WARKWORTH CONTINUATION 2014

Acoustics Review

6th May 2015

Document history and status

Revision	Date	Description	By	Review	Approved
A	31/03/2015	Draft Report	N Broner		N Broner
B	01/04/2015	Minor amendments	N Broner		N Broner
C	28/4/2015	Consideration of Wilkinson Murray Report	N Broner		N Broner

Executive Summary

Broner Consulting was engaged by the NSW Department of Planning and Environment to conduct an acoustics review of various aspects of the proposal by Warkworth Mining Limited and Mt Thorley Operations Pty Limited to expand their operation westwards (known as the Warkworth Continuation 2014 – WC14) so as to continue their operations at the Mt Thorley Warkworth mine.

The Author has reviewed many documents in relation to these and has concluded as follows:

1. The Author is satisfied that the significant amount of background noise level data collected in and around Bulga adequately portrays the range of background noise levels experienced in the area.
2. The Author is satisfied that the choice of an RBL of 30 dBA even where longer term measurements might suggest a higher value is a conservative approach which protects noise sensitive areas in and around Bulga appropriately. This also means that the project criteria are also conservatively set for this project.
3. SKM 2012 raised a concern that there was insufficient data collected in their survey to enable them to assess the accuracy of ongoing routine noise monitoring carried out by the Applicant. The Author is satisfied that this concern is no longer valid given the significant amount of data available since then.
4. The Author has seen this response successfully followed at MTW with operational changes successfully brought into play within an hour of the trigger.
5. The Author is satisfied that the current noise level management program is being successfully implemented.
6. The Author is satisfied that non-compliant noise measurements account for a very small percentage of the monitoring dataset.
7. The Author is satisfied with the future level predictions and validation thereof.
8. The Author believes that the Day Design Report August 2014 displays a lack of understanding of the application of the INP and a lack of understanding and appreciation of how the mine operates, of the mechanisms in place to control nightly noise emission and of the noise mitigation measures that have been and are being implemented
9. The Author notes that with respect to Low Frequency Noise, Section 4.1 of the INP specifically states “This section outlines the correction factors to be applied **to the source noise level at the receiver** before comparison with the criteria.” The Author is satisfied that when applied correctly in the mining context, a penalty at distances greater than of the order of 3 km should not be applied. Currently, such an application is a misapplication which will result in a perverse outcome. The Author is also satisfied that the likelihood of the Broner maximum criterion being exceeded is very minimal.
10. These conclusions are supported by the noise level measurements conducted by Wilkinson Murray in the Bulga area during April 2015.
11. The Author is satisfied that the removal of Saddleback Ridge will not result in a significant increase in noise level in noise sensitive areas in and around Bulga. This is mainly due to the presence of neutral/calm meteorological conditions which do not support enhanced propagation of mine noise being very infrequent and remaining so after the removal of Saddleback Ridge. The potential for noise levels to further increase when noise enhancing conditions are present is very limited.

Contents

Glossary

Term	Description
Noise Spectrum	The sound pressure level (or sound power level) as a function of frequency (eg octave band, 1/3 octave or narrow band). Generally used to identify noise sources or items contributing disproportionately to an overall noise level.
Ambient Noise Level	The prevailing noise level at a location due to all noise sources but excluding the noise from the specific noise source under consideration. Generally measured as a dB(A) noise level.
Background Noise Level	The lower ambient noise level, usually defined as the value of the time varying ambient noise level exceeded for 90% of the measurement time. Usually defined in the dB(A) scale - L_{A90}.
dB	Sound pressure levels are expressed in decibels as a ratio between the measured sound pressure level and the reference pressure. The reference pressure is $2x10^{-6}$ Pascal (Newtons per square meter).
dB(A)	The A-weighted sound pressure level in decibels, denoted dB(A) is the unit generally used for the measurement of environmental, transportation or industrial noise. The A-weighting scale approximates the sensitivity of the human ear when it is exposed to normal levels and correlates well with subjective perception. An increase or decrease in sound level of approximately 10 dB corresponds to a subjective doubling or halving in loudness. A change in sound level of 3dB is considered to be just noticeable.
Frequency	The rate of repetition of a sound wave. The unit of frequency is the Hertz (Hz), defined as one cycle per second. Human hearing at everyday sound pressure levels ranges approximately from 20 Hz to 20,000 Hz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands. For more detailed analysis each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
Sound Level Meter	An instrument consisting of a microphone, amplifier and data analysis package for measuring and quantifying noise.
LA1	The A weighted sound pressure level that is exceeded for 1% of the measurement period
LA10	The A weighted sound pressure level that is exceeded for 10% of the measurement period (approximately the average maximum noise level)
LA90	The A weighted sound pressure level that is exceeded for 90% of the measurement period (represents the background noise level)
LA95	The A weighted sound pressure level that is exceeded for 95% of the measurement period (represents the background noise level)
LAeq	The equivalent continuous sound level. The steady dBA level which would produce the same A weighted sound energy over a stated period of time as the time varying sound.
LAmax	Is the maximum a-weighted noise level measured during the measurement period

2.0 Introduction

Broner Consulting was engaged by the NSW Department of Planning and Environment to conduct an acoustics review of various aspects of the proposal by Warkworth Mining Limited and Mt Thorley Operations Pty Limited to continue their operations westwards at the Mt Thorley Warkworth mine (known as the Warkworth Continuation 2014 – WC14).

The Scope of the Review was as follows:

- Review of relevant documents
- Following the review of the relevant documents, advise the Department whether any additional information or noise monitoring is required to complete the review and/or justify the methodology or conclusions made in these documents. If additional noise monitoring was recommended, then to make suitable arrangements to obtain this data, in consultation with the Department.
- Preparation of a detailed report summarising the findings of the review. The report was to consider the following:
  - the adequacy of the methodology used in the noise impact assessments, particularly in regard to background noise levels;
  - the reasonableness and accuracy of the predicted impacts, particularly in regard to low frequency noise;
  - whether the assessments have been prepared in accordance with applicable NSW Government policies, including the NSW Industrial Noise Policy;
  - whether the proposed mitigation measures are reasonable and generally consistent with best practice; and
  - whether there are any additional mitigation measures that could be imposed to further reduce noise impacts (including plant and equipment, real-time noise management, noise barriers and bunds, retaining Saddleback Ridge) and the likely acoustic benefit of such measures.

The review focused on the Warkworth operations but any discussion and conclusions considered the Mt Thorley operations.

3.0 Documents Reviewed

In conducting this review, the Author reviewed the following documents:

- Warkworth Continuation 2014 EIS prepared by EMM, Volume 1 – Main Report and Appendix F Noise and Vibration Study, June 2014
- Warkworth Continuation Project – Preliminary Environmental Assessment
- Mt Thorley Continuation EIS, Appendix F Noise and Vibration Study
- NSW Land & Environment Court Decision Bulga Milbrodale Progress Association Inc vs Minister for Planning and Infrastructure and Warkworth Mining Limited Decision dated 15 April 2013
- Day Design ty Ltd “Acoustic Peer Review Mt Thorley and Warkworth Mine Continuation” 6 August 2014 prepared for the Bulga Milbrodale Progress Association
- Warkworth Continuation 2014 “Draft Response to Submissions” prepared by EEM Oct 2014 Volume 1 Main Report and Volume 2 - Appendices
- EPA Submission on Warkworth Continuation Project – SSD6464, August 2014
- EPA Submission on Mt Thorley Operations 2014 Project – SSD6465, August 2014
- SKM Mount Thorley/Warkworth Coal Mine Independent Noise Monitoring Cover Report April 2012 and Monitoring Site Reports for Locations 1 – 8 April 2012 and the Schedule 2 Noise Logger Charts March 2012
- Global Acoustics Noise Monitoring reports Quarter 1 – 4 2012
- Warkworth Continuation 2014 – Response to Submissions by EMM Oct 2014
- NSW Industrial Noise Policy
- NSW SEPP (Mining, Petroleum Production and Extractive Industries) 2007
- A Simple Outdoor Criterion for Assessment of Low Frequency Noise Emission by Broner April 2011

- Proposed Criteria for the Assessment of LFN Disturbance by Moorhouse et al UK DEFRA
- NSW Voluntary Land Acquisition and Mitigation Policy For State Significant Mining, Petroleum and Extractive Industry Developments (15 Dec 2014)
- Planning Assessment Commission "Warkworth Continuation Project Review Report" 04 March 2015
- Warkworth Continuation 2014 "Response to Planning Assessment Commission Review Report" prepared by EEM March 2015
- "Bulga Village Mine Noise – 10 Day Noise Audit" Wilkinson Murray Report 15084 Version B, April 2015.

