Liddell Coal Operations

Environmental Noise Monitoring

October 2017

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Global Acoustics Pty Ltd ~ Environmental noise modelling and impact assessment ~ Sound power testing ~ Noise control advice ~ Noise and vibration monitoring ~ OHS noise monitoring and advice ~ Expert evidence in Land and Environment and Compensation Courts ~ Architectural acoustics ~ Blasting assessments and monitoring ~ Noise management plans (NMP) ~ Sound level meter and noise logger sales and hire
EXECUTIVE SUMMARY

Global Acoustics were engaged by Liddell Coal Operations Pty Ltd (LCO) to conduct a monthly noise survey as required in the current LCO Noise Monitoring Program (NMP), which was approved in August 2015.

Modifications to the original development consent (DA 305-11-01) were granted by the Minister for Planning most recently in February 2016. The relevant noise conditions from Schedule 3 of the modification and the NMP are reproduced in Appendix A.

Environmental noise monitoring described in this report was undertaken during the night of 3 October 2017 at two locations. The purpose of the survey is to quantify and describe the acoustic environment around the site and compare with specified limits.

Attended monitoring was conducted in accordance with the Environment Protection Authority (EPA) ‘Industrial Noise Policy’ (INP) guidelines and Australian Standard AS 1055 ‘Acoustics, Description and Measurement of Environmental Noise’. The duration of each measurement was 15 minutes.

In accordance with the most recent development consent modification, activities from LCO complied with the relevant noise limits during the October 2017 survey as shown in Table 4.2 to Table 4.3.

Neither of the two measurements occurred during which LCO was directly measurable, was within 5 dB of the relevant criteria and where meteorological conditions resulted in the criteria applying (in accordance with the consent). Further analysis of low frequency content was not required.

Global Acoustics Pty Ltd
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INTRODUCTION

1.1 Background

Global Acoustics were engaged by Liddell Coal Operations Pty Ltd (LCO) to conduct a monthly noise survey around its operations, an open cut mine near Ravensworth, NSW.

Attended environmental noise monitoring described in this report was undertaken during the night of 3 October 2017 at two monitoring locations. Figure 1 shows the monitoring locations.

The purpose of the survey was to quantify and describe the acoustic environment around the site and compare results with the specified limits detailed in Section 2.3.

1.2 Attended Noise Monitoring Locations

There were two attended monitoring locations during this survey as detailed in Table 1.1 and shown on Figure 1.

Table 1.1: ATTENDED NOISE MONITORING LOCATIONS

<table>
<thead>
<tr>
<th>Report Descriptor</th>
<th>Monitoring Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1317 Hebden Road</td>
<td>Roadside, 1317 Hebden Road – representative of residential receivers R4, R5 and R6⁵</td>
</tr>
<tr>
<td>1246 Hebden Road</td>
<td>Roadside, 1246 Hebden Road – representative of residential receivers R1, R2 and R3³</td>
</tr>
</tbody>
</table>

Notes:
1. As indicated in LCO Noise Monitoring Program Section 3.1 (August 2015).
Figure 1: LCO Attended Environmental Noise Monitoring Locations
### 1.3 Terminology & Abbreviations

Some definitions of terms and abbreviations, which may be used in this report, are provided in Table 1.2.

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>( L_A )</td>
<td>The A-weighted root mean squared (RMS) noise level at any instant</td>
</tr>
<tr>
<td>( L_{A\text{max}} )</td>
<td>The maximum A-weighted noise level over a time period or for an event</td>
</tr>
<tr>
<td>( L_{A1} )</td>
<td>The noise level which is exceeded for 1 per cent of the time</td>
</tr>
<tr>
<td>( L_{A10} )</td>
<td>The noise level which is exceeded for 10 percent of the time, which is approximately the average of the maximum noise levels</td>
</tr>
<tr>
<td>( L_{A50} )</td>
<td>The noise level which is exceeded for 50 per cent of the time</td>
</tr>
<tr>
<td>( L_{A90} )</td>
<td>The level exceeded for 90 percent of the time, which is approximately the average of the minimum noise levels. The ( L_{A90} ) level is often referred to as the “background” noise level and is commonly used to determine noise criteria for assessment purposes</td>
</tr>
<tr>
<td>( L_{A\text{min}} )</td>
<td>The minimum A-weighted noise level over a time period or for an event</td>
</tr>
<tr>
<td>( L_{A\text{eq}} )</td>
<td>The average noise energy during a measurement period</td>
</tr>
<tr>
<td>dB(A)</td>
<td>Noise level measurement units are decibels (dB). The “A” weighting scale is used to describe human response to noise</td>
</tr>
<tr>
<td>SPL</td>
<td>Sound pressure level (SPL), fluctuations in pressure measured as 10 times a logarithmic scale, the reference pressure being 20 micropascals</td>
</tr>
<tr>
<td>Hertz (Hz)</td>
<td>Cycles per second, the frequency of fluctuations in pressure, sound is usually a combination of many frequencies together</td>
</tr>
<tr>
<td>VTG</td>
<td>Vertical temperature gradient in degrees Celsius per 100 metres altitude. Estimated from wind speed and sigma theta data</td>
</tr>
<tr>
<td>IA</td>
<td>Inaudible. When site only noise is noted as IA, there was no noise from the source of interest audible at the monitoring location</td>
</tr>
<tr>
<td>NM</td>
<td>Not Measurable. If site only noise is noted as NM, this means some noise from the source of interest was audible at low-levels, but could not be quantified</td>
</tr>
<tr>
<td>Day</td>
<td>This is the period 7:00am to 6:00pm</td>
</tr>
<tr>
<td>Evening</td>
<td>This is the period 6:00pm to 10:00pm</td>
</tr>
<tr>
<td>Night</td>
<td>This is the period 10:00pm to 7:00am</td>
</tr>
</tbody>
</table>
2 DEVELOPMENT CONSENT

