

12 November 2019

Chris Cooke
Quarry Manager
Hanson Construction Materials Pty Ltd
Level 5, 75 George Street
Parramatta NSW 2150

Re: Quarter 3 - 2019: East Guyong Quarry noise and blast monitoring

Dear Chris,

1 Introduction

EMM Consulting Pty Ltd (EMM) has been commissioned by Hanson Construction Materials Pty Ltd (NSW) (Hanson) to complete quarterly noise monitoring for the East Guyong Quarry, as required by the site's approved Noise Management Plan. The quarry is located approximately 22 km southeast of Orange, NSW. Operator-attended noise monitoring was undertaken on 16 September 2019.

The following material was referenced as part of this assessment:

- Environment Protection Authority (EPA), *Industrial Noise Policy (INP) 2000*;
- Environment Protection Authority (EPA), *Industrial Noise Policy - Application notes 2017*;
- Environment Protection Authority (EPA), *Noise Policy for Industry (NPfI) 2017*;
- Hanson Construction Materials and R. W. Corkery & Co Pty Limited (RWC), *Noise Management Plan for the East Guyong Quarry (NMP) – Mod 2 Revision, July 2019*;
- Department of Planning and Infrastructure (DP&I), *East Guyong Quarry Project Modification (06_0193 MOD 1) approval (PA) 2012*; and
- Australian and New Zealand Environment Council (ANZEC) 1990, *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*.

Analysis of data from one blast event that occurred on 8 July 2019 has also been included in this report.

Several technical terms are discussed in this report and are explained in Appendix A.

2 Methodology

2.1 Site operations

At the time of the attended noise monitoring on 16 September 2019, the quarry's activities comprised of the following:

- extraction of basalt using standard drill, load and haul techniques;
- processing of extracted basalt and stockpiling of material; and
- transportation of quarry products.

The quarry's approved hours of operation are:

- Monday to Friday (non-daylight savings) from 6 am to 6 pm;
- Monday to Friday (daylight savings) from 6 am to 8 pm; and
- Saturdays from 7 am to 1 pm.

Material crushing and screening currently occurs on site from Monday to Thursday. This restriction to approved hours is an operational decision by the quarry and aids in the planning for maintenance and repairs.

