Noise Assessment

35 Honeysuckle Drive
Newcastle, NSW

Prepared for: KDC Pty Ltd
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MAC170597RP1V02

Muller Acoustic Consulting

Document Information

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by KDC Pty Ltd on behalf of DomaGroup to conduct a Noise Assessment (NA) for the proposed multi storey development to be established at 35 Honeysuckle Drive, Newcastle, NSW (the 'project').

This report presents the results, findings and recommendations of the NA and has been prepared to accompany the project's Secretary's Environmental Assessment Requirements (SEARS) (SSD8999).

Key acoustic elements addressed as part of this assessment include:

- Road and light rail noise intrusion (internal impacts to apartments);
- Rooftop emissions, including mechanical and tenant noise emissions from rooftop terrace (to neighbouring receivers); and
- Potential noise emissions from ground floor commercial tenancies including licenced premises noise (to neighbouring receivers and tenants).

A review of licenced premises in the vicinity of the project has been completed. The closest licenced premises were identified to be The Family Hotel (160m) and the Honeysuckle Hotel (300m). These venues generate noise levels that are acoustically insignificant compared to road noise emissions at the façade of the project building. Furthermore, recommendations in this report are anticipated to more than adequately attenuate any residual noise from surrounding licenced premises. Hence, noise emissions from licenced premises have not been considered further in this assessment.

Taking into consideration the acoustic elements considered in this assessment, the following policies and guidelines have been adopted:

- Environment Protection Authority (EPA) 2017, NSW Noise Policy for Industry (NPI);
- Department of Planning (DPI) 2008, Development Near Rail Corridors and Busy Roads - Interim Guideline;
- Environment Protection Authority (EPA) 2011, NSW Road Noise Policy (RNP);
- Environment Protection Authority (EPA) 2013, Rail Infrastructure Noise Guideline (RING);
- Standards Australia AS 1055.1:1997, Acoustics - Description and measurement of environmental noise - General Procedures;
- Standards Australia AS 3671-1989, Acoustics - road traffic noise intrusion - building site and construction;

- Standards Australia AS 2107:2000, Acoustics - Recommended design sound levels and reverberation times for building interiors;
- The Office of Liquor, Gaming and Racing (OLGR) criteria related to licensed premises; and
- Newcastle City Councils (NCC) Technical Guideline for the Assessment and Control of Low Frequency Noise from the Development of Musical Entertainment Venues (NCC) (2006).

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**. **Figure 1** presents the project site and nearest surrounding receivers that have been considered in this assessment.

FIGURE 1

LOCALITY PLAN

REF: MAC170597

0 50m

KEY	
R1	RECEIVER LOCATION
NM1	ATTENDED LOCATION
L1	UNATTENDED LOCATION
	PROJECT SITE

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*Imagery Source : nearmaps

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2 Existing Noise Environment

2.1 Attended Noise Monitoring

To gain a better understanding of the existing noise environment surrounding the project, MAC conducted attended noise monitoring in the vicinity of the project site during calm clear weather conditions. The purpose of the measurements was to ascertain dominant ambient noise sources and to quantify any existing commercial, licenced premises or industrial noise contributions. The results of attended noise measurements and observations are summarised in **Table 1.** See **Figure 1** for monitoring positions.

Table 1 Ambient Noise Monitoring Summary – Attended Monitoring

Location	Date/Time	Primary Noise Descriptor (dB(A) re 20 µPa)			Meteorology	Description and SPL, dB(A)
		LAmax	LAeq	LA90		
NM1 Harbourside	31/1/2018 15:44	68	53	50	Temp 27°C W 1.5m/s	Local traffic 48-62 Harbour noise <42 Intermittent Construction 50-53
	31/1/2018 20:27	65	51	48	Temp 20°C SW 1.5m/s	Local traffic 48-60 Birds 50-52 Urban hum 40-42
	1/2/2018 00:15	86	50	42	Temp 17°C S 1.5m/s	Local traffic 42-48 Pedestrians 43-48 Urban hum/harbour <42
NM2 Roadside	31/1/2018 16:02	68	60	56	Temp 27°C W 1.5m/s	Local traffic 55-72 Harbour noise <40
	31/1/2018 20:45	77	60	47	Temp 20°C SW 1.5m/s	Local traffic 43-77 Birds 52-59 Urban hum/harbour <42
	1/2/2018 00:38	86	50	42	Temp 17°C S 1.5m/s	Local traffic 40-69 Birds 39-44 Urban hum/harbour <42

Attended noise monitoring was completed at the project site at two positions; on the north side of the project site adjacent to the harbour, and adjacent to Honeysuckle Drive on the southern boundary of site.

Ambient sources included traffic noise from Honeysuckle Drive, pedestrian noise, birds, urban hum and minor levels of harbour noise. Notwithstanding, it was noted that during the noise survey, winds were from the south directing harbour noise emissions away from this location. Detailed analysis of noise logging data identified that harbour noise contributions were generally at or below 40dBA at the project site. Therefore, glazing recommended in this report to attenuate traffic is anticipated to be adequate to attenuate harbour noise.

3 Noise Policy and Criteria

3.1 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 102 (Road) of the State Environmental Planning Policy (SEPP) for Infrastructure (Infrastructure SEPP):

"If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LAeq levels are not exceeded:

- *in any bedroom in the building: 35dBA at any time 10pm–7am; and*
- *anywhere else in the building (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 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.

Traffic volumes for Honeysuckle Drive (2018) were sourced from the Report for Transport for NSW-Newcastle Light Rail (GHD, 2016) (the 'report'). Traffic flows for Honeysuckle Drive between Steel Street and Worth Place were referenced from Table 6-15 of the report. The estimated AADT flow for this section of Honeysuckle Drive were 22,157 vehicles and were adopted to calibrate the noise model for this assessment.

3.1.1 Road Noise Screening Test

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.

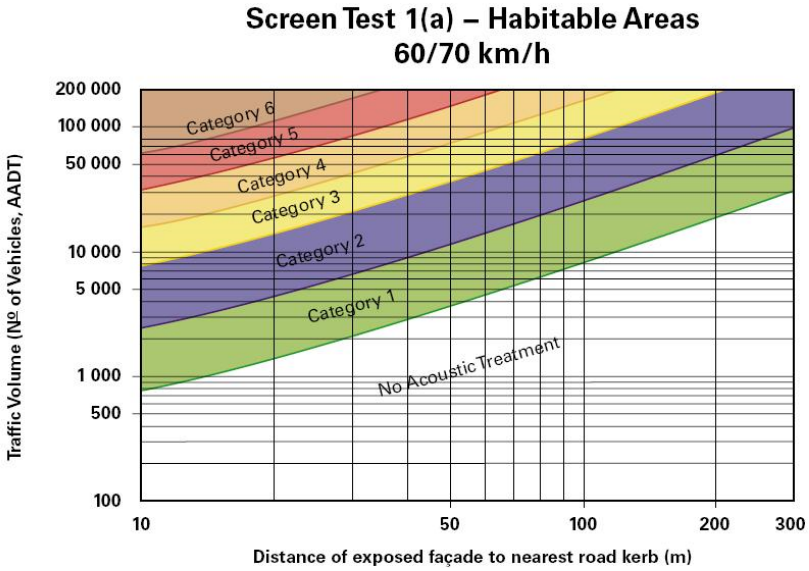

Figure 2 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 60/70 km/hr zones.

