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29 October 2013

Chris Ellis
Environmental Officer
LDO Group
16 Spitfire Place
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Re: Chain Valley Colliery - Ventilation fans additional information

Dear Chris,

1 Introduction

EMGA Mitchell McLennan Pty Limited (EMM) has compiled information requested by Mr Carl Dumpleton of the NSW Department of Planning and Infrastructure (DP&I) pertaining to the noise impact assessment for the proposed Chain Valley Colliery Mining Extension1 Project (the Project).

The information requested is summarised below:

- justification for the sound power level from the ventilation fans being greater in the assessment of the Project compared with levels presented in the Chain Valley Colliery Domains 1 and 2 Continuation Project Noise Assessment (AECOM July 2011) and subsequent noise assessment provided in the response to submissions document for that same project (AECOM November 2011);
- detailed description of any attenuation carried out at the ventilation fans;
- summary of available monitoring and audit data:
- impact of ventilation fans at receptor 22 (R22) during regular operations;
- comparison of prediction against the amenity criteria;
- review of noise levels at R8 and R9; and
- provision of details around the prevailing meteorology analysed in accordance with the Industrial Noise Policy (INP) (EPA 2000) for the site.

2 Findings

2.1 Justification for upgrading the ventilation fan

2.1.1 Safety and capacity

Prior to the installation and commissioning of the new ventilation fans in July 2012, LakeCoal operated a single axial fan at the ventilation shaft site. The old fan was operating at the limits of its electrical and mechanical capacity. Improvements were made to the ventilation system, such as sealing the Wallarah workings and the interseam shaft between Fassifern and Great Northern seams to improve its efficiency. However, despite these improvements and the old fan operating at full capacity, the mine had reached the limit where it could provide sufficient quantities of air required to meet statutory limits and maintain the safety of mine employees.

Without an upgrade to enable sufficient quantities of air flow, the Colliery would have been forced to significantly modify the approved mining methods. This would have resulted in a substantial reduction in the Colliery's extraction volume and, under this scenario, the Colliery would not be economically viable. As such, the viability of the mine was contingent on an upgrade to the main fan.

A number of options were considered for the new ventilation fans. The preferred option, two parallel ventilation fans, was selected as:

- it provides contingency against single fan failure;
- it allows fan maintenance to occur without interrupting mine ventilation; and
- despite increasing ventilation flows in the order of 100% when compared to the old fan, they are measurably quieter by a minimum of 4 dB(A) and do not have the associated tonal penalties due to their design (which is equivalent to a further 5 dB(A) when compared to the old fan).

2.1.2 Justification of sound power levels

In July 2011, AECOM prepared a noise impact assessment for the Chain Valley Colliery Domains 1 and 2 Continuation Project Environmental Assessment (Appendix J). This document modelled the noise contribution from the ventilation fans as 36 dB(A) at R22. Following EMM's review of this assessment, however, several aspects of the modelling approach remained uncertain, including overall sound power levels adopted for the ventilation fans and the meteorological conditions modelled. Additionally, the distance to site boundary is stated as 1,100 m for R22 which appears to be an anomaly. Therefore, the predicted levels from the AECOM (July 2011) assessment could not be compared to results from the current assessment. Further information on the modelling approach in AECOM (July 2011) is provided in Section 2.3.5 of the response to submissions report prepared for the Project (EMM 2013).

In November 2011, AECOM prepared a response to submissions report for the Chain Valley Colliery Domains 1 and 2 Continuation Project which included an additional noise study presented in Appendix D. The report contains information that is sufficient to enable a comparison with EMM's noise impact assessment of the Project (EMM 2013).

The comparison identified that the AECOM (November 2011) assessment specifies sound power based on 'data with acoustic mitigation applied to meet the project criteria'. Therefore, the sound power level of the ventilation fans was reduced to demonstrate compliance with relevant criteria at R22. The sound power level resulting from this adjustment was 92 dB(A) and consisted of a new attenuated fan (89dB(A)) and a new fan motor (89dB(A)). Based on arbitrary sound power levels values for the fans and motors, specifically designed to meet the criteria in the INP, this above approach had significant limitations and appears to

significantly underestimate the sound power level from underground coal mine ventilation fans in general when benchmarked against other ventilation fans in the hunter valley region as discussed below.

LakeCoal was highly cognisant of the ventilation fan site's location, being on Summerland Point and directly adjacent to the shores of Lake Macquarie and its proximity to residences when undertaking detailed design. Accordingly, substantial investment was committed to during the design phase to reduce potential environmental impacts, including the associated noise emissions.

