Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 1 Ending March 2021.

Prepared for: Holcim (Australia) Pty Ltd
March 2021
MAC180611-02RP11

Muller Acoustic Consulting

Document Information

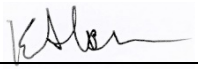
Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 1 Ending March 2021

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-02RP11	Final	12 March 2021	Kristian Allen		Rod Linnett	

CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Lynwood Quarry (the 'quarry'), Marulan, NSW.

The monitoring has been conducted in accordance with the Lynwood Noise Management Plan (NMP) and in general accordance with the Noise Policy for Industry (NPI), at four representative monitoring locations. This assessment has been undertaken for the quarterly period ending March 2021, and forms part of the annual noise monitoring program to address conditions outlined in the Development Consent.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Lynwood Quarry Noise Management Plan (NMP), 2016;
- Lynwood Quarry Environmental Protection Licence (EPL), 2013 (12939);
- Lynwood Quarry, Development Consent, 2005 (DA128-5-2005); and
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

The Lynwood Quarry Noise Management Plan (NMP), outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1**.

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)	dB LA1(1min)
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

NMP ID	EPL ID	Address	Criteria dB			
			Day	Evening	Night	Night
			$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$
N1	L1	1114 Carrick Road, Marulan	35	35	35	45
N2	L6	End of Maclura Drive, Marulan	35	37	36	46
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]	47
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36	47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

3.2 Assessment Methodology

The attended noise measurements were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 9 February 2021 and Thursday 11 February 2021. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2019- Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Noise measurements were of 15-minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Tuesday 9 February 2021 and Thursday 11 February 2021 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ quarry noise contribution for comparison against the relevant criteria. In the event of quarry attributed noise being above criteria, prevailing meteorological conditions for the monitoring period are sourced from the onsite meteorological station and analysed in accordance with Fact Sheet D of the NPI to determine the stability category present at the time of each attended measurement.

Where the quarry is inaudible, the contribution is estimated to be at least 10dBA below the ambient noise level.

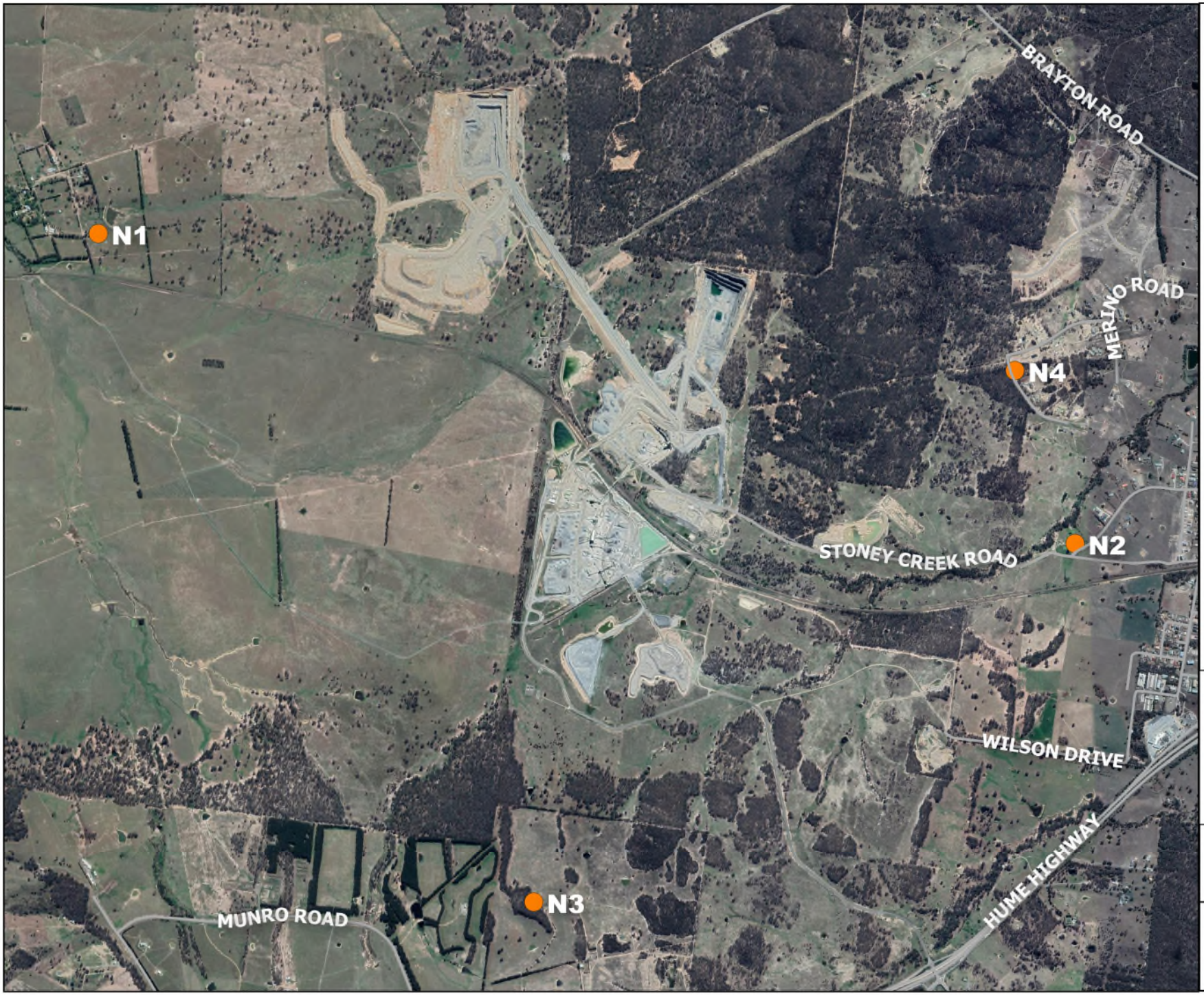

FIGURE 1

Site Locality

MAC180611-02

Holcim Lynwood Quarry

KEY

Noise Monitoring Locations

0 200 400 600 800 1000 m

N

MAC
Muller Acoustic Consulting

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
09/02/2021	14:46 (Day)	66	38	32	WD: SE WS: 1.5m/s Rain: Nil	Wind 29-43 Birds 26-48 Operator 55-66 Quarry – Haul Trucks 26-33 (Multiple movements 7-10 minute duration)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<33
11/02/2021	23:59 (Night)	55	39	29	WD: N WS: <0.5m/s Rain: Nil	Insects 28-36 Distant Traffic <25-28 Train 30-55 Quarry Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
Lynwood Quarry $L_{A1(1min)}$ Contribution						<40

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
09/02/2021	13:38 (Day)	55	41	37	WD: S WS: 0.5m/s Rain: Nil	Distant Traffic 35-44 Birds 32-50 Train 35-55 Quarry Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
11/02/2021	22:57 (Night)	58	43	37	WD: SW WS: 0.5m/s Rain: Nil	Insects 35-45 Distant Traffic 32-46 Residential Noise 30-32 Train 35-58 Quarry Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
Lynwood Quarry $L_{A1(1min)}$ Contribution						<40