2.2 Noise monitoring

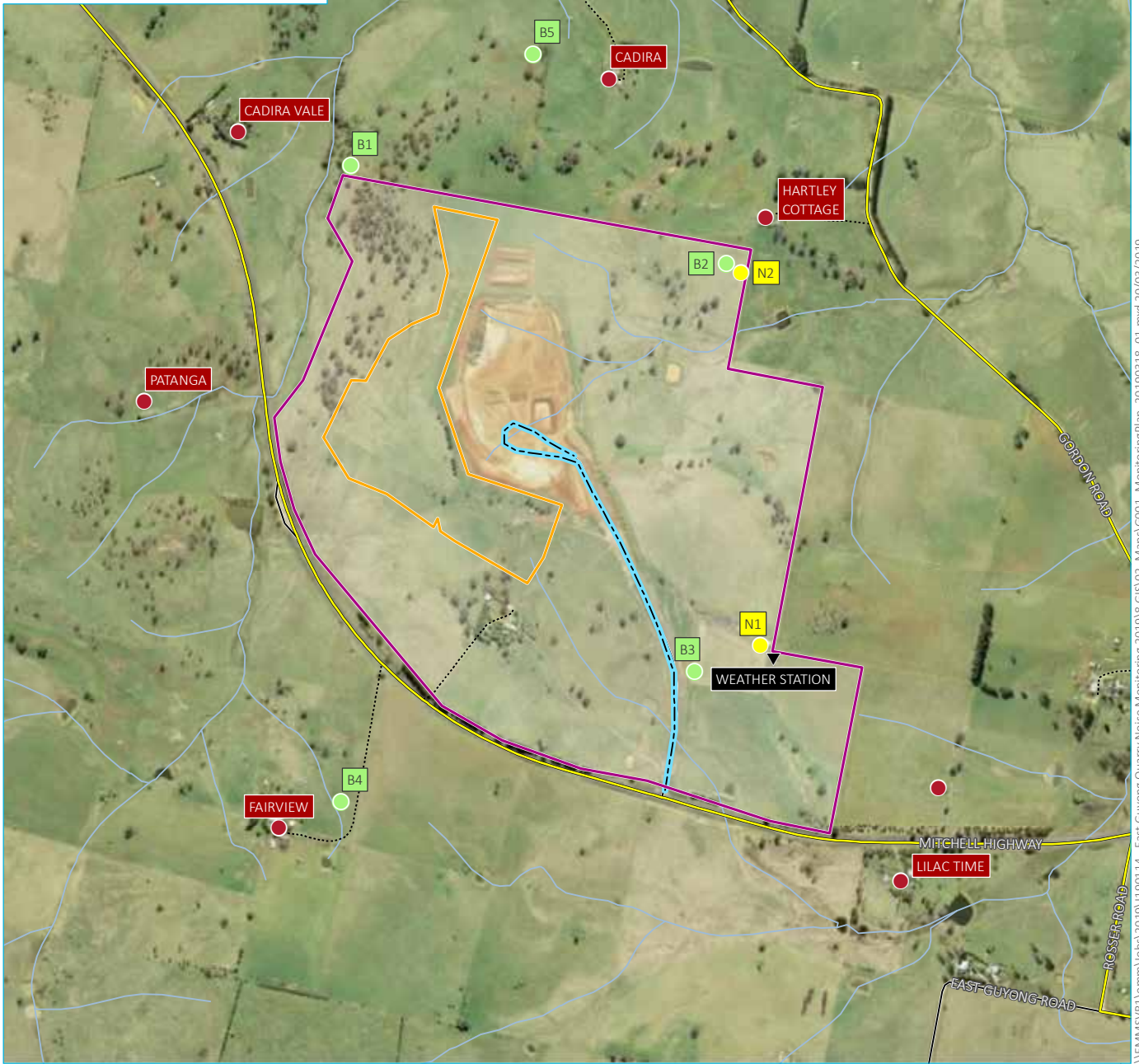
Operator-attended 15-minute noise measurements were conducted at locations N1 and N2, as shown in Figure 1, when the quarry was in full operation. The operator quantified the contribution of each significant quarry noise source where possible. Noise monitoring was conducted in general accordance with the INP and Australian Standard AS 1055.1-2018 *Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

A Brüel & Kjær 2250 Type 1 sound analyser (s/n 3008201) was used for the noise monitoring. The sound analyser was calibrated before and after the completion of the surveys using a Rion NC74 calibrator (s/n 34372752). The instruments were within a current NATA calibration period at the time of the noise monitoring and relevant certificates are provided in Appendix B.

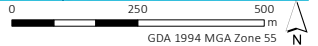
2.3 Assessment locations

The noise monitoring included four 15-minute operator-attended noise measurements during the daytime period on 16 September 2019 to quantify noise emissions from the quarry at locations N1 and N2. Noise monitoring was not conducted prior to 7 am as the quarry was not in operation.

Locations N1 and N2 are near the south-east and north-east boundaries of the site, respectively. Location N1 is approximately 500 m from "Wheatfields", the closest residence situated south-east of the quarry. Location N2 is approximately 150 m from "Hartley Cottage", the closest residence situated north-east of the quarry. These monitoring locations were selected to not inconvenience surrounding residents and are consistent with the approved Noise Management Plan for the East Guyong Quarry – Mod 2 Revision (Hanson & RWC, 2019). Monitoring at these locations, rather than at the residences, also provides a better opportunity to quantify site related noise since they are closer to the operations.



Source: EMM (2019); DFSI (2017); GA (2011)



KEY

- Blast monitoring location
- Residences
- Attended noise monitoring location
- ▼ Weather station
- Site boundary
- Extraction area boundary
- Transport route
- Main road
- Local road
- Vehicular track
- Watercourse/drainage line

Site location and monitoring plan

East Guyong Quarry
Noise and blast monitoring
Figure 1

\\EMMSVR1\emm\pos\2019\190114 - East Guyong Quarry Noise Monitoring 2019\GIS02_Maps\G001_MonitoringPlan_20190318_01.mxd 20/03/2019

3 Criteria

3.1 Operational noise

Condition 3(5) of PA 06_0193 states that the noise assessment criteria are $L_{Aeq,15\text{ minute}}$ 35 dB at any residence for all assessment periods. The exception is the "Fairview" residence which has a daytime criterion of $L_{Aeq,15\text{ minute}}$ 36 dB. In accordance with the PA 06_0193, "Noise generated by the project is to be measured in accordance with the relevant requirements, and exemptions (including certain meteorological conditions), of the NSW Industrial Noise Policy."