2.1 LCO 2014 Modification

A modification to the original development consent (DA 305-11-01) was granted by the Minister for Planning most recently in February 2016. The relevant noise conditions from Schedule 3 – Specific Environmental Conditions of the modification are reproduced in Appendix A. Relevant criteria are detailed in Table 2.1.

2.2 LCO Noise Monitoring Program

Specific noise monitoring requirements are detailed in the LCO Noise Monitoring Program (NMP). The most recent version of the NMP was approved in August 2015. Relevant sections are reproduced in Appendix A.

2.3 Project Specific Criteria

2.3.1 Impact Assessment Criteria

Impact assessment criteria for LCO are detailed in Table 2.1.

Table 2.1: LCO IMPACT ASSESSMENT CRITERIA (dB)

<table>
<thead>
<tr>
<th>Monitoring Location</th>
<th>Day ( L_{Aeq,15\text{minute}} )</th>
<th>Evening ( L_{Aeq,15\text{minute}} )</th>
<th>Night ( L_{Aeq,15\text{minute}} )</th>
<th>Night ( L_{A1,1\text{minute}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1317 Hebden Road</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>1246 Hebden Road</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>45</td>
</tr>
</tbody>
</table>

Notes:
1. LCO 2016 modification, Day: 7:00am to 6:00pm ~ Evening: 6:00pm to 10:00pm ~ Night: 10:00pm to 7:00am.

2.4 Meteorological Conditions

Appendix 6 of Mod 6 (February 2016) of the development consent outlines meteorological conditions required for criteria to be applicable.

Noise criteria detailed in the consent applies under all meteorological conditions except for the following:

(a) during periods of rain or hail;

(b) average wind speed at microphone height exceeds 5m/s;

(c) wind speeds greater than 3 m/s measured at 10m above ground level; or

(d) temperature inversion conditions greater than 3°C/100m, or alternatively stability class F and G.
2.5 INP Modifying Factors

Noise monitoring and reporting is carried out generally in accordance with the Environment Protection Authority (EPA) ‘Industrial Noise Policy’ (INP). Chapter 4 of the INP deals specifically with modifying factors that may apply to industrial noise. The most common modifying factors are addressed in detail below.

2.5.1 Tonality, Intermittent and Impulsive Noise

As defined in the INP:

Tonal noise contains a prominent frequency and is characterised by a definite pitch.

Impulsive noise has high peaks of short duration and a sequence of such peaks.

Intermittent noise is characterised by the level suddenly dropping to the background noise levels several times during a measurement, with a noticeable change in noise level of at least 5 dB. Intermittent noise applies to night-time only.

Years of monitoring have indicated that noise levels from mining operations, particularly those levels measured at significant distances from the source are relatively continuous. Given this, noise levels from LCO at the monitoring locations are unlikely to be intermittent. In addition, there is no equipment on site that is likely to generate tonal or impulsive noise as defined in the INP.

2.5.2 Low Frequency Noise

INP Method

As defined in the INP:

Low frequency noise contains major components within the low frequency range (20 Hz to 250 Hz) of the frequency spectrum.

As detailed in Chapter 4 of the INP, low frequency noise should be assessed by measuring the site only C-weighted and site only A-weighted level over the same time period. The correction/penalty of 5 dB is applied if the difference between the two levels is 15 dB or more.

Broner Method

Low frequency noise can also be assessed against criteria specified in the paper “A Simple Method for Low Frequency Noise Emission Assessment” (Broner JLFNV vol29-1 pp1-14 2010). If the total predicted site only C-weighted noise level at a receptor exceeds the relevant criterion, a 5 dB penalty (modifying factor) is added to measured levels. This method is included to provide a comparison with the INP method.
**dING Method**

Whilst the INP is the current document for assessment of industrial noise impact in NSW, the EPA has recently published the Draft Industrial Noise Guideline (dING), which is expected to replace the INP in the near future. The dING contains an alternate method of assessing low frequency noise to the INP, which is:

*Measure/assess C-weighted and A-weighted $L_{eq,T}$ levels over the same time period. The low frequency noise modifying factor correction is to be applied where the C-A level exceeds 15 dB and:*