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
09/02/2021	12:51 (Day)	48	38	35	WD: SW WS: 0.5m/s Rain: Nil	Distant Traffic 33-40 Birds 30-48 Quarry – Haul Trucks <30 (3 movements, 2-4 minute duration) Quarry – Reverse Alarms <30 (multiple 3-5 second durations) Quarry – Vehicles enter/exit Site 30-35 (3 movements, 2-3 minute duration) Quarry – Loader <30 (multiple movements 6-8 minute duration)
Lynwood Quarry $LA_{eq(15min)}$ Contribution						32
11/02/2021	22:20 (Night)	54	43	39	WD: SE WS: 0.5m/s Rain: Nil	Insects 38-50 Distant Traffic <35-42 Operator 54 Quarry – Alarms <30 (multiple 3-5 second durations) Quarry – Train Loading 30-35 (6-8 minute duration) Quarry – Train Shunting 35-45 (5 second duration) Quarry – Hum <30 (constant duration)
Lynwood Quarry $LA_{eq(15min)}$ Contribution						<35
Lynwood Quarry $LA_{1(1min)}$ Contribution						<47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
09/02/2021	14:04 (Day)	58	39	35	WD: SE WS: 1.0m/s Rain: Nil	Train 35-50 Birds 30-58 Distant Traffic 30-38 Wind 30-43 Quarry Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
11/02/2021	23:20 (Night)	51	42	34	WD: SW WS: 0.5m/s Rain: Nil	Insects 32-51 Distant Traffic 30-40 Quarry Not Audible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
Lynwood Quarry $L_{A1(1min)}$ Contribution						<40

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

5 Discussion

5.1 Discussion of Results - Location N1

Monitoring on Tuesday 9 February 2021 identified quarry noise was audible during the daytime measurement with quarry noise contributions estimated to satisfy the relevant daytime noise limits. Monitoring on Thursday 11 February 2021 identified quarry noise was inaudible during night-time measurements with quarry noise contributions estimated to satisfy the relevant night-time noise limits. Audible quarry noise sources included the haul truck movements. Extraneous noise sources measured included birds, traffic, train, insects, operator noise, and wind.

5.2 Discussion of Results - Location N2

Monitoring on Tuesday 9 February 2021 and Thursday 11 February 2021 identified quarry noise was inaudible during both daytime and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits. Extraneous noise sources measured included birds, traffic, train, insects, and residential noise.

5.3 Discussion of Results - Location N3

Monitoring on Tuesday 9 February 2021 and Thursday 11 February 2021 identified that quarry noise was audible during both daytime and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits. Quarry noise sources audible during the survey included the site alarms, vehicle reverse alarms vehicles entering/exiting site, loader movements, haul truck movements, trains loading and shunting and general site hum. Extraneous noise sources included birds, traffic, operator noise and insects.

5.4 Discussion of Results - Location N4

Monitoring on Tuesday 9 February 2021 and Thursday 11 February 2021 identified quarry noise was inaudible during both daytime and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits. Extraneous noise sources measured included wind, insects, birds, traffic, and trains.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 1, ending March 2021.

Attended noise monitoring was undertaken on Tuesday 9 February 2021 and Thursday 11 February 2021 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible at two locations, however quarry noise emissions were below the relevant noise criteria, satisfying the applicable noise criteria throughout the survey period.

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Appendix A - Glossary of Terms

Table A1 provides a number of technical terms have been used in this report.

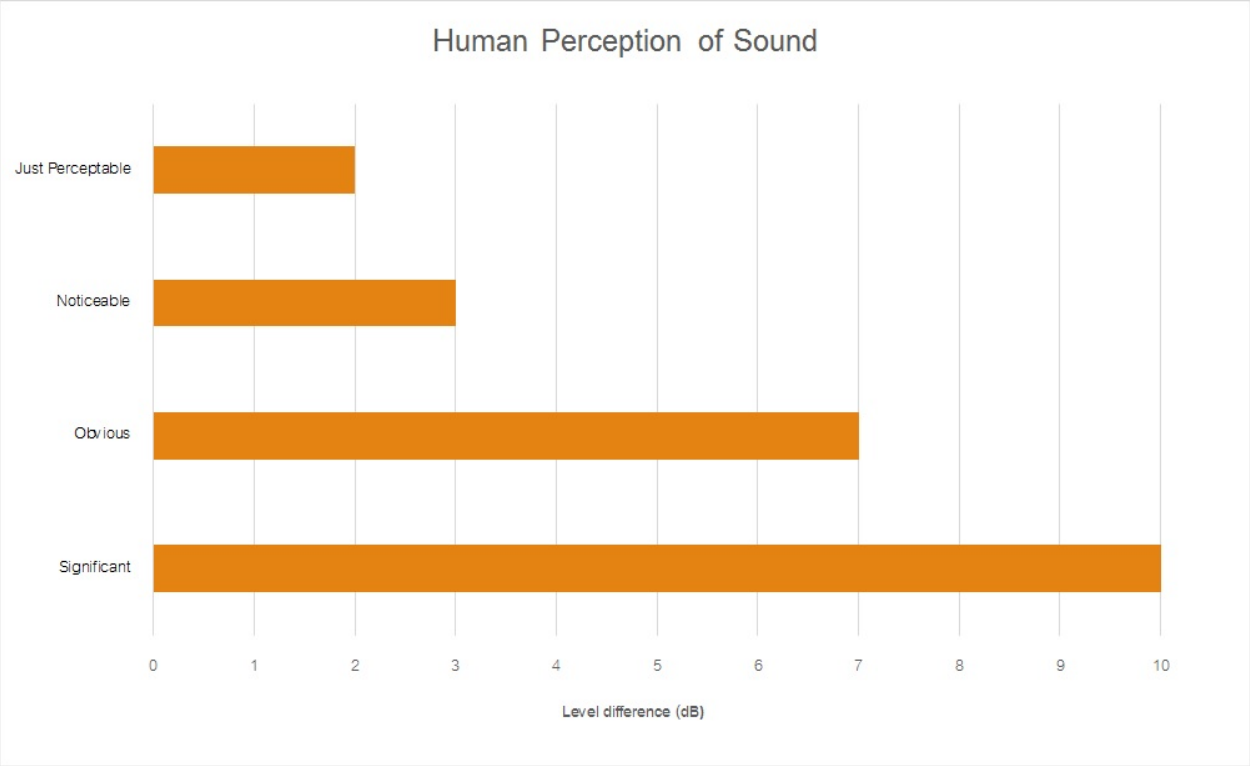
Table A1 Glossary of Terms

Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 2 Ending June 2021.

Prepared for: Holcim (Australia) Pty Ltd
May 2021
MAC180611-02RP12

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 2 Ending June 2021

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-02RP12	Final	31 May 2021	Kristian Allen		Rod Linnett	

CONTENTS

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1 Introduction

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The assessment has been conducted in accordance with the following documents:

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- Lynwood Quarry Noise Management Plan (NMP), 2016;
- Lynwood Quarry Environmental Protection Licence (EPL), 2013 (12939);
- Lynwood Quarry, Development Consent, 2005 (DA128-5-2005); and
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

The Lynwood Quarry Noise Management Plan (NMP), outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1**.