Noise amelioration measures applied to the ventilation fans, included:

- upgrade of the motor housing to incorporate an acoustic enclosure kit, which included the use of an enclosed motor room with 100 mm rockwool insulated panels to attenuate noise created from fan motors;
- installation of inlet silencers on the inlet side of the main impeller housing;
- installation of outlet silencers for each of the vertical stacks from the outlet of both fans; and
- modification of fan casing thickness from the standard 8 mm design to a 50% thicker 12 mm option.

The noise amelioration measures implemented by LakeCoal as best practice cost an additional $250,000 (approximate).

With the application of the noise amelioration measures listed above, the maximum worst case sound power level achieved for the new ventilation fans is 105 dB(A).

For the purposes of benchmarking, the sound power level of the ventilation fans at four Hunter Valley underground coal mines were reviewed with levels of 102 dB(A), 104 dB(A), 106 dB(A) and 109 dB(A) reported respectively. The levels achieved by the new ventilation fans are well within the typical range achieved at other underground coal mines.

2.2 Historic noise monitoring assessments and audits

2.2.1 Attended measurements

Attended noise monitoring is conducted quarterly for LakeCoal by Global Acoustics (GA) at seven monitoring locations. Monitoring during this period was undertaken at either R22 or R22B, with both locations being identified as receiver ATN007. R22B is located 70 m to the south east of R22 on the same property. It has been confirmed that R22B is not an approved residence; hence, DP&I's additional information request is focussed on R22.

A summary of the noise contribution from the Colliery at R22 (and R22B) is provided in Table 1. The operating duty of the ventilation fan(s) and wind speed and direction is also shown.

Table 1 Historic noise monitoring data (R22 and R22B)

Date	Period	Location[1]	Criteria L_{eq}, dB(A)	Measured fan noise contribution L_{eq}, dB(A)	Ventilation fan duty	Wind speed (m/s) and direction (deg)
21/11/2012	Day	R22B	40	45	100% (1 x fan)	1m/s @ 30°
12/12/2012	Evening	R22B	40	35	88% (2 x fans)	0.4m/s @ 120°
13/12/2012	Night	R22B	40	35	88% (2 x fans)	0.3m/s @ 20°
13/03/2013	Day	R22B	40	40	88% (2 x fans)	0.4m/s @ 40°
19/03/2013	Evening	R22B	40	41	88% (2 x fans)	calm
25/03/2013	Night	R22B	40	40	88% (2 x fans)	calm
31/05/2013	Day	R22B	40	39	88% (2 x fans)	calm
11/06/2013	Evening	R22B	40	40	88% (2 x fans)	calm
12/06/2013	Night	R22B	40	40	88% (2 x fans)	calm
04/09/2013	Day	R22	40	38	88% (2 x fans)	N/A
04/09/2013	Day	R22B	40	40	88% (2 x fans)	N/A
18/09/2013	Evening	R22	40	35	88% (2 x fans)	N/A
18/09/2013	Night	R22	40	35	88% (2 x fans)	N/A
28/09/2013	Night	R22	40	35	88% (2 x fans)	N/A

Note 1 : R22B has been used as a reference monitoring location only and is not an approved dwelling.

2.2.2 Predictive modelling

To address the supplementary information requested by DP&I, a noise model was completed to quantify levels for one ventilation fan operating at 100% duty and two fans at 88% duty to represent normal operations. The purpose of the model was to calibrate against attended monitoring results.

A second model was completed using the calibrated model to quantify noise emissions from two ventilation fans at 88% duty during worst case source to receptor meteorological conditions at R22. Table 2 presents a summary of modelled results.

Table 2 Summary of model results

Date	Period	Modelled fan noise contribution L_{eq}, dB(A)	Ventilation fan duty	Wind speed (m/s) and direction (deg)
21/11/2012	Day	39	100% (1 x fan)[1]	1m/s @ 30°
N/A[1]	N/A	29	88% (2 x fans)[2]	1m/s @ 30°
12/12/2012	Evening	28	88% (2 x fans)	0.4m/s @ 120°
N/A[1]	N/A	31	88% (2 x fans)	3m/s @ 135°

Note 1 : includes a sound power level of 101 dB(A) for one fan operating at 100% duty.

Note 2 :includes a sound power level of 88 dB(A) per fan operating at 88% duty.

