

Noise Assessment

Proposed School Development
Lot 1 Magpie Hollow Road
South Bowenfels, NSW

Prepared for: Dezign Pty Ltd
February 2024
MAC231890-01RP1



Document Information

Noise Assessment

Proposed School Development

Lot 1 Magpie Hollow Road

South Bowenfels, NSW

Prepared for: Dezign Pty Ltd

19 John Street

Lawson NSW 2783



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	DATE	PREPARED	SIGNED	REVIEWED	SIGNED
MAC231890-01RP1	16 February 2024	Louis Abell		Oliver Muller	

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1	INTRODUCTION.....	5
2	PROJECT DESCRIPTION.....	7
2.1	BACKGROUND.....	7
2.1.1	PROPOSED ACTIVITIES & OPERATING HOURS.....	8
2.1.2	RECEIVER REVIEW.....	9
3	NOISE POLICY AND GUIDELINES.....	11
3.1	THE AAAC GUIDELINE.....	11
3.2	NOISE POLICY FOR INDUSTRY.....	11
3.2.1	PROJECT NOISE TRIGGER LEVELS (PNTL).....	12
3.2.2	RATING BACKGROUND LEVEL (RBL).....	12
3.2.3	PROJECT INTRUSIVENESS NOISE LEVEL (PINL).....	13
3.2.4	PROJECT AMENITY NOISE LEVEL (PANL).....	13
3.3	INTERIM CONSTRUCTION NOISE GUIDELINE.....	16
3.3.1	STANDARD HOURS FOR CONSTRUCTION.....	18
3.3.2	CONSTRUCTION NOISE MANAGEMENT LEVELS.....	18
4	EXISTING ENVIRONMENT.....	21
4.1	UNATTENDED NOISE MONITORING.....	21
5	ASSESSMENT CRITERIA.....	23
5.1	NOISE EMISSION CRITERIA FROM CHILDCARE CENTRES.....	23
5.2	OPERATIONAL NOISE CRITERIA.....	23
5.2.1	INTRUSIVENESS NOISE LEVELS.....	23
5.2.2	AMENITY NOISE LEVELS AND PROJECT AMENITY NOISE LEVELS.....	24
5.2.3	PROJECT NOISE TRIGGER LEVELS.....	24
5.3	CONSTRUCTION NOISE CRITERIA.....	24
6	MODELLING METHODOLOGY.....	25
6.1	SOUND POWER LEVELS.....	26
6.2	NOISE ATTENUATION ASSUMPTIONS, CONTROLS AND RECOMMENDATIONS.....	26
7	NOISE ASSESSMENT RESULTS.....	27

7.1	OUTDOOR PLAY ACTIVITIES NOISE EMISSION	27
7.2	OPERATIONAL NOISE ASSESSMENT (MECHANICAL PLANT AND ONSITE VEHICLES)	28
7.3	CONSTRUCTION NOISE ASSESSMENT	29
8	CONSTRUCTION RECOMMENDATIONS.....	31
9	DISCUSSION AND CONCLUSION	33
	APPENDIX A – GLOSSARY OF TERMS	
	APPENDIX B – SITE PLANS	
	APPENDIX C – NOISE MONITORING CHARTS AND ABL SUMMARY	

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Dezign Pty Ltd to prepare a Noise Assessment (NA) to quantify emissions from the proposed school development (the 'project') to be located at Lot 1 Magpie Hollow, South Bowenfels, NSW.

The NA has quantified potential operational and construction noise emissions from the project and recommends reasonable and feasible noise controls where required.

This assessment has been undertaken in accordance with the following documents:

- NSW Department of Environment and Climate Change (DECCW), NSW Interim Construction Noise Guideline (ICNG), 2009;
- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI) 2017;
- Association of Australasian Acoustical Consultants (AAAC), Guideline for Child Care Centre Acoustic Assessment (2020);
- NSW Environment Protection Authority (EPA), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022; and
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise - General Procedures.

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

This page has been intentionally left blank

2 Project Description

2.1 Background

The project proposes the development of a school at a greenfield site located at Lot 1 DP527491, Magpie Hollow Road, South Bowenfels, NSW. The proposed structures are to be constructed:

- Ground Floor – Junior School / Reception;
- First Floor – Senior School;
- Gymnasium / Dining Area;
- Gymnasium Mezzanine Area;
- Junior Playground;
- Sports Field;
- Fenced Carpark; and
- Bus Dropoff / Pickup Lane.

Site plans are provided in **Appendix B**.

2.1.1 Proposed Activities & Operating Hours

The school is proposed to operate from 8.30am to 3pm, Monday to Friday. Additionally, there is scope for before school care to be available from 7am until 8.30am, with after school care available until 6pm.

There are several key activities associated with the project that have the potential to generate acoustic impacts on nearby receivers. **Table 1** provides a summary of project related noise sources and the assessment period in which they propose to occur.

Table 1 Noise Generating Activities		
Activity/Source	NPI Period ¹	Operational
Internal and External School Classroom Activities	Day	✓
	Evening	X
	Night	X
Mechanical Plant	Day	✓
	Evening	X
	Night	X
Car Parking	Day	✓
	Evening	X
	Night	X

Note 1: As per the NPI, 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.

2.1.2 Receiver Review

A review of residential receivers in close proximity to the project has been completed and are summarised in **Table 2**. **Figure 1** provides a locality plan showing the position of these receivers in relation to the project.

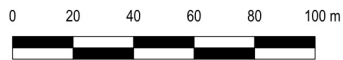
Table 2 Receiver Locations				
Receiver	Receiver Type	Receiver Height m	Coordinates (MGA56)	
			Easting	Northing
C01	Commercial Receiver	1.5	232806	6288935
R01	Residential Receiver	1.5	232591	6288997
R02	Residential Receiver	1.5	232629	6289020
R03	Residential Receiver	1.5	232662	6289053
R04	Residential Receiver	1.5	232707	6289081
R05	Residential Receiver	1.5	232734	6289023
R06	Residential Receiver	1.5	232811	6289014
R07	Residential Receiver	1.5	232830	6288987
R08	Residential Receiver	1.5	232829	6288962
R09	Residential Receiver	1.5	232920	6288941
R10	Residential Receiver	1.5	232927	6288921
R11	Residential Receiver	1.5	232907	6288886
R12	Residential Receiver	1.5	232914	6288849
R13	Residential Receiver	1.5	232444	6288966
R14	Residential Receiver	1.5	232532	6289084



FIGURE 1
 Locality Plan
 MAC231890-01
 Proposed School Facility
 Lot 1 Magpie Hollow Road
 South Bowenfels
 NSW 2790

KEY

- Receiver
- Unattended Noise Monitoring
- Project Boundary



3 Noise Policy and Guidelines

3.1 The AAAC Guideline

The Guideline for Childcare Centre Acoustic Assessment (GCCCAA) been prepared by the AAAC. The document provides criteria for the assessment of noise intrusion into and noise emissions from CCCs and also provides recommendations for treatment to minimise noise upon surrounding receptors. The guideline aligns with the NPI for establishing criteria for CCCs with respect to the following noise sources:

- mechanical plant (air conditioning condensers and mechanical ventilation);
- on-site traffic, deliveries and ingress and egress of vehicles;
- on-site drop off/collection areas of children; and
- noise emissions from children at play.

3.2 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.
4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.
5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.
6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels (PNTL)

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level (PINL)** and **Project Amenity Noise Level (PANL)** determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Rating Background Level (RBL)

The Rating Background Level (RBL) is a determined parameter from noise monitoring and is used for assessment purposes. As per the NPI, the RBL is an overall single figure background level representing each assessment period (day, evening and night) over the noise monitoring period. The measured RBLs relevant to the project are contained in **Section 4**.

3.2.3 Project Intrusiveness Noise Level (PINL)

The PINL ($LA_{eq}(15min)$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

Background noise levels need to be determined before intrusive noise can be assessed. The NPI states that background noise levels to be measured are those that are present at the time of the noise assessment and without the subject development operating. For the assessment of modifications to existing premises, the noise from the existing premises should be excluded from background noise measurements. It is noted that the exception is where the premises has been operating for a significant period of time and is considered a normal part of the acoustic environment; it may be included in the background noise assessment under the following circumstances:

- the development must have been operating for a period in excess of 10 years in the assessment period/s being considered and is considered a normal part of the acoustic environment; and,
- the development must be operating in accordance with noise limits and requirements imposed in a consent or licence and/or be applying best practice.

Where a project intrusiveness noise level has been derived in this way, the derived level applies for a period of 10 years to avoid continuous incremental increases in intrusiveness noise levels. This approach is consistent with the purpose of the intrusiveness noise level to limit significant change in the acoustic environment. The purpose of the project amenity noise level is to moderate against background noise creep.

3.2.4 Project Amenity Noise Level (PANL)

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **Project Amenity Noise Level (PANL)** – is the recommended level for a receiver area, specifically focusing the project being assessed.

Additionally, Section 2.4 of the NPI states: “to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows”:

PANL for new industrial developments = recommended **ANL** minus 5dBA.

The following exceptions apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

The NPI states with respect to high traffic noise areas:

The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the LAeq, period(traffic) minus 15 dB(A).

Where relevant this assessment has considered influences of traffic with respect to amenity noise levels (ie areas where existing traffic noise levels are 10dB greater than the recommended amenity noise level).

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 3**.

Table 3 Amenity Noise Levels

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq(period)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.	See column 4	See column 4	5dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School Classroom	All	Noisiest 1-hour period when in use	35 (internal) 45 (external)
Hospital ward			
- internal	All	Noisiest 1-hour	35
- external	All	Noisiest 1-hour	50
Place of worship			
- internal	All	When in use	40
Passive Recreation	All	When in use	50
Active Recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial	All	When in use	70

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7 of the NPI.

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.