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)	dB LA1(1min)
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

NMP ID	EPL ID	Address	Criteria dB			
			Day	Evening	Night	Night
			$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$
N1	L1	1114 Carrick Road, Marulan	35	35	35	45
N2	L6	End of Maclura Drive, Marulan	35	37	36	46
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]	47
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36	47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

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The attended noise measurements were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Wednesday 26 May 2021 and Thursday 27 May 2021. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2019- Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Noise measurements were of 15-minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Wednesday 26 May 2021 and Thursday 27 May 2021 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ quarry noise contribution for comparison against the relevant criteria. In the event of quarry attributed noise being above criteria, prevailing meteorological conditions for the monitoring period are sourced from the onsite meteorological station and analysed in accordance with Fact Sheet D of the NPI to determine the stability category present at the time of each attended measurement.

Where the quarry is inaudible, the contribution is estimated to be at least 10dBA below the ambient noise level.

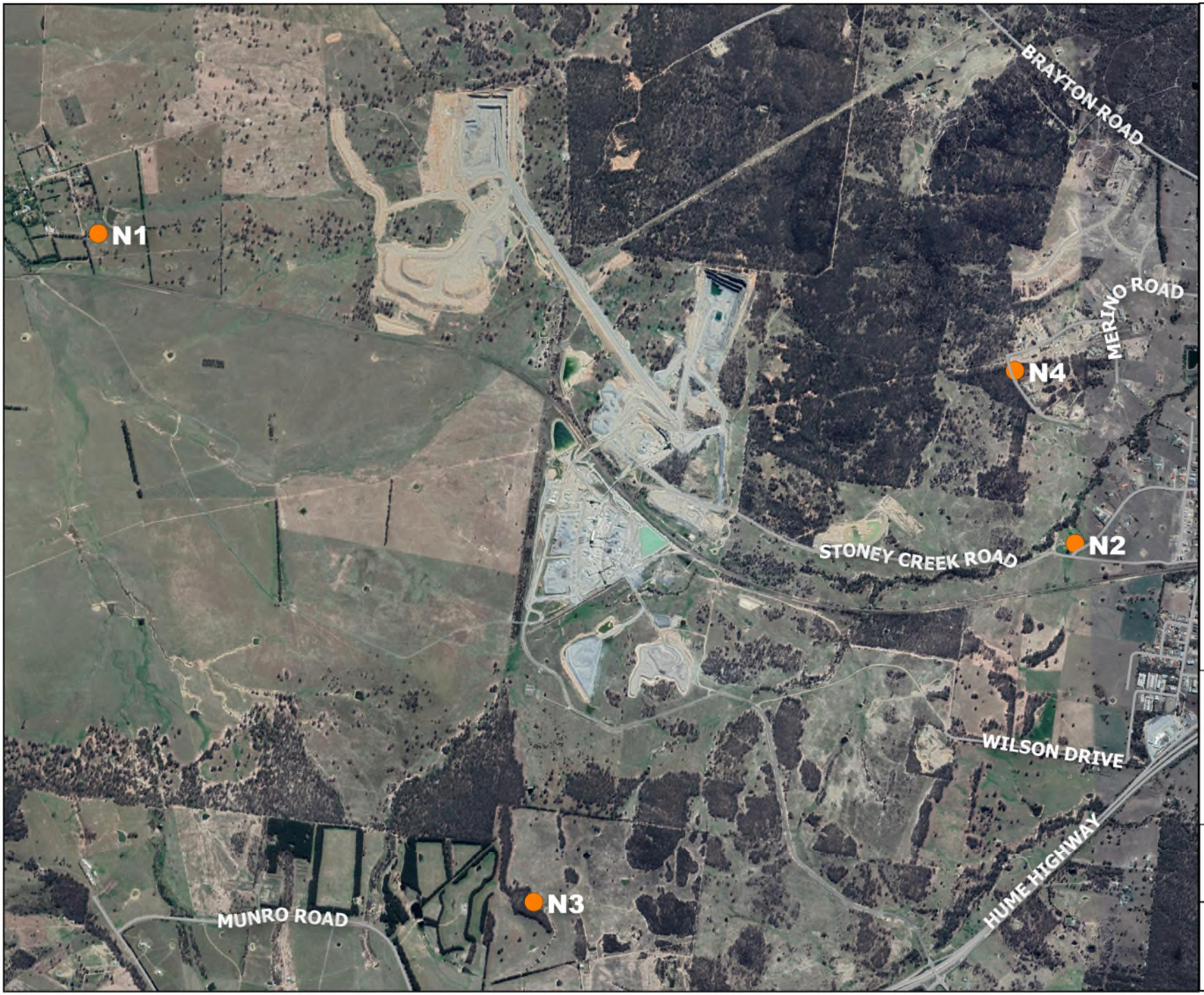

FIGURE 1

Site Locality

MAC180611-02

Holcim Lynwood Quarry

KEY

Noise Monitoring Locations

0 200 400 600 800 1000 m

N

MAC
Muller Acoustic Consulting

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/05/2021	10:20 (Day)	63	45	40	WD: W WS: 3.0m/s Rain: Nil	Wind 36-63 Birds 33-53 Aircraft 40-51 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
26/05/2021	20:03 (Evening)	55	38	34	WD: SW WS: 2.0m/s Rain: Nil	Wind 30-55 Train 30-51 Insects <32 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
26/05/2021	23:13 (Night)	71	37	33	WD: SW WS: 1.5m/s Rain: Nil	Wind 30-47 Distant Traffic <28 Insects <31 Operator 71 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
Lynwood Quarry $L_{A1(1min)}$ Contribution						<40

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/05/2021	09:04 (Day)	60	41	39	WD: W WS: 1.5m/s Rain: Nil	Wind 37-60 Distant Traffic 34-40 Aircraft 34-52 Birds 34-37 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<35
26/05/2021	21:03 (Evening)	53	42	40	WD: SW WS: 1.5m/s Rain: Nil	Wind 39-53 Distant Traffic 36-41 Insects <36 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<37
27/05/2021	00:14 (Night)	48	40	37	WD: W WS: 1.0m/s Rain: Nil	Wind 30-48 Distant Traffic 33-44 Quarry Haul Trucks 30-38 (5-8 minute total duration)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					35
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<46

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/05/2021	08:28 (Day)	55	42	40	WD: W WS: 1.0m/s Rain: Nil	Wind 38-48 Distant Traffic 35-40 Insects <35 Birds 35-55 Quarry FEL/Reverse Alarms <34 (infrequent 5-10s durations)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
26/05/2021	21:40 (Evening)	49	42	38	WD: SW WS: 1.5m/s Rain: Nil	Wind 34-49 Distant Traffic 37-44 Insects <34 Quarry FEL/Reverse Alarms <34 (infrequent 5-10s durations)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
26/05/2021	22:20 (Night)	49	40	38	WD: SW WS: 1.0m/s Rain: Nil	Wind 33-49 Distant Traffic 36-43 Insects <33-35 Quarry FEL/Reverse Alarms <34 (infrequent 5-10s durations)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
Lynwood Quarry $L_{A1(1min)}$ Contribution						<45

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/05/2021	09:41 (Day)	72	48	38	WD: W WS: 2.0m/s Rain: Nil	Wind 36-58 Traffic 33-72 Birds 33-46 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<37
26/05/2021	20:40 (Evening)	64	44	41	WD: SW WS: 2.5m/s Rain: Nil	Wind 39-64 Traffic 36-44 Insects <36 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<37
26/05/2021	23:51 (Night)	50	39	36	WD: W WS: 1.0m/s Rain: Nil	Wind 33-50 Traffic 30-38 Insects <30 Quarry Haul Trucks <30-33 (3-5 minute total duration)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						31
Lynwood Quarry $L_{A1(1min)}$ Contribution						<40

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

5 Discussion

5.1 Discussion of Results - Location N1

Monitoring on Wednesday 26 May 2021 and Thursday 27 May 2021 identified quarry noise was inaudible during daytime, evening and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Extraneous noise sources measured included birds, distant traffic, train, insects, operator noise and wind.