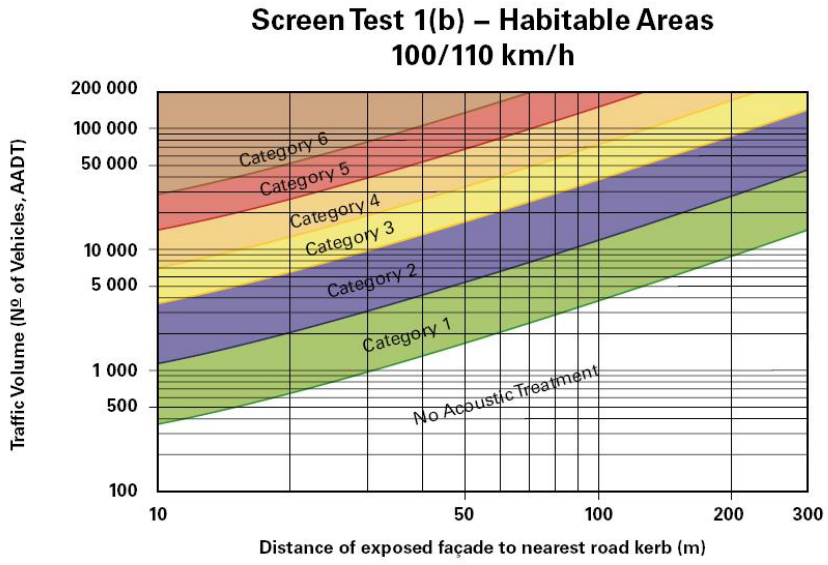

Figure 3 Screen test for habitable areas of single/dual occupancy dwellings adjacent to 100/110 km/hr zones.

3.2 Road Noise Policy

The EPA's RNP (EPA, 2011) has been reviewed and is designed to quantify the noise intrusion from the road network on existing receptors. As this project is related to the construction of new dwellings, the RNP is not applicable to this assessment.

3.3 Rail Infrastructure Noise Guideline

The EPA's RING (EPA, 2013) provides guidance to ensure noise and vibration impacts related to rail development projects are assessed in a consistent manner. The airborne noise triggers for residential land uses as per the RING are reproduced in **Table 2**.

Table 2 Noise Trigger Levels

	Existing Rail Line or redevelopment of existing line, dB	New Rail	Alarm /priority, dB	Comments
New South Wales	65 $L_{Aeq(day)}$	60 $L_{Aeq(day)}$	n/a	Triggers for assessment purposes. Light Rail triggers are set at 60/50dB L_{Aeq} (day/night) and 80dB L_{Amax}
	60 $L_{Aeq(night)}$	55 $L_{Aeq(night)}$		
	85 L_{Amax}	80 L_{Amax}		

3.4 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, taking into account 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.

3.4.1 Project Noise Trigger Levels

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (that is, the more stringent) value 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.

3.4.2 Project Intrusiveness Noise Level

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 needs to be measured:

- to provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development; and
- to carry out functions relating to the prevention, minimisation and control of noise from premises scheduled under the Act.

Unattended noise monitoring was completed at the western boundary of the project site between Friday 23 March 2018 to Thursday 29 March 2018 to quantify the noise environment and the influence of road noise.

Unattended noise monitoring was conducted using a SVANTEK 957 Type 1 octave sound analyser, programmed to collect samples at 15-minute intervals with 'Fast' time weighting and 'A' frequency weighting. The analyser was calibrated before and after the monitoring period with no drift in calibration noted. Monitoring was conducted in general accordance with the procedures described in Australian Standard AS 1055, 1997 Acoustics - Description and Measurement of Environmental Noise. Data affected by adverse meteorological conditions has been excluded from the results in accordance with methodologies provided in the NPI.

The results of long-term unattended monitoring are provided in **Table 3**. **Appendix B** presents the noise logging charts for the assessment period.

Table 3 Noise Logging Results

Measurement Location	Measured Background Noise Level, LA_{90}, dBA			Measured LA_{eq}, dBA[1]		
	Day	Evening	Night	Day	Evening	Night
L1	53	49	43	62	59	56

Note: Excludes periods of wind or rain affected data, meteorological data obtained from the Bureau of Meteorology at Nobbys Pilot Station AWS (32.9184°S 151.7985°E.).

Note: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night the remaining periods. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night the remaining periods.

Note 1: $LA_{eq\ (period)}$ is the average for the week of data collected.

The unattended monitoring confirms that the ambient noise environment surrounding the project is dominated by road traffic and urban noise.

A summary of the intrusive noise criteria is provided in **Table 4**.

Table 4 Project Intrusiveness Noise Levels

Location	Assessment Period[1]	RBL, dBA	Intrusiveness Noise Level, dB $L_{Aeq(15min)}$
All Residential Receivers	Day	53	58
	Evening	49	54
	Night	43	48

Note 1: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night the remaining periods. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night the remaining periods.

3.4.3 Project Amenity Noise Levels

PANLs are 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.
- **Project Amenity Noise Levels (PANL)** – is the recommended levels for a receiver area, specifically focusing the project under investigation.

As per Section 2.4 of the NPI, ANLs and PANLs consider:

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

The recommended amenity noise levels as per Table 2.2 of the NPI reproduced in **Table 5**.

Table 5 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level L_{Aeq}, dBA
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	5dBA above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School classroom – internal	All	Noisiest 1 hour period when in use	35
Hospital ward - internal - external	All	 Noisiest 1 hour Noisiest 1 hour	 35 50
Place of worship – internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	70
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dBA to recommended noise amenity area

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.

Time of day is defined as follows: (These periods may be varied where appropriate, for example, see A3 in Fact Sheet A.)

- day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays;
- evening – the period from 6 pm to 10 pm;
- night – the remaining periods.

In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable LAeq noise level may be increased to 40dB LAeq(1hr).

The Project Amenity Noise Levels (PANLs) for residential receivers and other sensitive receivers potentially affected by the project are presented in **Table 6.**

Table 6 Amenity Noise Levels and Project Amenity Noise Levels

Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended ANL dB $L_{Aeq,period}$[2]	PANL dB $L_{Aeq,period}$[3]	PANL dB $L_{Aeq,15min}$[4]
Residential	Urban	Day	60	55	58
		Evening	55	50	53
		Night	45	40	43
Commercial	All	When in use	65	60	63

Note 1: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night the remaining periods. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night the remaining periods.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Project Amenity Noise Level -5dB due to other adjoining industry.

Note 4: Includes a +3dB adjustment to the amenity period level to convert to a fifteen-minute assessment period as per Section 2.2 of the NPI.

3.4.4 Project Noise Trigger Levels

The PNTLs is the lower of either the PINL or the PANL. **Table 7** presents the derivation of the PNTL's in accordance with the methodologies outlined in the NPI.

Table 7 Project Noise Trigger Levels

Receiver	Period[1]	PINL dB $L_{Aeq,15min}$	PANL dB $L_{Aeq,15min}$	PNTL, dB $L_{Aeq,15min}$
Residential	Day	58	58	58
	Evening	54	53	53
	Night	48	43	43
Commercial	All	N/A	68	63

Note 1: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night the remaining periods. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night the remaining periods.

3.5 NSW Office of Liquor, Gaming and Racing (OLGR)

There is the potential for the ground floor tenancies of the project to consist of licenced premises (ie restaurants or cafes). Therefore, the NSW EPA's Noise Guide for Local Government (NGFLG) (2013) has been adopted to quantify potential noise emissions from the ground floor tenancies. The OLGR criteria are reproduced from NGFLG below and have been adopted for this assessment:

> *'The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) by more than 5dB between 7:00am and 12:00midnight at the boundary of any affected residence.*
>
> *The LA10 noise level emitted from the licensed premises shall not exceed the background noise level in an Octave Band Centre Frequency (31.5Hz – 8kHz inclusive) between 12:00midnight and 7:00am at the boundary of any affected residence. Notwithstanding compliance with the above, the noise from the licensed premises shall not be audible within any habitable room in any residential premises between the hours of 12:00midnight and 7:00am.'*

The relevant OLGR criterion for the period up to midnight has been derived by analysing seven days of single octave statistical levels from the historic noise logging data for the period between 6pm to midnight. This period is representative of peak operating hours for (potential licensed) ground floor tenancies of the proposal. **Table 8** reproduces the adopted OLGR noise criteria.

