30	<30	<30	54 (35)
	Night	<30	<30	<30	42 (35)
R2 (82)	Day	<30	<30	<30	54 (35)
	Evening	<30	<30	<30	54 (35)
	Night	<30	<30	<30	42 (35)
R3 (97)	Day	<30	<30	<30	54 (35)
	Evening	<30	<30	<30	54 (35)
	Night	<30	<30	<30	42 (35)
R4 (109)	Day	<30	<30	<30	54 (35)
	Evening	<30	<30	<30	54 (35)
	Night	<30	<30	<30	42 (35)
R5 (110)	Day	30	<30	30	54 (35)
	Evening	30	<30	30	54 (35)
	Night	31	<30	31	42 (36)
R6 (86)	Day	40	<30	40	60 (35)
	Evening	40	<30	40	56 (35)
	Night	40	<30	40	48 (36)
R7 (85)	Day	43	31	43	60 (37)
	Evening	43	31	43	56 (35)
	Night	43	31	43	48 (38)
R8 (72)	Day	43	31	43	60 (37)
	Evening	43	31	43	56 (35)
	Night	43	32	43	48 (38)
R9 (73)	Day	39	<30	40	60 (35)
	Evening	39	<30	40	56 (35)
	Night	40	<30	40	48 (35)
R10 (66)	Day	41	31	41	60 (35)
	Evening	41	31	41	56 (35)
	Night	41	31	42	48 (35)

*The number shown in brackets in this column is the noise limit as per the current Conditions of Consent.

Noise modelling results under 3 m/s south-west wind indicate that the addition of the proposed VAM-RAB is predicted to increase noise levels by less than 1 dBA at only two of the nearest assessed residential locations; R9 and R10.

Furthermore, noise emission levels from Mandalong Mine, including the proposed VAM-RAB, are predicted to be significantly below the relevant Project Specific Noise Criteria for a 3 m/s south-west wind at all assessed residential locations.

Figure 6 Mandalong Mine Predicted Noise Contours – SW Wind Night, including VAM-RAB