5.2 Discussion of Results - Location N2

Monitoring on Wednesday 26 May 2021 and Thursday 27 May 2021 identified quarry noise was inaudible during daytime and evening measurements and audible during night-time measurement with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources measured included haul truck movements. Extraneous noise sources included aircraft, birds, distant traffic, insects and wind.

5.3 Discussion of Results - Location N3

Monitoring on Wednesday 26 May 2021 and Thursday 27 May 2021 identified that quarry noise was just audible during daytime, evening and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources audible during the survey front end loader movements and reverse alarms. Extraneous noise sources included birds, distant traffic insects and wind.

5.4 Discussion of Results - Location N4

Monitoring on Wednesday 26 May 2021 and Thursday 27 May 2021 identified quarry noise was inaudible during daytime and evening measurements and just audible during night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources measured included haul truck movements. Extraneous noise sources included birds, traffic, insects and wind.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 2, ending June 2021.

Attended noise monitoring was undertaken on Wednesday 26 May 2021 and Thursday 27 May 2021 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible at three locations, however quarry noise emissions were below the relevant noise criteria, satisfying the applicable noise criteria throughout the survey period.

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Appendix A - Glossary of Terms

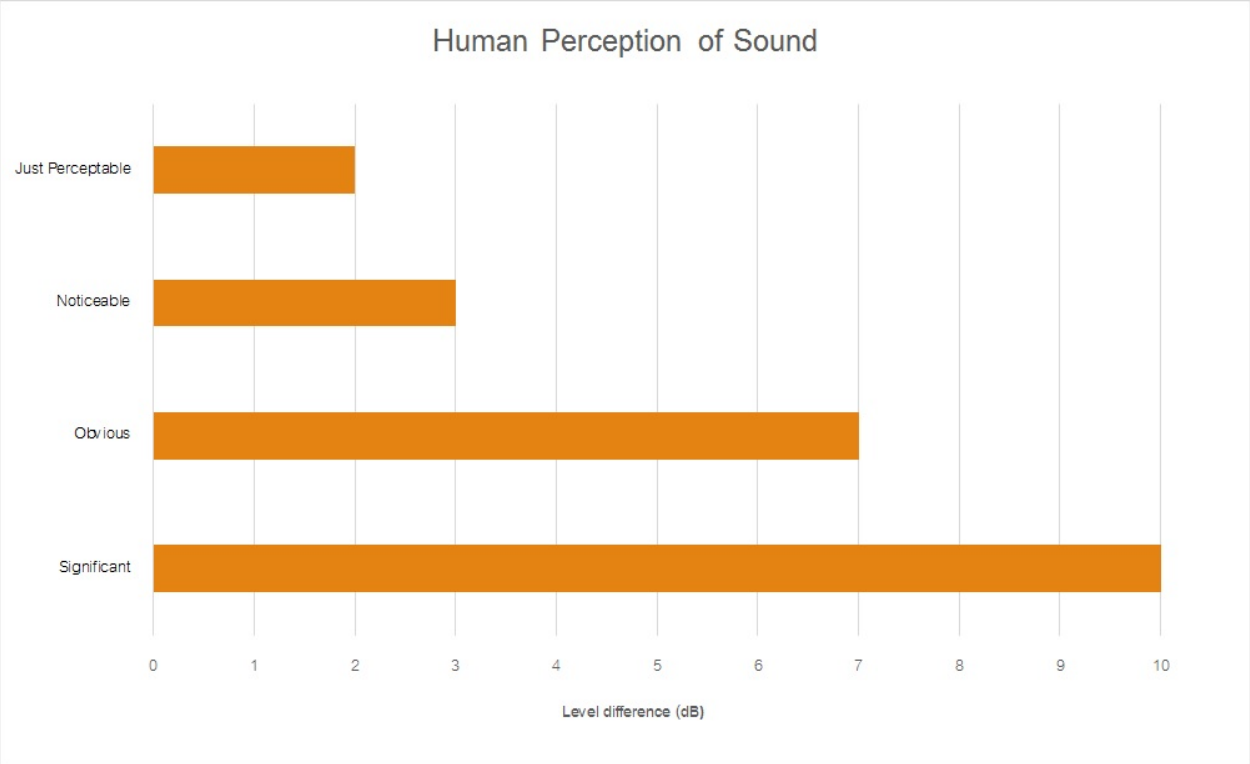
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
Ph: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 3 Ending September 2021.

Prepared for: Holcim (Australia) Pty Ltd
August 2021
MAC180611-02RP13

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 3 Ending September 2021

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-02RP13	Final	11 August 2021	Kristian Allen		Rod Linnett	

CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Lynwood Quarry (the 'quarry'), Marulan, NSW.

The monitoring has been conducted in accordance with the Lynwood Noise Management Plan (NMP) and in general accordance with the Noise Policy for Industry (NPI), at four representative monitoring locations. This assessment has been undertaken for the quarterly period ending September 2021, and forms part of the annual noise monitoring program to address conditions outlined in the Development Consent.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Lynwood Quarry Noise Management Plan (NMP), 2016;
- Lynwood Quarry Environmental Protection Licence (EPL), 2013 (12939);
- Lynwood Quarry, Development Consent, 2005 (DA128-5-2005); and
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

The Lynwood Quarry Noise Management Plan (NMP) outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1**.

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)	dB LA1(1min)
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

NMP ID	EPL ID	Address	Criteria dB			
			Day	Evening	Night	Night
			$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$
N1	L1	1114 Carrick Road, Marulan	35	35	35	45
N2	L6	End of Maclura Drive, Marulan	35	37	36	46
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]	47
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36	47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

3.2 Assessment Methodology

The attended noise measurements were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 27 July 2021 and Thursday 29 July 2021. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2019- Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Noise measurements were of 15-minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Tuesday 27 July 2021 and Thursday 29 July 2021 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ quarry noise contribution for comparison against the relevant criteria. In the event of quarry attributed noise being above criteria, prevailing meteorological conditions for the monitoring period are sourced from the onsite meteorological station and analysed in accordance with Fact Sheet D of the NPI to determine the stability category present at the time of each attended measurement.

Where the quarry is inaudible, the contribution is estimated to be at least 10dBA below the ambient noise level.