4.0 Background Noise Level and the RBL

What is going on around any given location is clearly very important in determining the background noise level and this needs to be fully understood before making any comparisons between any given locations. Local noise sources may differ between locations eg operating machinery, grazing cattle, presence of trees etc.

Section 3.1 of the INP states that "the background noise level is defined here as 'the underlying level of noise present in ambient noise when all unusual extraneous noise is removed'. Sound levels contributing to background levels can include sound from nearby traffic (see Section 3.1.3), birds, insects, animals, machinery and similar sources if these sounds are a normal feature of the location. The background noise level is considered to be represented by the LA90,(15 min) descriptor. In comparison, the rating background level (as defined in Section 3.1.2) is the single-figure background noise level derived from monitoring LA90,(15 min) over a representative period of time. The rating background level is used for the derivation of the intrusiveness criterion and ultimately for assessment purposes when the intrusiveness criterion is lower than the amenity criterion.

Section 3.1 further states "Background noise levels need to be determined before the intrusive noise can be assessed. The background noise levels to be measured are those that are present at the time of the noise assessment and without the subject development operating. Hence, for the assessment of modifications to an existing development, the noise from the existing development should be excluded from background noise measurements. When assessing a new development, it is important to undertake sufficient monitoring of background noise to allow intrusive noise to be assessed adequately". So it is important that in this case, to be consistent with the INP, Warkworth mine or Mt Thorley noise be excluded when determining the background noise level in the area.

Standard noise loggers measure and include ALL noise level contributions so using such data may not be appropriate, depending on the location of the mine which is the subject of determination and on which other mines may be affecting the measurement location. The advantage of a noise logger such as the Barn Owl is that it can separate the contributions from various noise sources and directions and therefore the RBL derived using the Barn Owl approach can be better used to provide a more appropriate RBL which forms the basis of the intrusiveness criterion in accordance with the requirement of the INP.

Many background noise level and RBL derivation studies have been conducted in and around the Bulga township over the years. EMM have concluded based on a significant amount of data analysis including the use of the Barn Owl system to exclude either Warkworth or Mt Thorley mine noise that the relevant RBL's should be in the range 30 – 33 dBA. Table E in Appendix F of the Warkworth Continuation 2014 EIS includes the ABL's for the day, evening and night times based on analysis of the comprehensive data set. It can be seen that at some locations, the night time ABL is less than 30 dBA on many occasions but it can also be observed that it also higher than 33 dBA on others. In Section 3.1.2 of the INP, it states that "Where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A)". Thus, adopting a minimum of 30 dBA is appropriate for some locations. However, limiting the RBL to 33 dBA as per the 2002 EIS while RBL's are higher in practice at other locations, can be seen to be an additional element of conservatism in the approach adopted in the assessment conducted by EMM.

SKM conducted independent noise monitoring in 2012 at 8 community locations in agreement with members of the Bulga community. The detailed reports at each of the locations show variations in background noise levels with levels mostly above LA90, 15min 30 – 35 dBA. At a number of the locations, the night time levels were higher than during the daytime and this situation seems to be somewhat characteristic of the area and may be seasonal. This could be explained by seasonal variations in meteorological conditions at night but also could be due to varying night time activity by local wildlife depending on season. This data includes all noise and does not exclude Warkworth mine (but did not include any significant noise contribution from Mt Thorley as it only commenced back on full operation in November 2012 after a hiatus in operations from mid 2006 until mid 2010). This comprehensive set of measurements supports the choice of RBL's in the range of 30 - 33 dBA at locations which are exposed to potentially higher background noise levels as being indeed a conservative approach.

The Author is satisfied that the significant amount of background noise level data collected in and around Bulga adequately portrays the range of background noise levels experienced in the area. The data sets employed used at a minimum, many months of data (3 – 11 months depending on location) and also considered seasonal variations and wind directions. For example, in the winter, winds are predominantly westerly and the backgrounds noise level data is less likely to be affected by mine noise and are less likely to be affected by wild life noise. Note that Section 3.5 of the INP requires only "Typically, one week's worth of valid data covering the days and times of operation. The data set for the Bulga area is thus very comprehensive.

The Author is satisfied that the choice of an RBL of 30 dBA even where longer term measurements might suggest a higher value is a conservative approach which protects noise sensitive areas in and around Bulga appropriately. This also means that the project criteria are also conservatively set for this project.

The SKM 2012 report acknowledged that the "Results during the Independent monitoring program were lower than those obtained during the MTW Routine monitoring program". However, they also raised a concern that there was insufficient data collected in their survey to enable them to assess the accuracy of ongoing routine noise monitoring carried out by the Applicant. We note that even if there was insufficient data then (and this is not clear), since that time there is a history of quarterly noise level surveys, the noise management plan execution and data supporting very substantial compliance (Section 10.5.3 of Volume 1 of the Warkworth Continuation 2014 EIS Main Report dated June 2014 explains that an assessment of monitoring data (publically available via the Rio Tinto Coal Australia website www.riotintocoalaustralia.com.au) demonstrates predominant compliance with noise criteria having been been achieved throughout the life of the mine. Non-compliant noise measurements accounted for only a very small percentage of the monitoring dataset at 0.37 per cent (10 non-compliances measured from 2,689 individual assessments undertaken). Therefore, the Author believes that this concern is no longer valid.

As an aside, the Author notes that in all reports that were reviewed, the noise floor of the instrumentation (A, C and Linear) was not provided nor has the frequency response of the instrumentation been provided. This can be very important when measuring low sound levels and low frequency noise. Having said that, based on specifications, the various noise loggers and sound level meters that have been or are being used currently do nominally have an appropriately low noise floor and an adequate frequency response to cover the frequencies of interest. In order to verify this, NATA certificates showing the noise floor and frequency response of the system should be provided for all the sound level meters and noise loggers being used to document noise levels in the area.

5.0 Two Mines Together Versus Two Separate Mines

The initial application for the Extension considered both the Warkworth and Mount Thorley Mines as a single entity and the project specific noise levels (PSNL's) were derived on that basis. This was a conservative approach in which the noise emission from both mines was assessed against the criteria. However, in Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure, and Warkworth Mining Ltd (2013 NSWLEC 48) Justice Preston agreed with the Bulga Milbrodale Progress Association that the two mines should have individual criteria. What this means is that now each mine is separately assessed against the criteria so that for

the present project, intrusive noise impacts from Warkworth alone is considered in assessing compliance and that when determining the rating background noise levels (RBL's) for Warkworth, noise from Mt Thorley along with that of other nearby mines is to be included. The practical consequences of this decision are quite large from the residents point of view and, in practice, a step backward for them. For example, using this approach, the number of properties entitled to mitigation in Bulga reduce from 20 to 4 as compared to that proposed by the Department in their 2010 assessment of Warkworth and Mt Thorley as one complex.