Results identified predicted noise levels slightly over predicting although were within 2 dB(A) of actual field measurements at R22B demonstrating good correlation. The results identify that when two (new) fans are operating at normal duty (88%) compliance with the existing consent criteria would be achieved at R22 during worst case noise enhancing conditions.

The EMM (2013) noise assessment of the Project does, however, include a more detailed worst case noise model based on the actual sound power levels recorded from both fans operating at 100% duty.

Accordingly, adoption of these predictions as criteria would more accurately reflect the potential long term noise levels at R22 when mine ventilation require the fans to be operated at an increased duty due to continued mine development. Again, it is noted that the worst case sound power level from the two new fans, 105 dB(A), is 4 dB(A) quieter than the single fan that was replaced, 109 dB(A), and do not have the associated tonal penalties due to their design (which is equivalent to a further 5 dB(A) reduction when compared to the old fan).

LakeCoal is committed to undertaking future additional acoustic treatment on both fans to satisfy relevant criteria at R22.

2.2.3 Comparison of decommissioned ventilation fan

Noise monitoring of the now decommissioned ventilation fan was undertaken on 4 July 2012. A Svantek 979 sound analyser, which complies with Type 1 sound meter in accordance with Australian Standards 2004, *AS1055-1: Acoustics-Description and measurement of environmental noise*, was used for the assessment. The meter was field calibrated before and at the completion of each measurement. The instrument was within its NATA laboratory calibration period during the time of these readings and certificates can be made available on request (serial number 21095).

Table 3 presents the results of sound power and octave analysis for the now decommissioned ventilation fans.

Table 3 L_{eq}dB(A)[1] sound power level (Lw)[2] spectrum

Fan speed	'A' Weighted frequency (Hz)									Total
	31.5	63	125	250	500	1000	2000	4000	8000	dB(A)
	Decommissioned ventilation fan									
N/A	66	82	104	106	101	95	90	84	76	109

Notes: 1. L_{eq}: Energy average noise from a source. This is the equivalent continuous sound pressure level over a given period.

Analysis of the decommissioned ventilation identified tonal noise components that would incur a correction factor of +5 dB. Additionally, in-field attended measurements identified that C-A was greater than 15 dB. Therefore, a low frequency modifying factor correction in accordance with Table 4.1 of the INP is applicable. It is noted that where both, low frequency and tonal noise components are present, only one 5 dB correction is applicable.

The decommissioned fan was incorporated into the model to quantify the difference in noise levels between the decommissioned fan and the new fan at R22. Results of the comparison are presented in Table 4.

Table 4 Summary of model results – comparison of new fan versus decommissioned fan

Fan type	Modelled fan noise contribution L_{eq}, dB(A)	Ventilation fan duty	Wind speed (m/s) and direction (deg)
	R22		
New fan	39	100% (1 x fan)[1]	1m/s @ 30°
New fan	29	88% (2 x fans)[2]	1m/s @ 30°
Decommissioned fan	46 (without 5 dB modifying correction factor) 51 (with 5 dB modifying correction factor)	100% (1 x fan)[1]	1m/s @ 30°

Note 1 : includes a sound power level of 101 dB(A) for one fan operating at 100% duty.

Note 2 :includes a sound power level of 88 dB(A) per fan operating at 88% duty.

For R22, results of the model show that for one fan operating 100% duty noise levels are 7dB lower than the decommissioned fan and 17 dB lower when two new fans are at 88% duty than the decommissioned fan.

Taking into consideration a 5dB modifying factor for tonality, the difference is 12dB lower for one fan at 100% duty and 22 dB lower for two fans operating at 88% duty. As demonstrated, the replacement of the decommissioned fan has resulted in a significant noise reduction at R22: a 12 dB and 22 dB decrease results in a 57% and 80% in perceived reduction of loudness, respectively.

2.3 Amenity criteria comparison for R22

The INP's amenity assessment is based on noise criteria specific to a particular land use. The INP recommends that maximum ambient levels within an area from industrial noise should not typically exceed the levels specified in Table 2.1 of the INP which are considered to represent best practice levels for assessing industrial noise. Additionally, the INP recommends all reasonable and feasible mitigation be applied to industrial sources before the recommended maximum noise levels are referenced.

Table 5 reproduces the base amenity levels for both suburban and urban categories from Table 2.1 of the INP.