- *where any of the 1/3 octave noise levels in Table C2 are exceeded by up to 5 dB and cannot be mitigated, a 2 dBA positive adjustment to measured A weighted levels applies for the evening/night period; and*

- *where any of the 1/3 octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5 dBA positive adjustment to measured A weighted levels applies for the evening/night period and a 2 dBA positive adjustment applies for the daytime period.*

Table C2 of the dING is reproduced below:

**Table C2: One-third octave low frequency noise thresholds**

<table>
<thead>
<tr>
<th>Hz/dB(Z)</th>
<th>One-third octave $L_{Zeq,15minute}$ threshold level</th>
</tr>
</thead>
<tbody>
<tr>
<td>f, Hz</td>
<td>10 12.5 16 20 25 31.5 40 50 63 80 100 125 160</td>
</tr>
<tr>
<td>dB(Z)</td>
<td>92 89 86 77 69 61 54 50 50 48 48 46 44</td>
</tr>
</tbody>
</table>

Note: $dB(Z) = \text{decibel (Z-weighted)}$; $f, Hz = \text{frequency in Hertz}$; $Hz/dB(Z) = \text{hertz per decibel (Z-weighted)}$. For the assessment of low frequency noise, care should be taken to select a wind screen that has wind-induced noise characteristics at least 10 dB below the threshold values in Table C2 for wind speeds up to 5 metres per second. It is likely that high performance larger diameter wind screens (nominally 175 mm) will be required to achieve this performance (Hessler et al. 2008). In any case, the performance of the wind screen and wind speeds at which data will be excluded needs to be stated.

Low frequency noise shall be assessed under the meteorological conditions under which noise limits would apply.

Measurements should be made between 1.2 and 1.5 metres above ground level unless otherwise approved through a planning instrument (consent/approval) or Environment Protection Licence and at locations nominated in the development consent or license.

### 2.5.3 Low Frequency Assessment Methods

Low frequency assessment methods are summarised in Table 2.2.

**Table 2.2: LOW FREQUENCY ASSESSMENT METHODS AND MODIFYING FACTOR TRIGGERS**

<table>
<thead>
<tr>
<th>Assessment Method</th>
<th>Calculation Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broner, 2010</td>
<td>Site only $L_{Ceq}$</td>
</tr>
<tr>
<td>INP</td>
<td>Site only $L_{Ceq}$ minus site only $L_{Aeq}$</td>
</tr>
<tr>
<td>dING</td>
<td>1. Site only $L_{Ceq}$ minus site only $L_{Aeq}$</td>
</tr>
<tr>
<td></td>
<td>2. One third octave low frequency noise threshold</td>
</tr>
</tbody>
</table>

Triggers and penalties associated with each method are outlined in Section 2.5.2.
3 METHODOLOGY

3.1 Overview

All noise monitoring was conducted at the nearest residences in accordance with the EPA INP guidelines, Australian Standard AS1055 ‘Acoustics, Description and Measurement of Environmental Noise’ and the LCO NMP.

3.2 Meteorological Data

Meteorological data was obtained from the LCO meteorological station located near the office and car park (south-east of the operation). Atmospheric parameters included wind speed, wind direction, rainfall and sigma theta. This data allowed correlation of atmospheric parameters and measured noise levels. Meteorological data was available in 5 minute intervals.

When meteorological data is provided in less than 15-minute intervals, an analysis must be conducted to determine the meteorological conditions present for the majority of the measurement period and whether those conditions relate to noise criteria being applicable. In order to accurately compare 5-minute meteorological data to 15-minute noise level measurement periods, a rolling 15-minute meteorological interval was produced by converting each 5-minute meteorological interval into an average of the preceding three 5-minute intervals. The rolling 15-minute meteorological interval which most closely matched the 15-minute noise level measurement period was then adopted as the predominant meteorological conditions for that measurement period.

Where rolling averages could not be used (such as for VTG and stability class), the predominant condition, corresponding with the majority of 5-minute meteorological intervals, was adopted.

3.3 Attended Noise Monitoring

During this survey, monthly attended monitoring was undertaken during the night period, once at each location. The duration of each measurement was 15 minutes.

Attended monitoring is preferred to the use of noise loggers when determining compliance with prescribed limits as it allows the most accurate determination of the contribution, if any, to measured noise levels by the source of interest, in this case LCO.

A measurement of $L_{A1,1\text{minute}}$ corresponds to the highest noise level generated for 0.6 second during one minute. In practical terms this is the highest noise level, or $L_{A\text{max}}$, received from the site during the entire measurement period (i.e. the highest level of the worst minute during the 15 minute measurement).
If the exact contribution of the source of interest cannot be established, due to masking by other noise sources in a similar frequency range, but site noise levels are observed to be well below (more than 5 dB lower than) any relevant criterion, a maximum estimate of the potential contribution of the site might be made based on other measured site-only noise levels, for example, $L_{A10}$, $L_{A50}$ or $L_{A90}$. This is generally expressed as a 'less than' quantity, such as $<$20 dB or $<$30 dB.