In taking the approach to separate the mines, it is absolutely necessary to separate out the contribution of each mine so that only the mine noise under consideration is assessed against the PSNL's in accordance with the NSW Industrial Noise Policy (INP). Most current noise logger systems can only measure all noise omni-directionally ie coming from all directions equally. In this case, such a measurement does not provide the information required to separate out the necessary separate noise level contributions. The only appropriate means of obtaining such information is to make use of a directional measurement system such as the Barn Owl real time directional noise monitor or a similar technology. The Barn Owl monitor uses three microphones to separate level versus direction and can allow for real time compliance assessment. Currently, there are 5 Barn Owl's deployed at locations in and around Bulga. These are currently being used for the purpose of real-time noise management.

6.0 Is 40 dBA Accepable As An External Noise Level

The INP (Section 1.4.4 and Section 2) sets two separate noise criteria to meet environmental noise objectives, one to account for intrusive noise and the other to protect the amenity of particular land uses and the more stringent of the two criteria is chosen as the project specific noise level. The intrusiveness criterion is based on the background noise level in an area. In areas with low background noise levels such as around Bulga, where the ambient background noise level is generally less than or equal to 30 – 35 dBA, the intrusiveness criterion becomes the driving criterion for setting noise emission limits rather than the amenity criterion (See Table 2.1 Amenity Criteria in the INP which sets the LAeq(night) at 40 dBA for a residence in a rural area).

Note that as stated in Section 2.1 of the INP, the approach for determining the background noise level and the rating background level (RBL) "aims to result in the intrusive noise criterion being met for at least 90% of the time periods over which annoyance reactions can occur (taken to be periods of 15 minutes)." This means that there is a realisation that not everyone will be protected for 100% of the time and that there can be up to 10% of occasions when the noise criterion might be exceeded and would be considered as acceptable given other factors such as the need for the development and the implementation of a reasonable and feasible noise mitigation program.

For the above reasons, it is therefore very important to see that the correct RBL is used in setting the intrusiveness criterion. In Section 3.5 of the INP, in relation to the question of duration of monitoring, it is stated that "For example, if a minimum background noise level of 30 dB(A) is assumed as the rating background level and the assessment shows no impact, then there is no need for background noise monitoring, as this represents a conservative and limiting case". This means that a choice of 30 dBA for the RBL is recognised as being conservative because 30 dBA is a low level of noise. To provide some context, AS/NZS 2107:2000 "Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors" sets satisfactory and maximum indoor LAeq noise levels recommended for different occupancies. The satisfactory level is defined in Section 4.5 of AS/NZS 2107:2000 as "one that has been found to be acceptable by most people for the environment in question and also to be not intrusive." For sleeping areas in houses in areas with negligible transportation, the satisfactory level is 25 dBA and the maximum is 30 dBA. This is for indoors. The outdoor equivalent is at least 10 dBA higher, so would be at least 35 dBA. For a reading area in a library, which is usually considered a quiet area, the recommended satisfactory level is LAeq 40 dBA and the maximum recommended is LAeq 45 dBA. Thus, in absolute terms, an external noise level of LAeq(15min) 35 – 40 dBA could not be considered loud, as such.

It appears that the key issue for the small number of complainants in Bulga does not relate so much to the general mine noise colloquially known as the "noise continuum" with a slightly higher low frequency content but rather due to a specific tonal noises such as due to truck exhausts, beepers and track slap. Many of these

transient noises have either been treated via the noise mitigation program or are being treated and minimised in the on-going truck attenuation program.

Note that the World Health Organisation (WHO)1 have reported a number of modest effects on sleep beginning when the external night noise was in the range of Lnight,outside 30–40 dBA. It states that "There is no sufficient evidence that the biological effects observed at the level below 40 dB Lnight,outside are harmful to health" and sets a night noise guideline at 40 dBA with an interim target of 55 dBA (recognising that it may be difficult in practice to achieve the guideline in the short term}. The intensity of the effect, however, varies with the nature of the source of the noise and the number of noise events. For continuous noise without tonality or specific noise events such as muffler noise or track slap, the impact can be expected to be much less, if any at all. The Lnight,outside noise measure is yearly average exposure. It is "the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year; in which the night is eight hours (usually 23.00 – 07.00 local time)". For mine noise, the LAeq(15min) is of the order of 3 dBA higher than the single night LAeq,night. Thus at the minimum, an outdoor LAeq(15mins) of 43 dBA would be the equivalent (if not a higher level due to the averaging across the year). For all locations around Warkworth, the PSNL is set at least 5 dB less than this and would therefore provide an acceptable outdoor noise level. For an outdoor level of the order of LAeq(15mins) of 40 dBA, the indoor level would be less than say 30 dBA even with the windows open and the external noise source is unlikely to be noticeable under most normal circumstances.

Note that as mentioned above, the final PSNL is based on the lowest of the intrusiveness and the amenity criteria. In this case, the amenity criterion is LAeq(15min) 40 dBA. With the RBL's varying from 30 dBA to 33 dBA, the intrusiveness criterion varies between 35 dBA to 38 dBA. Thus, in this case, the PSNL's are less than the amenity criterion of 40 dBA (and which would be the upper limit in this instance if the RBL's were actually higher). The PSNL's are lower than the Lnight,outside level of 40 dBA recommended by WHO and is significantly less than than Lnight,outside 55 dBA interim guideline.

7.0 Current Noise Emission Level Management

MTW is using a robust approach to noise level management. There are currently five Barn Owl loggers around the MTW complex (4 in Bulga and 1 shared with HVO at Long Point) with thresholds sets to trigger before criteria are exceeded. If complaints are going to occur at all, then they would likely occur at night when propagation conditions towards Bulga might be more adverse. Thresholds are set to trigger 2 dBA below the criterion for the given location (and also another trigger is set at the criterion level) and when a threshold is activated, the pro-active noise management team dispatch a Community Assessment Officer to the location to assess what the noise sources are that maybe an issue. The Community Assessment Officer then reports back to the night operations team who then take immediate control actions in terms of modifying operational equipment based on previous protocols to so as to minimise noise emission (if required, the same response approach occurs 24/7). In general, a Community Assessment Officer is in the area every night from around 7 – 8 PM and, depending on weather conditions, may be in the area until 5 – 6 AM. They can and do advise operations if they notice anything which requires attention at any time. The MTW also currently uses a predictive approach to the weather on a daily basis and then decide how to organise the operations accordingly. This is to ensure smooth operations even under adverse propagation conditions and shows a further pro-active approach to noise management.

The Author has seen this response successfully followed at MTW with operational changes successfully brought into play within an hour of the trigger.

The Author believes this noise management approach is appropriate and consistent with current world's best practice.

[1] WHO. Night noise guidelines for Europe. Copenhagen: World Health Organization, 2009. Available from: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

8.0 Monitoring of Compliance

The effectiveness of the MTW noise management system has been tested on a number of occasions in recent years, including formal compliance audits by Global Acoustics (2004 to present and in more recent years, monitoring has included low frequency noise assessment) and MTW continues to demonstrate a position of overwhelming compliance with noise criteria, and a high level of adherence to the measures outlined in the noise management plan.

Section 10.5.3 of Volume 1 of the Warkworth Continuation 2014 EIS Main Report dated June 2014 explains that an assessment of monitoring data (publically available via the Rio Tinto Coal Australia website www.riotintocoalaustralia.com.au) demonstrates predominant compliance with noise criteria has been achieved throughout the life of the mine These are shown in Tables 10.10 and Table 10.11 excerpted from the report. These tables also demonstrate that there are no sustained exceedances.

Table 10.10 Summary of noise measurements for Warkworth Mine

Total assessments (2004-2014 YTD)	2,689
Total number of exceedances (2004-2013 YTD)	24
Total number of non-compliances (2004-2013 YTD)	10
Percentage of non-compliant assessment (2004-2013 YTD)	0.37

Note: 1. Exceedance refers to a measured result greater than the relevant consent limit, but within the 2dB allowable tolerance listed in Chapter 11 of the INP.