As per Condition 3(5) of PA_0193, to demonstrate compliance at residential locations, the noise monitoring results are to be assessed against the following (intermediate) noise criteria for monitoring locations N1 and N2:

- N1 - $L_{Aeq,15\text{ minute}}$ 43 dB; and
- N2 - $L_{Aeq,15\text{ minute}}$ 50 dB.

It is stated in the NMP that by satisfying criteria at these intermediate locations, quarry noise at neighbouring residences would also satisfy residential criteria. This assumes the presence of soil and product stockpiles, bunding and intervening topography between the site and surrounding residences, which provide some degree of attenuation of site noise.

The NMP specifies that noise limits are to be applied under meteorological conditions of:

- wind speeds up to 3m/s at 10 metres above ground level; and/or
- temperature inversion conditions of up to 3°C/100 metres.

Further to the above, section 11.1.3 of the INP identifies that a development is deemed to be in non-compliance if the monitored noise levels from the development are more than 2 dB above the statutory limit.

3.2 Low frequency noise criteria

Section 11.2.3 of the NMP states that modification factors in Section 4 of the INP (EPA 2000) should be applied to the measured noise levels where applicable. The INP application notes state that Section 4 of the INP has been withdrawn and the modifying factor adjustments outlined in Fact Sheet C of the NPfl are to be used when assessing the characteristics of a noise source. Fact sheet C of the NPfl (EPA 2017) states that modification factor corrections shall be applied to the measured noise levels where relevant.

Fact sheet C of the NPfl (EPA 2017) provides guidelines for applying modifying factor corrections to account for annoying noise characteristics, such as tonal and low frequency noise emissions. The NPfl specifies that for low frequency noise, a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels identifies the potential for an unbalanced spectrum and potential increased annoyance.

Where a difference of 15 dB or more between site 'C-weighted' and site 'A-weighted' noise emission levels is identified, the one-third octave noise levels recorded should be compared to the values in Table C2 of the NPfl (EPA 2017), which has been reproduced in Table 3.1 below.

Table 3.1 One-third octave low-frequency noise thresholds

One-third octave $L_{Zeq,15\text{ minute}}$ threshold level													
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB (Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The modifying factor correction to be applied where the site ‘C-weighted’ and site ‘A-weighted’ noise emission level is 15 dB or more and:

- where any of the one-third octave noise levels in Table 3.1 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period; or
- where any of the one-third octave noise levels in Table 3.1 are exceeded by more than 5 dB and cannot be mitigated, a 5 dB positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB positive adjustment applies for the daytime period.

Hence, where possible throughout each survey the operator has estimated the difference between site ‘C-weighted’ and site ‘A-weighted’ noise emission levels by matching audible sounds with the response of the analyser ($L_{Ceq}-L_{Aeq}$). Where this was deemed to be 15 dB or greater, the measured one-third octave frequencies have been compared to the values in Table 3.1 to identify the relevant modifying factor correction (if applicable). This method has been applied to this assessment as presented in Section 4.

It is of note that the NPfI (EPA 2017) states that low-frequency noise corrections only apply under the standard and/or noise-enhancing (ie applicable) meteorological conditions.

3.3 Blast monitoring

Blast overpressure and vibration monitoring is managed by Hanson for all blast events. Blast overpressure and ground vibration are monitored at three locations within or at the site’s boundary as well as two locations outside of the site’s boundary (one south of the Mitchell Highway near the Fairview property and one north of the site near the Cadira property). Monitoring locations are situated closer to blasting locations than the residential structures (refer to Figure 2.1), and therefore overpressure and vibration levels would likely be lower at the actual residential dwellings than those measured.

Blast emissions criteria for the quarry apply at any residence on privately-owned land surrounding the site and are presented in Table 3.2.