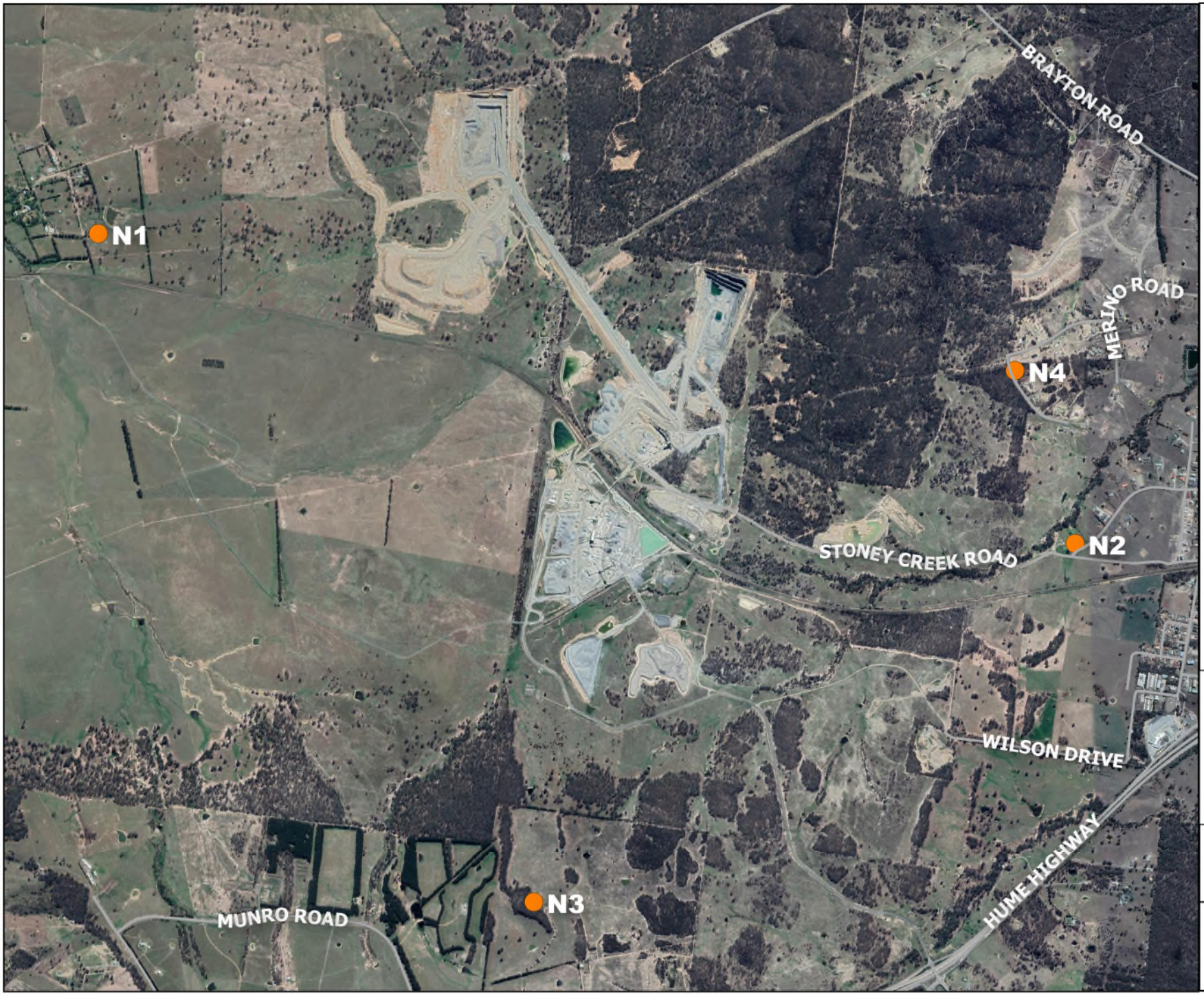

FIGURE 1

Site Locality

MAC180611-02

Holcim Lynwood Quarry

KEY

Noise Monitoring Locations

0 200 400 600 800 1000 m

N

MAC
Muller Acoustic Consulting

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/07/2021	15:00 (Day)	69	47	31	WD: W WS: 1.5m/s Rain: Nil	Wind in Tress 28-46 Birds 25-69 Livestock 35-30 Train 35-57 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<25
29/07/2021	21:44 (Evening)	69	50	39	WD: NW WS: 1.5m/s Rain: Nil	Insects 34-39 Wind in Trees 37-48 Train 40-69 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
29/07/2021	22:10 (Night)	46	37	33	WD: NW WS: 1.0m/s Rain: Nil	Insects 31-39 Wind in Trees 28-46 Quarry Inaudible
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
Lynwood Quarry $L_{A1(1min)}$ Contribution						<45

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/07/2021	13:56 (Day)	51	39	36	WD: W WS: 1.5m/s Rain: Nil	Wind in Trees 33-47 Birds 30-51 Aircraft 30-40 Residential Noise 35-43 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
29/07/2021	20:47 (Evening)	57	42	38	WD: W WS: <0.5m/s Rain: Nil	Insects 35-44 Distant Traffic 32-40 Train 35-56 Aircraft 35-57 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
29/07/2021	23:17 (Night)	68	52	38	WD: W WS: 0.5m/s Rain: Nil	Insects 37-43 Distant traffic 34-40 Train 35-68 Quarry Haul Trucks <34-37 (3-5 minute total duration)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<36
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<46

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/07/2021	13:19 (Day)	63	45	37	WD: W WS: 2.0m/s Rain: Nil	Wind in Trees 35-52 Birds 32-63 Quarry Processing <30 (Multiple 3-5 second durations) Quarry Trucks Enter/Exit <30 (3 movements @ 10-20 seconds each)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
29/07/2021	20:07 (Evening)	49	42	40	WD: W WS: 1.0m/s Rain: Nil	Insects 38-49 Distant Traffic 35-46 Wind in Trees <38 Quarry Alarms <35 (Infrequent 3-5 second durations)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<35
29/07/2021	23:58 (Night)	53	41	37	WD: W WS: 0.5m/s Rain: Nil	Insects 35-42 Distant Traffic 32-44 MAC Operator 53 Quarry Haul Trucks <32-40 (12-14 minute total duration) Quarry Haul Trucks <47 (Occasionally 3-5 second durations) Quarry Alarms <35-38 (Infrequent 3-5 second durations)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					35
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
27/07/2021	14:20 (Day)	58	38	33	WD: NW WS: 1.5m/s Rain: Nil	Wind in Trees 30-49 Birds 30-40 Train 35-46 Distant traffic <30 MAC Operator 58 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
29/07/2021	21:10 (Evening)	50	36	33	WD: NW WS: 0.5m/s Rain: Nil	Insects 32-38 Distant Traffic 30-35 Train 30-45 MAC Operator 50 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
29/07/2021	22:52 (Night)	50	39	36	WD: NW WS: 1.0m/s Rain: Nil	Insects 33-36 Wind in Trees 30-38 Distant Traffic 30-35 MAC Operator 50 Quarry Haul Trucks 30-44 (10-13 minute total duration) Quarry Alarms <33-36 (Infrequent 3-5 second durations)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<36
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

5 Discussion

5.1 Discussion of Results - Location N1

Monitoring on Tuesday 27 July 2021 and Thursday 29 July 2021 identified quarry noise was inaudible during daytime, evening and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Extraneous noise sources measured included birds, livestock, passing trains, insects and wind.

