Noise Assessment

Residential Manufactured Home Estate Development
Windella, NSW

Prepared for: Mavid Group Pty Ltd
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Muller Acoustic Consulting

Document Information

Noise Assessment

Residential Manufactured Home Estate Development

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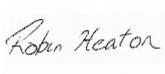
MAC221733-01RP1V3	15 December 2023	Robin Heaton		Oliver Muller	

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Mavid Group Pty Ltd (MG) to prepare a Noise Assessment (NA) to quantify and manage (if required) potential noise impacts associated with the Proposed Manufactured Home Estate Development (the project) to be located in Windella, NSW.

This NA presents the results and findings of the road traffic noise modelling, including identifying potentially affected areas where future lots may be subject to mitigation requirements. The NA has also quantified potential operational, construction and traffic generation noise emissions from the project and recommends reasonable and feasible noise controls where required. The assessment has been undertaken in general accordance with the following policies and guidelines:

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

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- NSW Environment Protection Authority (EPA's), Approved Methods for the measurement and analysis of environmental noise in NSW, 2022;
- NSW Department of Environment and Climate Change (DECCW), NSW Interim Construction Noise Guideline (ICNG), July 2009;
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), March 2011;
- NSW Government Department of Planning (DPI) 2008 – Development Near Rail Corridors and Busy Roads – Interim Guideline;
- Standards Australia AS/NZS 2107:2016 (AS2107) – Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors;
- Standards Australia AS2021:2015 Acoustics – Aircraft Noise Intrusion- Building siting and construction; and
- Standards Australia 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**.

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2 Project Description

2.1 Background

MAC understands that MG are proposing to develop two rural blocks of land (Lot 1 DP 245953 & Lot 9 DP553872) in Windella, NSW, to establish a Manufactured Home Estate (MHE).

The project will consist of 282 permanent manufactured home lots, managers office, community facilities and retention basins.

The project site is bound by the New England Highway to the south, River Road and residential dwellings to the west and undeveloped land to the north and east. Maitland airport is also located to the east of the project site across the undeveloped land. Two designated entry and exit points to the proposed development are be located on River Road and Denton Close on the western boundary of the project site. The project site and surrounds are presented in **Figure 1** with lot layout plans are presented in **Appendix B**.

The ambient noise environment surrounding the project site is dominated by passing traffic on the New England Highway.

2.1.1 Receiver Review

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

Table 1 Receiver Locations				
Receiver	Description	Receiver Height	Coordinates (GDA94/MGA56)	
		m	Easting	Northing
R01	Residential	1.5	357481	6380625
R02	Residential	1.5	357484	6380675
R03	Residential	1.5	357568	6380604
R04	Residential	1.5	357580	6380653
R05	Residential	1.5	357590	6380695
R06	Residential	1.5	357638	6380717
R07	Residential	1.5	357683	6380703
R08	Residential	1.5	357710	6380677
R09	Residential	1.5	357731	6380622
R10	Residential	1.5	357798	6380593
R11	Residential	1.5	357850	6380699
R12	Residential	1.5	357773	6380705
R13	Residential	1.5	357857	6380766
R14	Residential	1.5	357815	6380804
R15	Residential	1.5	357779	6380768
R16	Residential	1.5	357741	6380772
R17	Residential	1.5	357778	6380889
R18	Residential	1.5	357828	6380951
R19	Residential	1.5	357895	6381034
R20	Residential	1.5	357987	6381035
R21	Residential	1.5	358054	6381011
R22	Residential	1.5	358202	6380990
R23	Residential	1.5	358300	6381019
R24	Residential	1.5	357977	6380224
R25	Residential	1.5	357784	6380198
R26	Residential	1.5	357490	6380265
C01	Commercial	1.5	358171	6380399

FIGURE 1

Locality Plan

MAC221733

Windella Manufactured Home Estate

KEY

- Site Boundary
- Attended Location
- Logger Location
- Receivers

0 30 60 90 120 150 180 m

N

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3 Noise Policy and Guidelines

3.1 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.

3.1.1 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.

3.1.2 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**.

3.1.3 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 note 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.

3.1.4 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 2**.

Table 2 Amenity Noise Levels

Receiver Type	Noise Amenity Area	Time[1] 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.

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.

3.1.5 Maximum Noise Assessment Trigger Levels

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 52dB or the prevailing RBL plus 15dBA, whichever is the greater.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.2 Development Near Rail Corridors and Busy Roads – Interim Guidelines

Guidance for the specification of internal noise levels of habitable rooms is prescribed in Department of Planning's (DoP) Development near Rail Corridors and Busy Roads – Interim Guidelines (2008) (the Guideline). The Guideline outlines internal criterion levels for Clause 120 (Road) of the State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021 (previously Clause 102 of the SEPP Infrastructure):

"If the development is for the purposes of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

- *in any bedroom in the residential accommodation: 35dBA at any time 10pm–7am; and*
- *anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway): 40dBA at any time."*

Table 3.1 of the guideline clarifies that the above noise criteria are to be determined as an $LA_{eq(15hr)}$ for the daytime and $LA_{eq(9hr)}$ for the night-time period.

The Guideline assists in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads and supports the Transport and Infrastructure SEPP. The Guidelines are mandatory for residential developments proposed adjacent to busy roads with an Annual Average Daily Traffic (AADT) of greater than 40,000 vehicles or for projects where traffic noise impacts are anticipated.

It is noted that there are no recommended noise levels for campgrounds or temporary accommodation outlined in Guideline. Therefore, this assessment has adopted the assessment criteria outlined in Table 4 of the Road Noise Policy (RNP)(DECCW), with the open space active use criteria of 60dBA LA_{eq} adopted for the day and for the night period.

3.3 Road Noise Screening Tests

Section 5.3.2 of the guideline provides screening tests for single and dual occupancy dwellings. The screening tests provide varying categories of noise control treatments for dwellings taking into consideration distance to the road and amount of traffic. The Guideline presents two screen tests for a 60/70 km/hr zone and 100/110 km/hr zone that are reproduced in **Figure 2** and **Figure 3** respectively. The screening tests have been adopted in this assessment to provide Guidance on building categories for the project.

Figure 2 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 60/70 km/hr zones.

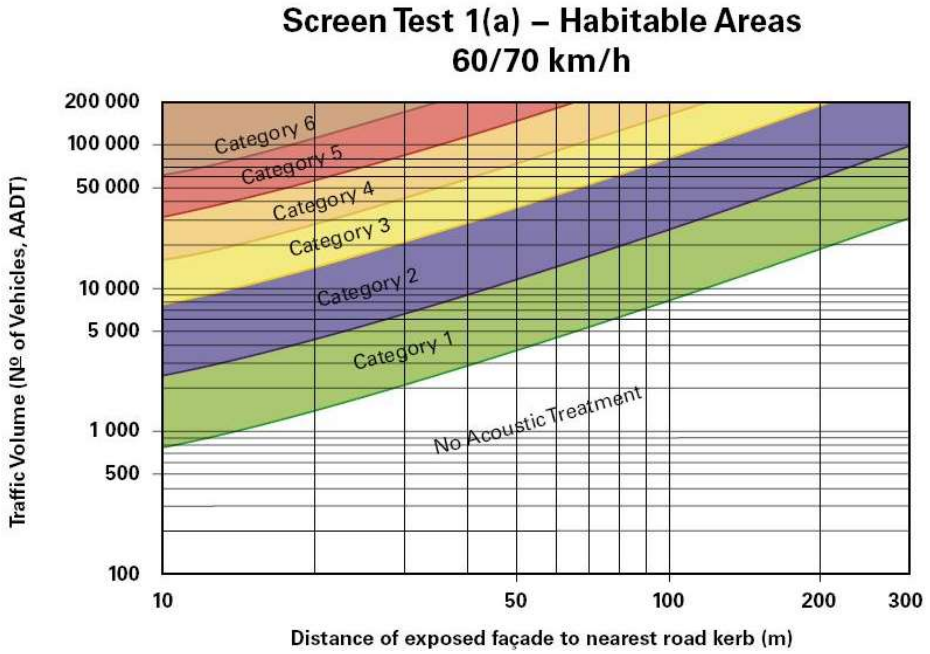
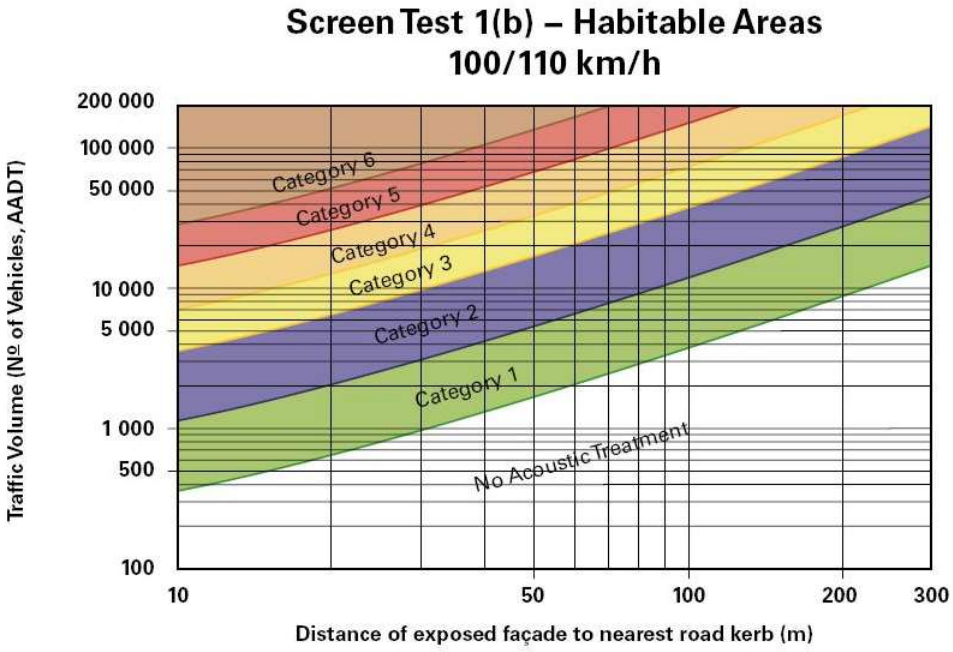


Figure 3 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 100/110 km/hr zones.



3.4 Road Noise Policy

The road traffic noise criteria are provided in the Road Noise Policy (RNP), 2011. The policy sets out noise criteria applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in detail in **Section 5.3.**

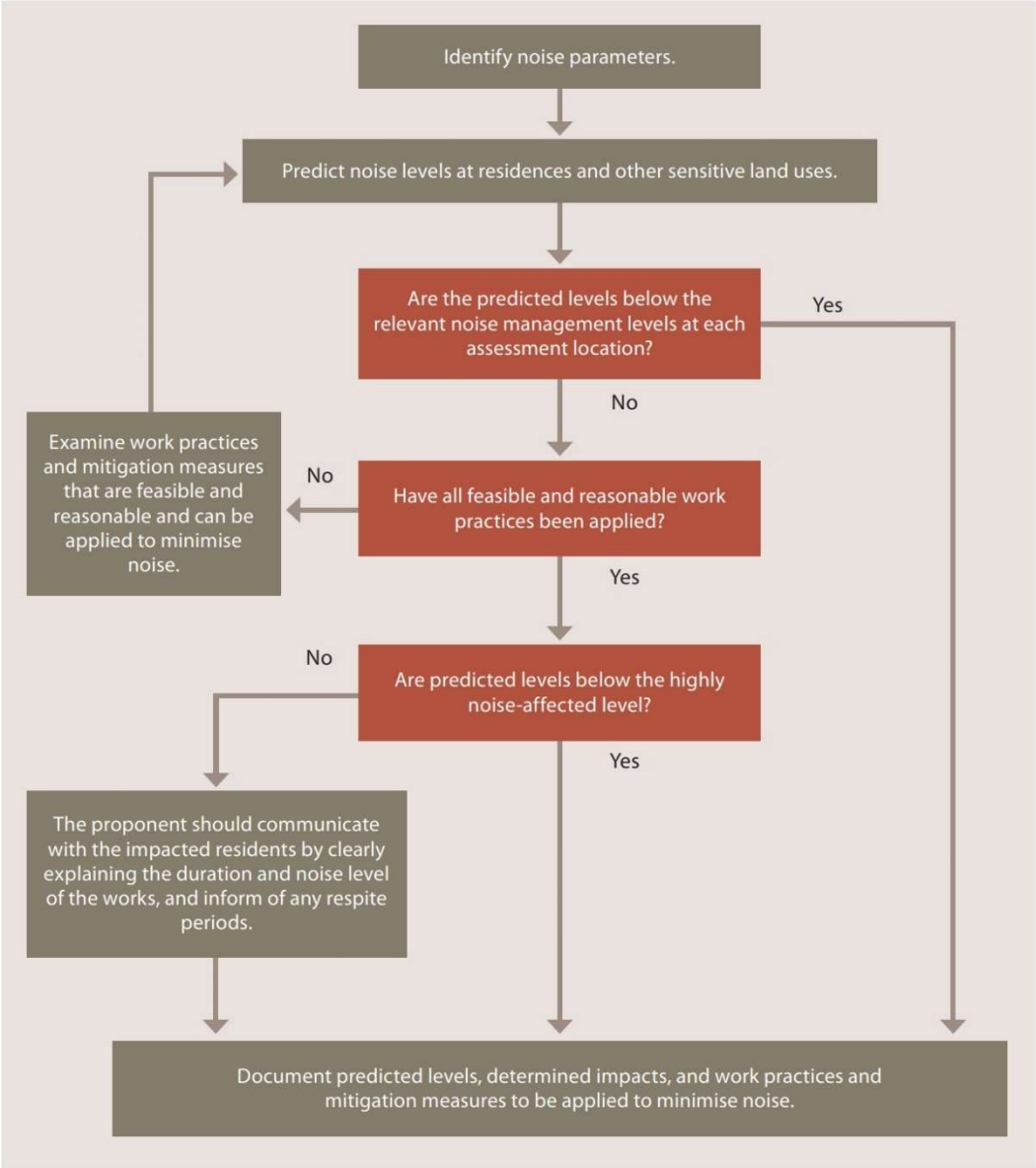
3.5 Interim Construction Noise Guideline