Table 3.2 Blast overpressure and vibration criteria

Location	Airblast overpressure criteria (dB (Linear Peak))	Ground vibration criteria (mm/s (Peak velocity))	Allowable exceedance
Any privately-owned residence surrounding the site.	115	5	5% of the total number of blasts in a 12-month period
	120	10	0%

4 Results

4.1 Noise monitoring results

Noise monitoring results for locations N1 and N2 are presented in Table 4.1. Data recorded by the site's weather station (shown in Figure 2.1) was used to identify weather conditions during the monitoring period and to determine the applicability of noise limits. Wind speed and direction observations are presented in Table 4.1

Wind speed averages were significantly above 3 m/s (at 10 m above ground) during all of the measurements at N1 and N2; hence noise limits were not applicable during these measurements. Wind speeds were above 5 m/s and as such noise measurements were likely contaminated (AS1055.1 states "caution should be applied" in these circumstances). Although it was evident that wind on the microphone was affecting the measured total 15-minute sound pressure level, at times it was possible for the operator to estimate the site's noise emission at the monitoring locations. Estimates were made during lulls in wind and results are consistent with previous monitoring periods, all of which clearly demonstrate compliance with criteria as per Condition 3(5) of PA_0193.

Low frequency noise modifying factors, in accordance with fact sheet C2 of the NPfl (EPA 2017), were not applied to any measured site contribution as measured noise levels did not exceed the relevant LFN thresholds.

All quarry contributions measured at locations N1 and N2 satisfied the relevant noise criteria, had they applied, as per the NMP. It is therefore expected that relevant criteria for surrounding residential receivers would also be satisfied.

Based on the preceding information, noise levels from the quarry were expected to satisfy the relevant residential criteria at all assessment locations identified in Condition 3(5) of PA_0193.

Table 4.1 Attended noise monitoring summary – 18 June 2019

Location	Start time	Attended noise monitoring results dB					Criteria dB	Meteorological conditions ¹		Criteria Applies? (Y/N)	Exceedance	Comments
		Total measured			Site contribution			Wind speed (m/s)	Wind direction ²			
		L ₉₀	L _{Aeq}	L _{Amax}	LFN mod. factor	L _{Aeq}						
N2	14:20	46	52	74	Nil	<47	50	13.1	302	N	Nil	Site consistently audible including crushing plant and engine revs. Other sources include wind in trees, birdsong and insects. Wind on microphone affecting SPL.
N2	14:35	45	50	61	Nil	<48	50	10	292	N	Nil	Site consistently audible including crushing plant and engine revs. Other sources include wind in trees and birdsong. Wind on microphone affecting SPL.
N1	15:14	44	54	73	Nil	<42	43	8.9	294	N	Nil	Site consistently audible including crushing plant. Other sources include, traffic noise from the Mitchell Highway and wind in trees. Wind on microphone affecting SPL.
N1	15:31	42	49	69	Nil	<41	43	6.9	288	N	Nil	Site consistently audible including crushing plant. Other sources include, traffic noise from the Mitchell Highway and wind in trees. Wind on microphone affecting SPL.

Notes: 1. Meteorological data was obtained from the site weather station at a height of 10 m above ground.
2. Wind direction reported in degrees from north (0°)
3. N/A = Not Applicable

4.2 Blast overpressure and ground vibration

One blast event occurred at the quarry since the last quarterly noise monitoring in June 2019. The blast overpressure and vibration monitoring results were provided by Hanson and are presented in Table 4.2. Note that monitoring locations are not the sensitive assessment locations. The monitoring results show that levels were within criteria relevant to residences at four of the five monitoring locations (refer to Figure 2.1). Hence, further analysis was required for the overpressure result at location B2 only.

Table 4.2 Blast emissions monitoring results

Date	Monitoring location	Airblast overpressure level (dB(Linear Peak))		Ground vibration - Peak particle velocity (mm/s)	
		Measured	Criteria ²	Measured	Criteria ²
8/7/2019	B1	106.5	115	3.77	5
	B2	119.2	115	0.53	5
	B3 ¹	-	115	-	5
	B4	108	115	0.56	5
	B5 ¹	-	115	-	5

Notes: 1. There was no trigger for this blasting event.
2. Criteria applies at the nearest residential location and not at the monitoring location.

An airblast overpressure level of 119.2 dB was recorded at the B2 monitoring location (Hartley Cottage). An in-depth investigation of this was conducted by Orica Australia Pty Ltd (Orica) and is documented in a report dated 15 July 2019. The relatively elevated level was found to be due to unfavourable weather conditions on the day of blasting. Considering the additional distance between the monitoring location and the residence (141m), Orica estimated that the overpressure at Hartley Cottage would be just below the relevant limit of 115 dB.