Table 8 OLRG Criteria[1]

	L_{A10} Noise Criteria, Octave Band Centre Frequency (Hz), dBA								
	31.5	63	125	250	500	1 k	2 k	4 k	8 k
Octave Background (L_{A90})	15	29	36	40	41	41	39	29	23
L_{A10} criteria (background +5dB)	20	34	41	45	46	46	44	34	28

3.6 NCC Technical Guideline

Interim Technical Guideline for the Assessment and Control of Low Frequency Noise from the Development of Musical Entertainment Venues (Newcastle City Council, 2006) has been adopted to assess potential amplified music from ground floor commercial tenancies of the project. **Table 9** reproduces Z-weighted 1/3 octave band criteria from the NCC Technical Guideline.

Table 9 NCC Technical Guideline Criteria

	1/3 Octave Band Centre Frequency (Hz), dBZ ($L_{Amax(fast)}$/$L_{Aeq30sec}$)									
	31.5	40	50	63	80	100	125	160	200	250
Internal habitable room All Receptors	50.0	42.8	36.2	30.6	25.6	21.3	17.2	13.1	9.5	6.5

3.7 Maximum Noise Level Assessment Criterion

Table 10 provides the sleep disturbance criterion for the nearest residential receivers. The sleep disturbance criterion has been derived based on the night RBL.

Table 10 Maximum Noise Level Assessment Screening Criterion

Operational		
$L_{Aeq\ 15min}$	RBL +5	Maximum Noise Screening Criteria
40	48	48
Transient Events		
L_{AFmax}	RBL +15	Maximum Noise Screening Criteria
52	58	**58**[1]

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

Note: NPI identifies that maximum of the two values is to be adopted.

Note 1: Bold indicates relevant criterion

3.8 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 11** provides the ICNG recommended $L_{Aeq,15min}$ NMLs and how they are to be applied.

Table 11 Noise Management Levels		
Time of Day	Management Level $LA_{eq,15min}$[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 + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $LA_{eq,15min}$ 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 75 dB	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 + 5 dB	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.

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.

The Construction Noise Management Levels established in accordance with the ICNG for the project are presented in Table 12.

Table 12 Construction Noise Management Levels

Location	Period[1]	Rating Background Level (RBL), LA_{90} dBA	Noise Management Level $LA_{eq(15min)}$ (RBL+10dB)
Residential receivers	Day	53	63
Commercial receivers	Day	N/A	70

4 Noise Assessment Methodology

4.1 Calculation of Road Traffic Noise

A theoretical assessment of road traffic noise was carried out to predict levels at the proposed façades of the project using the Calculation of Road Traffic Noise (CORTN) algorithm, as developed by the UK Department of Transport. This method incorporates flow volumes, 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. AADT distributions for Honeysuckle Drive have been included in the noise model.

Two road noise models were completed. The first was a calibration of existing flows, the second model incorporated post light rail traffic volumes to reflect volumes of traffic past the project site once constructed. The calculation parameters, assumptions and traffic flows used for the modelling assessment are summarised in **Table 13**.

Table 13 Calculation Parameters

Assessment Period	Traffic Volume[1]	% Heavy Vehicles	Speed Limit (km/hr)
Modelled Traffic Flows – Honeysuckle Drive, Current (2018)			
Day	17,647	3	50
Night	4,510	5	50
Modelled Traffic Flows – Honeysuckle Drive, Future (post light rail)			
Day	13,576	3	50
Night	3,470	5	50

Note 1: Report for Transport for NSW- Newcastle Light Rail, GHD, 2016.

4.2 Light Rail Noise

The Newcastle Light Rail, Technical Paper 2 – Noise and vibration assessment (GHD, 2016) presents the noise predictions of light rail movements for Hunter Street receivers.

The maximum predicted LA_{eq} for LRV pass-by was<50dBA for receivers in Honeysuckle Drive. These predictions are below the measured and future modelled road traffic noise levels along Honeysuckle Drive. Therefore, as the project does not directly front the light rail corridor and is shielded by intervening buildings, light rail noise is expected to be <50dBA at the project façade and is acoustically insignificant compared to road traffic noise contributions.

Thus, attenuation recommendations to ameliorate the noise from road traffic are expected to adequately attenuate light rail noise.

4.3 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 summarised in **Table 14**, which provides typical performance of buildings with respect to noise reduction. A masonry residence with single 3mm glazing would be expected to provide a reduction of approximately 25dBA 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 14 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.

4.4 Operational Noise Modelling Methodology

An assessment of potential operational noise emissions from the project has been completed. The assessment has identified several noise sources that may generate acoustic impacts at surrounding residences, such as amplified music and speech/conversation impacts from residents and patrons. Additionally, operational noise from the terrace, mechanical plant and truck deliveries have been assessed against relevant NPI criteria and construction has been assessed against the ICNG. **Table 15** presents the sound power levels for each source assessed in this report.

Table 15 Sound Power Levels[1]

Item	Octave Band Sound Power Level, dBA									Total dBA
	31.5	63	125	250	500	1000	2000	4000	8000	
Operational Assessment (L_{Aeq})										
Air Conditioning Condensers (x10)	40	48	51	57	66	62	64	64	49	71
Kitchen Exhaust	35	42	44	70	73	68	61	51	31	76
Rooftop Talking/Conversations	46	52	58	63	68	68	67	62	55	73
Truck Deliveries	68	75	77	73	78	84	88	85	84	92
OLGR/NCC Technical Guideline Assessment (LA_{10})[2]										
Talking/Conversations and amplified music	47	59	64	72	76	75	73	66	69	81
Sleep Disturbance Assessment (L_{Amax})										
Conversation noise	45	62	73	80	85	87	84	82	80	92

Note 1: Source - MAC database.

Note 2: As per the OLGR policy, the LA_{10} sound power is required rather than the L_{Aeq}.

Brüel and Kjær Predictor Type 7810 (Version 11.10) noise modelling software was used to assess potential noise impacts associated with the project. A three-dimensional digital terrain map providing all relevant topographic information was 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. Patron noise represented by up to 160 patrons (80 per building) during day and evening periods, (assuming 50% of which are talking simultaneously) was modelled at the ground floor on the northern façade representative of potential usage of the future tenancies for both buildings. For the night period patron noise was reduced by 60% to reflect patronage amounts after 10pm. Residential and mechanical plant noise were modelled on the rooftop terrace of the development (see Site Plans in **Appendix C**). It is noted that the kitchen will have one exhaust operating at up to two potential

locations per building, this assessment has assumed two operating (ie one at each project building fronting Honeysuckle Drive). The model incorporated noise from up to 40 patrons (ie assumes 50% (20 individuals per building) of patrons talking simultaneously) on the rooftop terrace the project buildings. The model also includes attenuation from a 1.8metre high parapet surrounding the rooftop terrace.

For construction, a fleet sound power level of 108dBA, $LA_{eq(15min)}$ was adopted to quantify construction emissions to surrounding receivers. This sound power level is considered generally representative of average emissions from a variety of construction tasks for residential developments.

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'.

5 Results

5.1 Road Noise Prediction Results

Road noise predictions for the project based on estimated 2018 traffic flows were compared to measured levels at the unattended monitoring location on the project site. This is considered a good practice technique to validate the assumptions made in the assessment. Results of the validation demonstrate a consistent correlation (±<2dB tolerance) when compared against measured levels.

A review of floor plans (SJB Architects, 2018) (**Appendix C**) for the project have been completed as part of the assessment. Bedrooms and living rooms from Level 1 to Level 7 on the southern, eastern and western facades (ie the most exposed to road traffic) of the project have been included in this assessment. The ground floor consist of primarily commercial premises and contain no residential receivers, and hence, have not been included in this assessment.