Table 10.11 Yearly breakdown of noise measurements for Warkworth Mine

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total number of assessments	230	276	280	279	292	275	269	290	261	201	36
Total number of exceedances[1]	1	0	1	1	1	8	1	4	4	3	0
Total number of non-compliances	1	0	0	0	0	4	1	2	1	1	0
Non-compliant assessments (%)	0.43	0.00	0.00	0.00	0.00	1.45	0.37	0.69	0.38	1.14	0.00

Note: 1. Exceedance refers to a measured result greater than the relevant consent limit, but within the 2 dB allowable tolerance listed in Chapter 11 of the INP.

The Department should be confident that it will be able to monitor compliance. The Author is aware that the Department is currently conducting a noise validation study in Bulga Village which will allow a comparison between noise levels collected using the Barn Owl system with hand held attended measurement data. Any discrepancies between the two noise level measurements will be investigated and understood so that compliance monitoring results will be validated.

Use of the Barn Owl directional noise monitoring to determine mine contribution is state of the art and consistent with worlds current best practice. It should also be noted that often the noise at any one receiver is predominantly dominated by noise from one direction due to the prevailing wind direction. This will assist in identifying and differentiating between Warkworth and Mt Thorley.

But it is also noted that the Department is not proposing to use anything other than attended monitoring for compliance purposes because attended monitoring allows for the determination of exactly which noise sources are significant at any location and the assessment of the impact of extraneous noise.

The Author also notes that differentiating between noise from Warkworth and that of Mt Thorley is difficult, however, it is no more difficult than differentiating between any two adjoining industrial facilities. This is common in industrial estates around NSW and around the world.

9.0 Future Noise Level Predictions

EMM report noise modelling for a total of three indicative scenarios. These are meant to reflect the worst case operating scenarios with respect to potentially affected residences and are designated as Year 3, Year 9 and Year 14 approximating the time after the anticipated commencement date. Year 3 is described as also generally representative of current operations. Year 9 is considered more representative of the worst case noise generation case and Year 14 is reasonably similar. For the modelling, EMM have employed a standard approach used by consultants i.e. they have used the sound power level data of all significant noise sources as an input, they have assumed locations and the numbers of all of these sources and then assumed that all sources are all working and generating noise at the same time (note that EMM made the further assumption that the noise mitigations currently being implemented by MTO would be completed by 2016 which does seem reasonable given where the program is at currently).. Using the 3D digitised contour information for the area and a worst case weather condition (a strong temperature inversion 3.9°C/100m and an inversion of 3°C/100m with a 2 m/s drainage flow along Wollombi Brook), noise level predictions have been made. The predicted excess over the criterion were characterised as either minor (1 -2 dBA), moderate (3 – 5 dBA) or significant based on the predicted excess over the PSNL's for Warkworth. The predicted excesses are shown to be minor in Bulga with a small number of locations elsewhere being moderate and one significant. Based on these predictions and depending on location, noise mitigations or acquisition were offered.

A very important issue in relation to noise level predictions is validation of these noise level predictions on site. EMM have addressed this by reference to an extensive field validation exercise which is documented in the 2002 and 2010 Warkworth noise assessments. Also available publicly are noise monitoring data for over a 10 year period with over 2500 assessments conducted and only 10 non compliances noted.

The Author accepts this validation and also notes that there have been many aspects of conservatism included in the predictions. As a result of these, the worst case predicted noise levels as indicated are generally unlikely to be realised in practice except for a small percentage of the peak years and at specific locations. For the majority of the project life and for most locations, the Author believes that the noise levels due to Warkworth and Mt Thorley will be less than predicted.

10.0 Day Design Report

The Day Design Report (DDR) titled "Acoustic Peer Review Mt Thorley and Warkworth Mine Continuation' Report No 5475-1.1R issued 6 August 2014. This report unfortunately appears to display a lack of understanding of the application of the INP and a lack of understanding and appreciation of how the mine operates and of the mechanisms in place to control nightly noise emission. There seems to be no understanding of the noise mitigation measures that have been and are being implemented by Warkworth Mt Thorley and how they fit in to the application of the INP. There are a number of generalised statements that display this and a number of the statements appear unsubstantiated and are emotive.

Reference will now be made to specific statements made in the DDR and comments by the Author are provided.

Para 12: DDR concludes that substantial modifications will be required in order to provide a "reasonable balance" between the continuation and the expected noise impact. In Section 8.2 of the INP, it allows for negotiation with the regulatory/consent authority to demonstrate that all feasible and reasonable mitigation measures have been applied. The regulatory/consent authority can choose to accept the level of impact proposed, or negotiate for a better level of control where this is considered achievable". It further states "Where, in the final analysis, the level of impact would still exceed the project-specific noise levels, the economic and social benefits flowing from the proposed development to the community should be evaluated against the undesirable noise impacts. Where it can be demonstrated by the proponent that the development offers net benefits, a regulatory/consent authority may consider these as grounds for applying the achievable noise levels, rather than the project-specific noise levels, as the statutory compliance limit". Section 8.2 further states that "Negotiation on what represents the best achievable level that is practicable for a development is often an

iterative process involving both the proponent and regulator/consent authority and the proponent and affected community". Section 8.2 also includes the following "The section below outlines a checklist that can be used as a guide by EPA officers to determine an acceptable level of residual noise impacts when setting statutory noise conditions, based on the consideration of social and economic costs and benefits". This means that the authority has to take into account what is reasonable from a state significance point of view and balance that against community concerns. DDR does not have all the information at hand but has made a determination of its own which with all due respect, it is not really in a position to do. DDR has only conducted an extremely brief study in contrast to that described in the documents prepared by EMM and has not demonstrated how a "reasonable balance" has not been achieved.

In accordance with the INP, the Intrusiveness Criterion is determined by first determining the rating background level and then adding 5 dB. Section 2.1 states "To account for the temporal variation of background noise levels, the method outlined in Section 3.1 is recommended for determining the background noise level (rating background level—RBL) to be used in the assessment. This approach aims to result in the intrusive noise criterion being met for at least 90% of the time periods over which annoyance reactions can occur (taken to be periods of 15 minutes)". Thus, it is indicated that that the goal is to protect potentially affected people for only 90% of the time, if not more within the realm of feasibility.

In terms of background noise levels, there are a number of issues that can be raised about this report. A Type 2 logger is used and there is no information regarding its calibration status nor of the noise floor of this particular logger and of the frequency response of the system. It is not explicit that the LA90 in Appendix D is LA90,15 min? It is strange to see in Appendix D of the DDR, that long periods of time during the day occur at which the LA90 is in the order of only 25 – 28 dBA. The Author refers to the SKM independent monitoring conducted over a few months (December 2011 – January 2012) and which showed LA90,15min levels generally in the range of 30 – 35 dBA and often higher and the Author's own experience on site in the area where it was hard to obtain a noise measurement that wasn't affected by the presence of either wind, birds, dogs or other wildlife apart from any noise due to manmade sources. In addition, to obtain such low background noise levels over many days implies many periods with no wind at all as well as the absence of other extraneous noise and this seems unlikely in this area. The DDR did not provide any detailed ABL's on a daily basis and provides no indication that the weather conditions were checked for validity over the period. No attended noise measurements were conducted to validate the levels claimed.

In paragraph 42, DDR claims that the Barn Owl network has been used to activate numerous noise alarms during the night shift in 2014. DDR then claims that "This demonstrates that exceedance of the noise criteria is common and that further expansion of the mines is likely to intensify the noise impact with more exceedances more often". There is a clear misunderstanding of the purpose of the Barn Owl loggers being used by Warkworth Mt Thorley as means of pro-active noise measurement. The alarms are set so as to avoid exceedances by providing knowledge of noise levels before they rise to exceeding the relevant noise criteria. These allow the Company officers to go out and observe any issues and call in for immediate resolution prior to any real exceedances. The MTW also currently use a predictive approach of the weather on a daily basis and then decide operations accordingly. If any calls are made to the information hot-line, these are immediately followed up by a Community Assessment field officer. In the second part of the sentence, DDR make an unsubstantiated statement. Why is it "likely to intensify the noise impact"? What is the noise impact being referred to? More exceedances of the criteria? Currently this is a fraction of all operations. How much "more often" will this occur and on what basis is this statement made? With the noise mitigation program on-going and with the noise management system working well to minimise noise emission, making such broad claims without supporting data is not accepted.