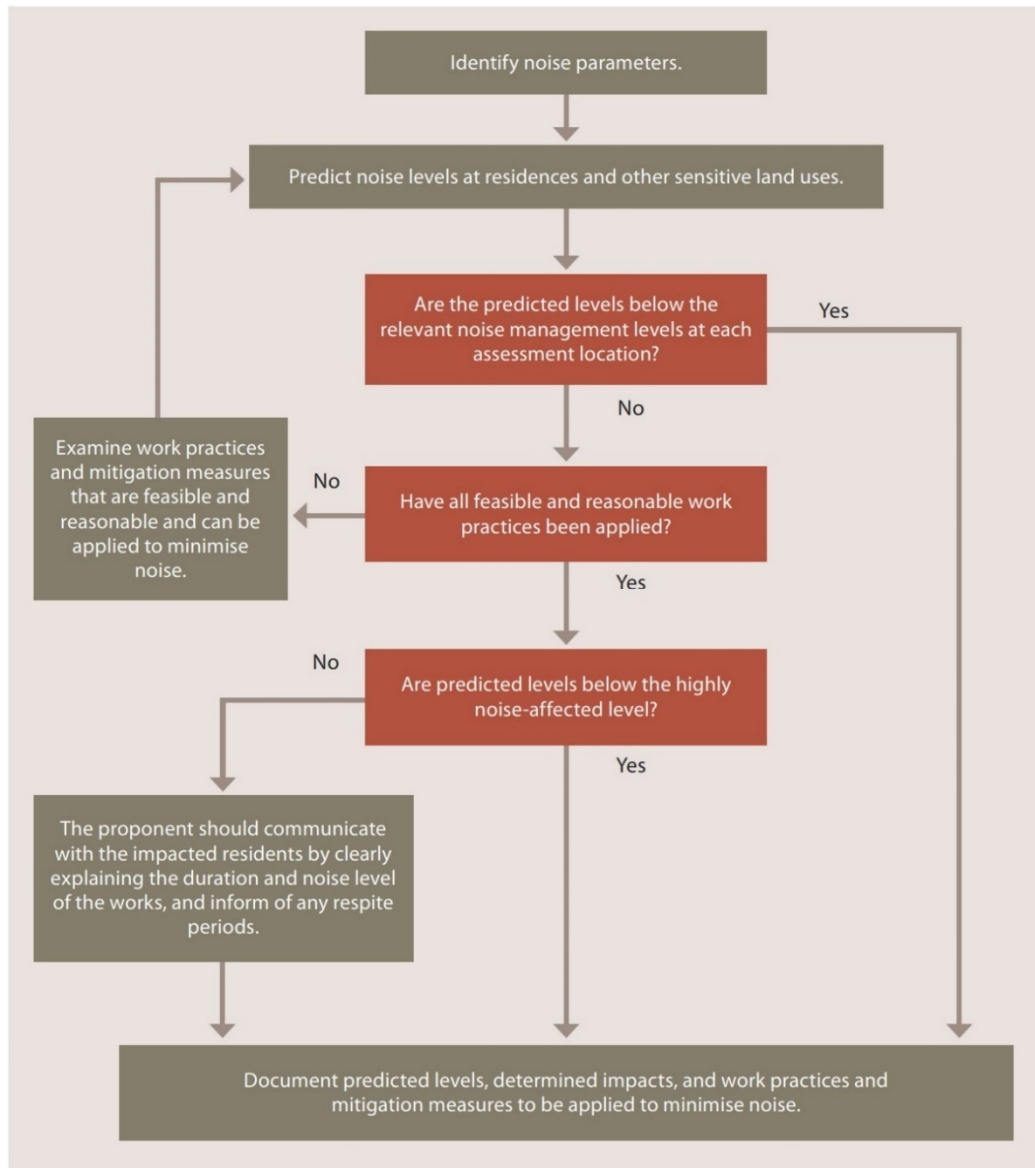
3.3 Interim Construction Noise Guideline

The ICNG sets out procedures to identify and address the impacts of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; and
- Qualitative, which is suited to short term infrastructure maintenance (< three weeks).

The qualitative assessment methodology is a more simplified approach that relies on noise management strategies. This NA has adopted a quantitative assessment approach which is summarised in **Figure 2**. The quantitative approach includes identification of potentially affected receivers, derivation of the construction noise management levels, quantification of potential noise impact at receivers via predictive modelling and, provides management and mitigation recommendations.

Figure 2 Quantitative Assessment Processes for Assessing and Managing Construction Noise



Source: Department of Environment and Climate Change, 2009.

3.3.1 Standard Hours for Construction

Table 4 presents the ICNG recommended standard hours for construction works.

Table 4 Recommended Standard Hours for Construction	
Daytime	Construction Hours
Monday to Friday	7am to 6pm
Saturdays	8am to 1pm
Sundays or Public Holidays	No construction

These recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Construction activities are anticipated to be undertaken during standard construction hours.

3.3.2 Construction Noise Management Levels

Section 4 of the ICNG details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are important indicators of the potential level of construction noise impact. **Table 5** reproduces the ICNG Noise Management Level (NML) for residential receivers. The NML is determined by adding 10dB (standard hours) or 5dB for Out of Hours (OOH) to the Rating Background Level (RBL) for each specific assessment period.

Table 5 Noise Management Levels

Time of Day	Management Level LAeq(15min) ¹	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75dBA (HNA)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Note 1: 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 construction noise management levels for noise assessment purposes and is the median of the ABL's.

This page has been intentionally left blank

4 Existing Environment

4.1 Unattended Noise Monitoring

To quantify the existing background noise environment of the area, unattended noise monitoring was conducted at one location representative of the ambient environment surrounding the project site. The selected monitoring location is shown in **Figure 1** and is considered representative of surrounding residential receivers as per Fact Sheet B1.1 of the NPI.

The unattended noise survey was conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics – Description and Measurement of Environmental Noise".

The measurements were carried out using one Svantek 977 noise analyser from Friday 2 February 2024 to Tuesday 13 February 2024. The acoustic instrumentation used carries current NATA calibration and complies with AS/NZS 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 ± 0.5 dBA. All equipment carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per the EPA's Approved methods for the measurement and analysis of environmental noise in NSW (EPA, 2022).

Observations on-site identified the surrounding locality was typical of suburban environment, with local traffic and distant construction audible.

Data affected by adverse meteorological conditions have been excluded from the results in accordance with methodologies provided in Fact Sheet A4 of the NPI. Residential receivers situated in the surrounding area have been classified under the EPA's suburban amenity category. This criteria is used in conjunction with the intrusiveness criteria to determine the limiting criteria. The results of long-term unattended noise monitoring are provided in **Table 6**. The noise monitoring charts for the background monitoring assessment are provided in **Appendix C**.

Table 6 Background Noise Monitoring Summary

Location	Measured Rating Background Noise Level ¹ (LA ₉₀), dBA			Measured LA _{eq} (period) Noise Level dBA		
	Day	Evening	Night	Day	Evening	Night
	7am to 6pm	6pm to 10pm	10pm to 7am	7am to 6pm	6pm to 10pm	10pm to 7am
L1	42	40	28	58	57	51

Note: Excludes periods of wind or rain affected data. Meteorological data obtained from the Marrangaroo (Defence) Bureau of Meteorology weather station (33.4346°S 150.1350°E 955m AMSL).

Note 1: Assessment background level (RBL) – the single-figure background level representing each assessment period day, evening and night as per NPI Fact Sheet A.

This page has been intentionally left blank

5 Assessment Criteria

5.1 Noise Emission Criteria from Childcare Centres

The AAAC's GCCCAA recommends a base criterion of 45dB LAeq(15min) for the assessment of outdoor play where the background noise level is less than 40dBA, however, where the background noise level is greater than 40dBA, the GCCCAA states:

The contributed Leq, 15min noise level emitted from an outdoor play and internal activity areas shall not exceed the background noise level by more than 5 or 10 dB at the assessment location, depending on the usage of the outdoor play area. AAAC members regard that a total time limit of approximately 2 hours outdoor play per morning and afternoon period should allow an emergence above the background of 10 dB (ie background +10 dB if outdoor play is limited to 2 hours in the morning and 2 hours in the afternoon).

Other noise emissions, from mechanical plant, drop off, pick up and any other activities are not to exceed the background noise level by more than 5dB. In regard to sleep disturbance, activities prior to 7am, such as the LAmax noise level from staff vehicles arriving, parking etc should not exceed the background noise level by more than 15dB. **Table 7** summarises the noise emission criteria from the CCC.

Table 7 CCC Noise Emission Criteria			
Location	Period	Activity	Criteria ¹
Residential Receivers R1-R14	Day (7am-6pm)	Outdoor Play	52dB LAeq(15min)
	Day (7am-6pm)	All other activities	52dB LAeq(15min)
	Morning Shoulder (6am-7am)	Staff Arrival	57dB LAmax

Note 1: Background plus 5dB for more than 4 hours (total) outdoor play per day. Background plus 10dB for up to 4 hours (total) outdoor play per day.

5.2 Operational Noise Criteria

5.2.1 Intrusiveness Noise Levels

The PINL for the project are presented in **Table 8** and have been determined based on the RBL +5dBA and only apply to residential receivers.

Table 8 Project Intrusiveness Noise Levels					
Location	Receiver Type	Period ¹	Measured RBL dB LA90	Adopted RBL dB LA90	PINL dB LAeq(15min)
L1	Residential	Day	42	42	47

Note 1: 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.

5.2.2 Amenity Noise Levels and Project Amenity Noise Levels

The PANL for residential receivers and other receiver types (ie non-residential) potentially affected by the project are presented in **Table 9**.

Table 9 Amenity Noise Levels and Project Amenity Noise Levels					
Receiver Type	Noise	Assessment	NPI Recommended ANL	ANL	PANL
	Amenity Area	Period ¹	dB LAeq(period)	dB LAeq(period)	dB LAeq(15min) ²
Residential	Suburban	Day	55	50	53

Note 1: 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 2: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.

5.2.3 Project Noise Trigger Levels

The PNTL are the lower of either the PINL or the PANL. **Table 10** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI.

Table 10 Project Noise Trigger Levels					
Receiver	Noise Amenity	Assessment	PINL	PANL	PNTL
Type	Area	Period ¹	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)
Residential	Suburban	Day	47	53	47

Note 1: 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.

5.3 Construction Noise Criteria

The relevant Noise Management Levels (NMLs) for standard construction hours are presented in **Table 11**.

Table 11 Construction Noise Management Levels			
Catchment (No)	Assessment Period ¹	Adopted RBL	NML
Receiver ID		dB LA90	dB LAeq(15min)
Suburban Residential	Standard Hours	42	52 (RBL+10dBA)
Commercial	Standard Hours	N/A	70

Note 1: See Table 4 for recommended standard hours for construction.

6 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2024) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613:1 and ISO 9613:2 including corrections for meteorological conditions using CONCAWE¹. The ISO 9613 standards are the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

¹ Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

6.1 Sound Power Levels

Table 12 presents the sound power level for each noise source modelled in this assessment. It is noted that sound power levels were sourced from manufacturer's specifications or from in-field measurements at similar project sites.

Table 12 Acoustically Significant Sources - Sound Power Level (re 10⁻¹² Watts)			
Item and number modelled per 15 minutes	Individual Lw dB LAeq	Modelled Source Lw dB LAeq(15min)	Source Height ¹
External Play Sources			
Group of 10 pre-primary aged students (x4)	85	91	1m
Group of 10 primary aged students (x3)	87	92	1m
Groups of 5 high school aged students (x3)	72	77	1.5m
Operational Noise LAeq 15 minute			
Large AC plant (x8)	78	78	1.5m
Car enters, park, start up, idle and drive off – External (x22) ²	73	86	0.5m
Construction Fleet LAeq 15 minute			
Combined Construction Fleet		108	1.5m

Note 1: Height above the relative ground or building below source.

Note 2: Includes a duration adjustment assuming vehicles operate for three (3) minutes continuously within a period of 15-minutes.

6.2 Noise Attenuation Assumptions, Controls and Recommendations

The noise model adopted the following assumptions, controls and recommendations:

- the project is constructed as per the site design and plans (see **Appendix B**), which includes the barrier attenuation provided by the project buildings orientation;
- one (1) in two (2) students are talking at any one time;
- all students are in the playground simultaneously, with the pre-primary students located in the northwest junior playground, primary students in the northern outdoor sports area and the proposed high school students located in eastern sports field;
- the existing boundary fences or similar are retained and have been modelled at a height of 1.5m; and
- the mechanical plant for the school is yet to be finalised. Therefore, the modelling assumes four large AC units on the roof of the learning and admin building (western building) and four large AC units on the roof of the gymnasium.

7 Noise Assessment Results

7.1 Outdoor Play Activities Noise Emission

Noise predictions from the cumulative proposed outdoor play activities from all student groups have been quantified at surrounding residential receivers to the project site and are presented in **Table 13** and assessed against the adopted the criteria established in **Section 5.1**.

Table 13 Noise Predictions – Outdoor Play

Receiver	Period ¹	Predicted Noise Level	Criteria	Compliant
		dB LAeq(15min)	dB LAeq(15min)	
R01	Day	41	52	✓
R02	Day	46	52	✓
R03	Day	37	52	✓
R04	Day	36	52	✓
R05	Day	42	52	✓
R06	Day	33	52	✓
R07	Day	35	52	✓
R08	Day	33	52	✓
R09	Day	<30	52	✓
R10	Day	<30	52	✓
R11	Day	<30	52	✓
R12	Day	<30	52	✓
R13	Day	<30	52	✓
R14	Day	<30	52	✓

Note 1: 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.