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 study has adopted a quantitative assessment approach which is summarised in **Figure 4.** 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 4 Quantitative Assessment Processes for Assessing and Managing Construction Noise



Source: Department of Environment and Climate Change, 2009.

3.5.1 Standard Hours for Construction

Table 3 presents the ICNG recommended standard hours for construction works.

Table 3 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 for this assessment are anticipated to be undertaken during standard construction hours.

3.5.2 Construction Noise Management Levels

Section 4 of the ICNG (DECC, 2009) 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 4** reproduces the ICNG 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 4 Noise Management Levels

Time of Day	Management Level $L_{Aeq(15min)}$[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 $L_{Aeq(15min)}$ 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.

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.

3.6 Australian Noise Exposure Forecasts (ANEFs)

Airservices Australia prepare Australian Noise Exposure Forecasts (ANEFs) along with Australian Noise Exposure Index (ANEI) contour charts for several major airports in Australia. The charts provide a single number measure of the noise exposure levels around airports. When developing the charts, the following factors are considered:

- the intensity, duration, total content and spectrum of audible frequencies in the noise of aircraft take-offs, approaches to landings and reverse thrust after landings; and
- the forecast frequency of aircraft types and movements on the various flight tracks.

Generally, ANEF (and ANEI) charts present 20, 25, 30, 35 and 40 contours. The greater the ANEF contour, the higher the noise exposure. AS2021 defines the acceptability of building types and land uses within varying ANEF categories.

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4 Existing Environment

4.1 Unattended Noise Monitoring

To quantify the existing background noise environment of the area, unattended noise monitoring was conducted on 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 Standards Australia AS 1055:2018, "Acoustics – Description and Measurement of Environmental Noise".

The measurements were carried out using one Svantek 977 noise analyser (L1) from Friday 2 December 2022 to Friday 9 December 2022. All acoustic instrumentation used carries appropriate and current NATA (or manufacturer) calibration certificates with records of all calibrations maintained by MAC as per Approved Methods for the measurement and analysis of environmental noise in NSW (EPA, 2022) 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 ±0.5dBA.

Observations on-site identified the surrounding locality was typical of a suburban environment, with traffic sources 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 summary results of long-term unattended noise monitoring are provided in **Table 5**. The measured daily ABLs for the background monitoring are provided in **Table C1** in **Appendix C** along with the noise monitoring charts.

Table 5 Background Noise Monitoring Summary

Location	Measured background noise level, RBL, dBA			Measured L_{Aeq}, dBA		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
L1	45	44	34	58	54	57

Note Excludes periods of wind or rain affected data. Meteorological data obtained from the Bureau of Meteorology weather station Maitland Airport AWS, NSW (Site 61428)

Table 6 presents the existing road traffic noise levels measured during the unattended noise survey.

Table 6 Unattended Noise Monitoring Results – Road Traffic Noise

ID	Measured Road Traffic Noise LA_{eq}, dB	
	Day Period (7am to 10pm)	Night Period (10pm to 7am)
L1	55.6	52.0

Note: Road noise is assessed over two periods, Day 7am to 10pm and Night 10pm to 7am (ie no evening).

4.2 Attended Noise Monitoring

To supplement the unattended noise assessment and to quantify the changes in ambient noise in the community surrounding the operation, one 15-minute attended measurement was completed.

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

The acoustic instrumentation used 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) 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 ±0.5dBA.

The attended noise monitoring was conducted using one Svantek 971 noise analyser at the site (see **Figure 1**) on Friday 2 December 2022 to quantify ambient background noise levels.

The attended measurement was completed during calm and clear meteorological conditions and confirmed that ambient traffic and commercial noise dominated the surrounding environment. The results of the short-term noise measurement and observations are summarised in **Table 7**.

Table 7 Operator-Attended Noise Survey Results - L1

Date/Time (hrs)	Noise Descriptor (dBA re 20 µPa)			Meteorology[1]	Description and SPL, dBA
	LA_{max}	LA_{eq}	LA_{90}		
02/12/2022 14:01	67	53	50	WD: S WS :1.5m/s Rain: Nil	Traffic 45-67 Birds 45-52 Insects 39-44 Wind in Trees 50-58

Note1: Meteorology data obtained in-field by MAC operator.

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5 Assessment Criteria

5.1 Operational Noise

5.1.1 Intrusiveness Noise Levels

The PINL 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 LA_{90}	PINL dB $LA_{eq(15min)}$
L1	Residential	Day	45	50
		Evening	44	49
		Night	34	39

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.

5.1.2 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 Amenity Area	Assessment Period[1]	NPI Recommended ANL dB $LA_{eq(period)}$	ANL dB $LA_{eq(period)}$	PANL dB $LA_{eq(15min)}$[2]
Residential	Suburban	Day	55	55	58
		Evening	45	45	48
		Night	40	42[3]	45
Commercial	All	When in use	65	60	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.

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.

Note 3: $LA_{eq,period}$ (traffic) as per section 2.4.1 of the NPI (i.e. existing $LA_{eq\ Traffic}$ -15dB)..

5.1.3 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 Type	Noise Amenity Area	Assessment Period[1]	PINL dB $L_{Aeq(15min)}$	PANL dB $L_{Aeq(15min)}$	PNTL dB $L_{Aeq(15min)}$
Residential	Suburban	Day	50	58	50
		Evening	49	48	48
		Night	39	45	39
Commercial	All	When in Use	N/A	63	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.

5.1.4 Maximum Noise Trigger Levels

The maximum noise trigger levels shown in **Table 11** are based on night-time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 11 Maximum Noise Trigger Levels (Night)

Residential Receivers			
$L_{Aeq(15min)}$		L_{Amax}	
40dB $L_{Aeq(15min)}$ or RBL + 5dB		52dB L_{Amax} or RBL + 15dB	
Trigger	40	Trigger	52
RBL +5dB	39	RBL +15dB	49
Highest	**40**	**Highest**	**52**

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am. Morning Shoulder 5am to 7am; Evening Shoulder 10pm to 12am.

Note: NPI identifies that maximum of the two values is to be adopted which is shown in bold font.

5.2 Construction Noise

The relevant Construction Noise Management Levels (CNMLs) for standard construction hours are presented in **Table 12**.

Table 12 Construction Noise Management Levels

Receiver ID	Assessment Period[1]	Adopted RBL dB LA_{90}	NML dB $LA_{eq(15min)}$
Residential	Standard Hours	45	55 (RBL+10dBA)
Commercial Premises	When in use	N/A	70 (external)

Note 1: Refer to Table 3 for Standard Recommended Hours for Construction.

5.3 Road Traffic Noise

Table 13 presents the road traffic noise assessment criteria reproduced from the RNP relevant to this assessment.

Table 13 Road Traffic Noise Assessment Criteria

Road category	Type of project/development	Assessment Criteria – dBA	
		Day (7am to 10pm)	Night (10pm to 7am)
Local roads	Existing residences affected by additional traffic on local roads generated by land use developments	55dB $LA_{eq(1hr)}$	50dB $LA_{eq(1hr)}$

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dBA, which is generally accepted as the threshold of perceptibility to a change in noise level. The road traffic noise criteria are provided in the RNP. For this assessment, the 'local road' category, as specified in the RNP, has been adopted for River Road.

5.4 Australian Noise Exposure Forecasts (ANEFs)

A summary of the acceptability of various building types within the ANEF categories is reproduced from AS2021 in **Table 14**.

Table 14 Building Site Acceptability Based on ANEF Zones

Building Type	ANEF Zone of Site		
	Acceptable[1]	Conditional[2]	Unacceptable[3]
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF

Note 1: Acceptable. No need for the building to provide specific protection from aircraft noise.

Note 2: Conditional. Buildings within the ANEF zone which has a conditional status are required to comply with internal noise levels appropriate for the intended use of the space.

Note 3: Unacceptable. Building site classified as unacceptable should not normally be considered.

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6 Modelling Methodology

6.1 Operational, Maximum Noise Levels and Construction Noise Modelling Methodology

The predictive noise model was utilized to assess potential construction noise emissions from the project site. Plant and equipment were modelled across four different areas within the project site to provide a representative construction scenario for all surrounding receivers. The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'.

6.2 Sound Power Levels

Table 15 presents the Sound Power Level for each noise source modelled in the assessment. It is noted that Sound Power Levels were sourced from manufacturer's specifications or from in-field measurements at similar project sites.

Table 15 Acoustically Significant Sources - Sound Power Levels dBA *(re 10^{-12} Watts)*

Item and quantity (per 15 minutes)	Sound Power Level dB LAeq	Total Sound Power Level dB LAeq(15min)	Source Height[1]
Operation - 15 minutes Sound Power Levels, $LA_{eq(15min)}$			
Car idle, start up and drive off (x50)[2]	81	90	0.5m
Light vehicles travelling throughout site (60 cars per 15min)	81	91	0.5m
Sleep disturbance assessment (LA_{max}), Night-time periods (10pm to 7am)			
Car Door Slam		87	1.0m
Construction Fleet - 15 minutes Sound Power Levels, $LA_{eq(15min)}$			
Road Trucks		103	1.5m
Excavator/Backhoe		106	1.5m
Hand tools		97	1.5m
Combined fleet construction noise level		**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.

6.3 Mitigation Included in Design and Noise Control Recommendations

The noise model incorporated the following recommendations and noise controls:

- the project is constructed as per the site design and plans (as presented in **Appendix C**) which includes the barrier attenuation provided by the project buildings orientation;

6.4 Calculation of Road Traffic Noise

A theoretical assessment of road traffic noise was carried out to predict levels at each façade of the proposed dwellings using the Calculation of Road Traffic Noise (CORTN) algorithm, as developed by the UK Department of Transport. This method incorporates consideration of traffic flow volume, average speed, percentage of heavy vehicles, and road gradient and includes attenuation via spherical spreading (or cylindrical in the case of a line source such as a road), soft ground, atmospheric absorption and screening from buildings or barriers.

Brüel and Kjær Predictor Type 7810 noise modelling software was used to assess potential road traffic noise impacts from the project. The model incorporated three-dimensional ground contours and buildings within the project site and the surrounding locality.

6.5 Existing Road Traffic Levels

Traffic volumes for New England Highway were sourced from the traffic counts conducted at New England Highway and River Road on Wednesday 7 December 2022, **Table 16** summarises the calculation parameters adopted for this assessment based on the traffic count data.

Table 16 Traffic Survey Data[1]

Road Name	Assessment Period	Traffic Volume	% Heavy Vehicles	Speed Limit (km/hr)
New England Highway, Windella, NSW	Day	14274	7	50
	Night	2095	7	50

Note 1: Conducted by Trans Traffic Survey (2022).