In paragraph 62, DDR states "The fact is that the residents receive low frequency noise and are disturbed by it regardless of it's origin". What low frequency noise is actually received by the residents, how many residents are so affected, how many are disturbed by the LFN? The Authors understanding is that only a small number of residents have actually complained out of the total population in the area. And not all the complaints are the same.

In addition to the above comments re the DDR report, Appendix I in the Warkworth Continuation 2014 – Response to Submissions appears to adequately respond to all the key substantive points raised by the Day Design report.

11.0 Low Frequency Noise

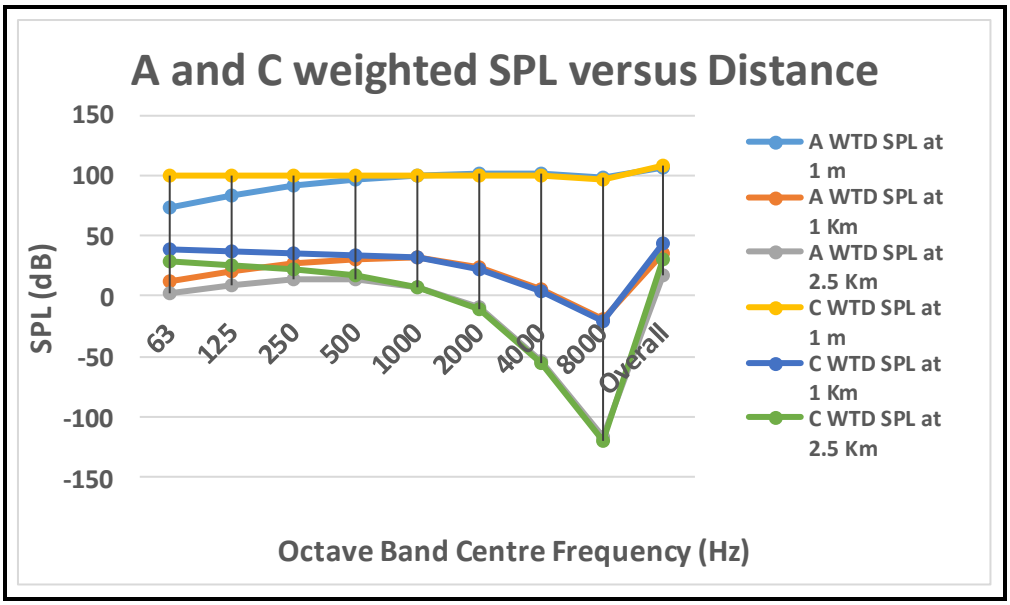
Day Design and some residents have claimed that there should be a penalty of 5 dBA applied to any measured or predicted A-weighted noise level at the residential locations to account for the low frequency noise (LFN) nature of the noise emission (in accordance with Table 4.1 of the INP). This is on the basis that the measured difference between the C-weighted versus the A-weighted noise level exceeds the 15 dB application test.

There are number of points that need to be addressed here. Firstly, the penalty does not apply to general noise. It must be applied specifically to the noise level at the receiver due to the noise source in question. Section 4.1 of the INP specifically states in the first paragraph "This section outlines the correction factors to be applied **to the source noise level at the receiver** before comparison with the criteria specified in Section 2 to account for the additional annoyance caused by these modifying factors". This makes sense. If a noise source such as a truck engine is generating low frequency noise in the mine, then it's contribution at a large distance will be more weighted to low frequency due to the much higher noise level reduction with distance for higher frequencies. However, also at larger distances, other noises in the background such as frogs and insects and possibly man made noise sources will tend to mask the truck engine noise. So if a LFN penalty is added to the overall noise level rather than the source noise level, then you would be penalising higher frequency sounds as well as the low frequency noise source.

Table 1 and Figure 1 below show a nominal spectrum for a noise source at 1 metre. Given the A and C weightings as shown and the "distance effect", the resultant overall A and C weighted noise levels can be calculated. The overall Z weighted SPL at 1 metre is 63 dBZ while the overall A and C weighted sound levels at 1 metre are 107 dBA and 108.5 dBC respectively. At 1 kilometre distance, the overall levels have dropped to 35.7 dBA and 42.9 dBC and at 2.5 km distance, to 17.7 dBA and 30.7 dBC.

TABLE Effect of Distance on Sound Levels

	63	125	250	500	1000	2000	4000	8000	Overall
Incident Noise Spectrum	100	100	100	100	100	100	100	100	109.0
A weighting	26.2	16.1	8.6	3.2	0	-1.2	-1	1.1	
C weighting	0.8	0.2	0	0	0	0.2	0.8	3	
Distance attenuation 1 Km	61	63	64	66	68	77	95	118	
Distance attenuation 2.5 Km	71	75	78	83	93	110	155	216	
	63	125	250	500	1000	2000	4000	8000	Overall
A WTD SPL at 1 m	73.8	83.9	91.4	96.8	100	101.2	101	98.9	107.0
A WTD SPL at 1 Km	12.8	20.9	27.4	30.8	32	24.2	6	-19.1	35.7
A WTD SPL at 2.5 Km	2.8	8.9	13.4	13.8	7	-8.8	-54	-117.1	17.8
C WTD SPL at 1 m	99.2	99.8	100	100	100	99.8	99.2	97	108.5
C WTD SPL at 1 Km	38.2	36.8	36	34	32	22.8	4.2	-21	42.9
C WTD SPL at 2.5 Km	28.2	24.8	22	17	7	-10.2	-55.8	-119	30.7



Effect of Distance on Sound Levels

The C – A level differences are 1.5 dB, 7.2 dB and 12.9 dB respectively at the various distances. So it can be seen that for this spectrum, the C – A level difference approaches 15 dB at about a distance of 3 km. And this is solely due to the effect of attenuation of the sound due to distance, molecular absorption and anomalous excess attenuation.

It is interesting to note the results of the independent noise monitoring conducted by SKM in 2012 in relation to this question. SKM conducted long term noise level measurements over the order of two months at 8 selected residential locations in the Bulga community and found that the C – A – weighted difference in noise levels exceeded the 15 dB application value for 15 to 45% of night time measurements depending on the measurement location. On the surface, this suggests a significant exceedance in many cases of nights over the monitoring period. However, it appears that SKM have simply used the overall measured values rather than checking the (C – A) level difference based on the Warkworth mine noise itself. It is very important to note that the LFN penalty is to be applied only to the noise due to the noise source under investigation and is not meant to be based on a comparison of the overall total measured noise levels which could contain level contributions from many other noise sources such as birds and insects. Not calculating the difference appropriately will give misleading results. The Author also notes that Mt Thorley mine was only partially in operation from mid 2010 until November 2011. Full operations only began in March 2012. This would provide a background noise level representing the future without the Mt Thorley operation with respect to the Warkworth mine operation and shows consistent noise levels with previous data. Also note that given most noise activities at Mt Thorley were happening to the east (the coal loader and CHPP), the operational noise is very unlikely to have been impacted in and around Bulga.

The Author has developed LFN criteria based on a simplified approach using overall C weighted noise levels. This was developed particularly for power stations and other noise sources with a significant low frequency noise imbalance at larger distances and for which the INP approach had significant limitations. It is the opinion of this Author that these limits could apply in this instance as well, though for mine noise it is possible that the limits could even be relaxed by, say 5 dBC. In the SKM report on the monitoring results, SKM also looked at compliance with the Broner overall C – weighted criteria. These results show, if the assumption is made that the C weighted level was solely due to the mines, that the desirable criterion was exceeded at night during only 1 – 6 % of the times with one location up to 29%. But the maximum Broner criterion of 65 dBC was exceeded only 0 – 1% of the time with the highest being 4% of the time. Based on observations on site, this is a more realistic upper bound of the real LFN problem. In practice, given the distance of the residences from the mines, when the mine noise is audible (excluding any truck exhausts and track slap which have a tonality and which are being addressed), it is audible as a continuum which is not particularly attention getting. This is especially so when wildlife and other background noises are present and which seem to be quite common in the area.