Table 16 presents a comparison of predicted road traffic noise against the respective day and night internal criteria. **Appendix D** presents the road traffic noise contours for day $LA_{eq(15hr)}$ and night $LA_{eq(9hr)}$ assessment periods.

Table 16 Noise Prediction Results – 35 Honeysuckle Drive

Facade	Receptor Room Category[1]	Predicted level, LA_{eq}, dBA[2] (internal)				Internal Criteria LA_{eq}, dBA	
		Day		Night		Day	Night
		Western	Eastern	Western	Eastern		
Level 1							
West	Bedrooms	43	31	39	27	40	35
West	Living Room	43	31	39	27	40	40
South	Bedrooms	47	46	43	43	40	35
South	Living Room	47	46	43	43	40	40
East	Bedrooms	40	42	36	38	40	35
East	Living Room	40	42	36	38	40	40
Level 2							
West	Bedrooms	44	32	39	28	40	35
West	Living Room	44	32	39	28	40	40
South	Bedrooms	47	47	43	43	40	35
South	Living Room	47	47	43	43	40	40
East	Bedrooms	41	43	37	39	40	35
East	Living Room	41	43	37	39	40	40
Level 3							
West	Bedrooms	43	32	39	28	40	35

Table 16 Noise Prediction Results – 35 Honeysuckle Drive							
Facade	Receptor Room Category[1]	Predicted level, LAeq, dBA[2] (internal)				Internal Criteria LAeq, dBA	
		Day		Night		Day	Night
		Western	Eastern	Western	Eastern		
West	Living Room	43	32	39	28	40	40
South	Bedrooms	46	46	42	42	40	35
South	Living Room	46	46	42	42	40	40
East	Bedrooms	41	43	37	38	40	35
East	Living Room	41	43	37	38	40	40
Level 4							
West	Bedrooms	43	31	39	27	40	35
West	Living Room	43	31	39	27	40	40
South	Bedrooms	46	46	41	41	40	35
South	Living Room	46	46	41	41	40	40
East	Bedrooms	40	42	36	38	40	35
East	Living Room	40	42	36	38	40	40
Level 5							
West	Bedrooms	43	31	38	27	40	35
West	Living Room	43	31	38	27	40	40
South	Bedrooms	45	45	41	41	40	35
South	Living Room	45	45	41	41	40	40
East	Bedrooms	40	42	35	38	40	35
East	Living Room	40	42	35	38	40	40
Level 6							
West	Bedrooms	42	31	38	26	40	35
West	Living Room	42	31	38	26	40	40
South	Bedrooms	45	44	40	40	40	35
South	Living Room	45	44	40	40	40	40
East	Bedrooms	39	42	35	37	40	35
East	Living Room	39	42	35	37	40	40
Level 7							
West	Bedrooms	42	31	38	26	40	35
West	Living Room	42	31	38	26	40	40
South	Bedrooms	45	44	40	40	40	35
South	Living Room	45	44	40	40	40	40
East	Bedrooms	39	42	35	37	40	35
East	Living Room	39	42	35	37	40	40

Note 1: Determined from proposed site drawing plans (SJB, 2018).

Note 2: Internally predicted to habitable rooms. Adjustments made assuming attenuation (20dB) for the façade with windows closed and includes +2.5dB façade correction.

Results of the noise assessment demonstrate that internal noise criteria for some habitable rooms associated with the project would be exceeded if standard construction materials were used. Therefore, noise control recommendations are provided in **Section 6** to satisfy internal noise criteria.

5.2 Operational Noise Prediction Results (NPI Assessment)

Operational noise levels from the rooftop terrace (tenancy noise), mechanical plant and daytime deliveries (ie 7am to 6pm) for the project have been predicted to the nearest proposed residential receivers adjacent to the project at 50 Honeysuckle Drive, Newcastle, NSW (R1) and adjacent commercial receivers (see **Figure 1**).

Table 17 presents the single point calculation results and demonstrate that operational noise emissions from the project remain below the relevant PNTL for all assessed receivers.

Table 17 Predicted Operational Noise Levels - $L_{Aeq(15min)}$, dBA

Location	Period	Predicted Noise Level, $L_{Aeq(15min)}$ dBA[1,2]	PNTL, $L_{Aeq(15min)}$ dBA
R1A	Day	41	58
	Evening	39	53
	Night	35	43
R1B	Day	52	58
	Evening	<30	53
	Night	<30	43
C1	Day	46	63
C2	Day	54	63
C3	Day	55	63
C4	Day	50	63

Note: Monday to Saturday: Day 7am to 6pm; Evening 6pm to 10pm; Night the remaining periods. On Sundays and Public Holidays, Day 8am to 6pm; Evening 6pm to 10pm; Night the remaining periods.

Note 1: Assumes truck deliveries will only occur during the day assessment period (ie 7am to 6pm).

Note 2: Assumes 160 (50% in conversation) patrons associated with commercial tenancies during the day and evening and 64 (50% in conversation) patrons at night (ie 60% of capacity).

5.3 Harbour Noise Emissions

Harbour noise emission contributions were determined by direct attended measurements and supplemented with unattended noise monitoring. The harbour noise contribution for the project site at the time of the noise monitoring assessment was identified to be <40dBA and below the recommended amenity noise level for an urban environment. Therefore, harbour noise levels are anticipated to be adequately attenuated to internal spaces of the project adopting standard construction materials.

Furthermore, glazing recommended in this report to attenuate traffic is anticipated to be adequate to attenuate residual harbour noise.

5.4 OLGR Noise Assessment

Noise calculations have been completed to assess against the OLGR requirements. Results of the calculations are presented in **Table 18** for the nearest potentially most affected residential receiver (R1A).

Table 18 OLGR Noise Assessment Results

	L_{A10} Noise Criteria, Octave Band Centre Frequency (Hz), dBA								
dBA	31.5	63	125	250	500	1 k	2 k	4 k	8 k
Received level R1A	3	16	20	31	35	33	32	28	21
Criteria	20	34	41	45	46	46	44	34	28
Exceedance	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**

Calculations of noise emissions from the project to the nearest residential receiver (R1A) are identified to satisfy the OLGR noise criteria.

5.5 NCC Technical Guideline Assessment Results

A prediction of patron and amplified music from the project to the nearest receptor location (R1) has been compared against the NCC Technical Guideline criteria. Predicted noise levels from patrons and amplified music were adjusted to the $L_{Aeq30sec}$ values in accordance with the NCC Technical Guideline.

Internal transmission into R1A was assumed via the weakest path (the glass windows present on the eastern facade). The calculations made allowances (+10dB) for a partially opened window (approximately 5%) for ventilation in accordance with the NCC Technical Guideline. **Table 19** presents the results of internally predicted patron and amplified music noise levels at R1A. Noise predictions identify that noise emissions from patrons and moderate levels of amplified music from the project would satisfy relevant NCC Technical Guideline criteria.

Table 19 NCC Technical Guideline Criteria										
	1/3 Octave Band Centre Frequency (Hz), dBZ ($LA_{Max(fast)}$/$LA_{eq30sec}$)									
	31.5	40	50	63	80	100	125	160	200	250
Criteria	50.0	42.8	36.2	30.6	25.6	21.3	17.2	13.1	9.5	6.5
Prediction (via windows)[1]	4.7	-0.1	8.5	4.5	0.8	1.4	-1.6	-4.3	4.2	1.9
Difference, dB	-45	-43	-28	-26	-25	-20	-19	-17	-5	-5

Note 1: Calculated to a point immediately inside the room boundary.

5.6 Sleep Disturbance

A comparison of LA_{max} noise emissions associated with the project (elevated conversations/yelling) from both the rooftop terrace and ground floor commercial tenancies have been assessed against the EPA sleep disturbance criteria.