6.6 Road Noise Assessment Validation

The noise model was validated using the results of the unattended noise monitor located on the project site (L1) as per the TfNSW Model Validation Guideline (2018). **Table 17** summaries the results of the validation modelling, outlining the modelled traffic noise levels for existing conditions compared to the measured traffic noise levels at the monitoring location. Predicted levels at L1 are within +/-2dB of the measured levels, therefore the model is considered to be validated.

Table 17 Road Traffic Noise Model Validation

Location	dB $LA_{eq(15hr)}$ Daytime Noise Level			dB $LA_{eq(9hr)}$ Night-time Noise Level		
	Measured Level	Predicted Level	Variance	Measured Level	Predicted Level	Variance
L1	55.6	56.9	+1.3	52.0	50.8	-1.2

6.7 Indicative Attenuation Levels

The Environmental Noise Management Manual (ENMM) (2001) provides a summary of indicative attenuation from standard building types. The indicative attenuation levels are summarized in **Table 18**, which provides typical performance of buildings with respect to noise reduction. A light frame residence with single glazing would be expected to provide a reduction of 20dBA from external to internal with windows closed. Where windows are closed, the fresh air requirements outlined in the Building Code of Australia are to be satisfied.

Table 18 Indicative Building Noise Attenuation

Building Type	Windows	Internal noise reduction, dBA
All	Open	10
Light frame	Single glazed (closed)	20
Masonry	Single glazed (closed)	25
	Double glazed (closed)	30

Note: Sourced from ENMM, 2001.

6.8 Road Noise Assessment Methodology (Noise Generated from Project)

Predicted road traffic movements from the project are presented in **Table 19.** The proposed movements generated by project related vehicles has been based on the number of lots and the adopted 7.4 movements per day per dwelling.

Table 19 Proposed Vehicle Movements

Travel Route	Hourly Generated Traffic Movements
River Road	115

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7 Noise Assessment Results

7.1 Operational Noise Assessment

Noise predictions from all operation noise sources including internal roadways and community space mechanical plant have been quantified at surrounding receivers. The coincidence of all plant occurring onsite simultaneously for an entire 15-minute period is unlikely. However, it is probable that several plant may operate simultaneously on occasion for a limited duration. To account for this, modelling has adopted the $LA_{eq(15min)}$ contribution of sources which were derived from in-field measurements of operation sources or activities. Results of the noise modelling predictions are presented in **Table 20**.

Table 20 Operational Noise Predictions – All Receivers

Residential Receivers

Rec No	Predicted Noise Level dB LAeq(15min)			PNTL dB LAeq(15min)			Comply
	Day	Evening	Night	Day	Evening	Night	
R01	<35	<35	<35	50	48	39	✓
R02	<35	<35	<35	50	48	39	✓
R03	<35	<35	<35	50	48	39	✓
R04	<35	<35	<35	50	48	39	✓
R05	<35	<35	<35	50	48	39	✓
R06	<35	<35	<35	50	48	39	✓
R07	<35	<35	<35	50	48	39	✓
R08	<35	<35	<35	50	48	39	✓
R09	<35	<35	<35	50	48	39	✓
R10	35	35	35	50	48	39	✓
R11	<35	<35	<35	50	48	39	✓
R12	<35	<35	<35	50	48	39	✓
R13	<35	<35	<35	50	48	39	✓
R14	<35	<35	<35	50	48	39	✓
R15	<35	<35	<35	50	48	39	✓
R16	<35	<35	<35	50	48	39	✓
R17	<35	<35	<35	50	48	39	✓
R18	<35	<35	<35	50	48	39	✓
R19	<35	<35	<35	50	48	39	✓
R20	<35	<35	<35	50	48	39	
R21	<35	<35	<35	50	48	39	
R22	<35	<35	<35	50	48	39	
R23	<35	<35	<35	50	48	39	
R24	<35	<35	<35	50	48	39	
R25	<35	<35	<35	50	48	39	
R26	<35	<35	<35	50	48	39	

Other Receivers

Rec No	Period	Predicted Noise Level dB LAeq(15min)	PNTL dB LAeq(15min)	Comply
C01	When in use	<35	63	✓

7.2 Maximum Noise Level Assessment

In assessing maximum noise events, typical L_{Amax} noise levels from transient events were assessed at the nearest residential receivers. For the sleep disturbance assessment, a Sound Power Level of 87dBA for a car door slam, were adopted for maximum noise level (L_{Amax}) events during the night period. Predicted noise levels from L_{Amax} events for assessed receivers are presented in **Table 21.**

Table 21 Maximum Noise Level Assessment (Night)[1]

Receiver	Predicted Noise Level dB L_{Amax}				Trigger Levels dB L_{Amax}
	Southwestern Carpark	Community Facility Carpark	Western Carpark	Northwestern Carpark	
R01	<35	<35	<35	<35	52
R02	<35	<35	<35	<35	52
R03	<35	<35	<35	<35	52
R04	<35	<35	<35	<35	52
R05	<35	<35	<35	<35	52
R06	<35	<35	<35	<35	52
R07	<35	<35	<35	<35	52
R08	<35	<35	<35	<35	52
R09	<35	<35	<35	<35	52
R10	<35	<35	<35	<35	52
R11	<35	<35	38	<35	52
R12	<35	<35	<35	<35	52
R13	<35	<35	<35	<35	52
R14	<35	<35	<35	<35	52
R15	<35	<35	<35	<35	52
R16	<35	<35	<35	<35	52
R17	<35	<35	<35	<35	52
R18	<35	<35	<35	<35	52
R19	<35	<35	<35	<35	52
R20	<35	<35	<35	<35	52
R21	<35	<35	<35	<35	52
R22	<35	<35	<35	<35	52
R23	<35	<35	<35	<35	52
R24	<35	<35	<35	<35	52
R25	<35	<35	<35	<35	52
R26	<35	<35	<35	<35	52

Note 1: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.

7.3 Road Traffic Noise Intrusion Assessment – MHE

A review of proposed lot layout plans (Studio26 Urban Design, 4 December 2023) (See **Appendix B**) that are proposed to be established on the project site has been completed as part of the assessment. It is noted that noise controls (where required) would generally apply to any dwelling constructed within the proposed building footprint, however primarily these are associated with the spaces facing onto the New England Highway. Accordingly, only lots 1 to 124 have been considered as part of this assessment.

Table 22 presents a comparison of predicted road traffic noise against the respective day and night internal criteria of the façade for the building with exposure to road noise, taking into account 20dB attenuation for standard glazing in a light framed structure with windows closed.

It is noted that where windows are required to remain closed to satisfy the criteria, consideration of alternative means of internal ventilation (eg air conditioning or wall ventilators) as per BCA requirements is recommended for lot 1 to Lot 124. Traffic noise intrusion contours showing lots requiring additional mitigation measures and lots requiring alternative means of internal ventilation are presented in **Figure 5** and **Figure 6** respectively.

The assessment of night time traffic noise intrusion into the project identified several lots which were above the nighttime noise criteria. The lots are highlighted in bold in **Table 22.** To attenuate the traffic noise to these units, it is recommended Class 2 treatments (see **Appendix D**) be fitted to the homes to be developed in these lots. Alternatively, 1.8m boundary fences may be installed along the southern boundary of these lots to attenuate road traffic noise intrusion.

Table 22 Road Noise Prediction Results – MHE									
Lot ID[1]	Predicted level, dB LAeq[2] (internal)		Internal Criteria dB LAeq[2]		Lot ID[1]	Predicted level, dB LAeq[2] (internal)		Internal Criteria dB LAeq[2]	
	Day	Night	Day	Night		Day	Night	Day	Night
Lot 01	<35	<35	40	35	Lot 63	39	<35	40	35
Lot 02	36	<35	40	35	Lot 64	40	**36**	40	35
Lot 03	37	<35	40	35	Lot 65	<35	<35	40	35
Lot 04	37	<35	40	35	Lot 66	<35	<35	40	35
Lot 05	38	<35	40	35	Lot 67	<35	<35	40	35
Lot 06	39	<35	40	35	Lot 68	35	<35	40	35
Lot 07	40	<35	40	35	Lot 69	36	<35	40	35
Lot 08	35	<35	40	35	Lot 70	37	<35	40	35
Lot 09	36	<35	40	35	Lot 71	38	<35	40	35
Lot 10	37	<35	40	35	Lot 72	39	<35	40	35
Lot 11	37	<35	40	35	Lot 73	40	**36**	40	35
Lot 12	38	<35	40	35	Lot 74	<35	<35	40	35
Lot 13	39	<35	40	35	Lot 75	<35	<35	40	35
Lot 14	40	<35	40	35	Lot 76	<35	<35	40	35
Lot 15	<35	<35	40	35	Lot 77	35	<35	40	35
Lot 16	35	<35	40	35	Lot 78	36	<35	40	35
Lot 17	36	<35	40	35	Lot 79	37	<35	40	35
Lot 18	37	<35	40	35	Lot 80	38	<35	40	35
Lot 19	38	<35	40	35	Lot 81	39	<35	40	35
Lot 20	38	<35	40	35	Lot 82	40	**36**	40	35
Lot 21	39	<35	40	35	Lot 83	40	35	40	35
Lot 22	40	**36**	40	35	Lot 84	40	**36**	40	35
Lot 23	<35	<35	40	35	Lot 85	40	35	40	35
Lot 24	35	<35	40	35	Lot 86	40	**36**	40	35
Lot 25	36	<35	40	35	Lot 87	40	**36**	40	35
Lot 26	37	<35	40	35	Lot 88	40	**36**	40	35
Lot 27	38	<35	40	35	Lot 89	40	**36**	40	35
Lot 28	38	<35	40	35	Lot 90	40	**36**	40	35
Lot 29	39	<35	40	35	Lot 91	37	<35	40	35
Lot 30	40	**36**	40	35	Lot 92	37	<35	40	35
Lot 31	<35	<35	40	35	Lot 93	37	<35	40	35
Lot 32	35	<35	40	35	Lot 94	37	<35	40	35
Lot 33	36	<35	40	35	Lot 95	37	<35	40	35
Lot 34	36	<35	40	35	Lot 96	37	<35	40	35

Table 22 Road Noise Prediction Results – MHE

Lot ID[1]	Predicted level, dB LAeq[2] (internal)		Internal Criteria dB LAeq[2]		Lot ID[1]	Predicted level, dB LAeq[2] (internal)		Internal Criteria dB LAeq[2]	
	Day	Night	Day	Night		Day	Night	Day	Night
Lot 35	37	<35	40	35	Lot 97	37	<35	40	35
Lot 36	38	<35	40	35	Lot 98	36	<35	40	35
Lot 37	39	<35	40	35	Lot 99	36	<35	40	35
Lot 38	40	<35	40	35	Lot 100	36	<35	40	35
Lot 39	<35	<35	40	35	Lot 101	36	<35	40	35
Lot 40	35	<35	40	35	Lot 102	36	<35	40	35
Lot 41	36	<35	40	35	Lot 103	36	<35	40	35
Lot 42	36	<35	40	35	Lot 104	36	<35	40	35
Lot 43	37	<35	40	35	Lot 105	<35	<35	40	35
Lot 44	38	<35	40	35	Lot 106	<35	<35	40	35
Lot 45	39	<35	40	35	Lot 107	<35	<35	40	35
Lot 46	40	<35	40	35	Lot 108	<35	<35	40	35
Lot 47	<35	<35	40	35	Lot 109	<35	<35	40	35
Lot 48	<35	<35	40	35	Lot 110	<35	<35	40	35
Lot 49	35	<35	40	35	Lot 111	<35	<35	40	35
Lot 50	36	<35	40	35	Lot 112	<35	<35	40	35
Lot 51	36	<35	40	35	Lot 113	<35	<35	40	35
Lot 52	37	<35	40	35	Lot 114	<35	<35	40	35
Lot 53	38	<35	40	35	Lot 115	<35	<35	40	35
Lot 54	39	<35	40	35	Lot 116	<35	<35	40	35
Lot 55	40	**36**	40	35	Lot 117	<35	<35	40	35
Lot 56	<35	<35	40	35	Lot 118	<35	<35	40	35
Lot 57	<35	<35	40	35	Lot 119	<35	<35	40	35
Lot 58	<35	<35	40	35	Lot 120	<35	<35	40	35
Lot 59	36	<35	40	35	Lot 121	<35	<35	40	35
Lot 60	36	<35	40	35	Lot 122	<35	<35	40	35
Lot 61	37	<35	40	35	Lot 123	<35	<35	40	35
Lot 62	38	<35	40	35	Lot 124	<35	<35	40	35

Note: Determined from proposed site layout plans (Zoran architecture, 2023).