7.2 Operational Noise Assessment (Mechanical Plant and Onsite Vehicles)

Noise predictions from all onsite sources excluding external educational activities have been quantified at surrounding residential receivers to the project site and are presented in **Table 14**. Results demonstrate the daytime PNTLs are satisfied for all assessed receivers.

Table 14 Noise Predictions – All Receivers

Receiver	Period ¹	Predicted Noise Level	PNTL	Compliant
		dB LAeq(15min)	dB LAeq(15min)	
R01	Day	<30	47	✓
R02	Day	<30	47	✓
R03	Day	<30	47	✓
R04	Day	<30	47	✓
R05	Day	<30	47	✓
R06	Day	<30	47	✓
R07	Day	<30	47	✓
R08	Day	<30	47	✓
R09	Day	<30	47	✓
R10	Day	<30	47	✓
R11	Day	<30	47	✓
R12	Day	<30	47	✓
R13	Day	<30	47	✓
R14	Day	<30	47	✓
C01	When in Use	34	63	✓

Note 1: 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.

7.3 Construction Noise Assessment

Table 15 presents the results of modelled construction noise emissions. Predictions identify that emissions from construction have the potential to be above the noise management levels at two assessed residential receivers. Accordingly, recommendations to reduce the impact of construction noise emissions on surrounding receivers are provided in **Section 8**.

Table 15 Construction Noise Levels – All Receivers				
Receiver	Period	Predicted Noise	Management Level	Compliant
		Level dB LAeq(15min)	dB LAeq(15min)	
R01	Standard Hours	54	52	X
R02	Standard Hours	54	52	X
R03	Standard Hours	46	52	✓
R04	Standard Hours	47	52	✓
R05	Standard Hours	48	52	✓
R06	Standard Hours	48	52	✓
R07	Standard Hours	49	52	✓
R08	Standard Hours	47	52	✓
R09	Standard Hours	43	52	✓
R10	Standard Hours	35	52	✓
R11	Standard Hours	44	52	✓
R12	Standard Hours	37	52	✓
R13	Standard Hours	41	52	✓
R14	Standard Hours	42	52	✓
C01	Standard Hours	57	70	✓

Note 1: See Table 4 for recommended standard hours for construction.

This page has been intentionally left blank

8 Construction Recommendations

The results of the Noise Assessment demonstrate that levels during standard construction hours are above the ICNG noise management levels at several receivers surrounding the project. Accordingly, it is recommended that noise management and mitigation measures be adopted during noise intensive construction activities to limit impacts on surrounding receivers.

Recommendations for consideration during construction activities for this project may include:

- implement boundary fences / retaining walls as early as possible to maximise their attenuation benefits to surrounding receivers;
- toolbox and induction of personnel prior to shift to discuss noise control measures that may be implemented to reduce noise emissions to the community;
- where possible use mobile screens or construction hording to act as barriers between construction works and receivers;
- all plant should be shut down when not in use. Plant to be parked/started at farthest point from relevant assessment locations;
- operating plant in a conservative manner (no over-revving);
- selection of the quietest suitable machinery available for each activity;
- avoidance of noisy plant / machinery working simultaneously where practicable;
- minimisation of metallic impact noise;
- all plant are to utilise a broadband reverse alarm in lieu of the traditional hi frequency type reverse alarm; and
- undertake letter box drops to notify receivers of potential works.

This page has been intentionally left blank

9 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Assessment to quantify emissions from the proposed school development to be located at Lot 1 Magpie Hollow, South Bowenfels, NSW.

The results of the Noise Assessment demonstrate that emissions from external educational activities within the school grounds associated with the larger student population will comply with the adopted noise criteria from the GCCCAA and Project Noise Trigger Levels, once recommendations provided in this report are implemented:

- the project is constructed as per the site design and plans (see **Appendix B**), which includes the barrier attenuation provided by the project buildings orientation;
- one (1) in two (2) students are talking at any one time;
- all students are in the playground simultaneously, with the pre-primary students located in the northwest junior playground, primary students in the northern outdoor sports area and the proposed high school students located in eastern sports field;
- the existing boundary fences or similar are retained and have been modelled at a height of 1.5m; and
- the mechanical plant for the school is yet to be finalised. Therefore, the modelling assumes four large AC units on the roof of the learning and admin building (western building) and four large AC units on the roof of the gymnasium.

Noise from mechanical plant and light vehicle movements associated with the project would satisfy the relevant PNTLs criteria at all assessed receivers during the daytime period.

Modelled noise emissions from operation construction activities identify that predicted noise emissions levels have the potential to be above the applicable construction management levels at two residential receivers. Accordingly, noise management measures are provided in this report to reduce potential impacts on surrounding receivers.

The Noise Assessment demonstrates that the proposal complies with relevant criteria without any additional ameliorate measures being adopted, accordingly, the Noise Assessment supports the Development Application for the project.

This page has been intentionally left blank

Appendix A – Glossary of Terms

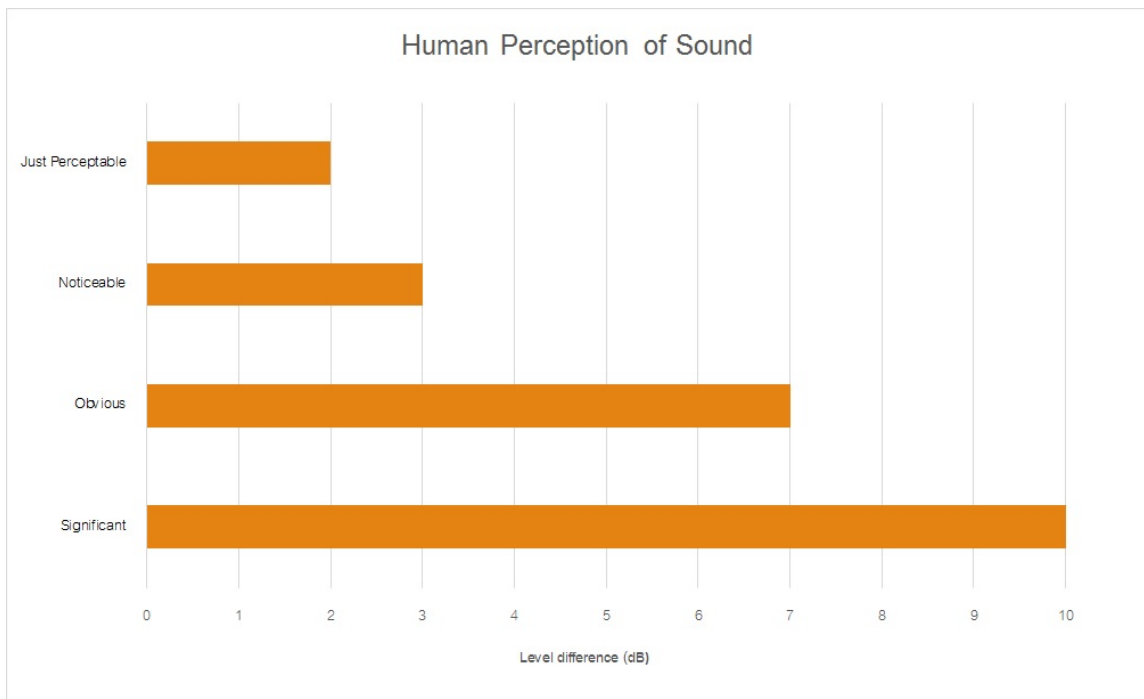
A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Acoustical 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 L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all 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 sound.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor
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 Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmx	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound power level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by $10 \cdot \log_{10} (W/W_0)$. Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

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 Pressure 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



This page has been intentionally left blank

Appendix B – Site Plans

Contents

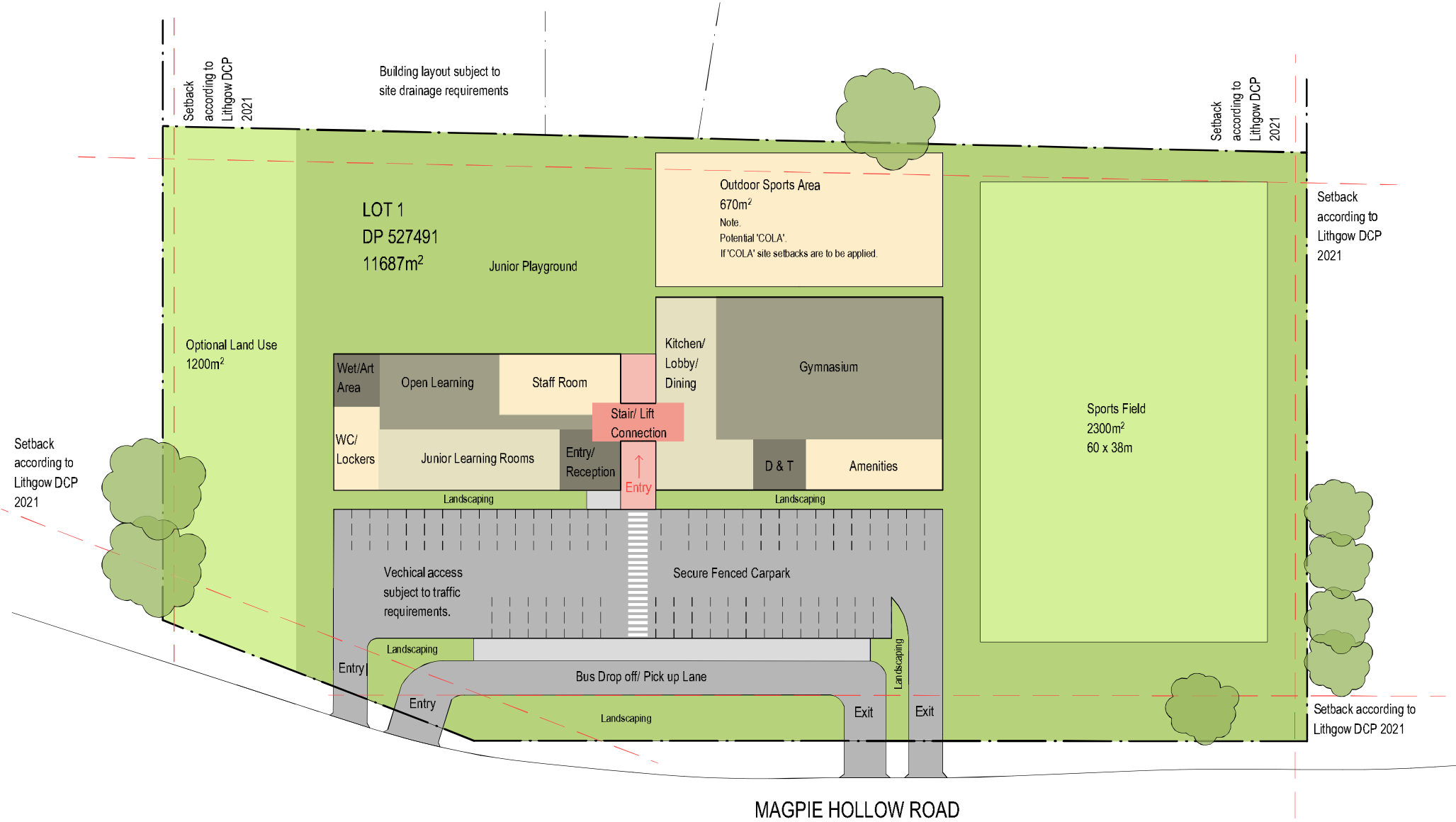
- SK 01 Cover Page
- SK 02 Site Plan Concept
- SK 03 Upper Floor Layout
- SK 04 Junior School / Reception Concept
- SK 05 Senior School - Upper Level
- SK 06 Gymnasium / Dining Concept
- SK 07 Gymnasium Mezzanine Concept