Note that the EPA has acknowledged that a test of C – A > 15 dB for the penalty to be applied breaks down at larger distances from noise sources due to the natural attenuation difference between high and low frequencies leading to a very unbalanced spectrum at larger distances which by default leads to (C – A) differences greater than 15 dB even though the sound levels at those larger distances are relatively low and would not cause any annoyance. The C – A > 15 dB test was originally developed for assessing noise sources close to the source. Localised winds can also cause the (C – A) difference to exceed 15 dB due to the LFN content of wind noise so that a failure could occur at larger distances solely due to winds.

The Volume 1 of the EMM Draft Response to Submissions dated October 2014 describes modelling of the C – A weighted difference for a representative set of residential locations in and around Bulga for the proposed Year 9 (or nominally 2013) which is generally the worst case for Bulga residences. This scenario is the worst case scenario across all years and therefore sets the upper bound of expected noise levels from the Warkworth mine. On the basis of this modelling, all differences were less than 15 dB and would therefore not require a LFN penalty in accordance with the INP. Also, the Broner criteria were also met.

As a further investigation of the potential LFN penalty, EMM conducted a night time noise level measurement in April 2014 at a mine owned residence on Putty Road. The purpose of this noise level measurement was to also assess compliance with the LFN indoor criterion developed by the UK DEFRA. The residence had a construction characteristic of the houses in the area. The location is 3 km west of MTO and should therefore be representative of the worst MTO noise exposure with the expansion. The average wind speed during the night was of the order of 2 m/s and these were southerlies. The external noise level was up to 58 dBC and 44 dBA. The nominal C – A difference was therefore 14 dB. The mining noise was audible outside but not inside. At this location, the INP penalty for LFN would not need to applied, the Broner criterion would be met and the internal noise level did not exceed the DEFRA criterion.

It is noted that Wilkinson Murray did a 10 day noise audit at 5 locations around Bulga in April 2015 to assess nominal noise compliance and found that the C – A noise level differences, based on the measured overall C and A weighted noise levels, exceeded a difference of 15 dB for most measurements. On this basis, a 5 dBA noise penalty could possibly be suggested if applying the EPA INP procedure. However, it needs to be noted that the C – A noise level difference for each mine as a separate LFN noise source (as required by the INP) could not be determined so that the assessment by WM based on overall noise levels would easily result in “false positives” in respect of the application of the 5 dBA penalty if this requirement was not considered. Even though the C – A level differences measured by Wilkinson Murray were generally in the order of 20 – 25 dB, both the Broner Assessment and the DEFRA methods showed that the actual LFN impact should be minimal, if any at all. Whilst EMM predicted a (C- A) level difference of less than 15 dB at the modelled sites, the reality is that, in practice, at a distance (see the Table above), the variability in the local A-weighted SPL can result in (C – A) level differences greater than 15 dB. This is not inconsistent with the EMM results because the EMM results were modelled for the noise source alone while the measured A (and C) weighted SPL’s reflect the total of the noise sources and the ambient.

The data also strongly supports calls for a revision of the current EPA INP LFN penalty based on a C – A difference of only 15 dB and strongly suggests that the EPA approach needs to be revisited, especially for locations at distances of say 3 km or more away from a source. Indeed, the Author suggests that the current data from Wilkinson Murray also support the Author’s contention that the C – A level difference needs to be at least 20 dB before a LFN impact is potentially observed. The data from Wilkinson Murray may also support the Authors contention that for mine noise, the recommended desirable overall dBC weighted level for a night time or continuous operation could be raised to 65 dBC with a maximum of 70 dBC.

Note that the Author’s research indicates that in practice, the (C – A) difference needs to be at least 20 - 25 dB for most people to really be annoyed by LFN and that this will occur generally when there is an aspect of “tonality” associated with the emission eg noise emission from open cycle gas turbine exhausts. In general, a 15 dB difference is hardly noticeable as a particularly low frequency noise which could be considered annoying.

12.0 Saddleback Ridge

It is clear that the Saddleback Ridge (SR) provides acoustic shielding for some noise emission from Warkworth towards some residents. The modelling by EMM shows that the impact is only of the order of 2 dBA and this seems reasonable given the distance for the mine to the residences. However, it is agreed that this acoustic benefit would only occur under calm weather conditions. However, in reality, based on weather data for the area, the area around Warkworth mine does not experience calm conditions for very much of the time. The EMM Draft Response to Submissions dated Oct 2014 indicates that at most only 4% of a particular season and period are calm (ie wind speeds less than 0.5 m/s).

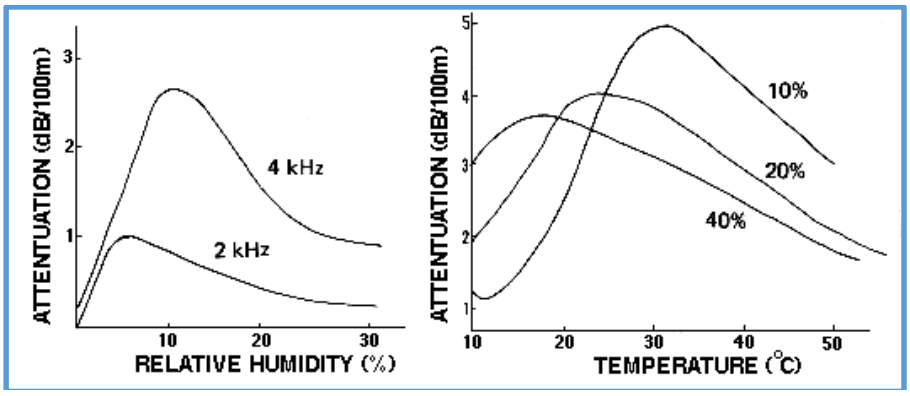
A more detailed study is referred to in Appendix B of the Warkworth Continuation 2014 "Response to Planning Assessment Commission Review Report" prepared by EEM in March 2015. In this, EMM confirms the calculation of annual occurrences of calm conditions as 1.8 per cent based on an analysis of the MTW operated weather station at Charlton Ridge for data between 2006 and 2013. EMM also quotes work done by Todoroski Air Sciences which also supports that his shows that calm conditions at the Charlton Ridge station are infrequent and would remain infrequent with the removal of Saddleback Ridge. The Author accepts that calm conditions at SR are very infrequent.

Differences of 2 – 3 dBA are not noticeable on a day to day comparison basis and it is very unlikely that residents would be able to perceive any real difference in their ambient acoustic environment over the time period during which the removal of SR would occur.

On this basis, the Author agrees that the impact of the removal of SR would not be significant to noise sensitive areas in and around Bulga.

As explained in the LEC, a noise level reduction (attenuation) of up to 5 dB(A) could occur due to Saddleback Ridge (SR) when the weather conditions are neutral and do not support enhanced propagation of mine noise ie during calm weather conditions. As described above, however, this only occurs very infrequently.
The performance of an acoustic barrier is dependent on a number of parameters. These include:

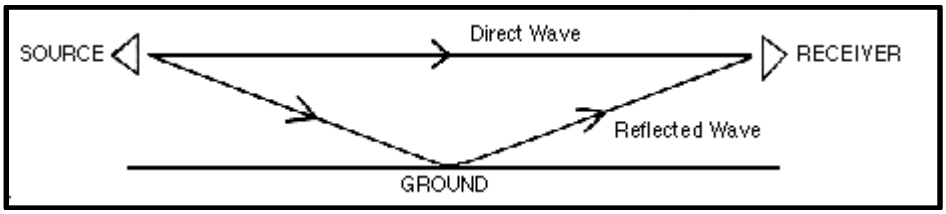
- The material of the barrier
- The distance of the noise source and receiver from the barrier
- The frequency of the noise source
- The ground type between the barrier and noise source and receiver eg concrete or grassland or forest
- Noise is attenuated due to air absorption and is dependent on frequency, relative humidity and temperature.