Table 20 Sleep Disturbance Predicted Emission Noise – LA_{max}, dBA			
Receiver	Source	Predicted LA_{max} noise levels, dBA	Sleep Disturbance Criteria LA_{max}
Residential Receivers			
R1A	Ground floor tenancy	52	58
R1A	Rooftop Terrace	<40	58

Results of the sleep disturbance calculations are identified to remain below the sleep disturbance screening criteria of 58dBA LA_{max} at all residential receivers. Therefore, sleep disturbance due to noise sources associated with the proposal are unlikely to cause awakening reactions to future adjacent residences.

5.7 Construction Noise Results

Predicted $LA_{eq(15min)}$ noise emissions for modelled construction are presented in **Table 21**. Noise modelling identifies that construction activities would remain below relevant NMLs. Furthermore, noise modelling identifies that construction emissions would satisfy the highly noise affected NMLs. Notwithstanding, management measures should be considered during the construction phase of the project to minimise impact to the surrounding community.

Table 21 Construction Noise Emissions, $LA_{eq(15min)}$		
Receiver ID	$LA_{eq(15min)}$, dBA	NML, LA_{eq}
R1A	61	63
R1B	62	63
C1	58	70
C2	62	70
C3	62	70
C4	59	70

6 Discussion and Summary of Recommendations

6.1 Road Noise Recommendations

Standard domestic glass is usually inadequate acoustically and can reduce the acoustic attenuation performance of the overall building facade. Upgrade options include thicker laminated glass or double-glazed laminated windows with an air gap between panels. The frames and air gaps should be adequately sealed to optimise noise reduction.

As windows must remain closed for effective noise reduction, alternative means of internal ventilation (eg air conditioning or wall ventilators) must be considered to allow windows to remain fully closed (refer to BCA requirements).

Table 22 provides the recommended minimal building categories as per the guideline (see **Appendix E**) for the project site.

Table 22 Noise Attenuation Recommendations – 35 Honeysuckle Drive

Facade	Minimum Guideline Category for Glazing Treatments[1, 2, 3]
Building 1 (Western)	
North	Category 2[4]
West	Category 2
East	Category 1
South	Category 3
Building 2 (Eastern)	
North	Category 2[4]
West	Category 1
East	Category 2
South	Category 3

Note 1: Category 1 glazing requirements include – Windows/Sliding Doors: Openable with minimum 4mm monolithic glass and standard weather seals.

Note 2: Category 2 glazing requirements include – Windows/Sliding Doors: Openable with minimum 6mm monolithic glass and full perimeter acoustic seals.

Note 3: Category 3 glazing requirements include – Windows/Sliding Doors: Openable with minimum 6.38mm laminated glass and full perimeter acoustic seals.

Note 4: Recommended to ameliorate against industrial/port noise rather than traffic.

6.2 Construction Noise Recommendations

Recommendations for consideration during construction and demolition activities to reduce emissions to the surrounding community for this project may include:

- implement any boundary fencing as early as possible to maximise their attenuation benefits;
- toolbox and induction of personnel prior to shift to discuss noise control measures that may be implemented to reduce noise emissions to the community;
- all plant should be shutdown when not in use. Plant to be parked/started at farthest point from relevant assessment locations (ie northern boundary);
- 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.

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed an assessment of potential noise impacts associated with the proposed multi storey development at 35 Honeysuckle Drive, Newcastle, NSW.

The assessment has quantified noise intrusion to the proposed development from transportation noise, and emissions from the development to surrounding receivers.

With respect to road noise attenuation and to protect the internal acoustic amenity of the development, window elements for the project should be considered to be upgraded to the specifications listed in Section 6.

Noise emission from the project including patrons from the ground floor tenancies, rooftop mechanical plant and tenants, and daytime deliveries are demonstrated to remain below relevant operational and sleep disturbance criteria for all assessed receivers. Furthermore, harbour noise emissions are anticipated to satisfy internal noise criteria for the project.

Construction noise emissions are predicted to remain below relevant noise management levels, notwithstanding to minimise community impacts recommendations have been provided for consideration.

Following the findings of the noise assessment, it is recommended that the development is approved based on noise control assumptions/recommendations and referenced architectural plans provided in this report.

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Appendix A – Glossary of Terms

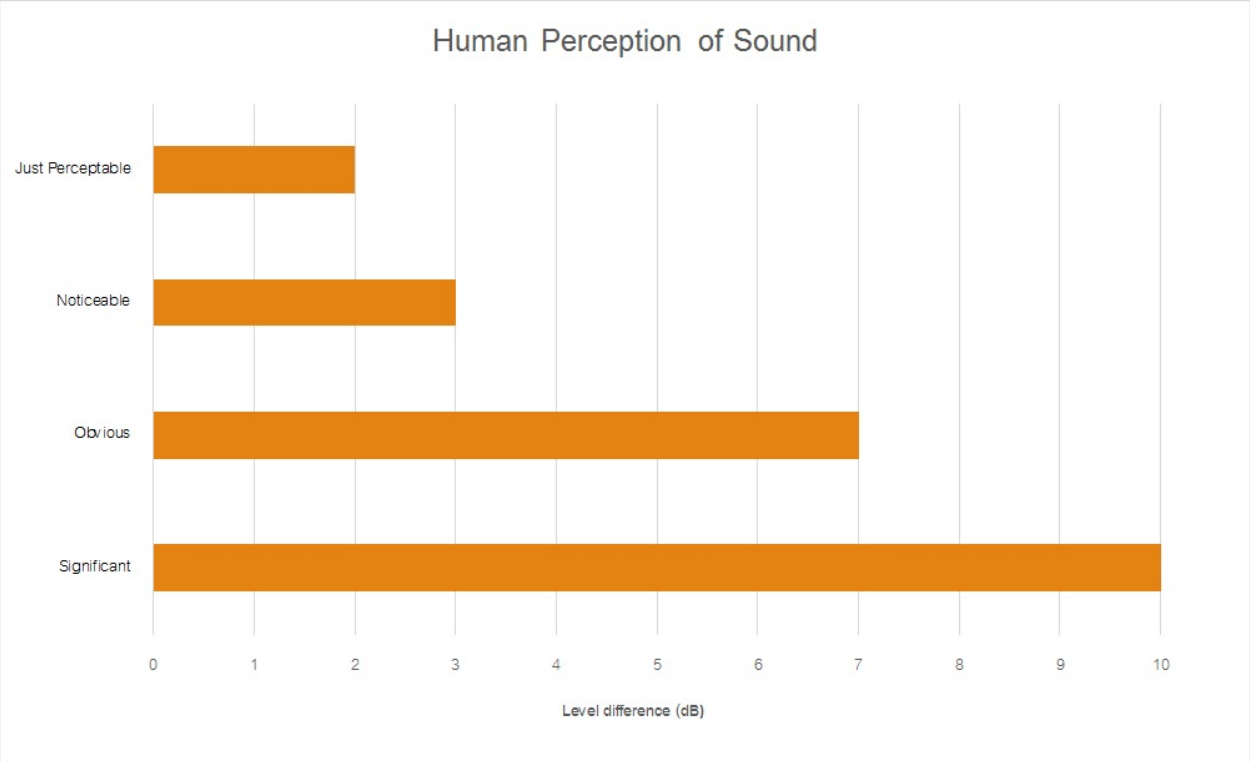
Table A1 provides a number of technical terms have been used in this report.