The terms 'Inaudible' (IA) or 'Not Measurable' (NM) may also be used in this report. When site noise is noted as IA, no site noise was audible at the monitoring location. When site noise is noted as NM, this means some noise was audible but could not be quantified. If site noise was NM due to masking but estimated to be significant in relation to a relevant criterion, we would employ methods as per the Industrial Noise Policy (e.g. measure closer and back calculate) to determine a value for reporting.

All sites noted as NM in this report are due to one or more of the following reasons:

- site noise levels were extremely low and unlikely, in many cases, to be even noticed;
- site noise levels were masked by another relatively loud noise source that is characteristic of the environment (e.g. breeze in foliage or continuous road traffic noise) that cannot be eliminated by moving closer; and/or
- it was not feasible or reasonable to employ INP methods such as move closer and back calculate. Cases may include, but are not limited to, rough terrain preventing closer measurement, addition/removal of significant source to receiver shielding caused by moving closer, and meteorological conditions where back calculation may not be accurate.

### 3.4 Attended Monitoring Equipment

The equipment used to measure environmental noise levels is detailed in Table 3.1. Calibration certificates are provided in Appendix B.

<table>
<thead>
<tr>
<th>Model</th>
<th>Serial Number</th>
<th>Calibration Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rion NA-28 sound level analyser</td>
<td>1070590</td>
<td>28/06/2018</td>
</tr>
<tr>
<td>Pulsar 106 acoustic calibrator</td>
<td>79631</td>
<td>30/03/2019</td>
</tr>
</tbody>
</table>
4 RESULTS

4.1 Attended Noise Monitoring

Overall noise levels measured at each location during attended measurement are provided in Table 4.1. Discussion as to the noise sources responsible for these measured levels is provided in Section 5 of this report.

Table 4.1: MEASURED NOISE LEVELS – OCTOBER 2017

<table>
<thead>
<tr>
<th>Location</th>
<th>Start Date and Time</th>
<th>L_{Amax} dB</th>
<th>L_{A1} dB</th>
<th>L_{A10} dB</th>
<th>L_{A50} dB</th>
<th>L_{Aeq} dB</th>
<th>L_{A90} dB</th>
<th>L_{Amin} dB</th>
<th>L_{Ceq} dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1246 Hebden Rd</td>
<td>03/10/2017 22:23</td>
<td>55</td>
<td>41</td>
<td>36</td>
<td>30</td>
<td>33</td>
<td>25</td>
<td>22</td>
<td>41</td>
</tr>
<tr>
<td>1317 Hebden Rd</td>
<td>03/10/2017 22:03</td>
<td>49</td>
<td>42</td>
<td>36</td>
<td>30</td>
<td>33</td>
<td>25</td>
<td>21</td>
<td>39</td>
</tr>
</tbody>
</table>

Notes:
1. Levels in this table are not necessarily the result of activity at LCO.

Table 4.2 to Table 4.3 detail noise levels from LCO in the absence of other noise sources. Criteria are then applied if weather conditions are in accordance with LCO’s development consent. Discussion as to the noise sources responsible for these measured levels is provided in Section 5 of this report.

Table 4.2: L_{Aeq,15minute} GENERATED BY LCO AGAINST IMPACT ASSESSMENT CRITERIA – OCTOBER 2017

<table>
<thead>
<tr>
<th>Location</th>
<th>Start Date and Time</th>
<th>Wind Speed m/s$^1$</th>
<th>Wind Direction Degrees$^1$</th>
<th>VTG $^\circ$C per 100m$^1$</th>
<th>Stab. Class</th>
<th>Criterion dB</th>
<th>Criterion Applies?</th>
<th>LCO L_{Aeq,15min} dB$^{54}$</th>
<th>Exceedance $^{54}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1246 Hebden Rd</td>
<td>03/10/2017 22:23</td>
<td>1.9</td>
<td>166</td>
<td>3.0</td>
<td>F</td>
<td>35</td>
<td>No</td>
<td>IA</td>
<td>NA</td>
</tr>
<tr>
<td>1317 Hebden Rd</td>
<td>03/10/2017 22:03</td>
<td>2.3</td>
<td>175</td>
<td>3.0</td>
<td>F</td>
<td>35</td>
<td>No</td>
<td>IA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Notes:
1. Atmospheric data is from LCO weather station;
2. Noise emission limits apply for all meteorological conditions except during rain, hail, winds greater than 3 metres per second (at a height of 10 metres), temperature inversion conditions greater than 3 degrees $^\circ$C per 100 metres, or stability class F or G;
3. NM denotes audible but not measurable, IA denotes inaudible;
4. These are results for LCO in the absence of all other noise sources;
5. Bold results in red are those greater than the relevant criterion (if applicable); and
6. NA in exceedance column means atmospheric conditions outside conditions specified in development consent and so criterion is not applicable.
Table 4.3: $L_{A1,1min}$ GENERATED BY LCO AGAINST IMPACT ASSESSMENT CRITERIA – OCTOBER 2017