Table 5 Base amenity criteria

Receiver	Time period	Recommended noise level dB(A), $L_{eq(period)}$	
		Acceptable	**Maximum**
Suburban	Day	55	60
	Evening	45	50
	Night	40	45
Urban	Day	60	65
	Evening	50	55
	Night	45	50

Source: INP (EPA, 2000)

Compliance monitoring for the area within Summerland Point identifies that ambient levels have reduced as result of the decommissioning of the old ventilation fan. Historically, levels in the vicinity of R22 were above recommended acceptable and maximum urban noise levels with the inclusion of the 5 dB modifying factor for the now decommissioned fan.

Installation of the new fans, including acoustic treatments (refer to Section 2.1.2) has seen a significant reduction in industrial noise within the locality surrounding Summerland Point and is now at a level that satisfies the acceptable and recommended maximum urban levels and the recommended maximum suburban levels.

2.4 Review of noise levels at R8 and R9

As per DP&I's request, further assessment was completed to quantify levels of noise received at R8 and R9 from the Colliery's pit top operations. R8 and R9 are located at the southern edge of Mannering Park residential area. To enable the assessment a model was completed. Model development included a review of prevailing meteorological conditions. The review focused on source to receiver winds from the Colliery to R8 and R9 and adopted the average prevailing wind speeds rather than the maximum prevailing winds speeds adopted in the EMM (2013) noise assessment of the Project. Average prevailing conditions are likely to be more representative of the subject site and provide a more realistic assessment of noise emissions from the Colliery. It is noted that EMM's method of quantifying prevailing meteorological conditions varies slightly from the AECOM methodology, while both methods are acceptable, EMM's methodology is considered more technically robust and conservative.

Attended measurements at R9 were also considered. It is noted that attended monitoring does not occur at R8, however given its location relative to R9, results from R9 are considered representative for both assessment locations. Attended measurements and modelling results are presented in the following sections.

2.4.1 Attended measurements

Attended noise monitoring is conducted quarterly for LakeCoal by GA. A summary of the ambient industrial noise and the noise contribution from the Colliery at R9 is provided in Table 6.

Table 6 Historic noise monitoring data R9

Date	Period	Criteria L_{eq}, dB(A)	Measured L_{eq}, dB(A)	Comments	Wind speed (m/s) and direction (deg)
21/11/2012	Day	40	46	Power station audible, CVC inaudible	1m/s @ 30°
12/12/2012	Evening	40	54		0.4m/s @ 120°
13/12/2012	Night	40	48		0.3m/s @ 20°
13/03/2013	Day	40	50		0.4m/s @ 40°
19/03/2013	Evening	40	47		calm
25/03/2013	Night	40	47		calm
31/05/2013	Day	40	49		calm
11/06/2013	Evening	40	48		calm
12/06/2013	Night	40	49		calm
04/09/2013	Day	40	50		N/A
18/09/2013	Evening	40	46		N/A
19/09/2013	Night	40	46		N/A

The attended noise monitoring over the previous 12 months identified the power station as the dominant noise source in the vicinity surrounding R9, GA notes that Colliery noise emissions were not audible during any attended measurements and were masked by the power station. Masking is the phenomenon of one sound interfering with the audible perception of another sound.

2.4.2 Modelling results

To quantify the Colliery contribution in the absence of the power station a noise model has been completed. Table 7 presents a summary of the modelled Colliery contribution at R8 and R9.

Table 7 Summary of model results

Location	Criteria L_{eq}, dB(A)	Modelled Colliery noise L_{eq}, dB(A)	Wind speed (m/s) and direction (deg)	Percentage occurrence (%)
R8	38	36[1]	1.8m/s @ 157.5°	38
R9	35	35[1]	2m/s @ 135°	38

Note 1 : includes -2dB model calibration factor as determined by field measurements.

Results predict noise levels satisfy the existing consent criteria at R8 and R9 during noise enhancing conditions, taking into account the 2 dB noise modelling tolerance.

It is evident from quarterly noise monitoring that the power station masks any noise from the Colliery. The noise contribution from the Colliery is 10 dB lower than prevailing industrial L_{eq} noise levels, it is generally accepted that where there is a difference of 10 dB between two noise levels, the combined overall change in noise is negligible.

Therefore, not only does the power station mask ambient Colliery emissions, it is evident from noise modelling that the colliery does not provide a significant contribution to increase ambient industrial noise in the vicinity of R8 and R9.

We trust this information satisfies your requirements and if you require any further details please contact the undersigned.

Yours sincerely

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Review : LS