Note 1: Lot identification is consistent with architectural plans.

Note 2: Internally predicted to habitable rooms. Adjustments made assuming attenuation (20dB) for a light framed structure with windows closed.

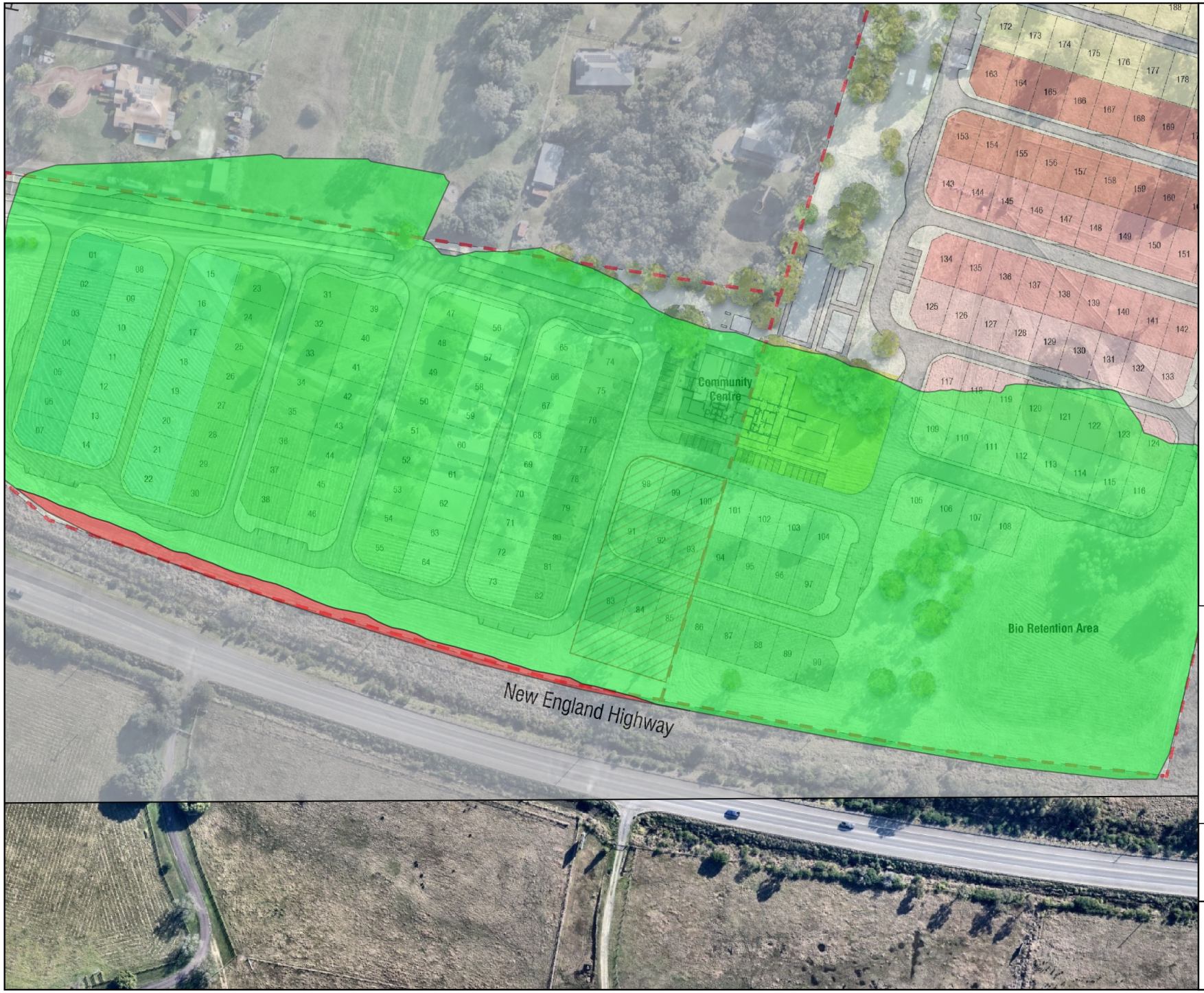


FIGURE 5

Daytime Road Traffic Noise Contours

MAC221733

Windella Manufactured Home Estate

KEY

day contours

Require Alternative Ventilation

Require Category 2 Treatments

0 20 40 60 80 m

N

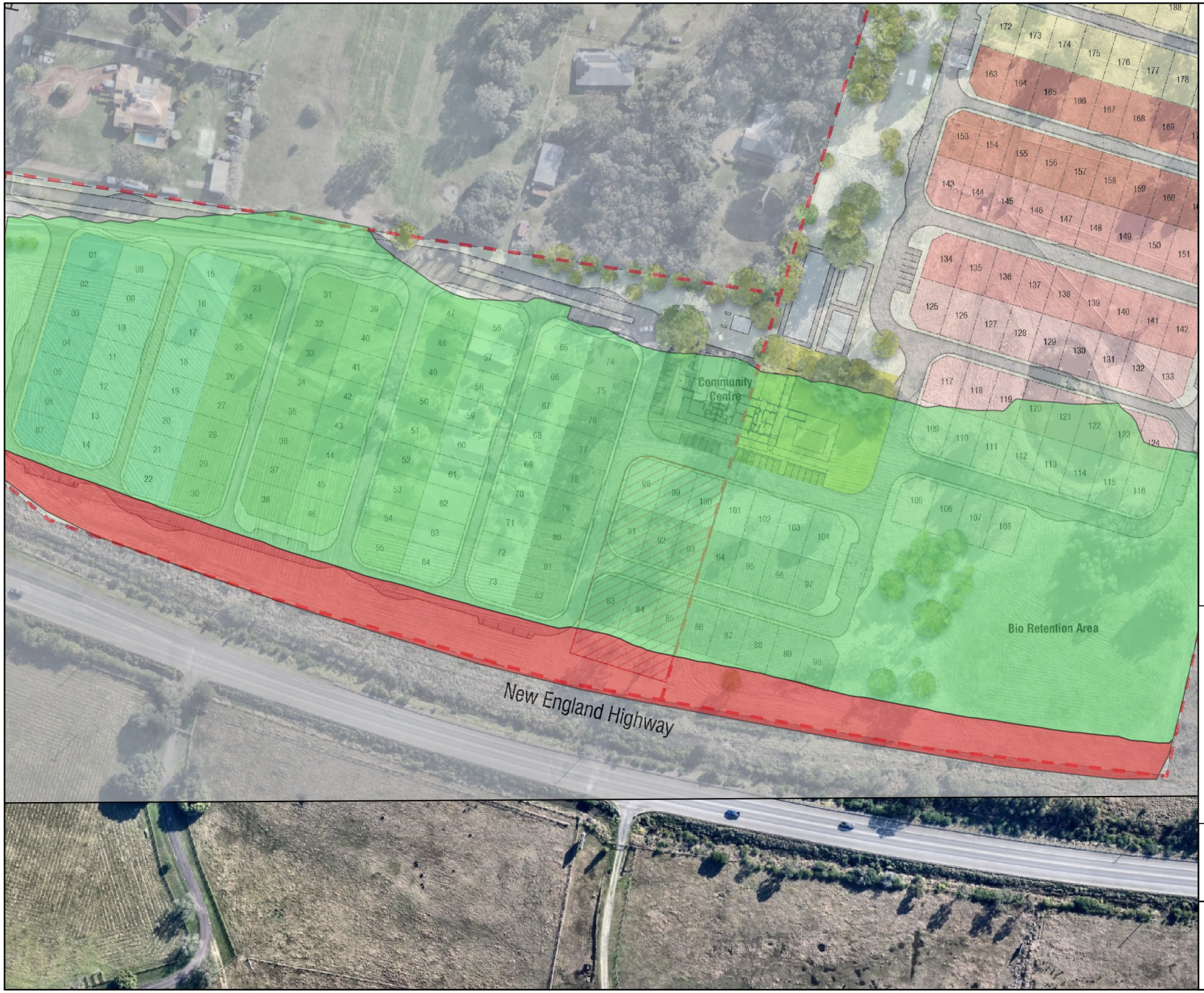


FIGURE 6

Nightime Road Traffic Noise Contours

MAC221733

Windella Manufactured Home Estate

KEY

day contours

Require Alternative Ventilation

Require Category 2 Treatments

0 20 40 60 80 m

N

7.4 Traffic Noise Results (Noise Generated from Project)

Calculations were completed, to represent traffic flows from the project at an offset distance of 12m for receivers adjacent to the proposed project access point on River Road using the Traffic Noise Model (TNM) by the United States Department of Transport, Federal Highway Administration Low Volume Calculation Tool. The results of the traffic noise calculations for operational road traffic volumes are presented in **Table 23** for the closest residential receivers to River Road. The traffic noise contribution from the project is predicted to remain below the assessment criteria at dwellings adjacent to River Road at an offset distance of 12m. In addition, night traffic movements from the project are anticipated to be significantly lower than the day traffic movements, hence are also expected to satisfy relevant criteria.

Table 23 Operational Road Traffic Noise Levels – Residential Receivers

Receiver	Offset Distance (m)	Predicted Project Traffic Noise dB $LA_{eq(1hr)}$	Assessment Criteria dB $LA_{eq(1hr)}$	Compliant
R01	12	51	55	✓

7.5 Construction Noise Assessment

Predicted $LA_{eq(15min)}$ noise emissions for modelled construction are presented in **Table 24**. Noise modelling identifies that construction activities have the potential to be above the relevant NML at one residential receiver (highlighted in bold) during Stage 11 to Stages 14 construction works. To appropriately manage construction noise levels for this project, noise management measures are recommended in **Section 8.2** and should be considered by the proponent.

Table 24 Construction Noise Emissions

Receiver ID	dB $LA_{eq(15min)}$[1]				NML, LA_{eq}
	Stages 1-6	Stages 7-10	Stages 11-14	Stages 15-18	
R01	48	<35	<35	<35	55
R02	44	<35	<35	<35	55
R03	54	35	<35	<35	55
R04	47	<35	<35	<35	55
R05	43	<35	<35	<35	55
R06	45	36	<35	<35	55
R07	45	36	<35	<35	55
R08	46	38	43	38	55
R09	50	48	44	<35	55
R10	49	52	52	<35	55
R11	<35	44	**59**	48	55
R12	38	41	47	43	55
R13	<35	41	51	54	55
R14	<35	<35	41	47	55
R15	<35	37	45	43	55
R16	<35	<35	43	40	55
R17	<35	<35	<35	44	55
R18	<35	<35	<35	45	55
R19	<35	<35	<35	43	55
R20	<35	<35	<35	46	55
R21	<35	<35	<35	47	55
R22	<35	<35	<35	41	55
R23	<35	<35	<35	37	55
R24	36	42	37	<35	55
R25	39	42	35	<35	55
R26	43	36	<35	<35	55
C01	<35	40	39	<35	70

Note 1: Results are representative of single or double story where applicable.

7.6 Australian Noise Exposure Forecasts (ANEFs)

Figure 7 presents the ANEF Contours overlayed on the project site. A review of ANEFs identifies that the project site lies partially within the ANEF 10 and 15 contours with the remainder outside the defined contour area. Accordingly, houses, home units, flays, caravan parks and commercial buildings are considered acceptable on the project site.