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

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

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

Figure A1 – Human Perception of Sound



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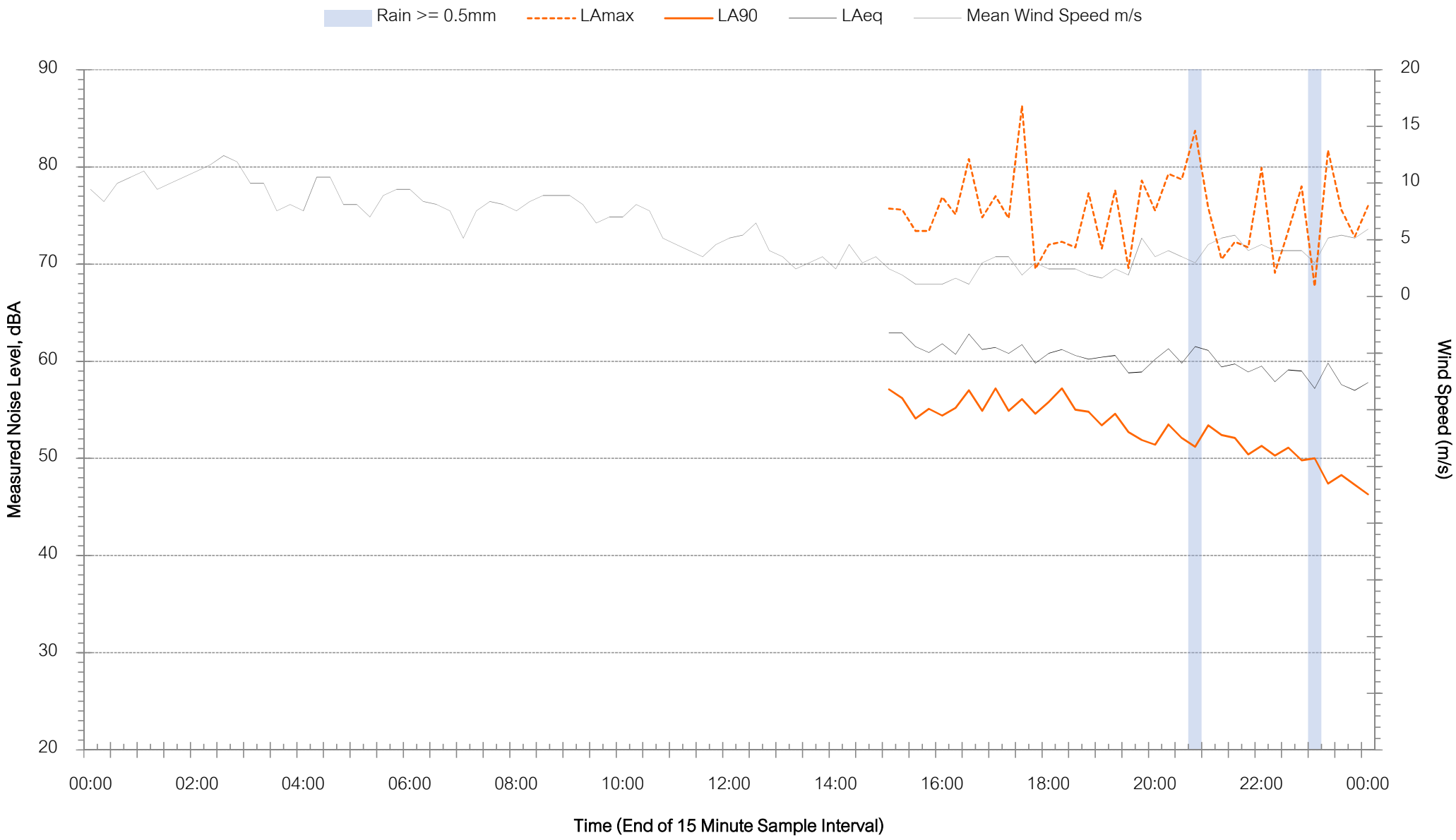
Appendix B – Noise Logging Data