<table>
<thead>
<tr>
<th>Location</th>
<th>Start Date and Time</th>
<th>Wind Speed m/s $^1$</th>
<th>Wind Direction Degrees $^1$</th>
<th>VTG °C per 100m $^1$</th>
<th>Stab. Class</th>
<th>Criterion dB</th>
<th>Criterion Applies? $^2$</th>
<th>LCO $L_{A1,1min}$ dB $^3,4,5$</th>
<th>Exceedance $^6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1246 Hebden Rd</td>
<td>03/10/2017 22:23</td>
<td>1.9</td>
<td>166</td>
<td>3.0</td>
<td>F</td>
<td>45</td>
<td>No</td>
<td>IA</td>
<td>NA</td>
</tr>
<tr>
<td>1317 Hebden Rd</td>
<td>03/10/2017 22:03</td>
<td>2.3</td>
<td>175</td>
<td>3.0</td>
<td>F</td>
<td>45</td>
<td>No</td>
<td>IA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Notes:
1. Atmospheric data is from LCO weather station;
2. Noise emission limits apply for all meteorological conditions except during rain, hail, winds greater than 3 metres per second (at a height of 10 metres), temperature inversion conditions greater than 3 degrees C per 100 metres, or stability class F or G;
3. NM denotes audible but not measurable, IA denotes inaudible;
4. These are results for LCO in the absence of all other noise sources;
5. Bold results in red are those greater than the relevant criterion (if applicable); and
6. NA in exceedance column means atmospheric conditions outside conditions specified in development consent and so criterion is not applicable.

4.2 Low Frequency Assessment

Table 4.4 provides statistics for attended noise monitoring undertaken around LCO during October 2017.

Table 4.4: ATTENDED MEASUREMENT STATISTICS FOR LCO – OCTOBER 2017

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Total for October 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of measurements</td>
<td>2</td>
</tr>
<tr>
<td>Number of measurements where criterion applied</td>
<td>0</td>
</tr>
<tr>
<td>Number of measurements where LCO was within 5 dB of the criterion and criterion applied</td>
<td>0</td>
</tr>
</tbody>
</table>

Neither of the two measurements occurred during which LCO was directly measurable (not “inaudible” or “not measurable” or less than a maximum cut-off value of “<30 dB”), was within 5 dB of the relevant criterion and where meteorological conditions resulted in criteria applying (in accordance with the development consent). No further low frequency assessment was required.
4.3 Atmospheric Conditions

Atmospheric condition data measured by the operator at each location using a Kestrel hand-held weather meter and compass is shown in Table 4.5. Atmospheric condition data is routinely recorded on a site-by-site basis to show conditions during the monitoring period. Wind speed, direction and temperature were measured at 1.8 metres.

Table 4.5: MEASURED ATMOSPHERIC CONDITIONS – OCTOBER 2017

<table>
<thead>
<tr>
<th>Location</th>
<th>Start Date and Time</th>
<th>Temperature °C</th>
<th>Wind Speed m/s&lt;sup&gt;1/2&lt;/sup&gt;</th>
<th>Wind Direction MN&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Cloud Cover eighths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1246 Hebden Rd</td>
<td>03/10/2017 22:23</td>
<td>15</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>1317 Hebden Rd</td>
<td>03/10/2017 22:03</td>
<td>16</td>
<td>0.1</td>
<td>20</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
1. “-” indicates that conditions were calm at 1.8 metres; and
2. Noise criteria do not apply if wind speeds at the microphone height exceed 5.0 metres per second. If this occurs, the measurement must be repeated.
5 DISCUSSION

5.1 Noted Noise Sources

Table 4.1 presents data gathered during attended monitoring. These noise levels are the result of many sounds reaching the sound level meter microphone during monitoring. Received levels from various noise sources were noted during attended monitoring and particular attention was paid to the extent of LCO’s contribution, if any, to measured levels. During each measurement, LCO’s $L_{Aeq,15\text{minute}}$ and $L_{A1,1\text{minute}}$ (in the absence of any other noise) were, where possible, measured directly, or, determined by frequency analysis.

Other major noise sources audible at times at the LCO monitoring locations include Mt Owen Complex, power stations and trains.

From these observations summaries have been derived for each location as detailed in the following sections. Statistical 1/3 octave band analysis of environmental noise was undertaken, and Figure 3 to Figure 4 display the frequency ranges for various noise sources at each location for $L_{A1}$, $L_{A10}$, $L_{A90}$, and $L_{Aeq}$. These figures also provide, graphically, statistical information for these noise levels.

An example is provided as Figure 2 where it can be seen that frogs and insects are generating noise at frequencies above 1000 Hz; mining noise is at frequencies less than 1000 Hz (this is typical). Adding levels at frequencies that relate to mining only allows separate statistical results to be calculated. This analysis cannot always be performed if there are significant levels of other noise at the same frequencies as mining; this can be dogs, cows, or, most commonly, road traffic.