FIGURE 7

ANEF Contours

MAC221733

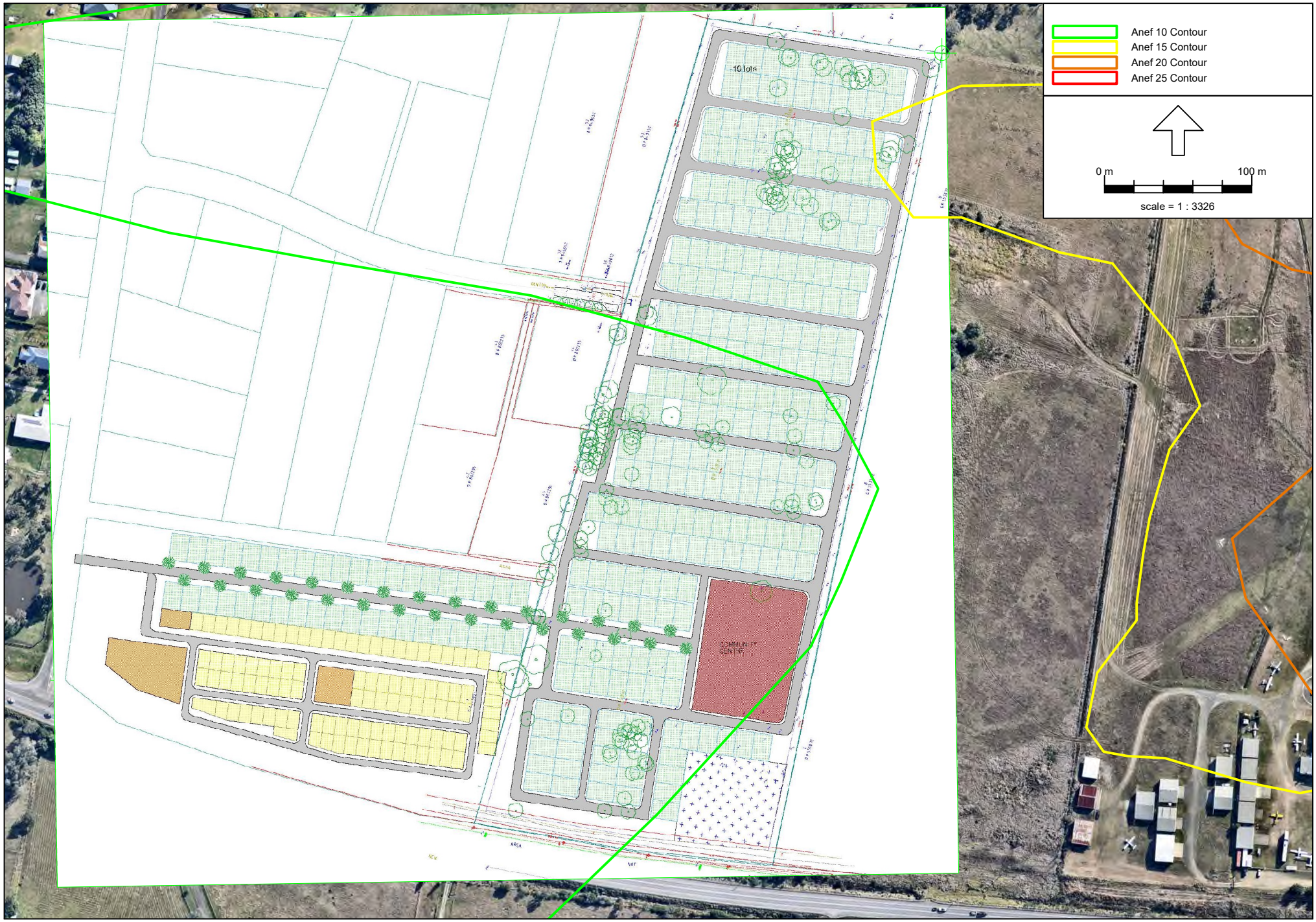
Windella Manufactured Home Estate

KEY

ANEF10 Contour

ANEF15 Contour

Windella MHE - ANEF Contours Overlay



Muller Acoustic Consulting Pty Ltd

7.7 Aircraft Engine Ground Running Test

Engine ground running is a test operation of an engine attached to an aircraft. It is a mandatory procedure for all aircraft returning into service after engine maintenance. A typical test consists of a period of running the engine at idle power, a short full power run of the engine or a combination of both. When possible, aircraft are oriented into the wind during an engine ground run. Given the required test conditions, ground running is likely to be undertaken at a variety of different locations across the nearby Rutherford Aerodrome taking into account the prevailing wind and weather conditions on the day of the testing, access for the aircraft being test and other safety concerns. Engine ground running noise would be intermittent, with only one to two tests likely to be undertaken each calendar quarter period and are expected to be only undertaken during the daytime period.

For this assessment purposes the worst-case location of the end of the runway, approximately 100m away from the aerodromes western boundary has been adopted as the ground test location which is a setback distance of approximately 300m from the nearest MHE dwellings.

A qualitative assessment of the received noise levels from an engine ground test has been undertaken within the nearest MHE dwellings. As Rutherford Aerodrome primarily accommodates light aircraft, the typical take-off noise of a Cessna 172R aircraft outlined in AS2021:2015, has been adopted as the typical engine noise level for this assessment.

Adopting the worst case offset distance of 300m to the nearest dwelling in the MHE the external received level is 60dBA. Taking into account 20dBA for closed windows, the internal daytime noise level is expected to satisfy the 40dBA design limit for habitable rooms outlined in AS2107.

It is reiterated that these tests are infrequent and likelihood of it occurring along the western boundary are rare. Given the low likelihood of tests being undertaken in the worst-case location, the short duration of testing, and only daytime test expected to be undertake, the potential for noise impacts on residents in the MHE from ground running tests is considered negligible.

Notwithstanding, to assist with the management of engine ground running testing impacts on the proposed MHE, Rutherford Aerodrome should notify the management of the estate of any intended ground engine running tests allowing management to notify the potentially affected receivers which is a typical approach of other aerodromes during ground running tests.

8 Discussion and Summary of Recommendations

8.1 Road Noise Control Recommendation

Noise predictions identified that standard glazing (such as 3mm or 4mm monolithic glass) on all windows would be adequate to attenuate internal levels to satisfy relevant criteria with the exception of the lots identified in **Table 22**.. It is recommended that Category 2 treatments, including mechanical ventilation systems and upgraded windows to a minimum 6mm monolithic glass (openable) with full acoustic seals are implemented to satisfy internal noise levels for the identified lots. **Table 25** presents the construction element upgrades required to achieve the internal noise criteria.

Table 25 Rail Noise Management Zones

Management Zone	Construction Requirements to Achieve Internal Criteria
No Management Zone	Standard building elements
Mechanical Ventilation	Standard building elements (windows closed) + mechanical ventilation
Category 1	Mechanical ventilation + 4mm monolithic glass (openable) with standard weather seals
Category 2	Mechanical ventilation + 6mm monolithic glass (openable) with full perimeter acoustic seals
Category 3	Mechanical ventilation + 6mm laminated glass (openable) with full perimeter acoustic seals

Alternatively, should category 2 treatments not be implemented the identified residential lots, noise barriers along the southern boundary of the lots may be implemented.

8.2 Construction Noise Recommendations

The results of the NA identify that levels during standard construction hours are expected to satisfy the ICNG noise management levels at several surrounding residential receivers to the project. Notwithstanding, 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.

9 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Assessment of potential road traffic noise impacts for the proposed residential Manufactured Home Development to be established in Windella, NSW.

The assessment has quantified potential operational emissions pertaining to campsite generated noise, internal road and maximum noise events (ie impact noise, door slams) within the project site. The results of the Noise Assessment demonstrate that noise emissions from the operation would satisfy the relevant noise trigger levels at all assessed receivers for all assessment periods.

The Noise Assessment has also qualified the existing ambient environment with respect to road noise, using measured levels to calibrate predictions. The results of the predictive noise modelling and assessment demonstrate that a manufactured home with light weight building design elements and standard glazing (such as 3mm or 4mm monolithic glass) on all windows would be adequate to attenuate external road noise levels to satisfy relevant internal criteria with the exception of the lots identified in Table 22.. It is recommended that Category 2 treatments, including mechanical ventilation systems and upgraded windows to a minimum 6mm monolithic glass (openable) with full acoustic seals are implemented to satisfy internal noise levels for the identified lots.

Alternatively, should category 2 treatments not be implemented the identified residential lots, noise barriers along the southern boundary of the lots may be implemented.

Modelled noise emissions from project construction activities identify that predicted noise emissions levels at one residential receiver during Stage 11 to Stages 14 construction works. To appropriately manage construction noise levels for this project, noise management measures are recommended in Section 8.2 and should be considered by the proponent.

The road traffic noise assessment demonstrates that the road noise criteria as specified in the RNP will be satisfied for the nearest residential receivers adjacent to the proposed site access road off River Road.

A review of ANEFs identifies that the project site lies partially within the ANEF 10 and 15 contours with the remainder outside the defined contour area. Accordingly, houses, home units, flays, caravan parks and commercial buildings are considered acceptable on the project site.

Given the low likelihood of tests being undertaken in the worst-case location, the short duration of testing, and only daytime test expected to be undertake, the potential for noise impacts on residents in the MHE from ground running tests is considered negligible.

Notwithstanding, to assist with the management of engine ground running testing impacts on the proposed MHE, Rutherford Aerodrome should notify the management of the estate of any intended ground engine running tests allowing management to notify the potentially affected receivers which is a typical approach of other aerodromes during ground running tests.

In summary, the Noise Assessment supports the project incorporating the recommendations and controls outlined in this report without additional amelioration measures required.

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Appendix A – Glossary of Terms

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

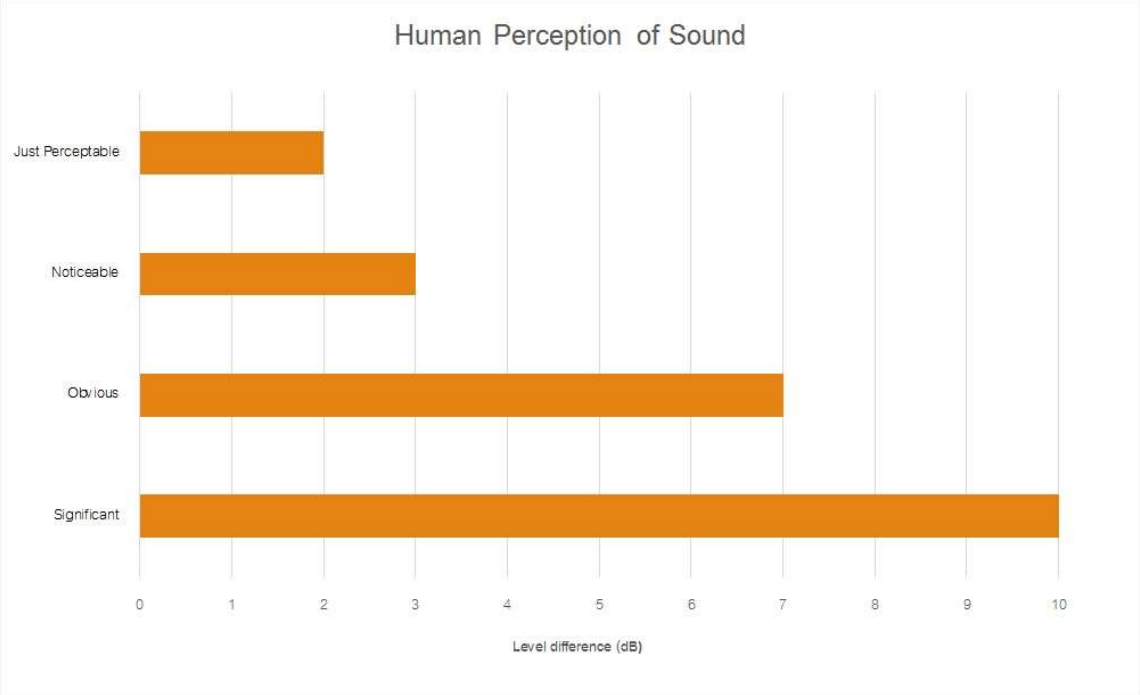
Table A1 Glossary of Acoustical Terms

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.
LAmax	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.log10 (W/Wo). 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



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Appendix B – Site Plans

Key

- STAGE 1 - 7 Dwelling Sites
- STAGE 2 - 15 Dwelling Sites
- STAGE 3 - 16 Dwelling Sites
- STAGE 3 - Temporary Bio Retention Area
- STAGE 4 - 17 Dwelling Sites
- STAGE 5 - 18 Dwelling Sites
- STAGE 6 - 9 Dwelling Sites and Stage 1 of the Clubhouse
- STAGE 7 - 15 Dwelling Sites and Bio Retention Area
- STAGE 8 - 7 Dwelling Sites
- STAGE 9 - 12 Dwelling Sites
- STAGE 10 - 17 Dwelling Sites
- STAGE 11 - 19 Dwelling Sites
- STAGE 12 - 19 Dwelling Sites
- STAGE 13 - 20 Dwelling Sites
- STAGE 14 - 21 Dwelling Sites
- STAGE 15 - 21 Dwelling Sites
- STAGE 16 - 20 Dwelling Sites
- STAGE 17 - 19 Dwelling Sites
- STAGE 18 -10 Dwelling Sites