5 Conclusion

EMM has completed an assessment of noise and blasting emissions from East Guyong Quarry operations. Noise monitoring was undertaken at locations around the site on 16 September 2019.

Noise limits were not applicable during these measurements due to excessive wind speeds. Although it was evident that wind on the microphone was affecting the measured total 15-minute sound pressure level, at times it was possible for the operator to estimate the site's noise emission at the monitoring locations. Estimates were made during lulls in wind and results are consistent with previous monitoring periods, all of which clearly demonstrate compliance with criteria as per Condition 3(5) of PA_0193.

Therefore, it is concluded that noise levels from quarry operations satisfied the relevant criteria at all assessment locations identified in Condition 3(5) of PA_0193.

The blast overpressure and ground vibration monitoring results for the single blast that occurred since the last compliance review satisfied the relevant criteria at all assessment locations. An elevated airblast overpressure level was recorded at monitoring location B2. An in-depth investigation by Orica concluded that considering the additional distance from the monitoring location to the residence, the overpressure would have satisfied relevant criteria at the residence.

Yours sincerely



Rick Scully

Acoustic Consultant

rscully@emmconsulting.com.au

Review: KT 27/09/19 & NI 11/11/2019

Appendix A

Glossary of acoustic terms

A number of technical terms are required for the discussion of noise. These are explained in Table A.1.

Table A.1 Glossary of acoustic terms

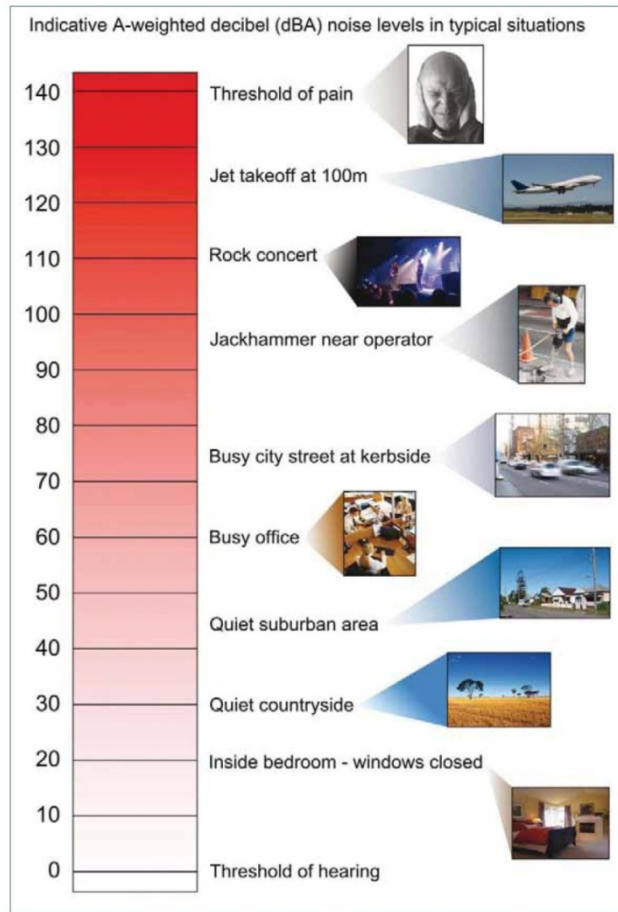
Term	Description
dB	Noise is measured in units called decibels (dB).
A-weighting	There are several scales for describing noise, the most common being the 'A-weighted' scale. This is an adjustment made to sound-level measurement to approximate the response of the human ear.
C-weighting	This is an adjustment made to sound-level measurements which takes account of low-frequency components of noise within the audibility range of humans.
L _{A90}	Commonly referred to as the background noise level. The A-weighted noise level exceeded 90% of the time.
L _{Aeq}	The A-weighted, energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The LAeq(15-min) descriptor refers to an LAeq noise level measured over a 15-minute period.
L _{Amax}	The A-weighted maximum root mean squared sound pressure level received during a measuring interval.
Day period	Monday – Saturday: 7 am to 6 pm, on Sundays and Public Holidays: 8 am to 6 pm.
Evening period	Monday – Saturday: 6 pm to 10 pm, on Sundays and Public Holidays: 6 pm to 10 pm.
Night period	Monday – Saturday: 10 pm to 7 am, on Sundays and Public Holidays: 10 pm to 8 am.
L _{peak}	The maximum instantaneous sound pressure during a measurement period or noise event.
PPV	Peak particle velocity - The greatest instantaneous particle velocity during a given time interval.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table A.2 gives an indication as to what an average person perceives about changes in noise levels:

Table A.2 Perceived change in noise

Change in sound level (dB)	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

Examples of common noise levels are provided in Figure A.1.