P 02 6332 5885
 M 0424 156 450
 E BRETT@BMDD.COM.AU
 12 MAXWELL DRIVE, EGLINTON NSW 2795



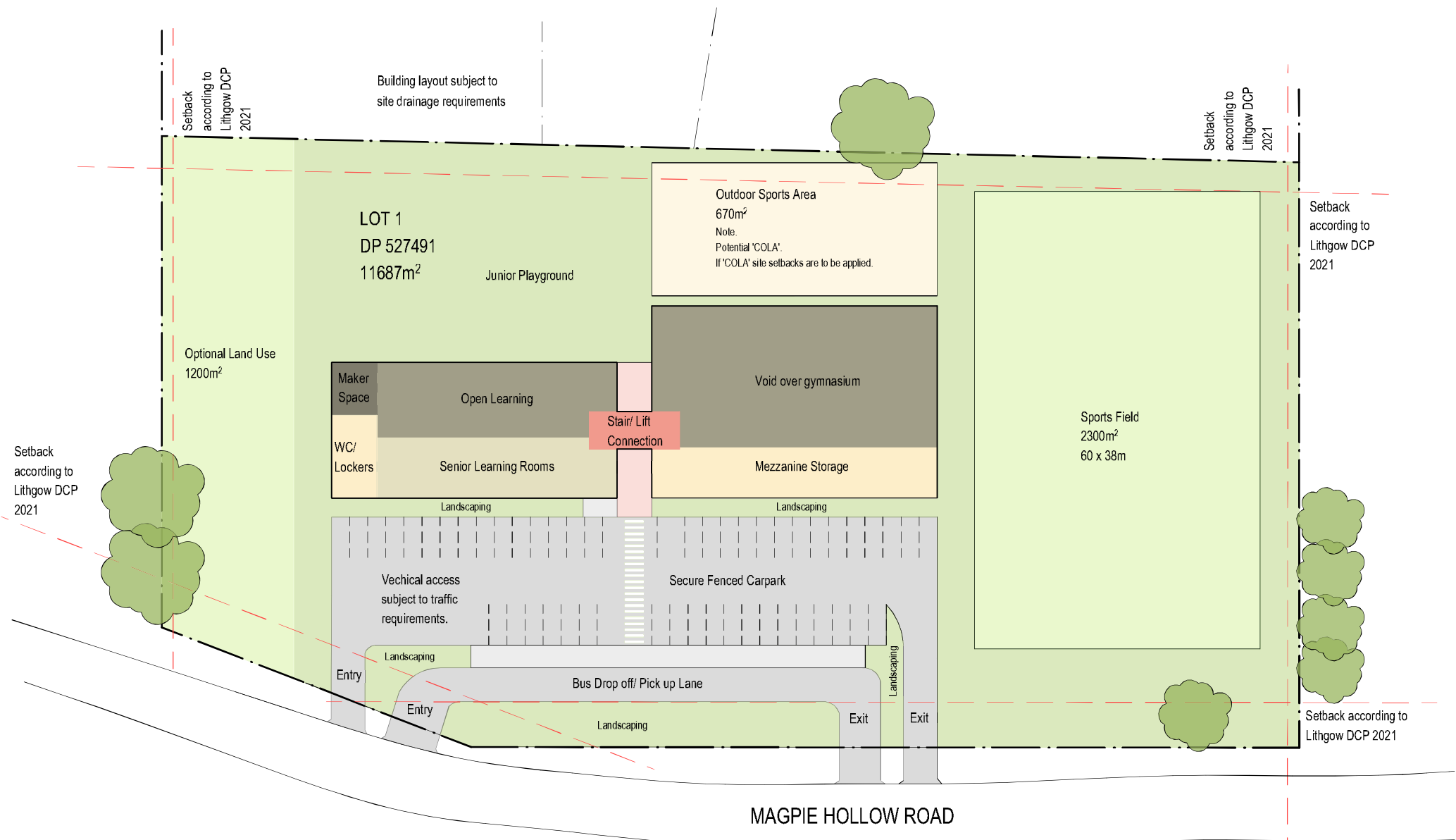
NOT FOR CONSTRUCTION	FOR CONSTRUCTION	CONSTRUCTION
08/06/23	C	Issued for comment
13/04/23	B	Issued for comment
13/04/23	A	Issued for comment
Date		Amendment



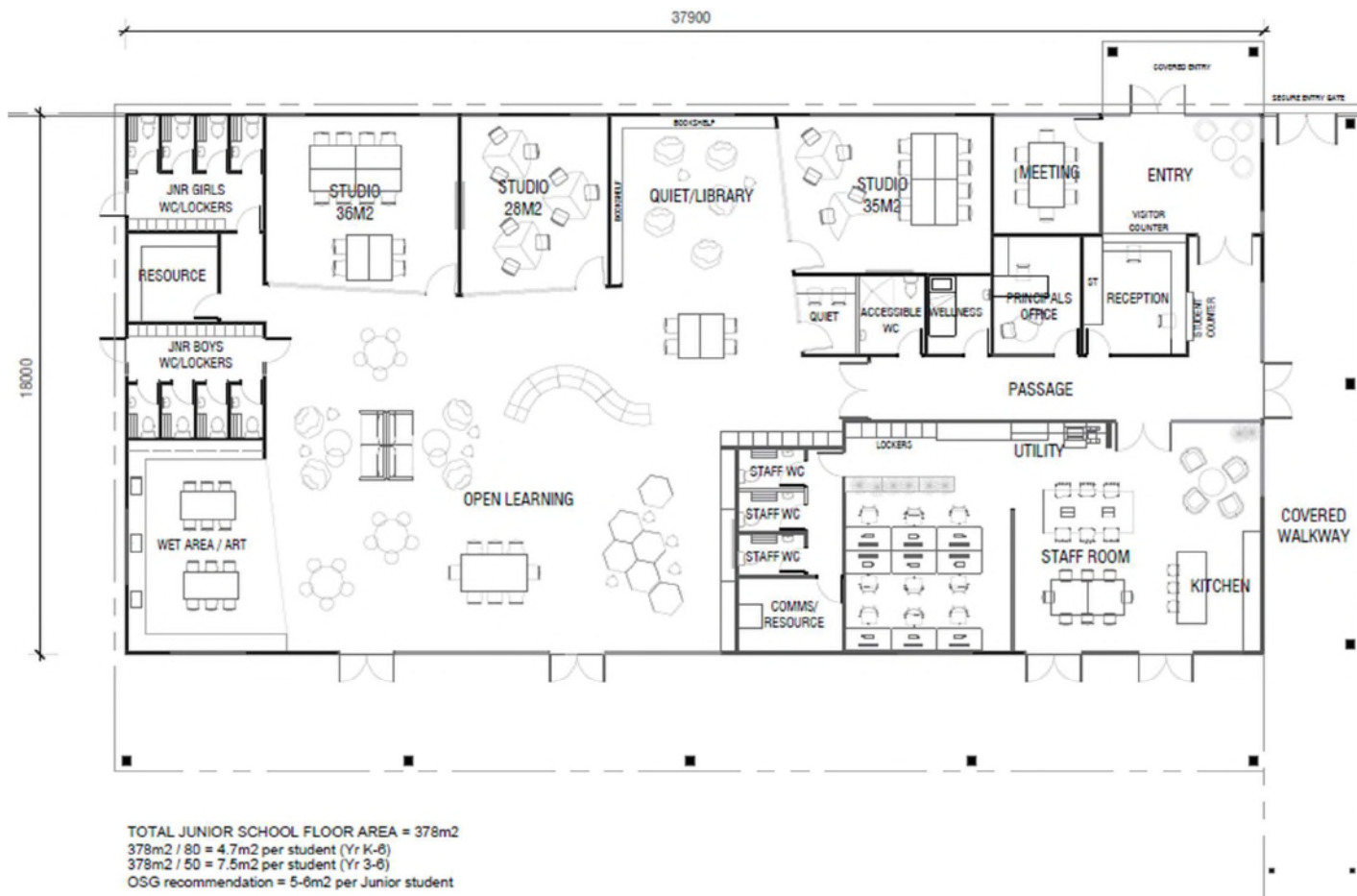


NOT	FOR	CONSTRUCTION
08/06/23	C	Issued for comment
13/04/23	B	Issued for comment
13/04/23	A	Issued for comment
Date		Amendment



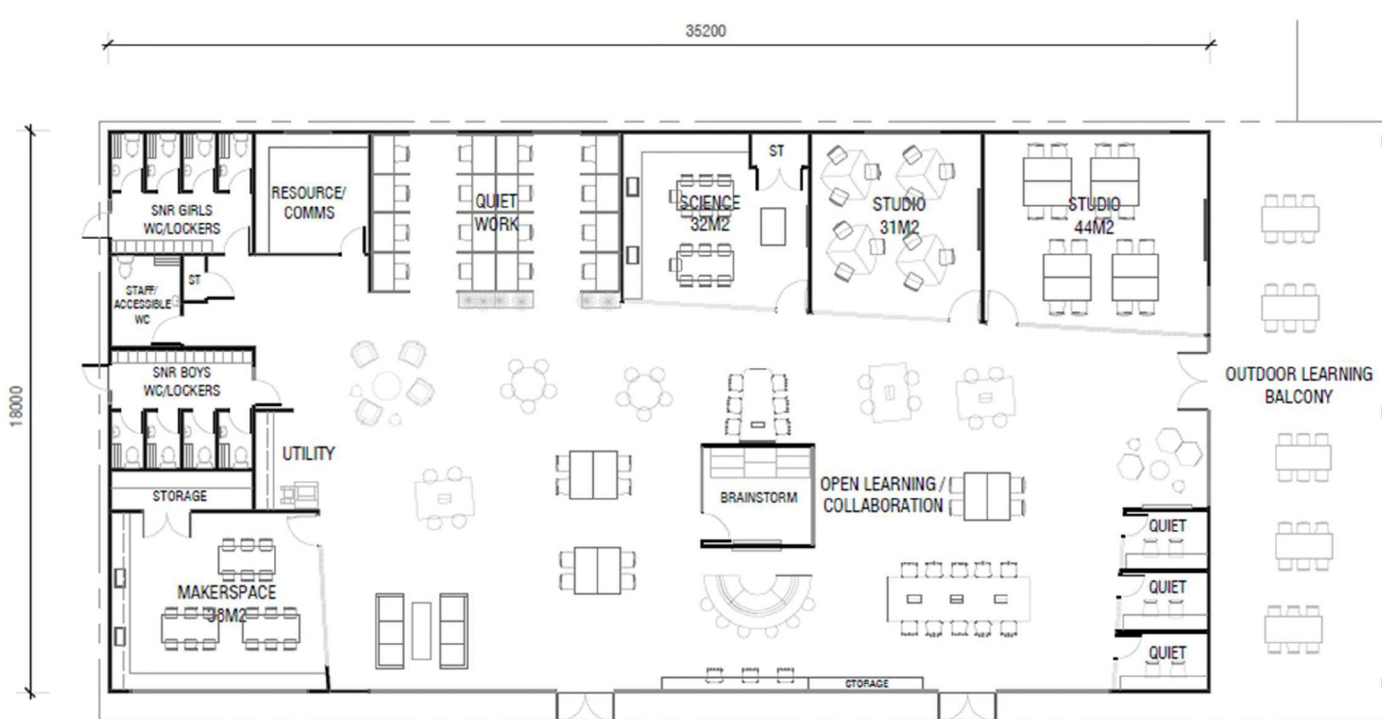


NOT	FOR	CONSTRUCTION
08/06/23	C	Issued for comment
13/04/23	B	Issued for comment
13/04/23	A	Issued for comment
Date		Amendment