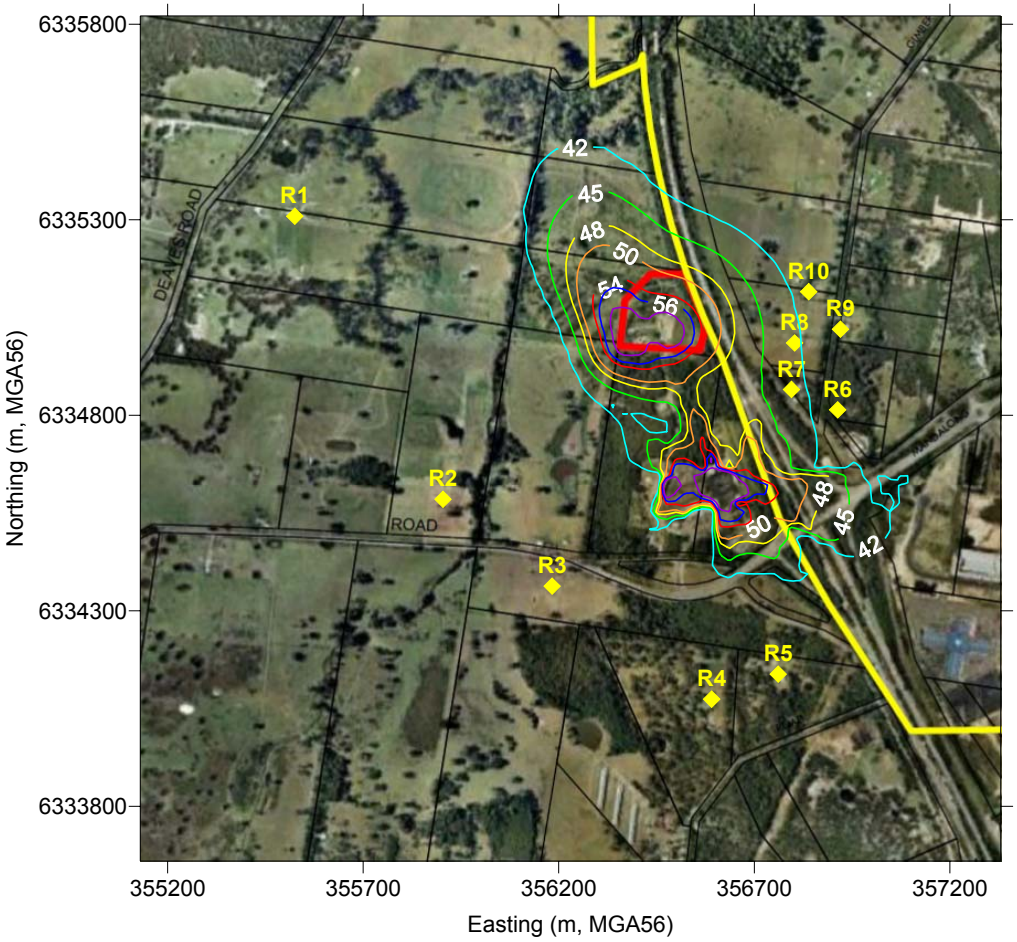
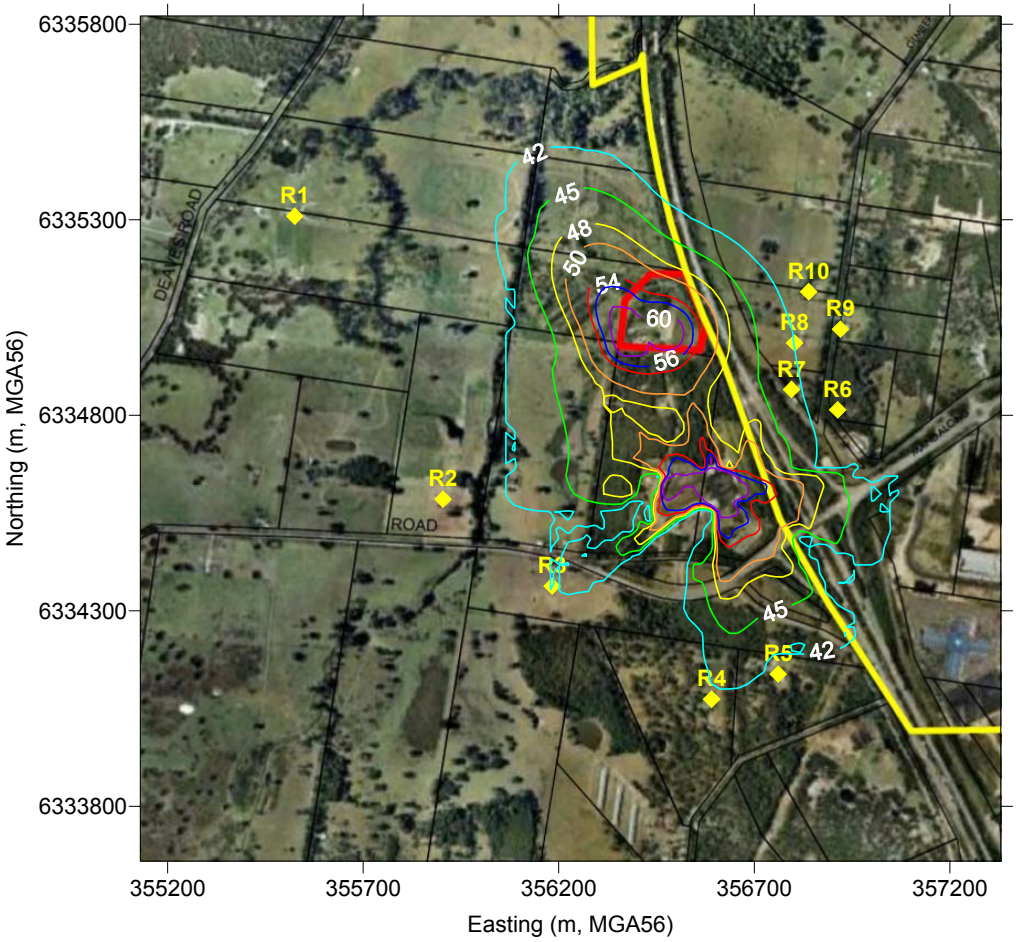


Table 12 Predicted Intrusive Noise Levels – Mandalong Mine, Inversion

Location	Period	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)			Project Specific Noise Criteria* ($L_{Aeq(15minute)}$)
		Without VAMRAB	VAMRAB Only	Total	
R1 (64)	Night	32	<30	32	42 (35)
R2 (82)	Night	39	<30	39	42 (35)
R3 (97)	Night	42	<30	42	42 (35)
R4 (109)	Night	38	<30	38	42 (35)
R5 (110)	Night	41	<30	41	42 (36)
R6 (86)	Night	40	<30	40	48 (36)
R7 (85)	Night	43	<30	43	48 (38)
R8 (72)	Night	42	31	43	48 (38)
R9 (73)	Night	39	<30	39	48 (35)
R10 (66)	Night	40	30	41	48 (35)

*The number shown in brackets in this column is the noise limit as per the current Conditions of Consent.