It should be noted that the method of summing statistical values up to a cut-off frequency can overstate the $L_{A1}$ result by a small margin but is entirely accurate for $L_{Aeq}$. 
Figure 2: Sample graph (See Section 5.1 for explanation)
5.1.1 1246 Hebden Road, 3 October 2017

LCO was inaudible during the measurement.

Cows and birds generated the measured $L_{A1}$, $L_{A10}$, and $L_{Aeq}$.

Frogs and insects and a low level continuum from another mine contributed to the $L_{A90}$.

A bat, power station continuum and dog were also noted.
5.1.2 1317 Hebden Road, 3 October 2017

LCO was inaudible during the measurement.

Cows and birds generated the measured $L_{A1}$, $L_{A10}$ and $L_{Aeq}$.

Frogs and insects and a low level continuum from another mine contributed to the $L_{A90}$.

Figure 4: Environmental Noise Levels - 1317 Hebden Road
6 SUMMARY OF COMPLIANCE

6.1 Operational Noise Assessment

Environmental noise monitoring described in this report was undertaken on the night of 3 October 2017. Activities from LCO complied with the relevant development consent noise limits during the survey at both monitoring locations.

6.2 Low Frequency Assessment

Neither of the two measurements occurred during which LCO was directly measurable, was within 5 dB of the relevant criteria and where meteorological conditions resulted in the criteria applying (in accordance with the consent). No further low frequency assessment was required.

Global Acoustics Pty Ltd
APPENDIX

A DEVELOPMENT CONSENT
The noise sections of the relevant project approval and licence are reproduced below.

**LIDDELL COAL OPERATIONS DEVELOPMENT CONSENT**

A.1.1 LCO 2016 Modification

Modifications to the original development consent (DA 305-11-01) were granted by the Minister for Planning in July 2007, May 2008, October 2009, December 2014 and February 2016. The relevant noise conditions from Schedule 3 – Specific Environmental Conditions and Appendix 6 of the most recent modification is reproduced below.

**Impact Assessment Criteria**

1. The Applicant shall ensure that the noise generated by the development does not exceed the noise impact assessment criteria in Table 1 at any residence.

<table>
<thead>
<tr>
<th>Assigned residential location number</th>
<th>Day ($L_{Aeq(15min)}$)</th>
<th>Evening ($L_{Aeq(15min)}$)</th>
<th>Night ($L_{Aeq(15min)}$)</th>
<th>Night ($L_{Aeq(15min)}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,5,6,7,8,9,10,11,12,14</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>45</td>
</tr>
<tr>
<td>2</td>
<td>35</td>
<td>35</td>
<td>36</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>35</td>
<td>37</td>
<td>45</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>35</td>
<td>36</td>
<td>45</td>
</tr>
<tr>
<td>All other privately-owned land</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>45</td>
</tr>
</tbody>
</table>

Note: To interpret the locations referred to in Table 1, see Appendix 5.

Noise generated at the development is to be measured in accordance with the relevant requirements of the NSW Industrial Noise Policy. Appendix 6 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.

However, these criteria do not apply if the Applicant has an agreement with the owner(s) of the relevant residence or land to generate higher noise levels, and the Applicant has advised the Department in writing of the terms of this agreement.

**Operating Conditions**

2. The Applicant shall:
   (a) implement all reasonable and feasible measures to minimise the construction, operational, road and rail noise of the development;
   (b) operate a noise management system on site that uses attended noise monitoring data to ensure compliance with the relevant conditions of consent;
   (c) evaluate the effectiveness of the noise management system;
   (d) minimise the noise impacts of the development during meteorological conditions when the noise criteria in this consent does not apply (see Appendix 6); and
   (e) monitor and report on compliance with the relevant noise conditions of this consent, to the satisfaction of the Secretary.

**Monitoring Program**

3. The Applicant shall update and subsequently implement the Noise Monitoring Program for the development to the satisfaction of the Secretary. This program must be submitted to the Secretary by the end of May 2015, and must include regular attended monitoring in accordance with Appendix 6, and a noise monitoring protocol for evaluating compliance with the noise impact assessment criteria in this consent.
APPENDIX 6
NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in Table 1 of Schedule 3 are to apply under all meteorological conditions except the following:
   (a) during periods of rain or hail;
   (b) average wind speed at microphone height exceeds 5 m/s;
   (c) wind speeds greater than 3 m/s measured at 10 m above ground level; or
   (d) temperature inversion conditions greater than 3°C/100 m, or alternatively stability class F and G.

Determination of Meteorological Conditions

2. Except for wind speed at microphone height, the data to be used for determining meteorological conditions shall be that recorded by the meteorological station on or in the vicinity of the site.

Compliance Monitoring

3. Attended monitoring is to be used to determine compliance with the relevant conditions of this consent.

4. This monitoring must be carried out at least once a month (but at least two weeks apart), unless the Secretary directs otherwise.