5.2 Discussion of Results - Location N2

Monitoring on Tuesday 27 July 2021 and Thursday 29 July 2021 identified quarry noise was inaudible during daytime and evening measurements and occasionally just audible during the night-time measurement with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources measured included haul truck movements. Extraneous noise sources included aircraft, birds, passing trains, distant traffic, residential noise, insects and wind.

5.3 Discussion of Results - Location N3

Monitoring on Tuesday 27 July 2021 and Thursday 29 July 2021 identified that quarry noise was just audible during daytime and evening measurements and audible during night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources audible during the survey trucks entering and exiting site, processing, site alarms and haul truck movements. Extraneous noise sources included birds, MAC operator noise, distant traffic, insects and wind.

5.4 Discussion of Results - Location N4

Monitoring on Tuesday 27 July 2021 and Thursday 29 July 2021 identified quarry noise was inaudible during daytime and evening measurements and audible during night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources measured included haul truck movements and site alarms. Extraneous noise sources included birds, traffic, distant train pass-bys, MAC operator noise, insects and wind.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 3, ending September 2021.

Attended noise monitoring was undertaken on Tuesday 27 July 2021 and Thursday 29 July 2021 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible at three locations, however quarry noise emissions were below the relevant noise criteria, satisfying the applicable noise criteria throughout the survey period.

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Appendix A - Glossary of Terms

Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
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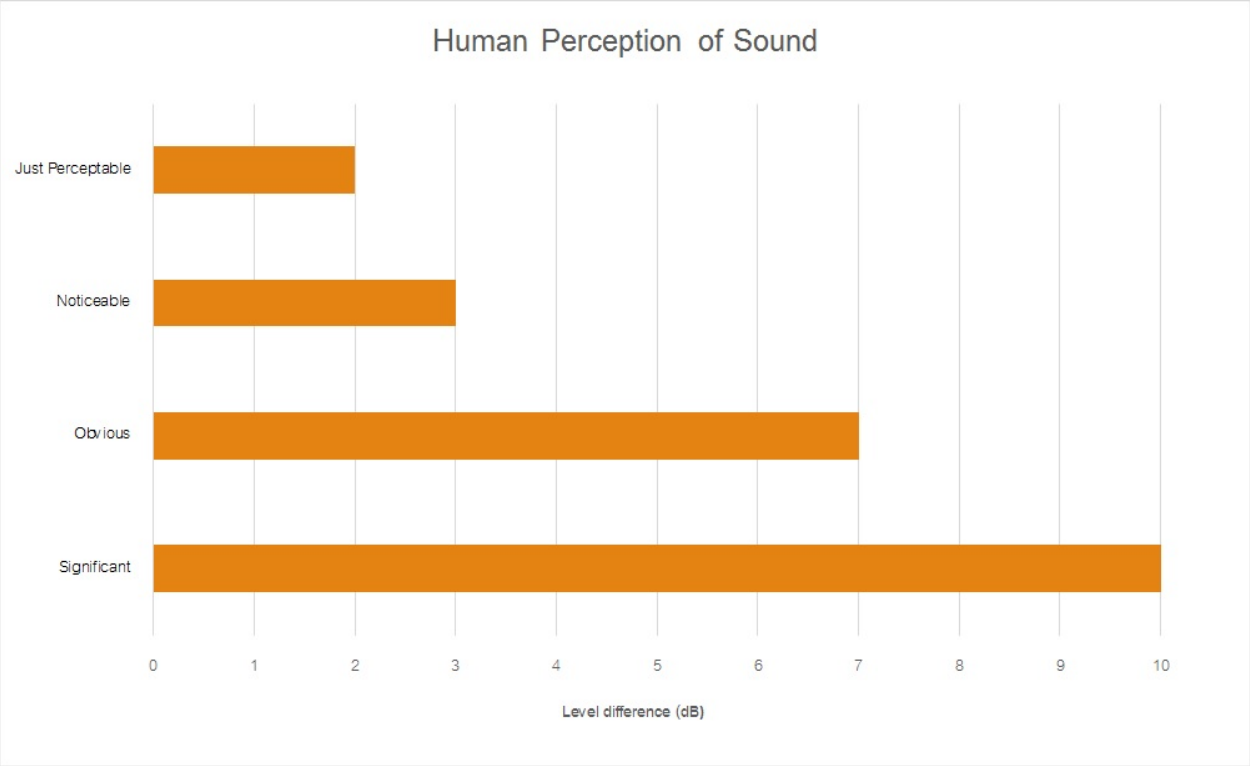
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
Ph: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW
Quarter 4 Ending December 2021.

Prepared for: Holcim (Australia) Pty Ltd
November 2021
MAC180611-02RP14

Muller Acoustic Consulting

Document Information

Noise Monitoring Assessment

Lynwood Quarry, Marulan, NSW

Quarter 4 Ending December 2021

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-02RP14	Final	10 November 2021	Kristian Allen		Rod Linnett	

CONTENTS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Lynwood Quarry (the 'quarry'), Marulan, NSW.

The monitoring has been conducted in accordance with the Lynwood Noise Management Plan (NMP) and in general accordance with the Noise Policy for Industry (NPI), at four representative monitoring locations. This assessment has been undertaken for the quarterly period ending December 2021, and forms part of the annual noise monitoring program to address conditions outlined in the Development Consent.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Lynwood Quarry Noise Management Plan (NMP), 2016;
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- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

The Lynwood Quarry Noise Management Plan (NMP) outlines the applicable noise criteria for residential receivers L1 – L16 surrounding the quarry, and are presented in **Table 1**.

Table 1 Noise Criteria[1]

Location	Day (7am to 6pm)	Evening (6pm to 10pm)	Night (10pm to 7am)	
	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)	dB LA1(1min)
L1	35	35	35	45
L2	35	35	35	45
L3	35	35	35	45
L4	35	37	35	46
L5	35	35	35	46
L6	35	37	36	46
L7	38	38	35	55
L8	39	38	36	55
L9	39	39	37	56
L10	42	42	40	53
L11	35	35	35[1]	47
L12	37	37	36	47
L13	40	38	37	47
L14	35	35	35	47
L15	35	35	35	47
L16	35	35	35	45

Note 1: Noise criteria adopted from the EPL.

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3 Methodology

3.1 Locality

The quarry is located near Marulan, NSW approximately 4km west of the town centre. Receivers in the locality surrounding the quarry are primarily rural and residential. The quarry is surrounded by rural properties to the west, with the Hume Highway situated to the east and south of the site. Highway traffic is a dominant noise source in the area along with rural noise. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan in **Figure 1** and presented in **Table 2.**

Table 2 Monitoring Location Addresses

NMP ID	EPL ID	Address	Criteria dB			
			Day	Evening	Night	Night
			$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{Aeq(15min)}$	$L_{A1(1min)}$
N1	L1	1114 Carrick Road, Marulan	35	35	35	45
N2	L6	End of Maclura Drive, Marulan	35	37	36	46
N3	L11	Northern Boundary, 16038 Hume Highway, Marulan[1]	35	35	35[2]	47
N4	L12	Corner of Dorsett and Suffolk Road, Marulan	37	37	36	47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 1: Intermediate noise monitoring point.