Figure 7 Mandalong Mine Predicted Noise Contours – Temp. Inversion, including VAM-RAB



Noise modelling results under a temperature inversion indicate that the addition of the proposed VAM-RAB is predicted to increase noise levels by less than 1 dBA at only two of the nearest assessed residential locations; R8 and R10.

Furthermore, noise emission levels from Mandalong Mine, including the proposed VAM-RAB, are predicted to meet the relevant Project Specific Noise Criteria under a temperature inversion at all assessed residential locations.

7.1.3 Predicted Operational Noise Levels - Amenity

Predicted amenity noise emission levels ($L_{Aeq(Period)}$) at the nearest potentially affected residential locations are provided in **Table 13**. These have been estimated from the predicted intrusive levels ($L_{Aeq(15minute)}$) based on the following assumption:

$$L_{Aeq(Period)} = L_{Aeq(15minute)} - 2 \text{ dBA}$$

Based on previous experience with other similar mining and industrial operations this is a conservative assumption. In SLR Consulting's experience, the $L_{Aeq(Period)}$ for such an operation is typically 2-5 dBA below the $L_{Aeq(15minute)}$ noise emission level.

For simplicity, the predicted amenity noise level is presented for the night-time only (since this period provides the strictest criteria) and under worst-case meteorological conditions ie temperature inversion and south-west wind.

Table 13 Predicted Amenity Noise Levels including the VAM-RAB Unit – Mandalong Mine

Location	Period	Predicted Noise Level $L_{Aeq(Period)}$ (dBA)		Project Specific Noise Criteria ($L_{Aeq(Period)}$)
		Temp. Inversion	SW wind	
R1 (64)	Night	30	<30	40
R2 (82)	Night	37	<30	40
R3 (97)	Night	40	<30	40
R4 (109)	Night	36	<30	40
R5 (110)	Night	39	<30	40
R6 (86)	Night	38	38	47
R7 (85)	Night	41	41	47
R8 (72)	Night	41	41	47
R9 (73)	Night	37	38	47
R10 (66)	Night	39	40	47

Noise amenity levels from Mandalong Mine, including the proposed VAM-RAB, are predicted to meet the relevant Project Specific Noise Criteria during the night-time period under adverse meteorological conditions at all assessed residential locations.

7.2 Development Consent Conditions

Results of current noise modelling (refer to **Sections 7.1.2** and **0** of this report) indicate that current mine noise emission levels are predicted to be up to 8 dBA above the current consent conditions. This is due to the fact that the current Mandalong Mine Consent conditions relevant to noise were established based on predicted noise emissions provided in *Mandalong Modification to Development Consent Environmental Assessment - Appendix D* (Bridges Acoustics, May 2008). Bridges' predictions differ from the current noise modelling primarily due to the different meteorological scenarios considered.

The meteorological scenarios considered as part of the current noise impact assessment represent acoustically worst-case conditions at the nearest potentially affected residential receivers and, thus, are considered appropriate for assessment purposes. Therefore, Centennial Mandalong will seek a modification to its current consent conditions to have the noise criteria modified to be consistent with the Project Specific Noise Criteria.

7.3 Sleep Disturbance Assessment

It is understood by SLR Consulting that the nature of the noise generated by the VAM-RAB unit is that of constant fan-type noise. Hence, no additional impacts in terms of potential for sleep disturbance are expected from operation of the VAM-RAB.

7.4 Construction Noise Assessment

7.4.1 Construction Noise Modelling Parameters

Plant and equipment considered in assessing noise from construction of the proposed development are provided, with the associated sound power levels, in **Table 14**. Sound power levels of construction equipment were obtained from a SLR Consulting database of similar equipment. Proposed construction equipment was modelled on the subject site at the proposed VAM-RAB location.

Table 14 Construction Plant and Equipment

Plant and Equipment	Sound Power Level
Sheep-foot roller	110 dBA
Truck (transport of fill)	108 dBA
Excavator	105 dBA
Concrete delivery truck	110 dBA
Concrete pump	107 dBA
Concrete vibrator	110 dBA
Hand held tools	Up to 95 dBA

7.4.2 Construction Noise Modelling Results

The results of construction noise predictions are provided in **Table 15**. For the purpose of predicting construction noise levels it was assumed that all equipment would operate simultaneously. This situation represents a worst-case scenario as it is highly unlikely that all equipment would be operating at the same time. Construction activity would occur only during the day time period hence, noise predictions have been conducted for daytime only under calm and adverse meteorological conditions (south-west wind).