   Note: The Secretary may direct that the frequency of attended monitoring increase or decrease at any time during the life of the development.

5. Unless otherwise agreed with the Secretary, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the NSW Industrial Noise Policy (as amended from time to time), in particular the requirements relating to:
   (a) monitoring locations for the collection of representative noise data;
   (b) meteorological conditions during which collection of noise data is not appropriate;
   (c) equipment used to collect noise date, and conformity with Australian Standards relevant to such equipment; and
   (d) modifications to noise data collected including for the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.
A.1.2 LCO 2015 Noise Monitoring Program

3.1 Monitoring Locations

A review of noise monitoring locations was conducted by Global Acoustics in March 2013 (refer Appendix A) and determined that the number of sites could be reduced to two (1246 (R1, R3) and 1307 (R4, R5, R6) Hebden Road) on the basis of:

- The Environment Protection Authority (EPA) has advised LCO, as part of the Pollution Reduction Program, that: ‘Noise sensitive receiver locations do not include any locations owned by the licencee or another coal mine or where a negotiated agreement (as outlined in the Industrial Noise Policy) is in place between the landowner and any licence holder’. While this statement refers to ‘another coal mine’ it is considered reasonable to substitute ‘another noise generating industry’ such as AGL Macquarie Liddell and Bayswater Power Stations into this statement. AGL Macquarie (R15) owns the Liddell Recreational Area (LRA) (R13) and monitoring has indicated it is significantly affected by Power Station generated noise.

- Noise monitoring has been undertaken at 1412 (R7) and 1525 (R9) Hebden Road on nominally three occasions per quarter, since quarter 4, 2010. The total sample count at both locations is 25 with a maximum mining LAeq at these locations of 32 dB, measured at 1412 (R7) Hebden Road; and

- Prior to and up until the review in March 2013, mining noise has been insignificant and inaudible, less than LAeq 20 dB, or, not measurable due to low level mine noise impact for 88 and 80 percent of the samples at 1412 (R7) and 1525 (R9) Hebden Road respectively. Therefore it can be said these locations have a history of receiving low to zero mining noise levels from LCO.

Noise Monitoring at LCO will be undertaken at the locations shown on Figure 1 – Noise Monitoring Locations. These locations have been selected to be representative of the local LCO community and likely properties that may be impacted by LCO operational noise. The locations are representative of currently occupied properties identified for monitoring in the Development Approval.

Current monitoring locations and a reference to the 2013 EIS residential property reference is provided in Table 3.

Table 3: Current noise monitoring locations and references to 2013 EIS property reference.

<table>
<thead>
<tr>
<th>Current Noise monitoring Location</th>
<th>Representative residential receivers from the 2013 EIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1317 Hebden Rd</td>
<td>12 R4 (also representative of R5 and R6)</td>
</tr>
<tr>
<td>1246 Hebden Rd</td>
<td>14 R1 (also representative of R2 and R3)</td>
</tr>
</tbody>
</table>

Residence 1246 Hebden Rd (14) is the closest occupied non-mined owned residence to Liddell Coal.

Attended noise monitoring will be undertaken once per calendar month at the representative locations nominated in Section 3.1 in accordance with the Environment Protection Authority (EPA) ‘Industrial Noise Policy’ (INP) guidelines and Australian Standard AS 1055 ‘Acoustics, Description and Measurement of Environmental Noise’.

All noise measurements will be accompanied by both qualitative description (including cloud cover) and quantitative measurements of prevailing weather conditions throughout the monitoring period. Quantitative data will be sourced from the meteorological monitoring station utilised by LCO.
Each monthly attended noise survey comprises up to two 15-minute measurements at each location.

DP&E require monitoring to determine if any impacts are systemic/sustained. Accordingly, if a noise criterion exceedance is measured, then a second measurement is to be made within the next 75 minutes. If the second measurement also results in an exceedance, this location would be deemed noise affected for that night. This will trigger follow up monitoring that will be undertaken at that specific location (not all locations) on one night during the following one week. The regular monitoring frequency will be resumed if no further exceedances are measured. However, if a further exceedance is measured during the follow up period (one week), then a comprehensive survey will be undertaken, to the satisfaction of the DP&E, to determine if these impacts are regular (systemic/sustained).

For each 15 minute monitoring period, the following information will be recorded:

- operator’s name;
- monitoring location;
- date and time that monitoring began at each location;
- quantitative meteorological data such as temperature, wind speed, wind direction and humidity;
- qualitative meteorological information such as cloud cover, fog, and rainfall;
- instrument calibration details before and after the monitoring period;
- the value or estimate of the LCO $L_{eq\text{,15}}$;
- the highest mining $L_{A1\text{,1minute}}$ noise level (to allow comparison with the relevant sleep arousal criterion);
- the overall $L_{eq\text{,15}}$ and $L_{Ceq\text{,15}}$;
- statistical noise level descriptors: $L_{A00}$, $L_{AS0}$, $L_{A10}$, $L_{A11}$, and $L_{Amax}$;
- notes that identify the noise source that generated the highest $L_{A1\text{,1minute}} (L_{Amax})$;
- measurements in one-third octave bands from 25 Hz to 10 kHz inclusive (or a broader range of bands) to assess if the mining noise has characteristics that may require modifying factors to be applied; and
- data suitable for assessing the relative contribution of mine-generated noise to the overall noise being measured by using a suitable low-pass filter.