Source: Road Noise Policy (Department of Environment, Climate Change and Water (DECCW) 2011).

Figure A.1 Common noise levels

Appendix B

Calibration certificates

CERTIFICATE OF CALIBRATION

Certificate No: CAU1700759

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CALIBRATION OF:

Sound Level Meter:	Brüel & Kjær	2250	No: 3008201
Microphone:	Brüel & Kjær	4189	No: 2983733
Preamplifier:	Brüel & Kjær	ZC-0032	No: 22666
Supplied Calibrator:	Brüel & Kjær	None	No: NONE
Software version:	BZ7222 Version 4.7.3	Pattern Approval:	PENDING
Instruction manual:	BE1712-22	Identification:	

CUSTOMER:

EMM Consulting
Suite 01, 20 Chandos Street
St Leonards NSW 1590

CALIBRATION CONDITIONS:

Preconditioning: 4 hours at 23 °C
Environment conditions: *see actual values in Environmental conditions sections*

SPECIFICATIONS:

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC61672-3:2006 class 1. Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær Sound Level Meter Calibration System B&K 3630 with application software type 7763 (version 6.0 - DB: 6.00) and test procedure 2250-4189.

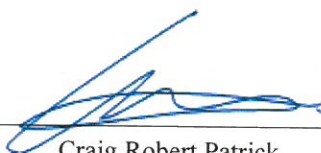
RESULTS:

	Initial calibration		Calibration prior to repair/adjustment
X	Calibration without repair/adjustment		Calibration after repair/adjustment


The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$ providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with EA-4/02 from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the device under calibration.

Date of Calibration: 18/08/2017

Certificate issued: 18/08/2017



Craig Robert Patrick
Calibration Technician



Jan Rasmussen
Approved signatory

CERTIFICATE OF CALIBRATION

CERTIFICATE NO: 24147

EQUIPMENT TESTED: Sound Level Calibrator

Manufacturer: Rion
Type No: NC-74 **Serial No:** 34372752
Owner: EMM Consulting
20 Chandos Street
St Leonards NSW 2065

Tests Performed: Measured output pressure level was found to be:

Parameter	Pre-Adj	Adj Y/N	Output: (db re 20 µPa)	Frequency: (Hz)	THD&N (%)
Level 1:	NA	N	94.10	1002.70	2.24
Level 2:	NA	N	NA	NA	NA
Uncertainty:			±0.11 dB	±0.05%	±0.20 %
Uncertainty (at 95% c.l.) k=2					

CONDITION OF TEST:

Ambient Pressure: 991 hPa ±1.5 hPa **Relative Humidity:** 45% ±5%

Temperature: 23 °C ±2° C

Date of Calibration: 13/02/2019 **Issue Date:** 13/02/2019

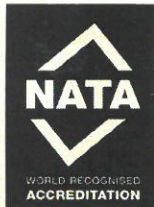
Acu-Vib Test Procedure: AVP02 (Calibrators)

Test Method: AS IEC 60942 - 2017

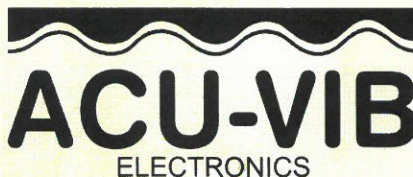
CHECKED BY: *[Signature]* **AUTHORISED SIGNATURE:** *[Signature]*
Jack Kielt

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibration and/or measurements included in this document are traceable to Australian/national standards.

The uncertainties quoted are calculated in accordance with the methods of the ISO Guide to the Uncertainty of Measurement and quoted at a coverage factor of 2 with a confidence interval of approximately 95%.



Accredited Lab. 9262
Acoustic and Vibration
Measurements



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