Table 15 Construction Noise Predictions

Residential Location	Predicted Construction Noise Level $L_{A10(15minute)}$ (dBA)		Construction Noise Goal, $L_{A10(15minute)}$ (dBA)
	Calm	SW Wind	Day
R1 (64)	35	30	69
R2 (82)	40	32	
R3 (97)	39	32	
R4 (109)	35	30	
R5 (110)	36	30	
R6 (86)	43	47	76
R7 (85)	47	51	
R8 (72)	48	52	
R9 (73)	44	49	
R10 (66)	46	51	

It is predicted that construction noise levels will be below the relevant noise goal for the daytime period at all assessed residential locations under calm and prevailing weather conditions.

8 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR Consulting) has undertaken a noise impact assessment for Phase 1 of the proposed greenhouse gas abatement plant at Centennial's Mandalong Mine Surface Facilities Area.

Project Specific Noise Criteria for the Project were adopted from *Mandalong Mine Modification to Development Consent Noise and Vibration Impact Assessment* by Bridges Acoustics (May 2008). Construction noise criteria were also established based on background noise levels determined by Bridges and in accordance with Schedule 2 Condition 43 of the current Development Consent (DA 97/800 Mod 4, July 2009).

Prevailing winds (from the south-west) were identified as a feature of the area based on an analysis of relevant meteorological data. Noise modelling under prevailing wind was therefore conducted as part of this investigation.

Meteorological data was not available to allow the determination of the percentage occurrence of temperature inversions during winter nights. A worst case analysis was therefore undertaken and the occurrence of temperature inversion during the night-time period has been considered as part of this noise assessment.

A computer model was used to predict noise emissions from the subject development. Topographic contours and operational information were supplied by Centennial for the purpose of modelling noise from the subject site. The model used this information, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Prediction of noise emission levels was carried out under calm and prevailing atmospheric conditions.

Sound power levels of relevant existing and approved plant and equipment were obtained from measurements of plant already operating at the site or have been sourced from a Heggies database of similar equipment. The sound power level of the proposed VAM-RAB unit has been estimated at 97 dBA based on measurements conducted of a similar unit and information provided by the manufacturer.

Noise modelling results under all considered meteorological conditions indicate that the addition of the proposed VAM-RAB is predicted to increase noise levels by less than 1 dBA at the nearest assessed residential locations.

Furthermore, noise emission levels from Mandalong Mine, including the proposed VAM-RAB, are predicted to meet the relevant Project Specific Noise Criteria for all considered meteorological conditions at all assessed residential locations.

Results of current noise modelling (refer to **Sections 7.1.2** and **0** of this report) indicate that current mine noise emission levels are predicted to be up to 8 dBA above the current consent conditions. This is due to the fact that the current Mandalong Mine Consent conditions relevant to noise were established based on predicted noise emissions provided in *Mandalong Modification to Development Consent Environmental Assessment - Appendix D* (Bridges Acoustics, May 2008). Bridges' predictions differ from the current noise modelling primarily due to the different meteorological scenarios considered.

The meteorological scenarios considered as part of the current noise impact assessment represent acoustically worst-case conditions at the nearest potentially affected residential receivers and, thus, are considered appropriate for assessment purposes. Therefore, Centennial Mandalong will seek a modification to its current consent conditions to have the noise criteria modified to be consistent with the Project Specific Noise Criteria.

It is understood by SLR Consulting that the nature of the noise generated by the VAM-RAB unit is that of constant fan-type noise. Hence, no additional impacts in terms of potential for sleep disturbance are expected from operation of the VAM-RAB.

It is predicted that construction noise levels will be below the relevant noise goal for the daytime period at all assessed residential locations under calm and prevailing weather conditions.

9 REFERENCES

The following documents and resources have been used in the production of this report:

- Mandalong Mine Project Approval (DA97/800 MOD4), July 2009
- Annual Environmental Management Report (AEMR), Centennial Mandalong, 2009
- Annual Environmental Management Report (AEMR), Centennial Mandalong, 2010
- CCC14-005, VAM Preliminary Environmental Assessment (VAM PEA)
- Mandalong Mine State of Environmental Effect (SoEE), SKM, 2004
- Mandalong Mine Modification to Development Consent Environmental Assessment (MDC EA), Appendix D Noise & Vibration Impact Assessment (Bridges, 2008)
- Mandalong Mine Methane Flare SoEE, Umwelt Australia, 2006
- Mandalong Mine Noise Compliance Assessment August – September 2010 (SLR Consulting (previously Heggies Pty Ltd, Sept 2010))

10 CLOSURE

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

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