In accordance with the methodology outlined in Section 3.4 of the INP (EPA, 2000), if any of the data in a 15 minute period is affected by rain or wind speeds in excess of 5 m/s then another entire 15 minute period of data unaffected by rain or excessive wind shall be undertaken.
APPENDIX

B CALIBRATION CERTIFICATES
Acoustic Research Labs Pty Ltd

Level 7 Building 2, 423 Pennant Hills Rd
Pennon Hills NSW AUSTRALIA 2120
Ph: +61 2 9484 0800 A.B.N. 65 166 399 119
www.acousticrosresearch.com.au

Sound Level Meter
IEC 61672-3:2006

Calibration Certificate

Calibration Number: C16323

Client Details: Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton NSW 2322

Equipment Tested/Model Number: Rion NA-28
Instrument Serial Number: 01070590
Microphone Serial Number: 08184
Pre-amplifier Serial Number: 52329

Pre-Test Atmospheric Conditions
Ambient Temperature: 21.4°C
Relative Humidity: 37.5%
Barometric Pressure: 100.19kPa

Post-Test Atmospheric Conditions
Ambient Temperature: 21.4°C
Relative Humidity: 37.5%
Barometric Pressure: 100.23kPa

Calibration Technician: Calvin Simplicendorfer
Calibration Date: 28/06/2016

Secondary Check: Riley Cooper
Report Issue Date: 30/06/2016

Approved Signatory: Ken Williams

Clause and Characteristic Tested | Result | Clause and Characteristic Tested | Result
--- | --- | --- | ---
11. Acoustical tests of a frequency weighting | Pass | 15. Linearity incl the level range control | Pass
12. Electrical tests of frequency weightings | Pass | 16. Tone burst response | Pass
13. Frequency and time weightings at 1 kHz | Pass | 17. Peak C sound level | Pass
18. Overload indication | Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed.

As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation test performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the clause 1 requirements of IEC 61672-3:2002.

The uncertainties of measurement are as follows:

\[
\text{Acoustic Tests} \begin{align*}
31.5 \text{ Hz to } 63 \text{ kHz} &\pm 0.12 \text{ dB} \\
12.5 \text{ kHz} &\pm 0.12 \text{ dB} \\
1 \text{ kHz} &\pm 0.12 \text{ dB} \\
100 \text{ Hz} &\pm 0.3 \text{ dB} \\
\end{align*}
\text{Electrical Tests} \begin{align*}
31.5 \text{ Hz to } 20 \text{ kHz} &\pm 0.12 \text{ dB} \\
\end{align*}
\]

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.
Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian National standards.

NATA

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ABN 94 094 985 734
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Ph: +61 2 9483 0800 A.B.N. 65 356 399 229
www.acousticsresearch.com.au

Sound Calibrator
IEC 60942-2004

Calibration Certificate
Calibration Number: C17149

Client Details: Global Acoustics Pty Ltd
12/16 Huntingdale Drive
Thornton NSW 2322

Equipment Tested/ Model Number: Pulsar 106
Instrument Serial Number: 79931

Atmospheric Conditions
Ambient Temperature: 21.9°C
Relative Humidity: 54.6%
Barometric Pressure: 98.84 kPa

Calibration Technician: Vicky Jaiwal
Calibration Date: 30/05/2017

Secondary Check: Riley Cooper
Report Issue Date: 31/05/2017

Approved Signatory: Juan Aguero

<table>
<thead>
<tr>
<th>Clause and Characteristic Tested</th>
<th>Result</th>
<th>Clause and Characteristic Tested</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.2: Generated Sound Pressure Level</td>
<td>Pass 5.1.2: Frequency Generated</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>2.2.3: Short Term Fluctuation</td>
<td>Pass 5.5: Total Distortion</td>
<td>Pass</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal Level</th>
<th>Nominal Frequency</th>
<th>Measured Level</th>
<th>Measured Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.0</td>
<td>1000.0 Hz</td>
<td>54.3</td>
<td>1000.2 Hz</td>
</tr>
</tbody>
</table>

The sound calibrator has been shown to conform to the class 2 requirements for periodic testing, described in Annex B of IEC 60942-2004 for the stated pressure level(s) and frequency(ies) stated for the environmental conditions under which the tests were performed.

The stated uncertainties of measurement of the Environment Conditions are:
- Temperature ±0.05°C
- Relative Humidity ±0.05%
- Barometric Pressure ±0.03 kPa

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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Accredited for compliance with ISO/IEC 17025

The results of the test, calibrations and/or measurements included in this document are traceable to Australian National standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.