Note 2: Noise criteria adopted from the EPL.

3.2 Assessment Methodology

The attended noise measurements were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise" and the Lynwood Quarry EPL. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 19 October 2021 and Thursday 21 October 2021. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2019- Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ±0.5dBA.

Noise measurements were of 15-minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Measurements were conducted at four locations (N1-N4) on Tuesday 19 October 2021 and Thursday 21 October 2021 to satisfy the requirements of the NMP.

Extraneous noise sources were excluded from the analysis to determine the $LA_{eq(15min)}$ quarry noise contribution for comparison against the relevant criteria. In the event of quarry attributed noise being above criteria, prevailing meteorological conditions for the monitoring period are sourced from the onsite meteorological station and analysed in accordance with Fact Sheet D of the NPI to determine the stability category present at the time of each attended measurement.

Where the quarry is inaudible, the contribution is estimated to be at least 10dBA below the ambient noise level.

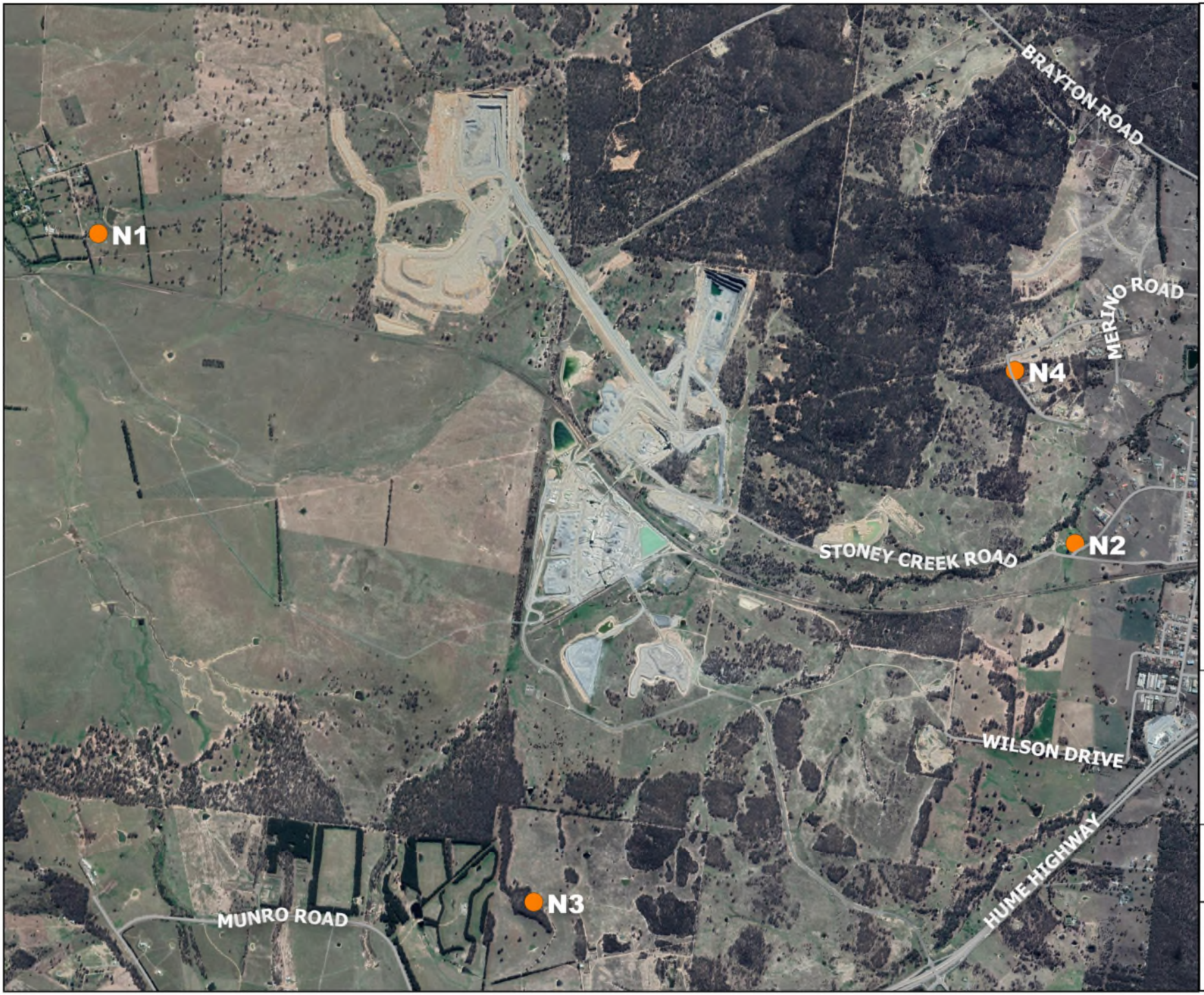

FIGURE 1

Site Locality

MAC180611-02

Holcim Lynwood Quarry

KEY

Noise Monitoring Locations

0 200 400 600 800 1000 m

N

MAC
Muller Acoustic Consulting

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4 Results

4.1 Assessment Results - Location N1

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N1 for the NMA are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location N1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/10/2021	14:35 (Day)	53	42	36	WD: S WS: 2.5m/s Rain: Nil	Wind in Trees 30-53 Birds 27-40 Quarry - Haul Trucks <30 (Barely to Just Audible 25% of measurement)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<30
21/10/2021	19:52 (Evening)	66	48	41	WD: SE WS: 0.5m/s Rain: Nil	Insects 38-45 Birds 35-51 Train 40-66 Quarry – Haul Trucks <35-38 (Just Audible 50% of measurement)
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						<35
21/10/2021	(Night)	-	-	-	WD: WS: m/s Rain: Nil	No Measurements due to instrument Issues
Lynwood Quarry $L_{Aeq(15min)}$ Contribution						-
Lynwood Quarry $L_{A1(1min)}$ Contribution						-

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2 Assessment Results - Location N2

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N2 for the NMA are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location N2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/10/2021	13:29 (Day)	58	40	33	WD: SW WS: 1.5m/s Rain: Nil	Wind In Trees 30-48 Birds 27-57 Train 35-58 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
21/10/2021	20:53 (Evening)	57	46	42	WD: SE WS: <0.5m/s Rain: Nil	Traffic 36-57 Insects 39-43 Dogs Barking 36-45 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<37
21/10/2021	22:42 (Night)	50	44	41	WD: SE WS: <0.5m/s Rain: Nil	Traffic 36-50 Insects 39-45 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<36
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<46

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.3 Assessment Results - Location N3

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N3 for the NMA are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location N3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/10/2021	12:52 (Day)	67	45	39	WD: SW WS: 2.0m/s Rain: Nil	Wind In Trees 36-54 Birds 33-67 Distant Traffic 33-43 Quarry – Trucks Enter/Exit Site (2 Movements, ~20 second durations)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<35
21/10/2021	21:36 (Evening)	51	44	42	WD: S WS: <0.5m/s Rain: Nil	Traffic 37-51 Insects 40-45 Quarry – Processing <35 (Just Audible 75% Measurement) Quarry – Haul trucks <35 (Just Audible 25% Measurement) Quarry – Reverse/Site Alarms <35 (Multiple 3-5 second durations)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<35
21/10/2021	22:00 (Night)	50	44	42	WD: S WS: <0.5m/s Rain: Nil	Traffic 37-50 Insects 40-45 Quarry – Processing <35 (Just Audible 75% Measurement) Quarry – Haul trucks <35 (Just Audible 25% Measurement) Quarry – Reverse/Site Alarms <35 (Multiple 3-5 second durations)
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<35
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.4 Assessment Results - Location N4

The monitored noise level contributions and observed meteorological conditions for each assessment period at Location N4 for the NMA are presented in **Table 6**.