Effect of Temperature and Relative Humidity on Sound Propagation

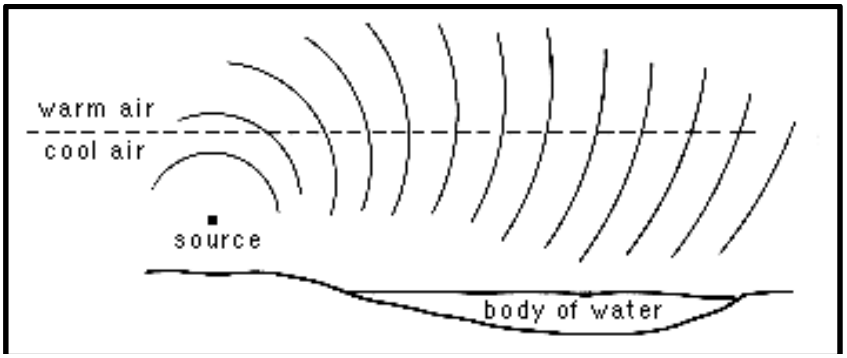
If sound is propagating over ground, attenuation will occur due to acoustic energy losses on reflection. These losses will depend on the surface. Smooth, hard surfaces will produce little absorption whereas thick grass or forests may result in sound levels being reduced by up to about 10 dB per 100 meters at 2000 Hz. High frequencies are generally attenuated more than low frequencies.

Reflection from the ground can result in another mechanism by which sound levels are reduced. When the source and receiver are both close to the ground, the sound wave reflected from the ground may interfere destructively with the direct wave. This effect (called the ground effect) is normally noticed over distances of several meters and more, and in the frequency range of 200-600 Hz. It is highly frequency dependent.



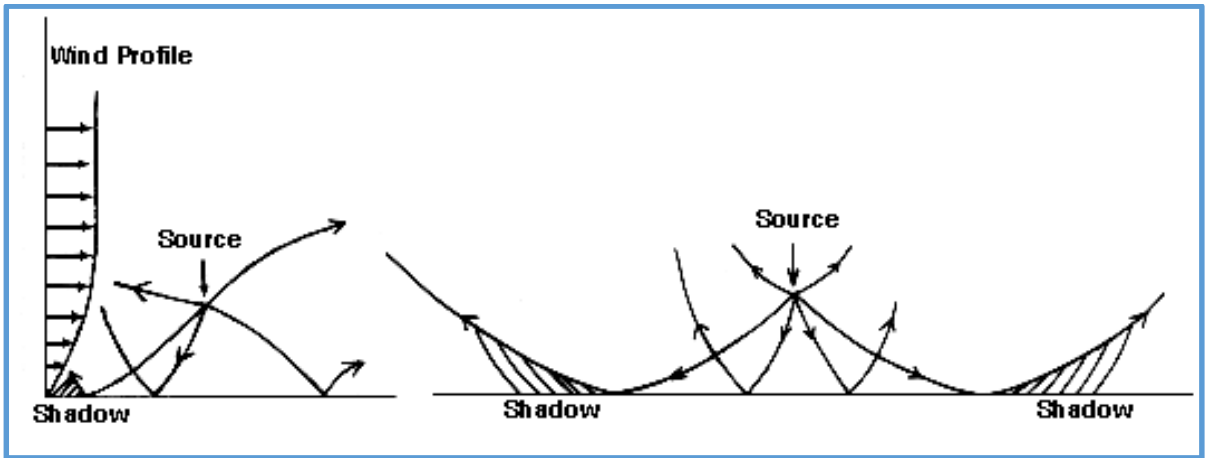
How a Ground Wave Interfered Destructively

Wind and Temperature Gradients effect the propagation of sound. The speed that sound propagates in a gas depends on the temperature of the gas. Higher temperatures produce higher speeds of sound. Since the temperature of the atmosphere is not uniform, there will be local variations in the sound speed. For example, under normal conditions the atmosphere is cooler at higher altitudes (this is called a temperature lapse condition) and this results in sound waves being 'bent' upwards. This results in the formation of a shadow zone, which is a region in which sound does not penetrate. In reality some sound will enter this zone due to scattering. In environmental noise situations, scattering is caused by air turbulence, rough surfaces, and obstacles such as trees. The scattering of sound by rain, snow or fog at ordinary frequencies is insignificant. Under conditions of a temperature inversion (this is when the temperature increases with increasing height), the sound waves will be refracted downwards, and therefore the sound may be heard over larger distances. This frequently occurs in winter and at sundown. It is a relatively common occurrence in the Hunter Valley. The figure below shows an example of refraction of sound waves by two layers of air at different temperatures as a result of the change of speed of the sound.



Refraction of Sound Waves

When a wind is blowing, there will always be a wind gradient. This is due to the layer of air next to the ground being stationary. A wind gradient results in sound waves propagating upwind being 'bent' upwards and those propagating downwind being 'bent' downwards.

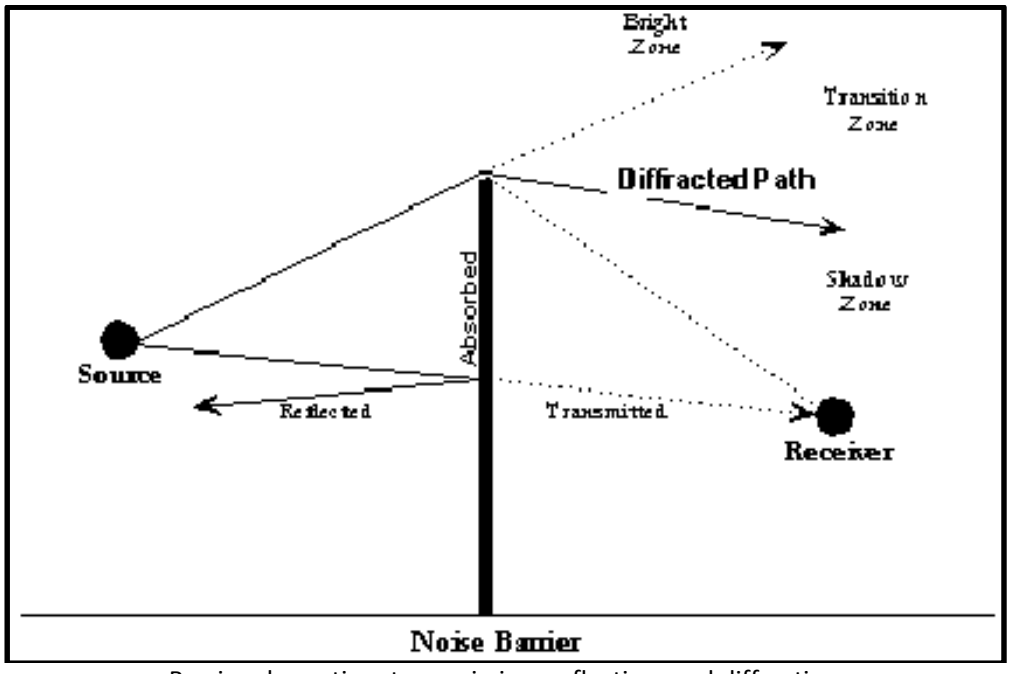


Effect of Wind on Sound Propagation

Temperature and wind gradients can result in measured sound levels being very different to those predicted from geometrical spreading and atmospheric absorption considerations alone. T hese differences may be as great as 10 - 20 dB at some frequencies. In terms of overall noise level, the increase is not as substantial, generally in the order of 3 – 5 dBA. Temperature and wind effects are particularly important where sound is propagating over distances greater than a few hundred meters. Importantly, temperature inversions and winds can also result in the effectiveness of a barrier being dramatically reduced due to the sound being "bent around" the barrier.