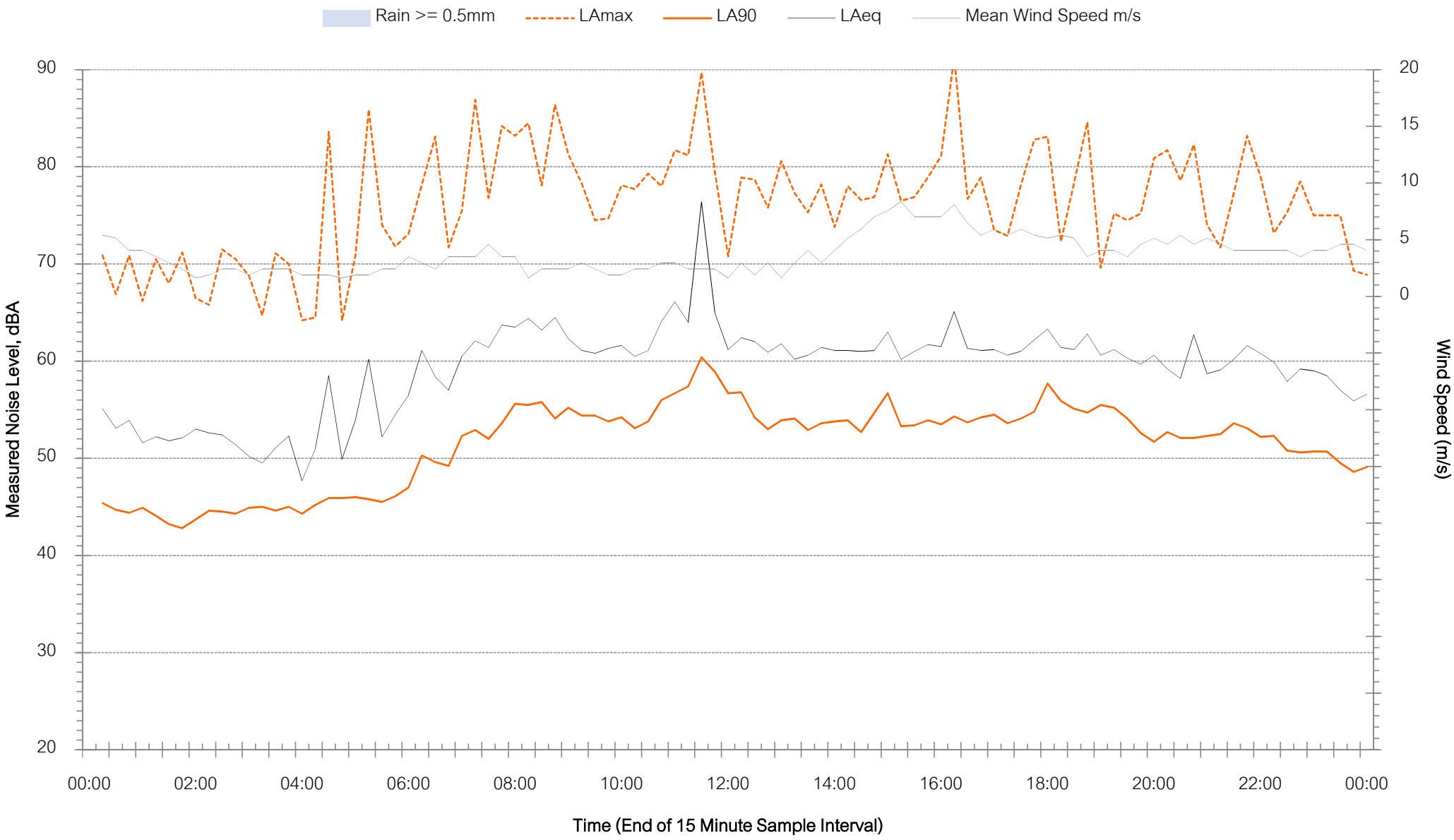
Background Noise Levels

35 Honeysuckle Drive, Newcastle - Friday 23 March 2018



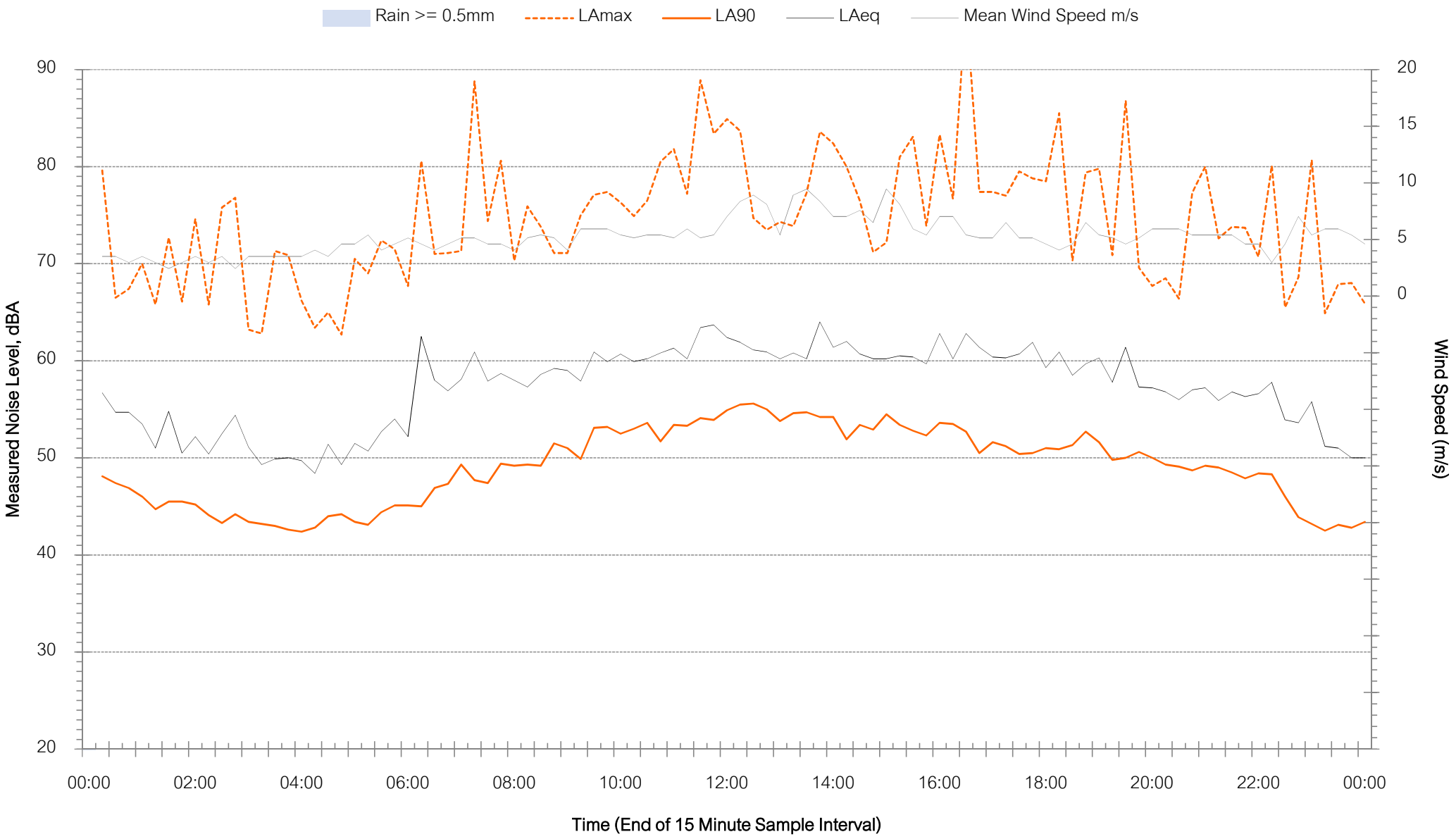
Background Noise Levels

35 Honeysuckle Drive, Newcastle - Saturday 24 March 2018



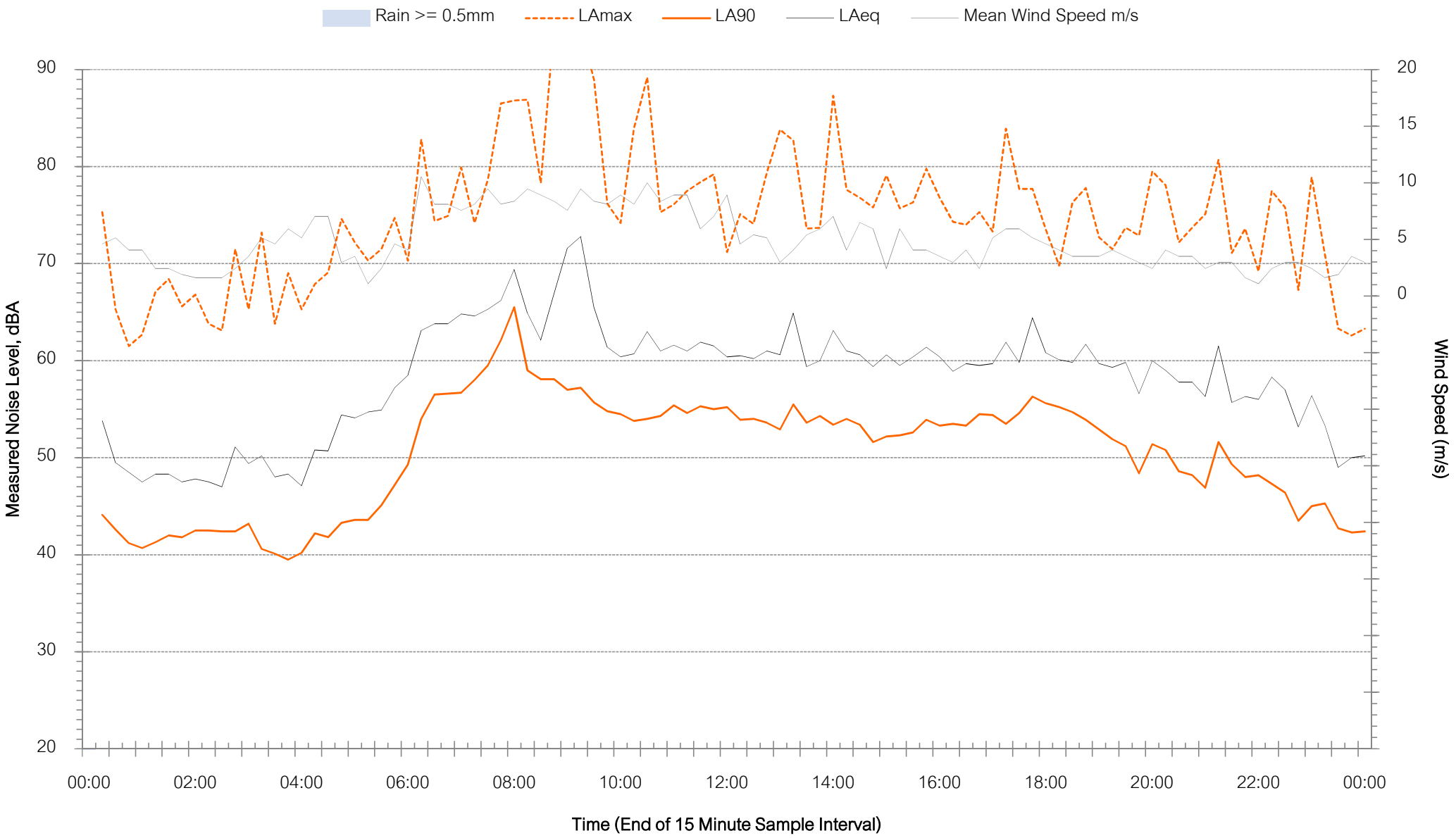
Background Noise Levels