NOT FOR CONSTRUCTION
 13/04/23 B Issued for comment
 13/04/23 A Issued for comment
 Date Amendment

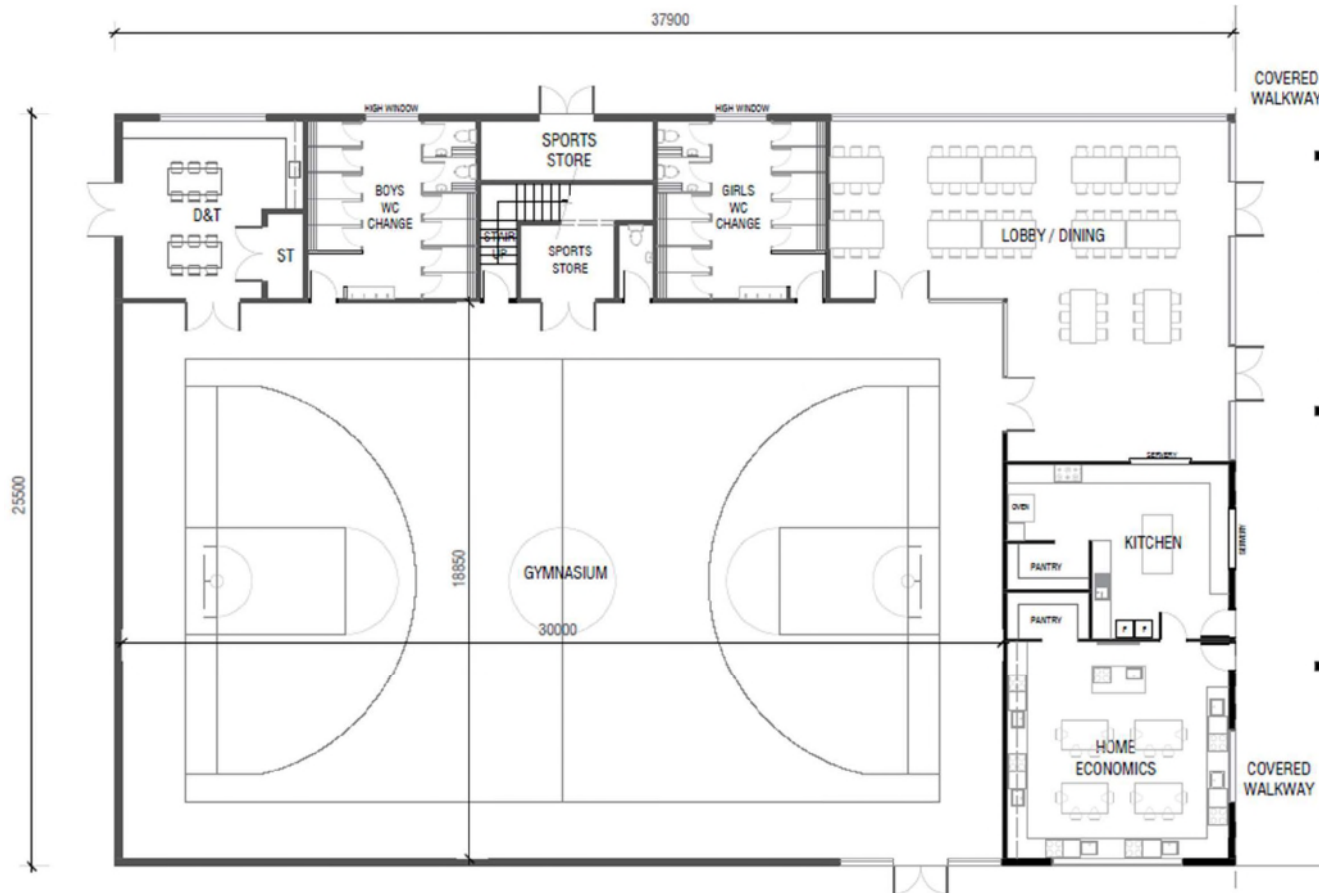




TOTAL SENIOR SCHOOL FLOOR AREA = 552m2
 552m2 / 50 = 11m2 per student
 OSG recommendation = 7-8m2 per Senior student

NOT FOR CONSTRUCTION
 13/04/23 B Issued for comment
 13/04/23 A Issued for comment
 Date Amendment





NOT	FOR	CONSTRUCTION
08/06/23	C	Issued for comment
13/04/23	B	Issued for comment
13/04/23	A	Issued for comment
Date		Amendment





NOT	FOR	CONSTRUCTION
08/06/23	C	Issued for comment
13/04/23	B	Issued for comment
13/04/23	A	Issued for comment
Date		Amendment



This page has been intentionally left blank

Appendix C – Noise Monitoring Charts and ABL Summary

Table C1 Background Noise Monitoring Summary – Location L1

Date	Measured Background Noise Level (LA90) dB ABL ¹			Measured dB LAeq(period)		
	Day	Evening	Night	Day	Evening	Night
	Friday-2-Feb-24	-	40	25	-	56
Saturday-3-Feb-24	41	38	24	59	56	52
Sunday-4-Feb-24	42	35	29	58	55	49
Monday-5-Feb-24	43	37	-	57	54	-
Tuesday-6-Feb-24	42	42	42	59	58	53
Wednesday-7-Feb-24	44	43	44	57	56	52
Thursday-8-Feb-24	43	41	39	57	55	50
Friday-9-Feb-24	42	43	36	58	60	50
Saturday-10-Feb-24	43	40	26	59	56	50
Sunday-11-Feb-24	41	39	26	57	58	49
Monday-12-Feb-24	-	38	27	-	58	51
Location1 – RBL / Leq Overall	42	40	28	58	57	51

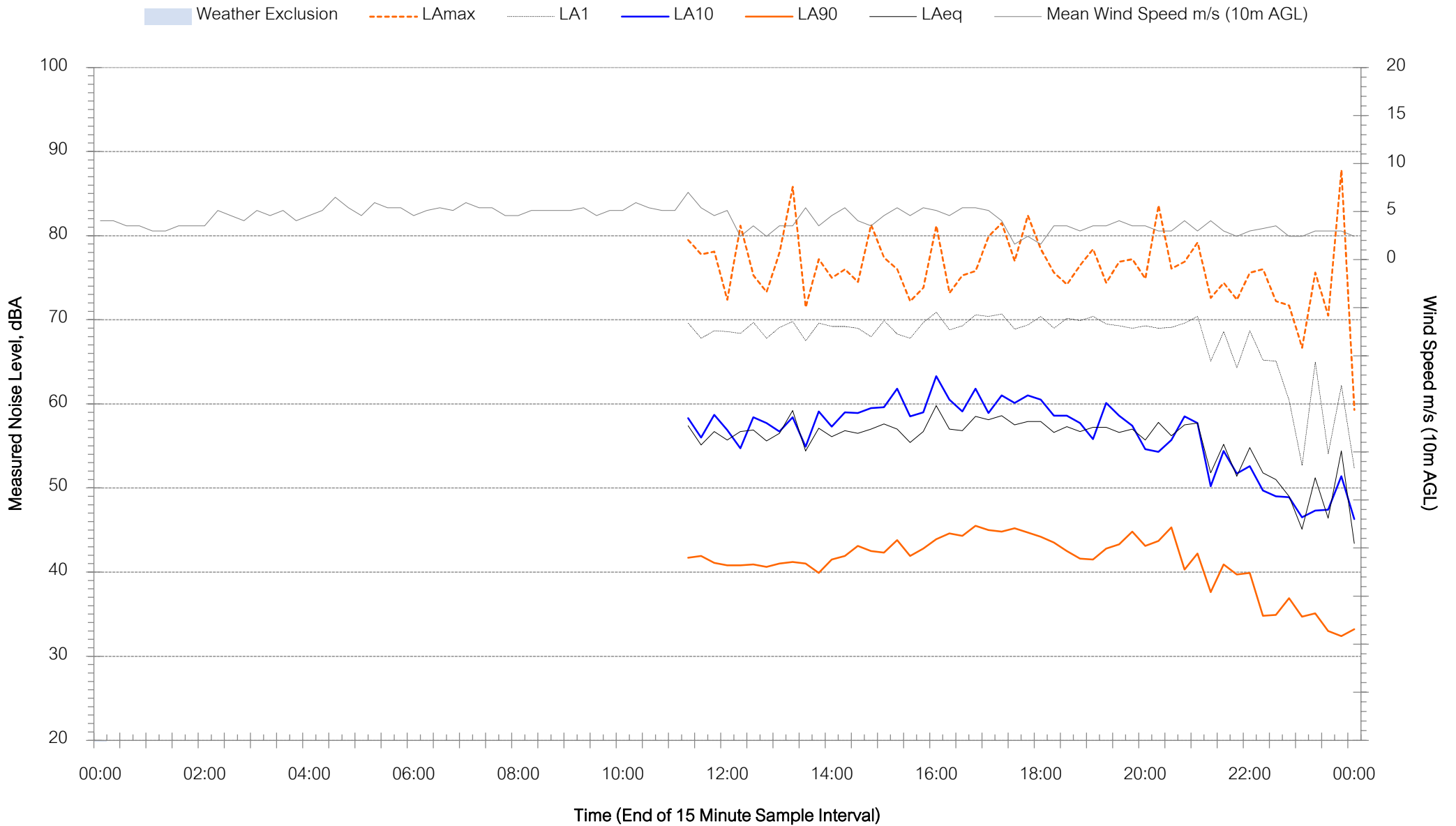
Note 1: Assessment background level (ABL) – the single-figure background level representing each assessment period day, evening and night as per NPI Fact Sheet A.

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.