0 10 20 30 40 50 100m
Approximate Scale

STUDIO 26
URBAN DESIGN

WINDELLA RETIREMENT COMMUNITY

Date: 14 Dec 23
Issue: B
Page: 1

Appendix C – Noise Monitoring Charts

Table C1 Background Noise Monitoring Summary – L1

Date	Measured Background Noise Level (LA90) dB ABL[1]			Measured dB LAeq(period)		
	Day[2]	Evening[2]	Night[2]	Day[2]	Evening[2]	Night[2]
Friday 02 December 2022	--	45	32	--	59	64
Saturday 03 December 2022	44	44	34	63	52	50
Sunday 04 December 2022	41	44	34	52	53	51
Monday 05 December 2022	43	42	41	51	50	53
Tuesday 06 December 2022	47	43	38	57	53	53
Wednesday 07 December 2022	46	46	42	58	53	51
Thursday 08 December 2022	46	46	33	57	52	52
Friday 09 December 2022	--	--	--	--	--	--
L1 – RBL / Leq Overall	45	44	34	58	54	57

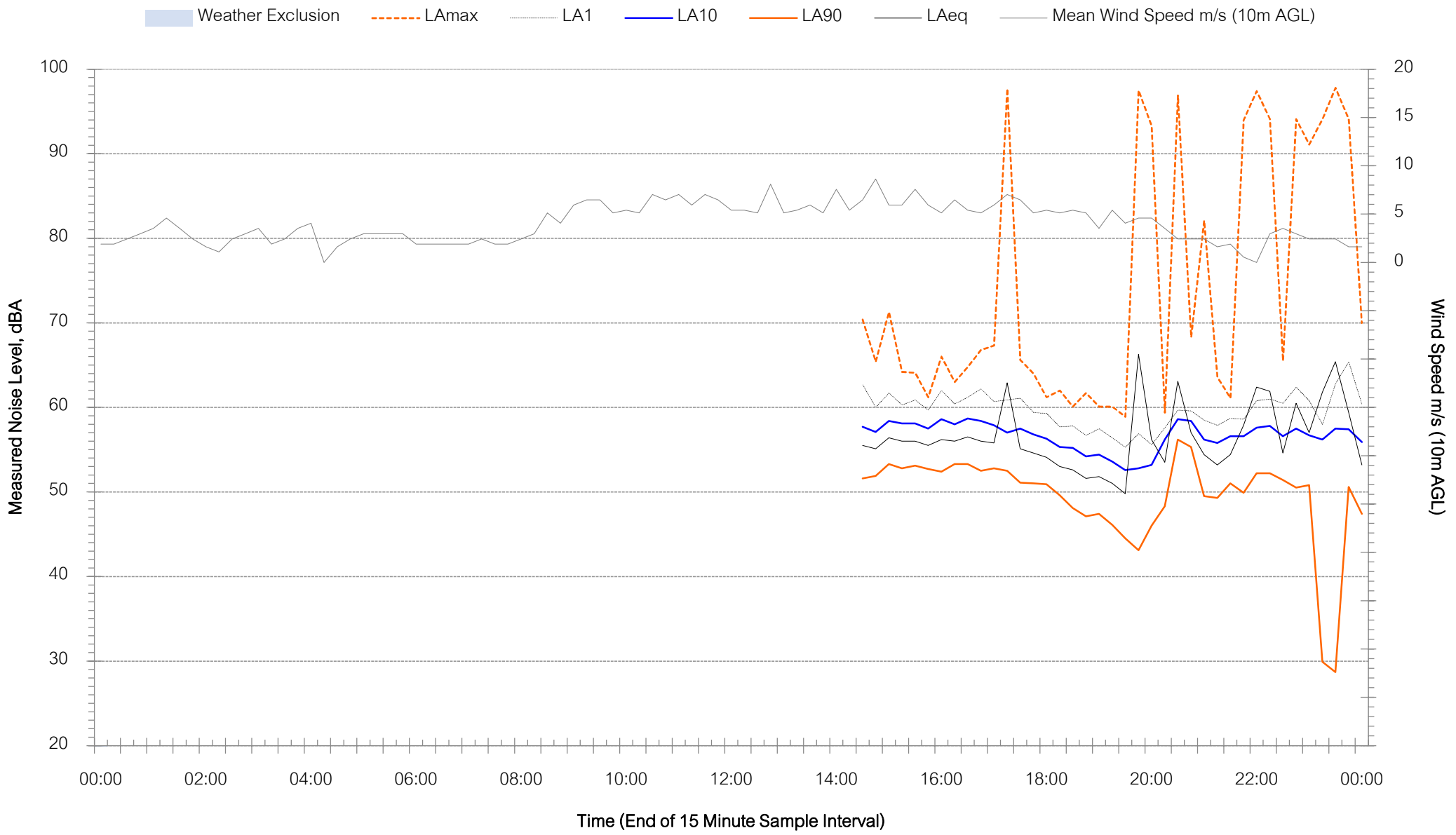
Notes: Excludes periods of wind or rain affected data. Meteorological data obtained from the Bureau of Meteorology weather station Moruya Airport AWS, NSW (Site 69148).

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 2: 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.