Table 6 Operator-Attended Noise Survey Results – Location N4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L_{Amax}	L_{Aeq}	L_{A90}		
19/10/2021	13:52 (Day)	79	55	41	WD: SW WS: 2.0m/s Rain: Nil	Wind In Trees 38-53 Birds 35-43 Residential Noise 35-42 Traffic 35-79 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<37
21/10/2021	20:30 (Evening)	51	39	36	WD: SE WS: <0.5m/s Rain: Nil	Traffic 30-51 Insects 33-36 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
21/10/2021	23:05 (Night)	49	37	35	WD: SE WS: 0.5m/s Rain: Nil	Traffic 30-49 Insects 32-38 Quarry Inaudible
	Lynwood Quarry $L_{Aeq(15min)}$ Contribution					<30
	Lynwood Quarry $L_{A1(1min)}$ Contribution					<47

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

5 Discussion

5.1 Discussion of Results - Location N1

Monitoring on Tuesday 19 October 2021 and Thursday 21 October 2021 identified quarry noise was just audible during daytime and evening measurements with quarry noise contributions estimated to satisfy the relevant noise limits. No night measurements were conducted at this location due to instrument issues, however previous measurements indicated that insect noise was most likely the dominant noise source throughout the night period

Quarry noise sources measured included haul truck movements. Extraneous noise sources measured included birds, passing trains, insects and wind.

5.2 Discussion of Results - Location N2

Monitoring Tuesday 19 October 2021 and Thursday 21 October 2021 identified quarry noise was inaudible during daytime, evening and night-time measurement with quarry noise contributions estimated to satisfy the relevant noise limits.

Extraneous noise sources included birds, passing trains, traffic, dogs barking, insects and wind.

5.3 Discussion of Results - Location N3

Monitoring on Tuesday 19 October 2021 and Thursday 21 October 2021 identified that quarry noise was barely to just audible during daytime, evening measurements and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Quarry noise sources audible during the survey trucks entering and exiting site, processing, site alarms, reverse alarms and haul truck movements. Extraneous noise sources included birds, traffic, insects and wind.

5.4 Discussion of Results - Location N4

Monitoring on Tuesday 19 October 2021 and Thursday 21 October 2021 identified quarry noise was inaudible during daytime, evening and night-time measurements with quarry noise contributions estimated to satisfy the relevant noise limits.

Extraneous noise sources included birds, traffic, residential noise, insects and wind.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for Holcim (Australia) Pty Ltd at the Lynwood Quarry, Marulan, NSW. The assessment was completed to assess the quarry's compliance with the relevant noise criteria during Quarter 4, ending December 2021.

Attended noise monitoring was undertaken on Tuesday 19 October 2021 and Thursday 21 October 2021 at four representative monitoring locations. The assessment has identified that noise emissions generated by Lynwood Quarry were audible at two locations, however quarry noise emissions were below the relevant noise criteria, satisfying the applicable noise criteria throughout the survey period.

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Appendix A - Glossary of Terms

Table A1 provides a number of technical terms have been used in this report.

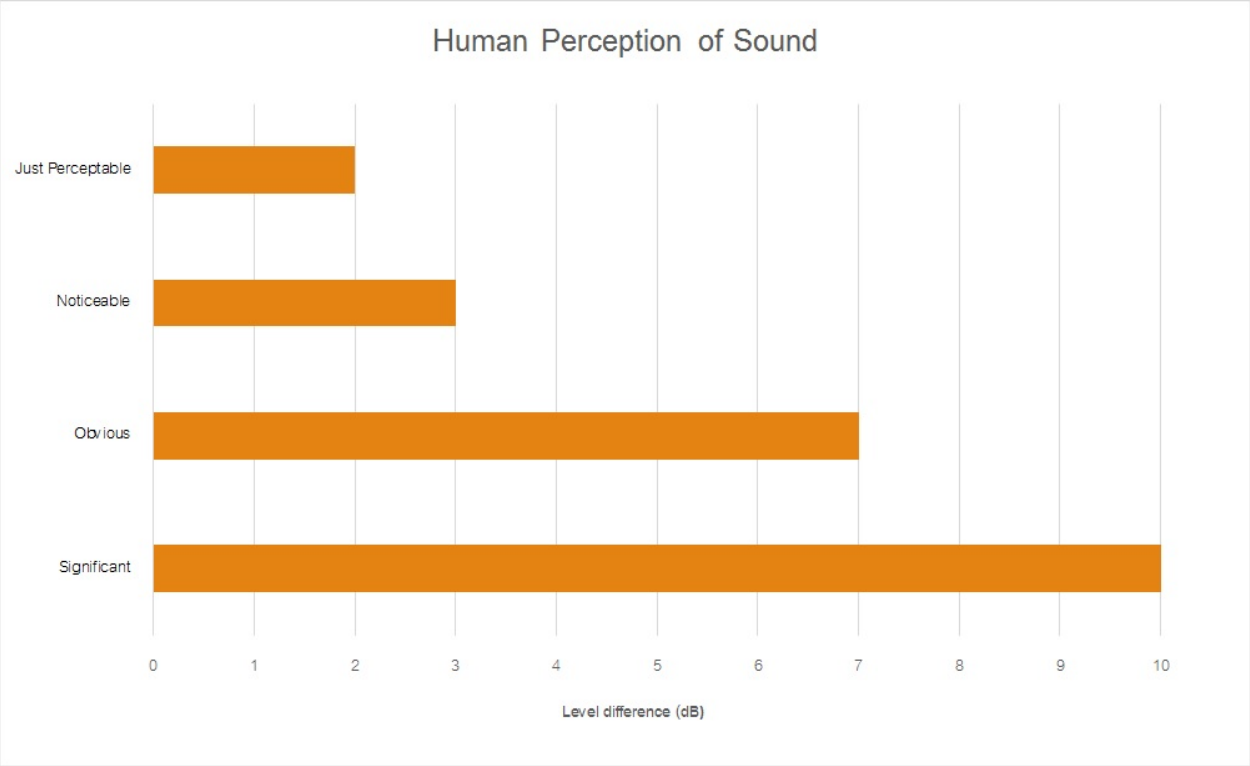
Table A1 Glossary of Terms

Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : = 10.log10 (W/Wo) Where : W is the sound power in watts and Wo is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 678, Kotara NSW 2289
ABN: 36 602 225 132
Ph: +61 2 4920 1833
www.mulleracoustic.com

MAC
Muller Acoustic Consulting