Reference: http://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/design/design03.cfm

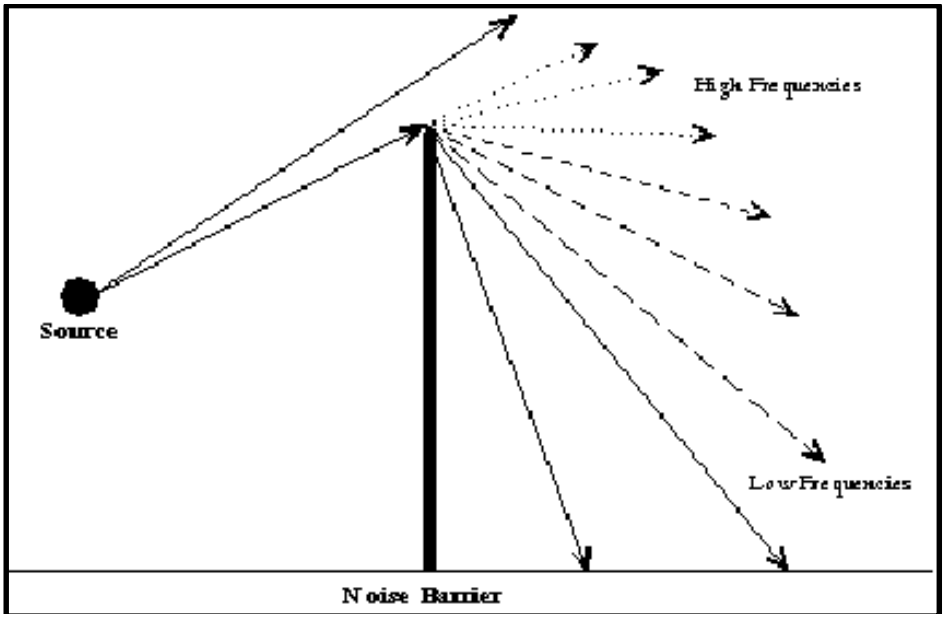
Noise barriers reduce the sound which is received at a receiver by either absorbing it, transmitting it, or by forcing the sound to take a longer path. The longer path is referred to as the diffracted path.



Barrier absorption, transmission, reflection, and diffraction

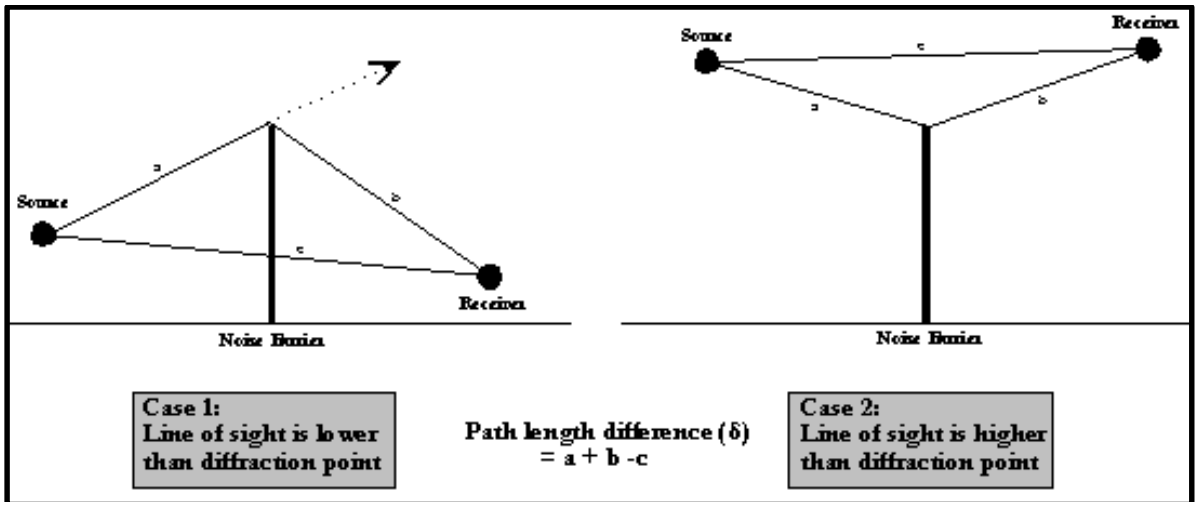
Diffraction, or the bending of sound waves can occur both at the top of the barrier and around the ends. This bending occurs much like other wave phenomena, such as light and water waves. Due to the nature of sound waves, diffraction does not bend all frequencies uniformly. Higher frequencies (shorter wavelengths) are diffracted to a lesser degree; while lower frequencies (longer wavelengths) are diffracted deeper into the

"shadow" zone behind the barrier. As a result, a barrier is, generally, more effective in attenuating the higher frequencies as compared with the lower frequencies.



Barrier diffraction

An important aspect of diffraction is the path length difference (δ) between the diffracted path from source over the top of the barrier to the receiver, and the direct path from source to receiver as if the barrier were not present as can be seen in the Figure below.



Path length difference

The path length difference is determined along the path defined by a particular source-barrier-receiver geometry. If the path length difference increases, the barrier attenuation increases. If the frequency increases, barrier attenuation increases as well. And vice versa. That is why if the source or receiver is very far from the barrier, the barrier will not provide a very high attenuation because the path length is relatively decreased. Similarly, with temperature inversion or wind blowing towards the receiver, the effective barrier performance is reduced. So, in Bulga under neutral conditions, the barrier would be more effective at up to 5 dBA but would only be effective at 1 – 2 dBA under prevailing weather conditions.

13.0 Conclusion

The Author has reviewed many documents in relation to the Warkworth Continuation project. In conclusion:

1. The Author is satisfied that the significant amount of background noise level data collected in and around Bulga adequately portrays the range of background noise levels experienced in the area.
2. The Author is satisfied that the choice of an RBL of 30 dBA even where longer term measurements might suggest a higher value is a conservative approach which protects noise sensitive areas in and around Bulga appropriately. This also means that the project criteria are also conservatively set for this project.
3. SKM 2012 raised a concern that there was insufficient data collected in their survey to enable them to assess the accuracy of ongoing routine noise monitoring carried out by the Applicant. The Author is satisfied that this concern is no longer valid given the significant amount of data available since then.
4. The Author has seen this response successfully followed at MTW with operational changes successfully brought into play within an hour of the trigger.
5. The Author is satisfied that the current noise level management program is being successfully implemented.
6. The Author is satisfied that non-compliant noise measurements account for a very small percentage of the monitoring dataset.
7. The Author is satisfied with the future level predictions and validation thereof.
8. The Author believes that the Day Design Report August 2014 displays a lack of understanding of the application of the INP and a lack of understanding and appreciation of how the mine operates, of the mechanisms in place to control nightly noise emission and of the noise mitigation measures that have been and are being implemented
9. The Author notes that with respect to Low Frequency Noise, Section 4.1 of the INP specifically states "This section outlines the correction factors to be applied **to the source noise level at the receiver** before comparison with the criteria." The Author is satisfied that when applied correctly in the mining context, a penalty at distances greater than of the order of 3 km should not be applied. Currently, such an application is a misapplication which will result in a perverse outcome. The Author is also satisfied that the likelihood of the Broner maximum criterion being exceeded is very minimal.
10. The Author is satisfied that the removal of Saddleback Ridge will not result in a significant increase in noise level in noise sensitive areas in and around Bulga. This is mainly due to the presence of neutral/calm meteorological conditions which do not support enhanced propagation of mine noise being very infrequent and remaining so after the removal of Saddleback Ridge. The potential for noise levels to further increase when noise enhancing conditions are present is very limited.

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