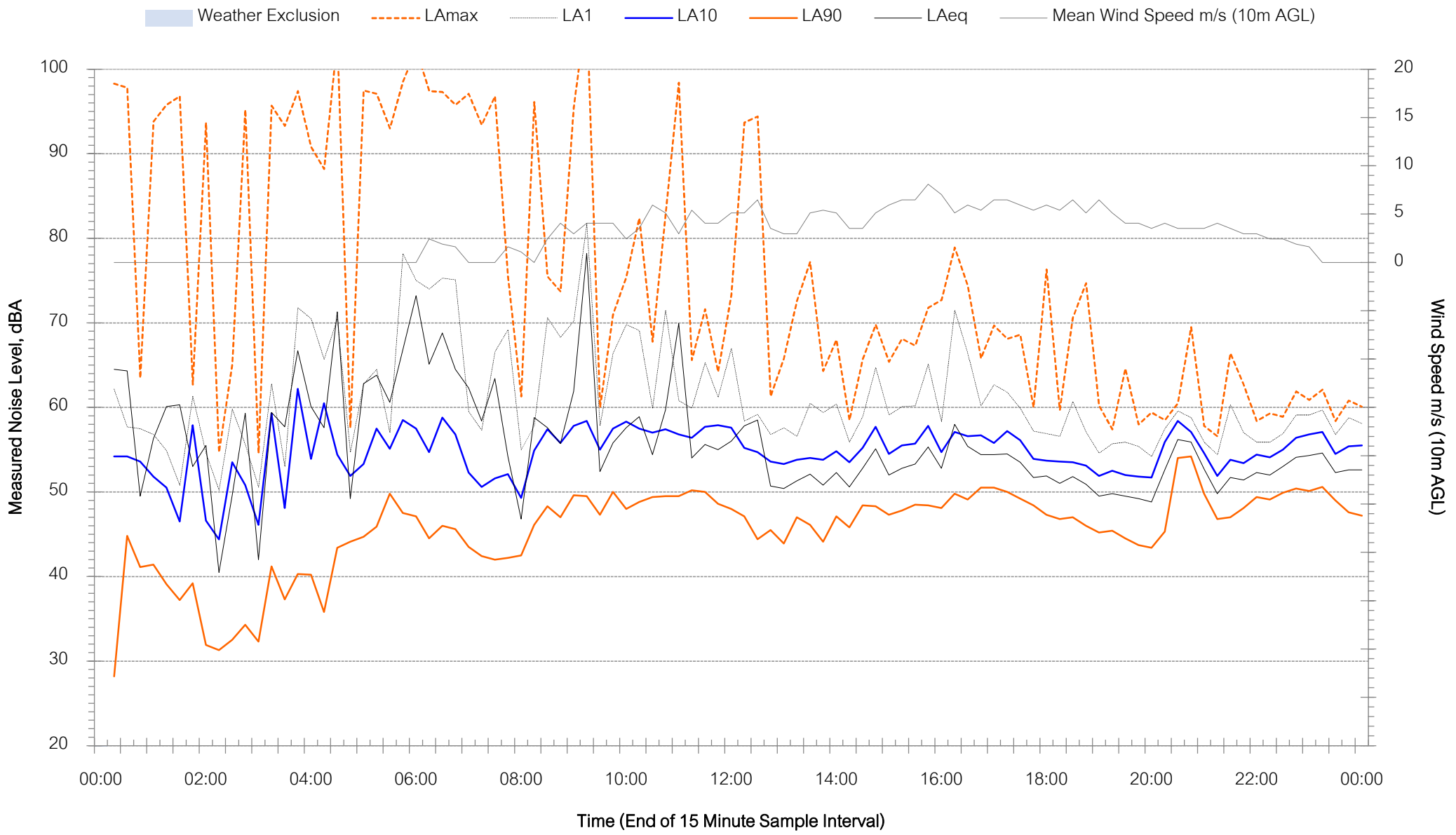
Background Noise Levels

Denton Close, Windella - Friday 2 December 2022



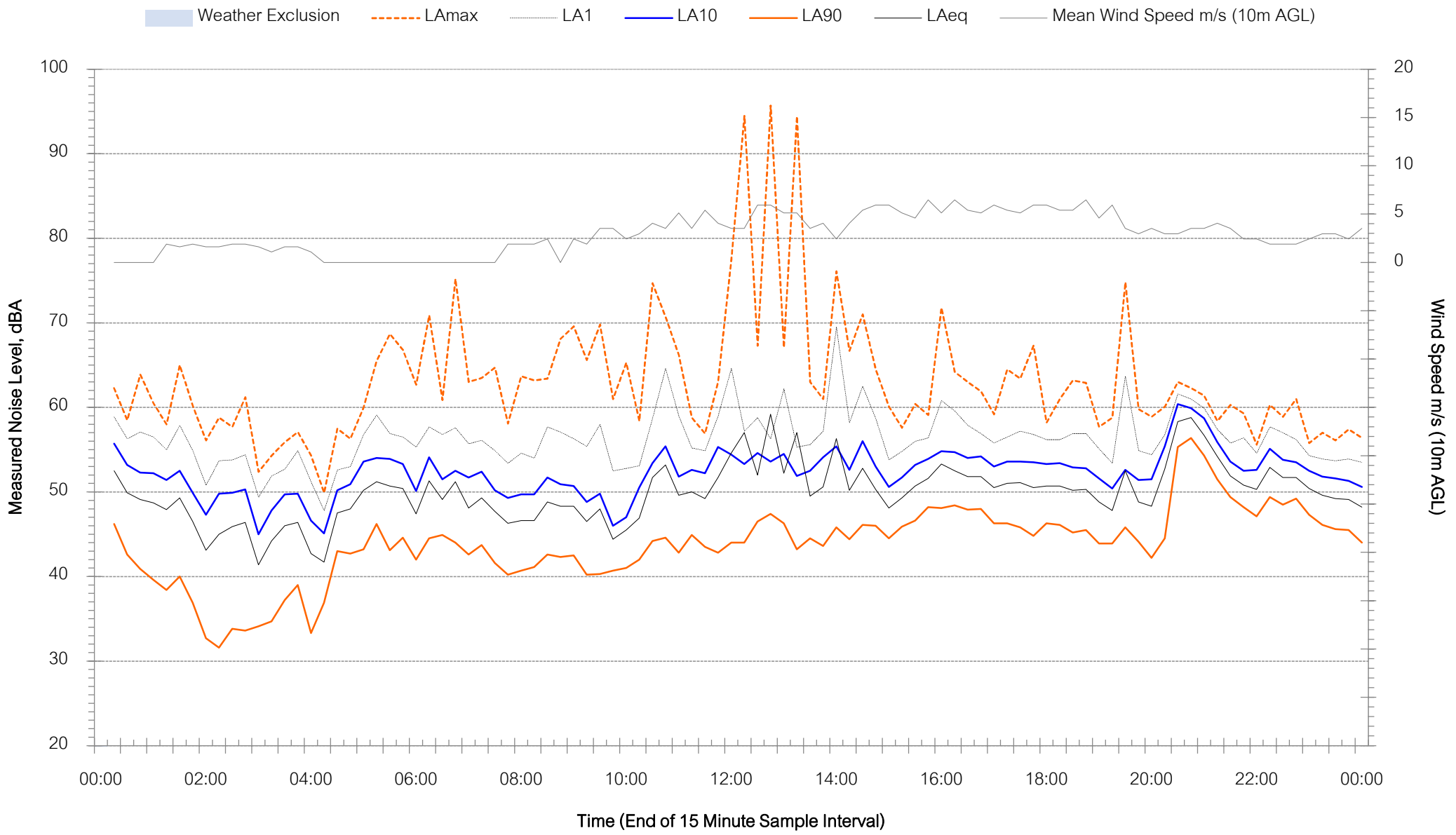
Background Noise Levels

Denton Close, Windella - Saturday 3 December 2022



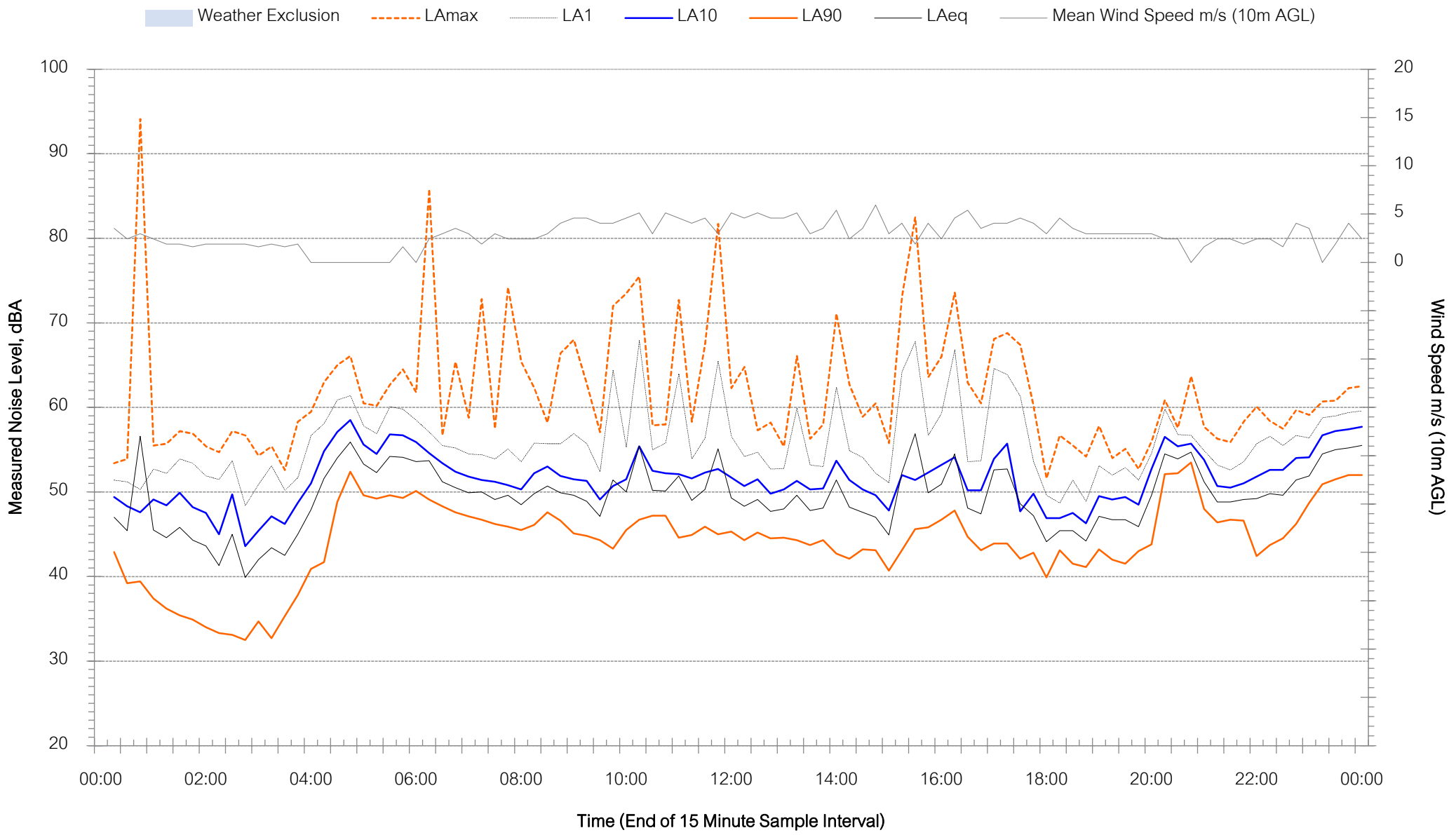
Background Noise Levels

Denton Close, Windella - Sunday 4 December 2022



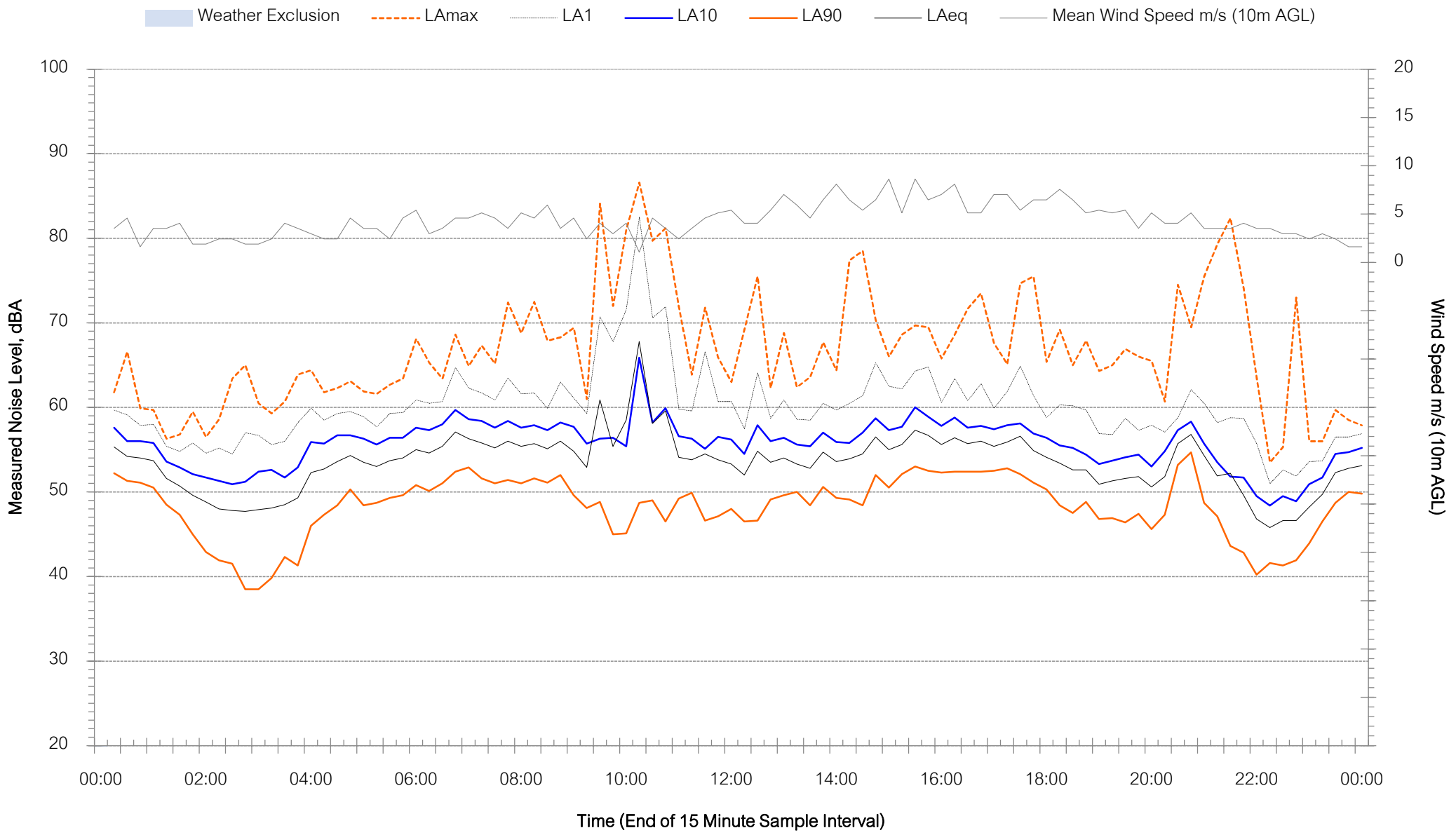
Background Noise Levels

Denton Close, Windella - Monday 5 December 2022



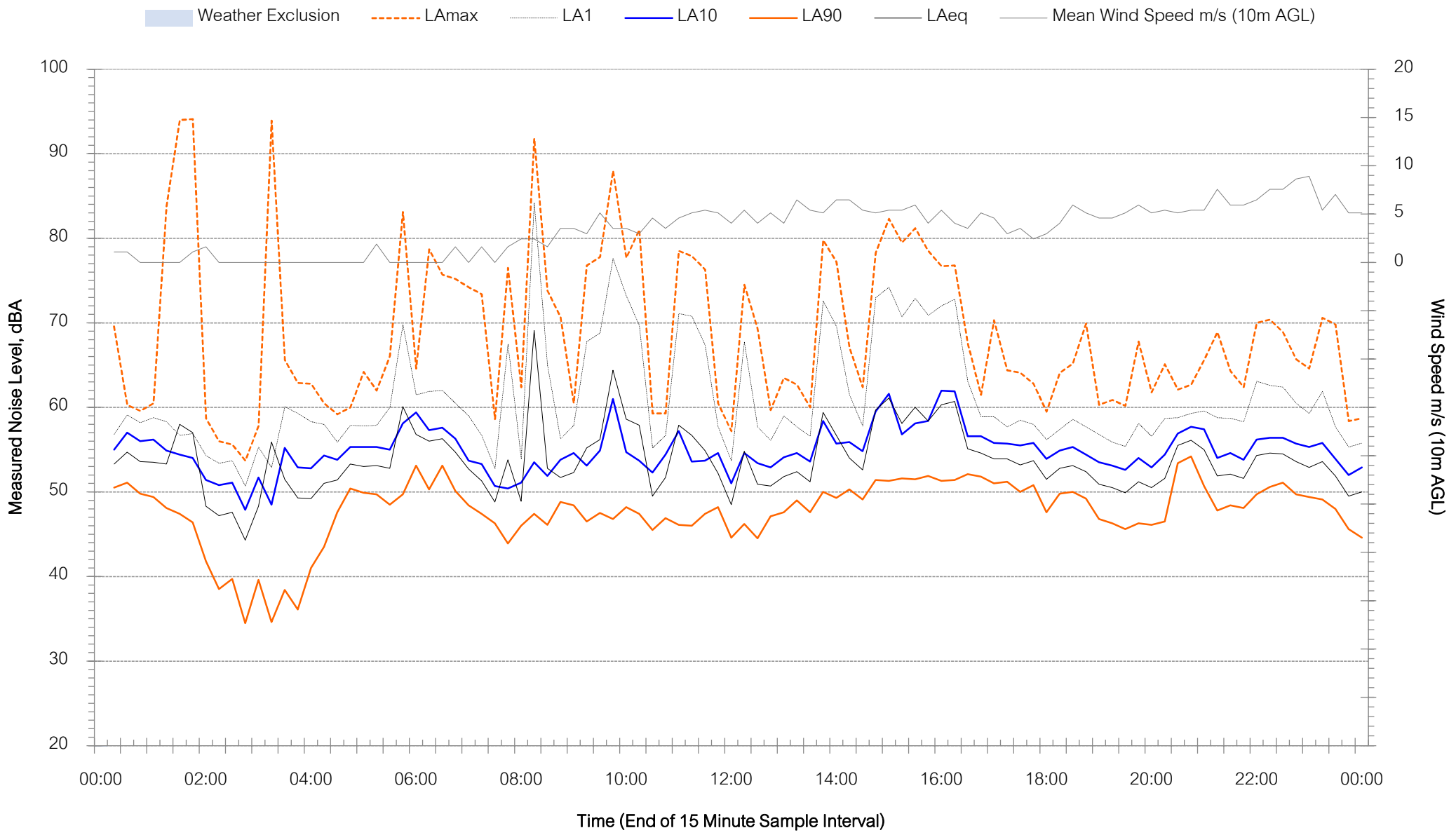
Background Noise Levels

Denton Close, Windella - Tuesday 6 December 2022



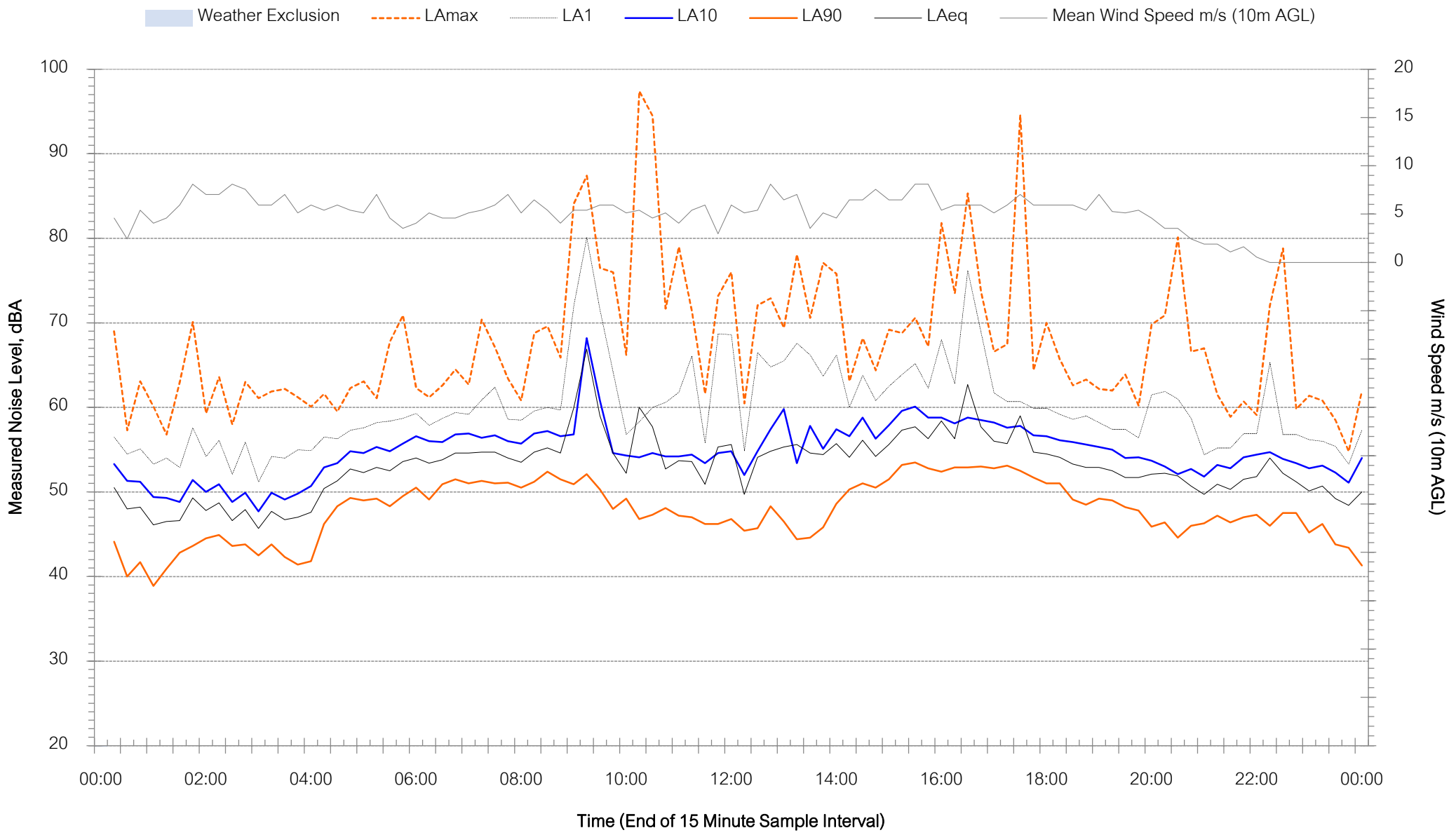
Background Noise Levels

Denton Close, Windella - Wednesday 7 December 2022



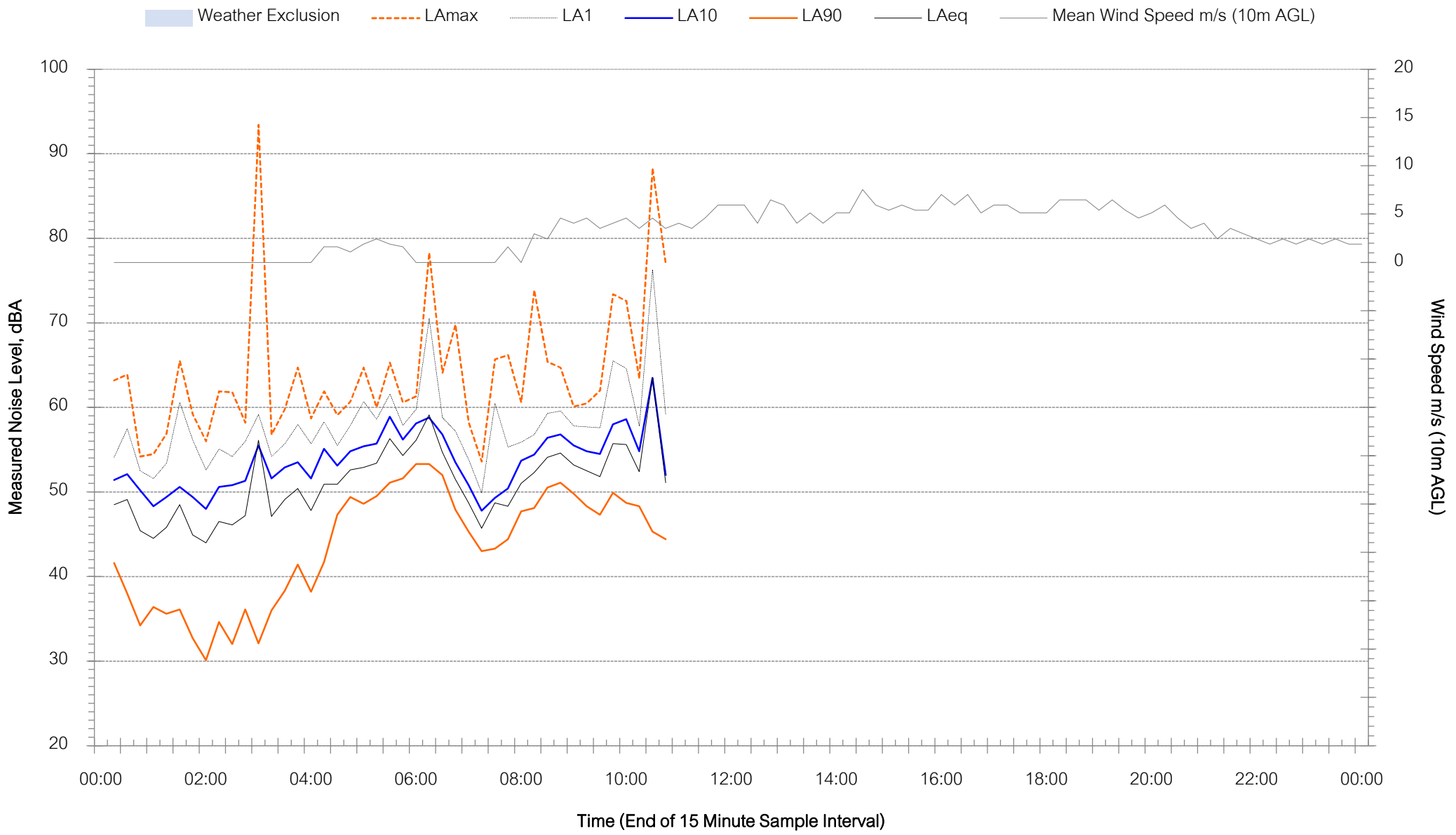
Background Noise Levels

Denton Close, Windella - Thursday 8 December 2022



Background Noise Levels

Denton Close, Windella - Friday 9 December 2022



Appendix D – Treatment Categories

Appendix C – Acoustic Treatment of Residences

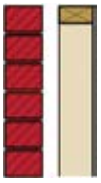
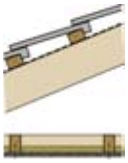
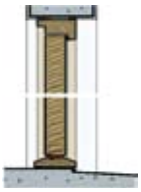
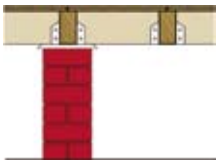
The following table sets out standard (or deemed-to-satisfy) constructions for each category of noise control treatment for the sleeping areas and other habitable areas of single / dual occupancy residential developments only. The assumptions made in the noise modelling are as follows:

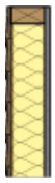
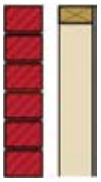
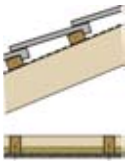
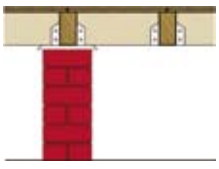
- Typical layout of a modern dwelling taken from a recent large residential development in an outer Sydney suburb
- Bedrooms and other habitable rooms are exposed to road noise

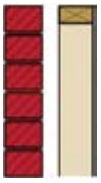
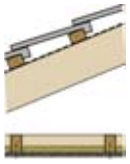
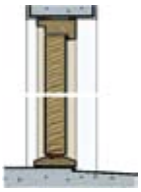
ACOUSTIC PERFORMANCE OF BUILDING ELEMENTS

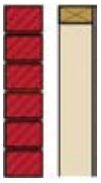
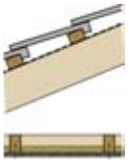
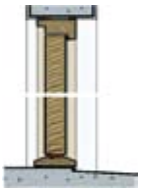
The acoustic performances assumed of each building element in deriving the Standard Constructions for each category of noise control treatment presented in the preceding Table, are presented below in terms of Weighted Sound Reduction Index (Rw) values, which can be used to find alternatives to the standard constructions presented in this Appendix:

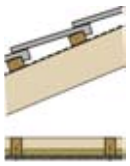
Category of Noise Control Treatment	R_w of Building Elements (minimum assumed)				
	Windows/Sliding Doors	Frontage Facade	Roof	Entry Door	Floor
Category 1	24	38	40	28	29
Category 2	27	45	43	30	29
Category 3	32	52	48	33	50
Category 4	35	55	52	33	50
Category 5	43	55	55	40	50

Category No.	Building Element	Standard Constructions	sample
1	**Windows/Sliding Doors**	Openable with minimum 4mm monolithic glass and standard weather seals	
	Frontage Facade	**Timber Frame or Cladding:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally	
		Brick Veneer: 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally	