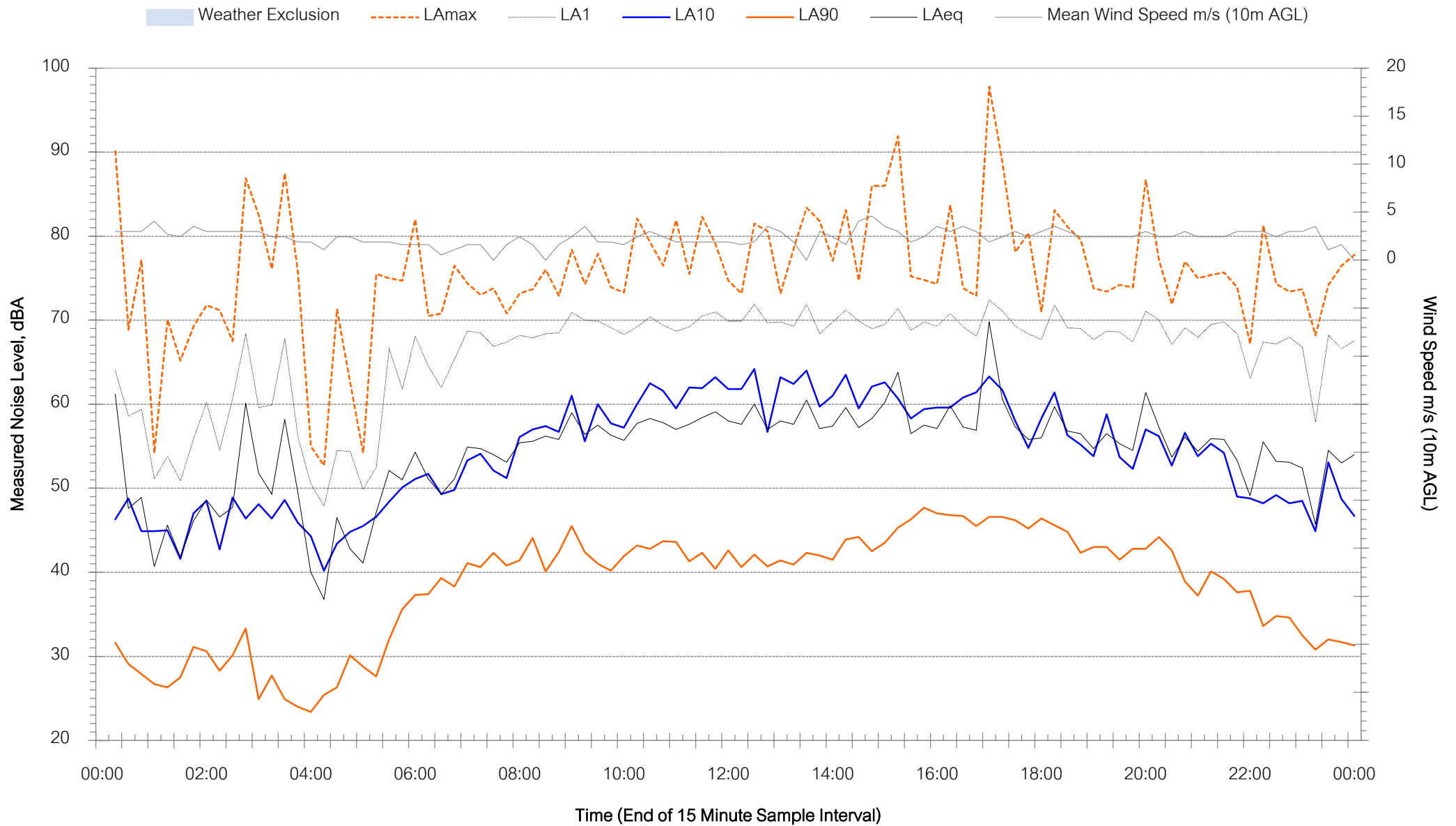
Background Noise Levels

Magpie Hollow Road, Lithgow - Friday 2 February 2024



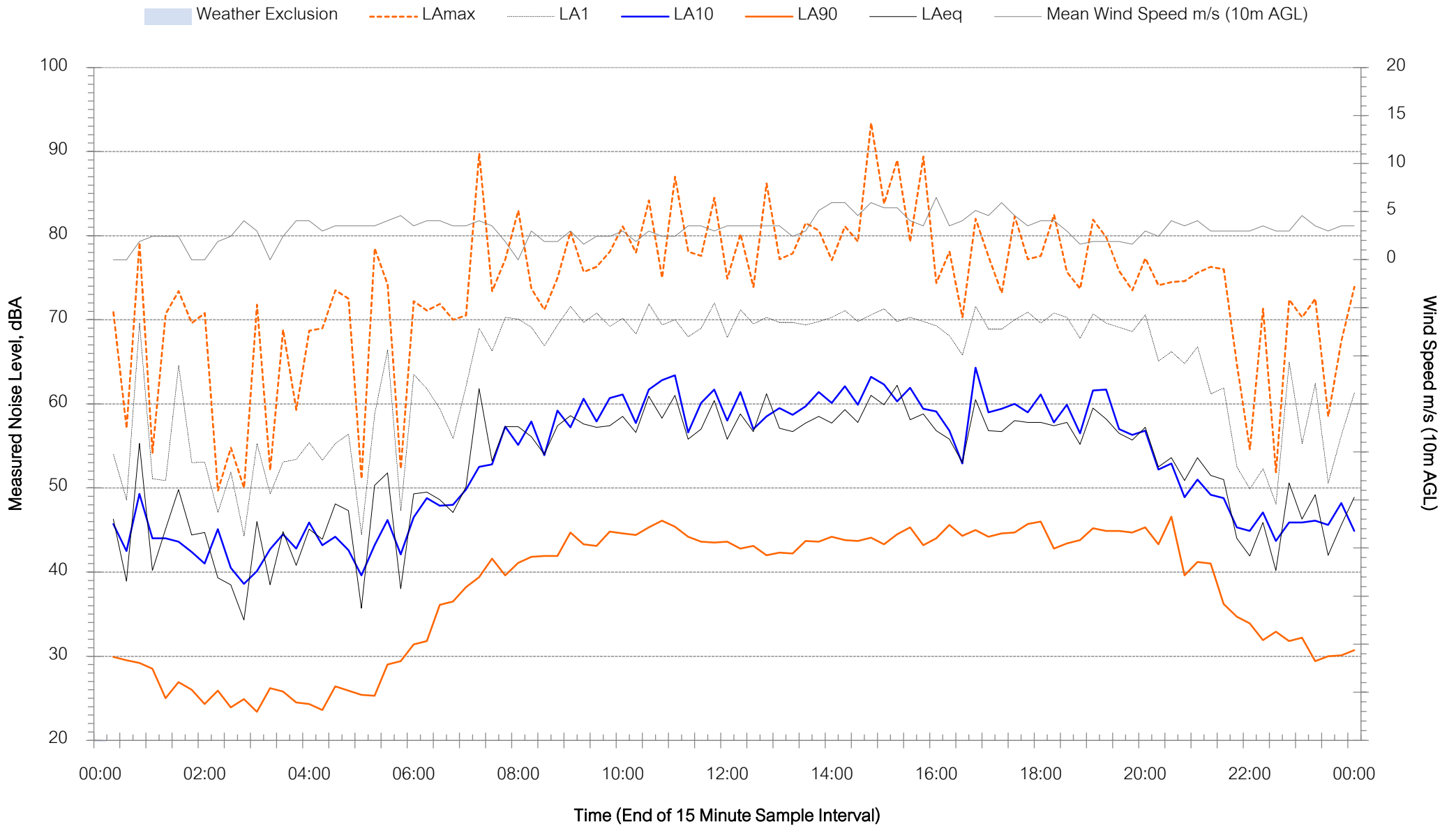
Background Noise Levels

Magpie Hollow Road, Lithgow - Saturday 3 February 2024



Background Noise Levels

Magpie Hollow Road, Lithgow - Sunday 4 February 2024





Background Noise Levels

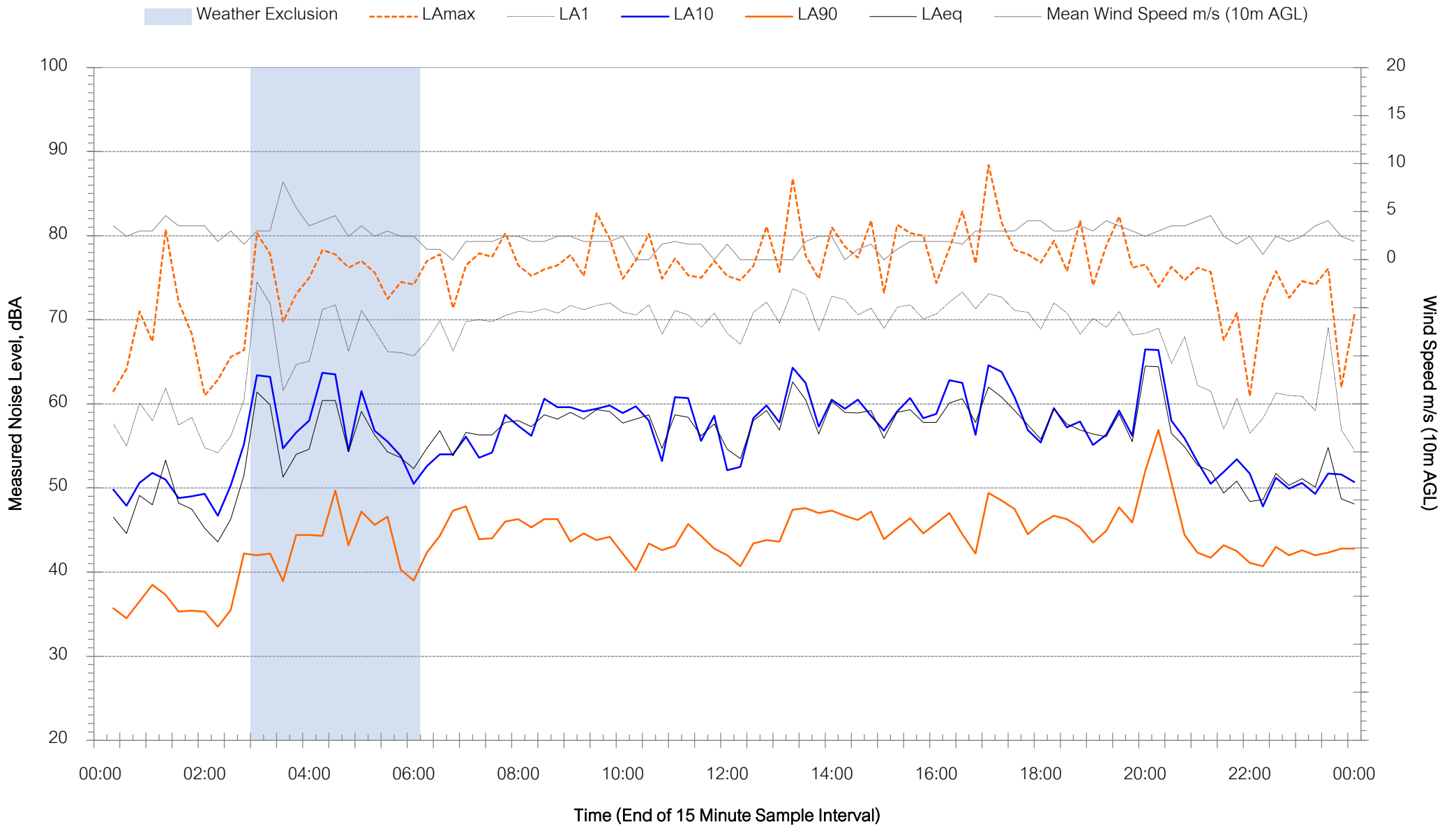
Magpie Hollow Road, Lithgow - Monday 5 February 2024