		Double Brick Cavity: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R1.5 insulation batts in roof cavity.	
	Entry Door	35mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
2	**Windows/Sliding Doors**	Openable with minimum 6mm monolithic glass and full perimeter acoustic seals	
	Frontage Facade	**Timber Frame or Cladding Construction:** 6mm fibre cement sheeting or weatherboards or plank cladding externally, 90mm deep timber stud or 92mm metal stud, 13mm standard plasterboard internally with R2 insulation in wall cavity.	
		Brick Veneer Construction: 110mm brick, 90mm timber stud frame or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or metal sheet roof with sarking, 10mm plasterboard ceiling fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	40mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	1 layer of 19mm structural floor boards, timber joist on piers	
		Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
3	**Windows/Sliding Doors**	Openable with minimum 6.38mm laminated glass and full perimeter acoustic seals	
	Frontage Facade	**Brick Veneer Construction:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or sheet metal roof with sarking, 1 layer of 13mm sound-rated plasterboard fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	45mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
4	**Windows/Sliding Doors**	Openable with minimum 10.38mm laminated glass and full perimeter acoustic seals	
	Frontage Facade	**Brick Veneer Construction:** 110mm brick, 90mm timber stud or 92mm metal stud, minimum 50mm clearance between masonry and stud frame, R2 insulation batts in wall cavity, 10mm standard plasterboard internally.	
		Double Brick Cavity Construction: 2 leaves of 110mm brickwork separated by 50mm gap	
	Roof	Pitched concrete or terracotta tile or sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joists, R2 insulation batts in roof cavity.	
	Entry Door	45mm solid core timber door fitted with full perimeter acoustic seals	
	Floor	Concrete slab floor on ground	

Category No.	Building Element	Standard Constructions	sample
5	**Windows/Sliding Doors**	Openable Double Glazing with separate panes: 5mm monolithic glass, 100mm air gap, 5mm monolithic glass with full perimeter acoustic seals.	
	Frontage Facade	**Double Brick Cavity Construction:** 2 leaves of 110mm brickwork separated by 50mm gap with cement render to the external face of the wall and cement render or 13mm plasterboard direct fixed to internal faces of the wall.	
	Roof	Pitched concrete or terracotta tile or sheet metal roof with sarking, 2 layers of 10mm sound-rated plasterboard fixed to ceiling joist using resilient mounts, R2 insulation batts in roof cavity	
	Entry Door	Special high performance acoustic door required - Consult an Acoustic Engineer	*Door to acoustic consultant's specifications*
	Floor	Concrete slab floor on ground	
6	**All**	Consult an Acoustic Engineer	

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MAC
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