Background Noise Levels

Magpie Hollow Road, Lithgow - Tuesday 6 February 2024

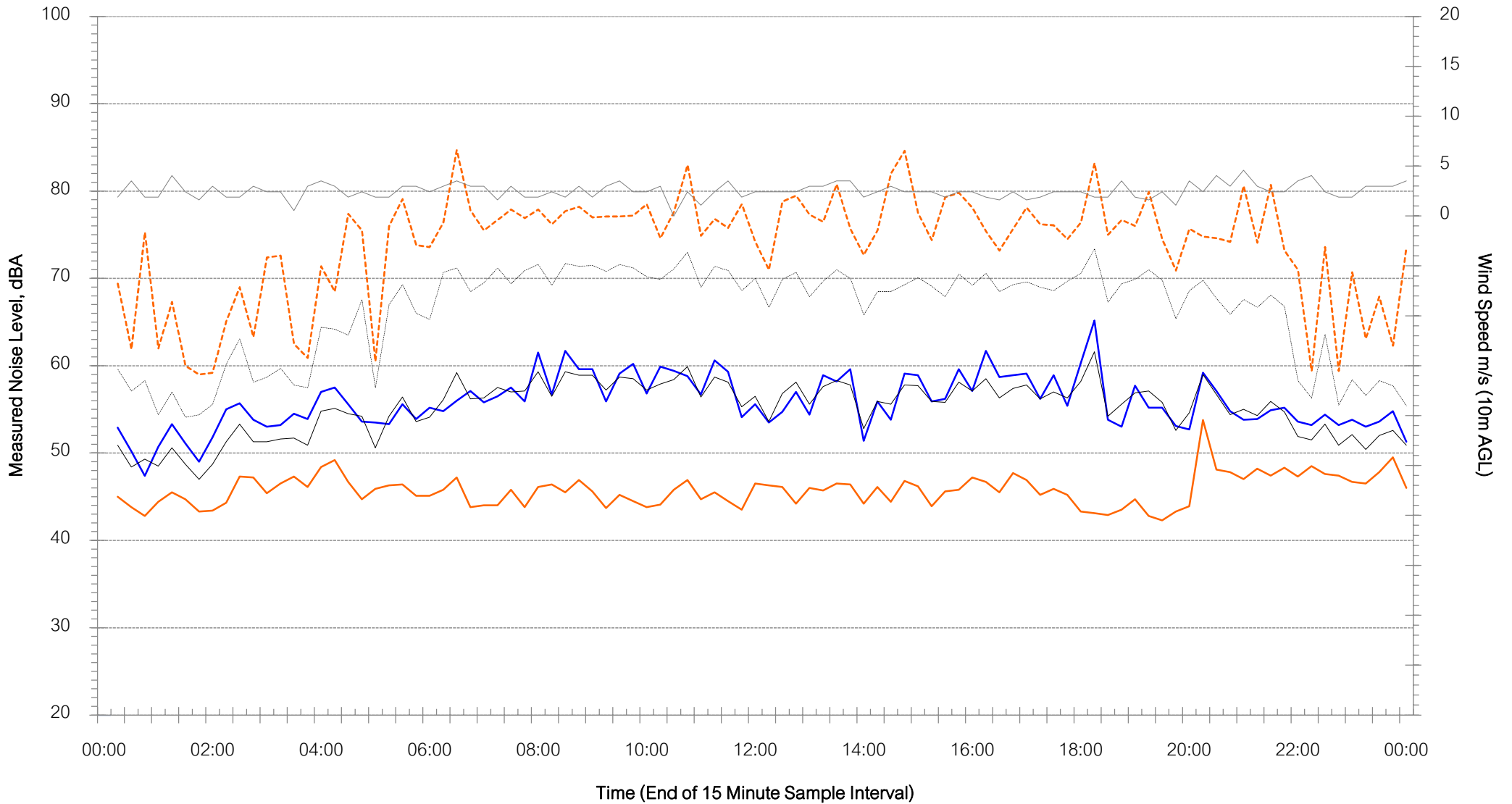




Background Noise Levels

Magpie Hollow Road, Lithgow - Wednesday 7 February 2024

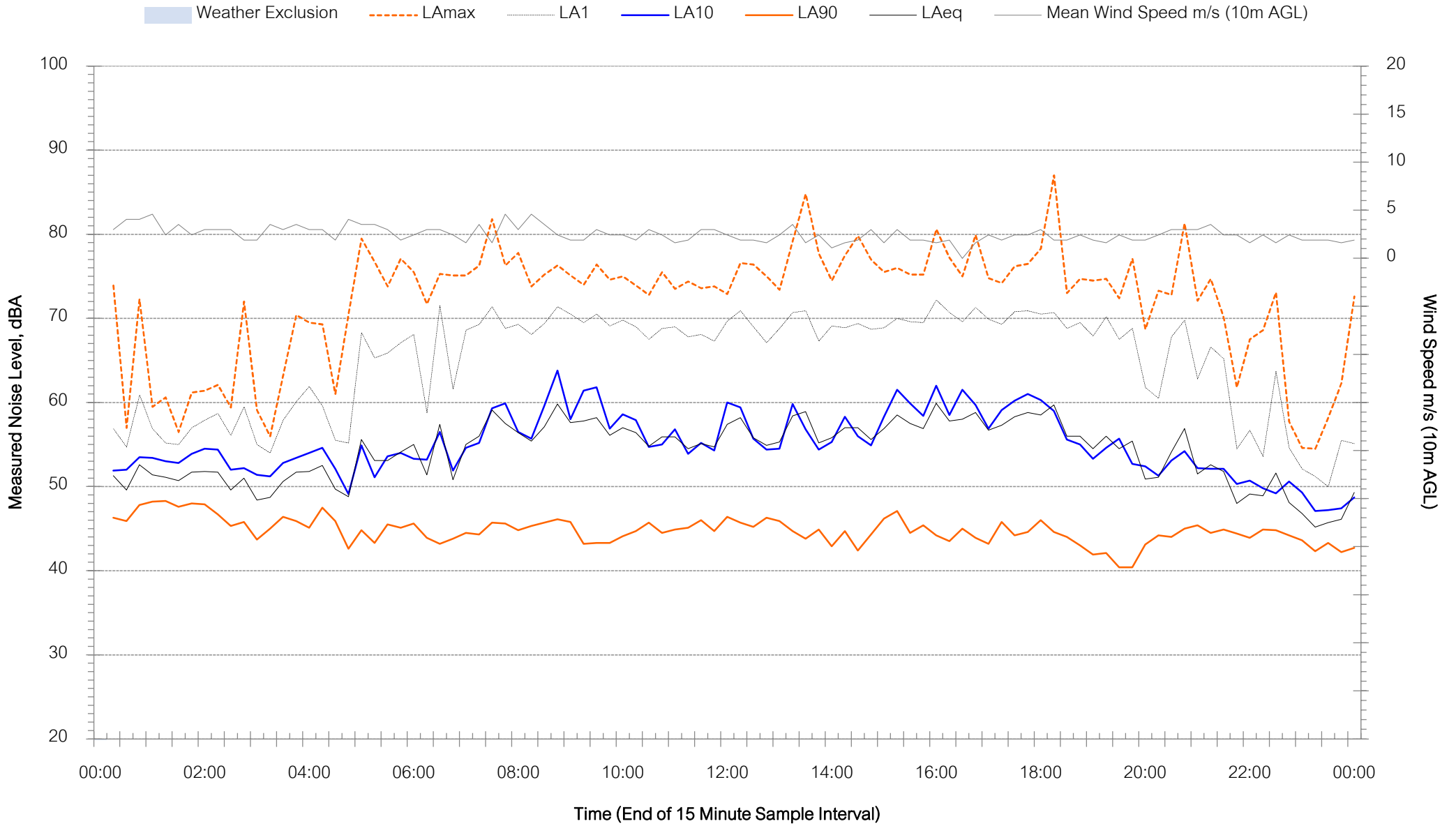
Weather Exclusion LAm_{ax} LA₁ LA₁₀ LA₉₀ LA_{eq} Mean Wind Speed m/s (10m AGL)





Background Noise Levels

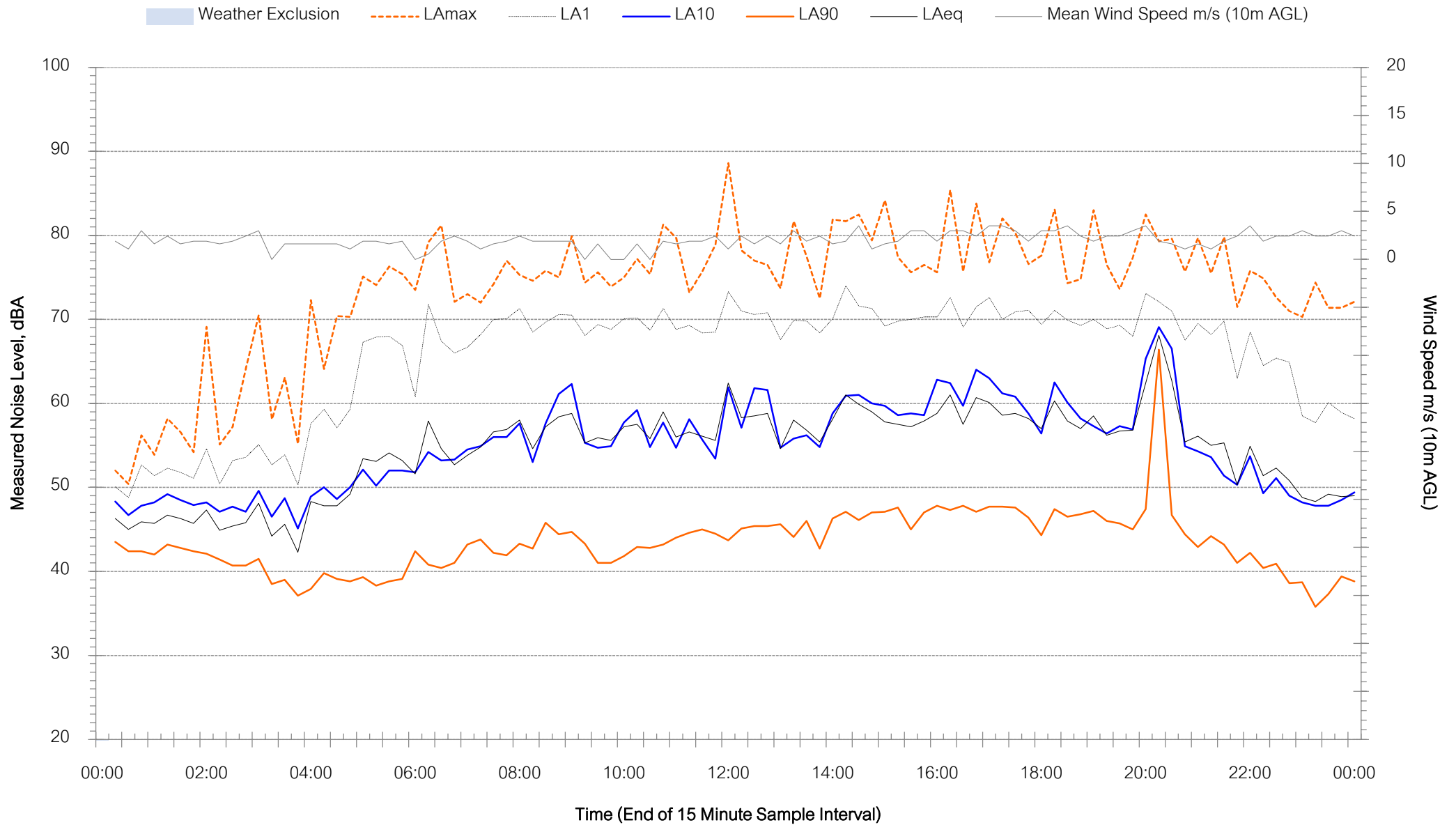
Magpie Hollow Road, Lithgow - Thursday 8 February 2024





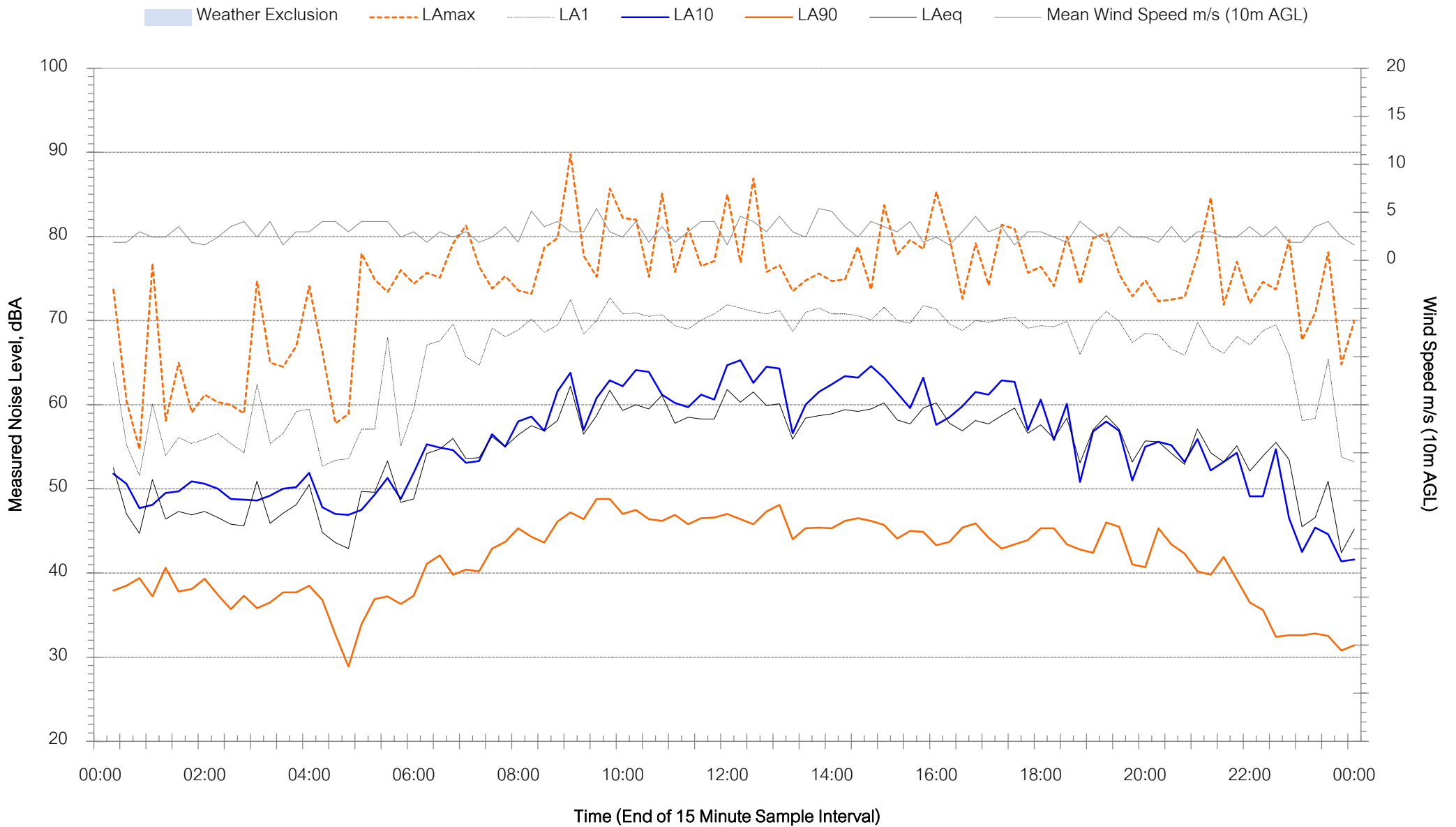
Background Noise Levels

Magpie Hollow Road, Lithgow - Friday 9 February 2024



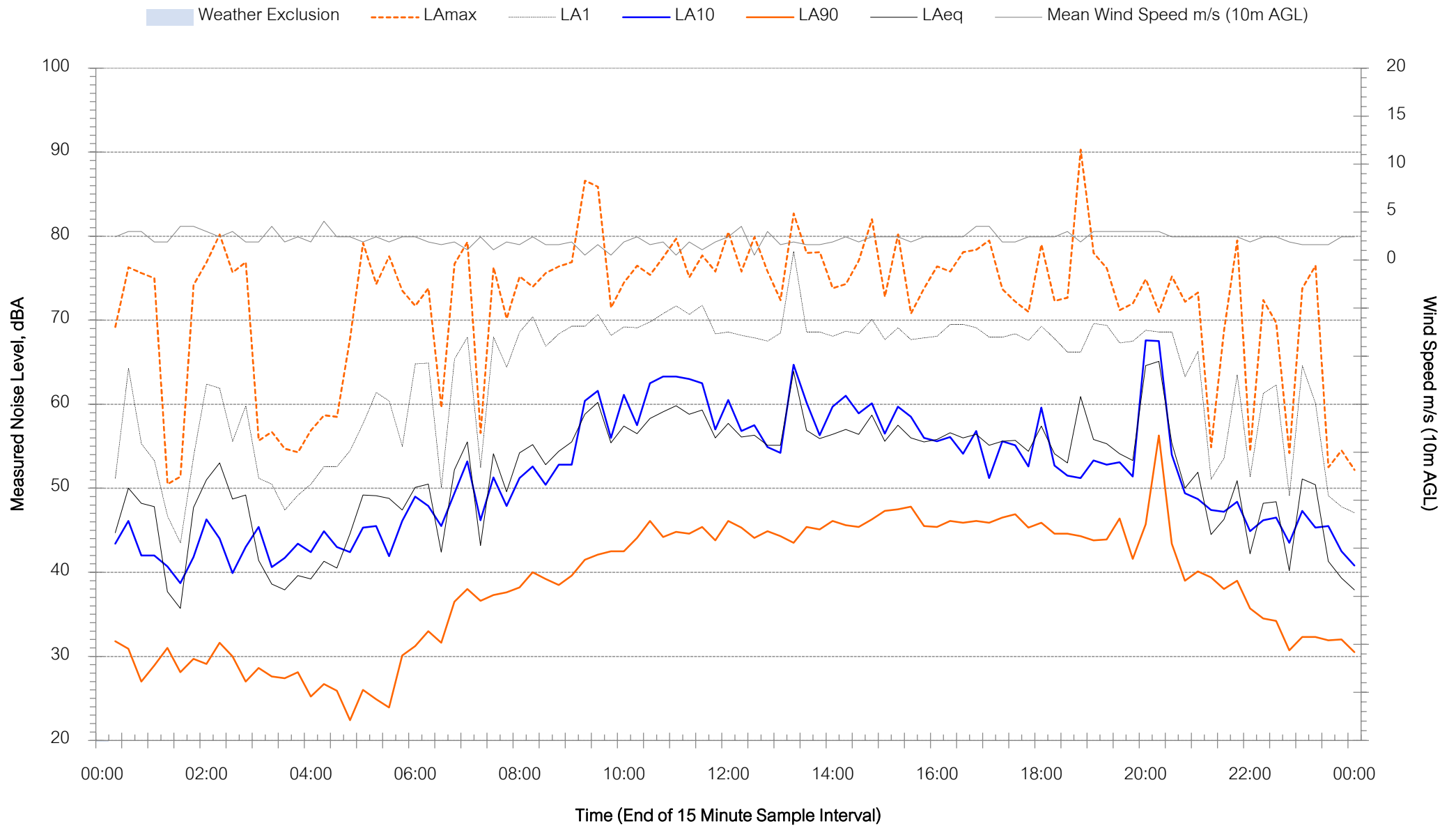
Background Noise Levels

Magpie Hollow Road, Lithgow - Saturday 10 February 2024



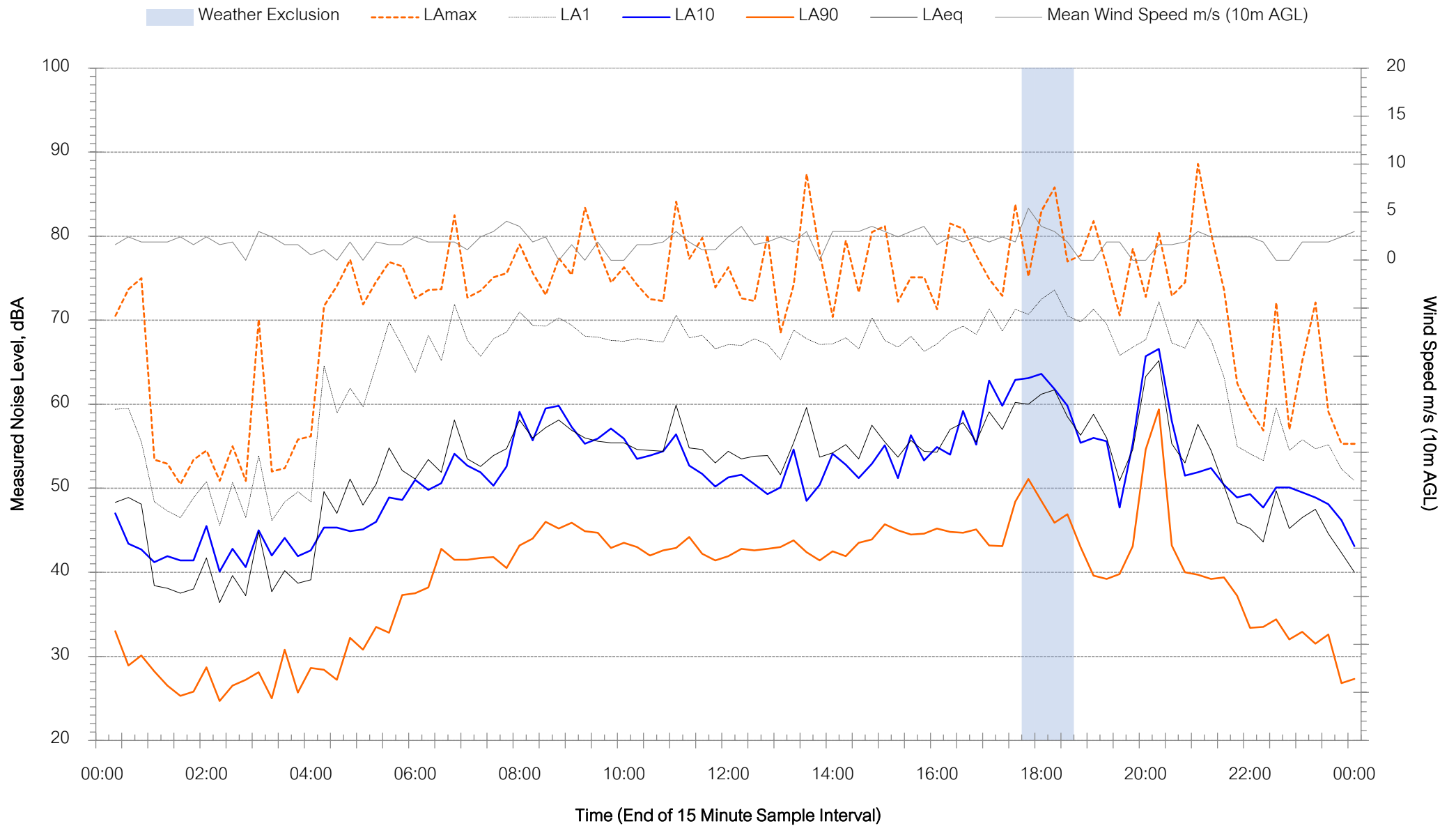
Background Noise Levels

Magpie Hollow Road, Lithgow - Sunday 11 February 2024



Background Noise Levels

Magpie Hollow Road, Lithgow - Monday 12 February 2024



Background Noise Levels

Magpie Hollow Road, Lithgow - Tuesday 13 February 2024



Muller Acoustic Consulting Pty Ltd

PO Box 678, Kotara NSW 2289

ABN: 36 602 225 132

Ph: +61 2 4920 1833

www.mulleracoustic.com