35 Honeysuckle Drive, Newcastle - Sunday 25 March 2018



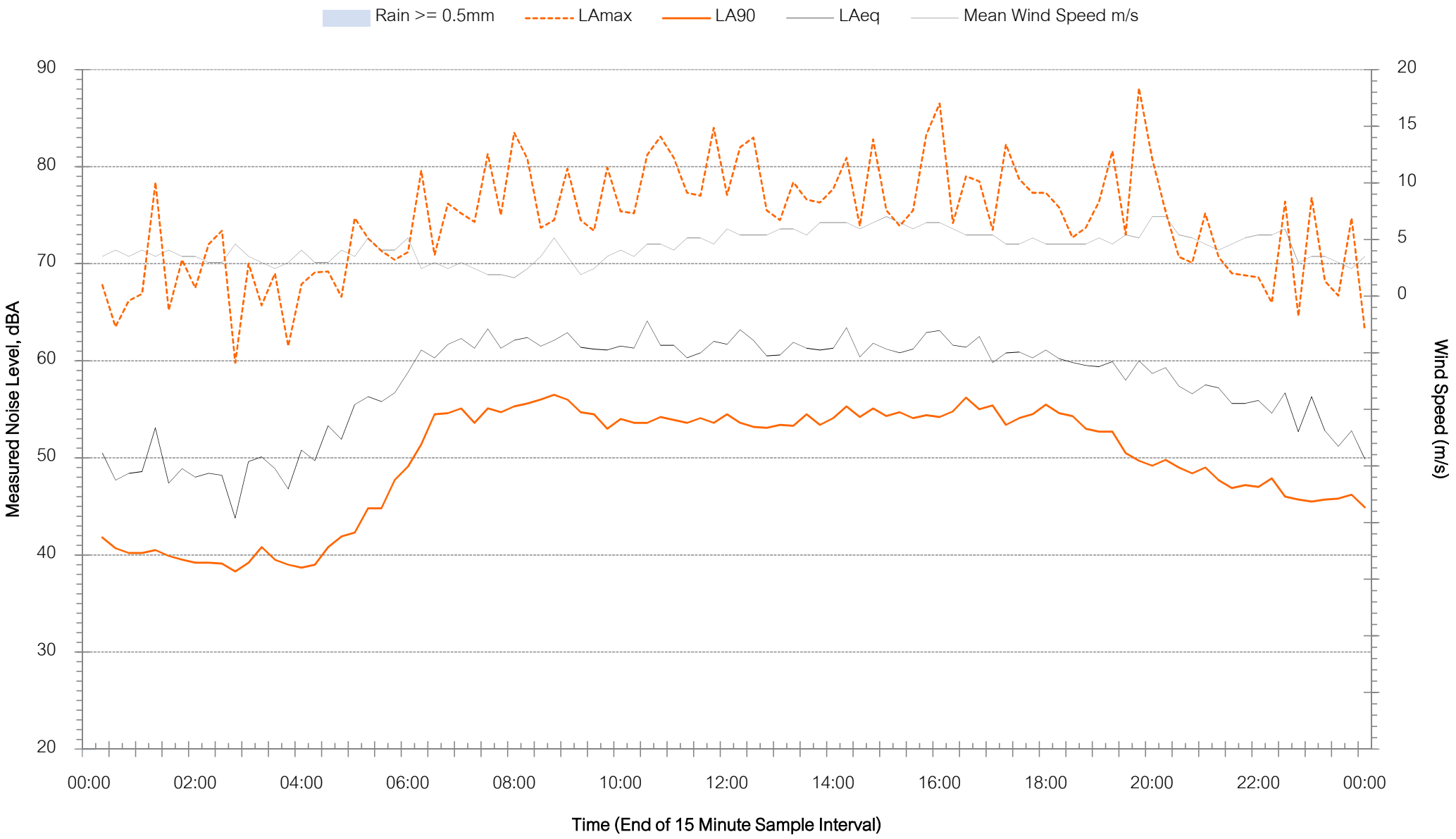
Background Noise Levels

35 Honeysuckle Drive, Newcastle - Monday 26 March 2018



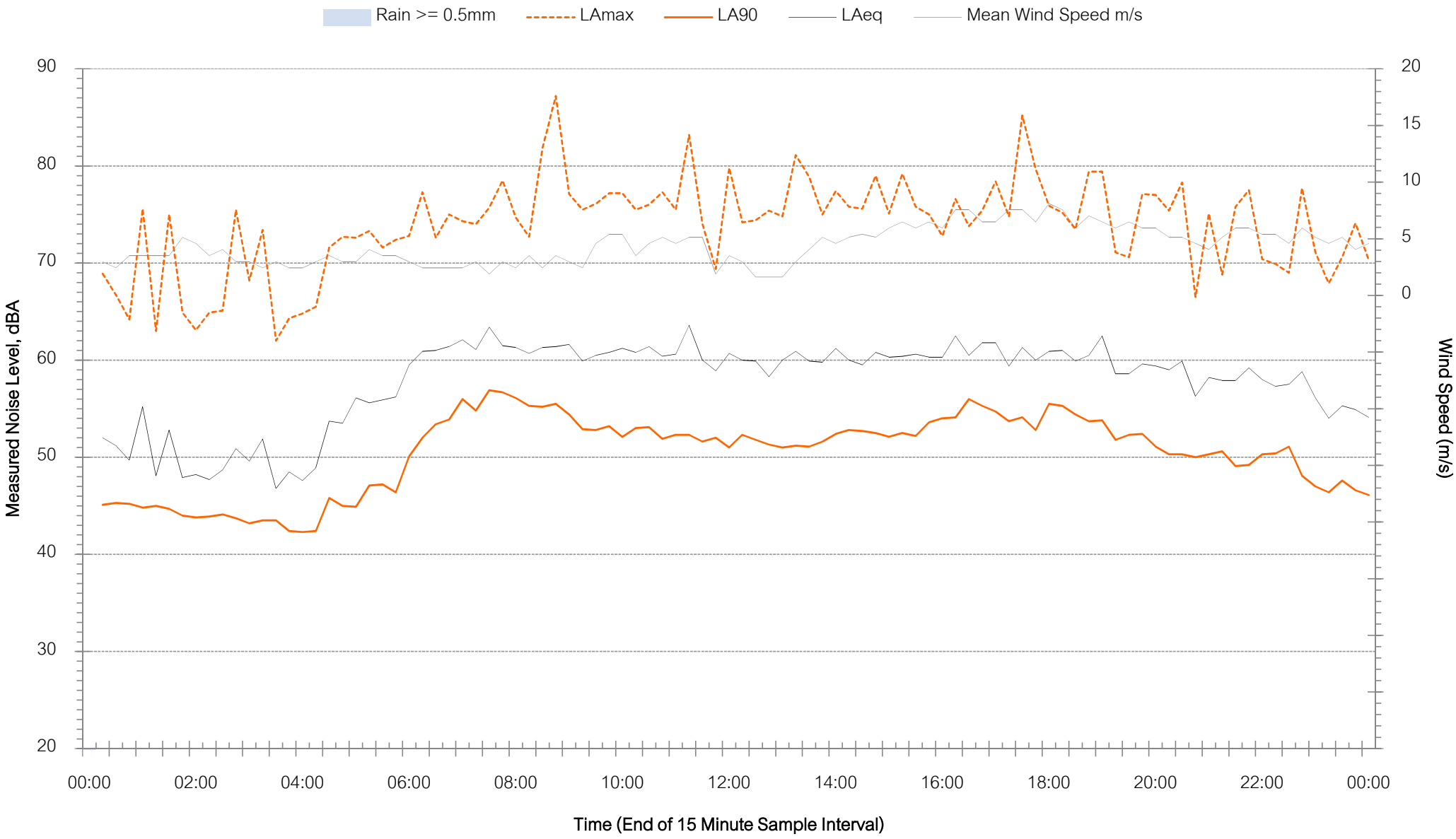
Background Noise Levels

35 Honeysuckle Drive, Newcastle - Tuesday 27 March 2018



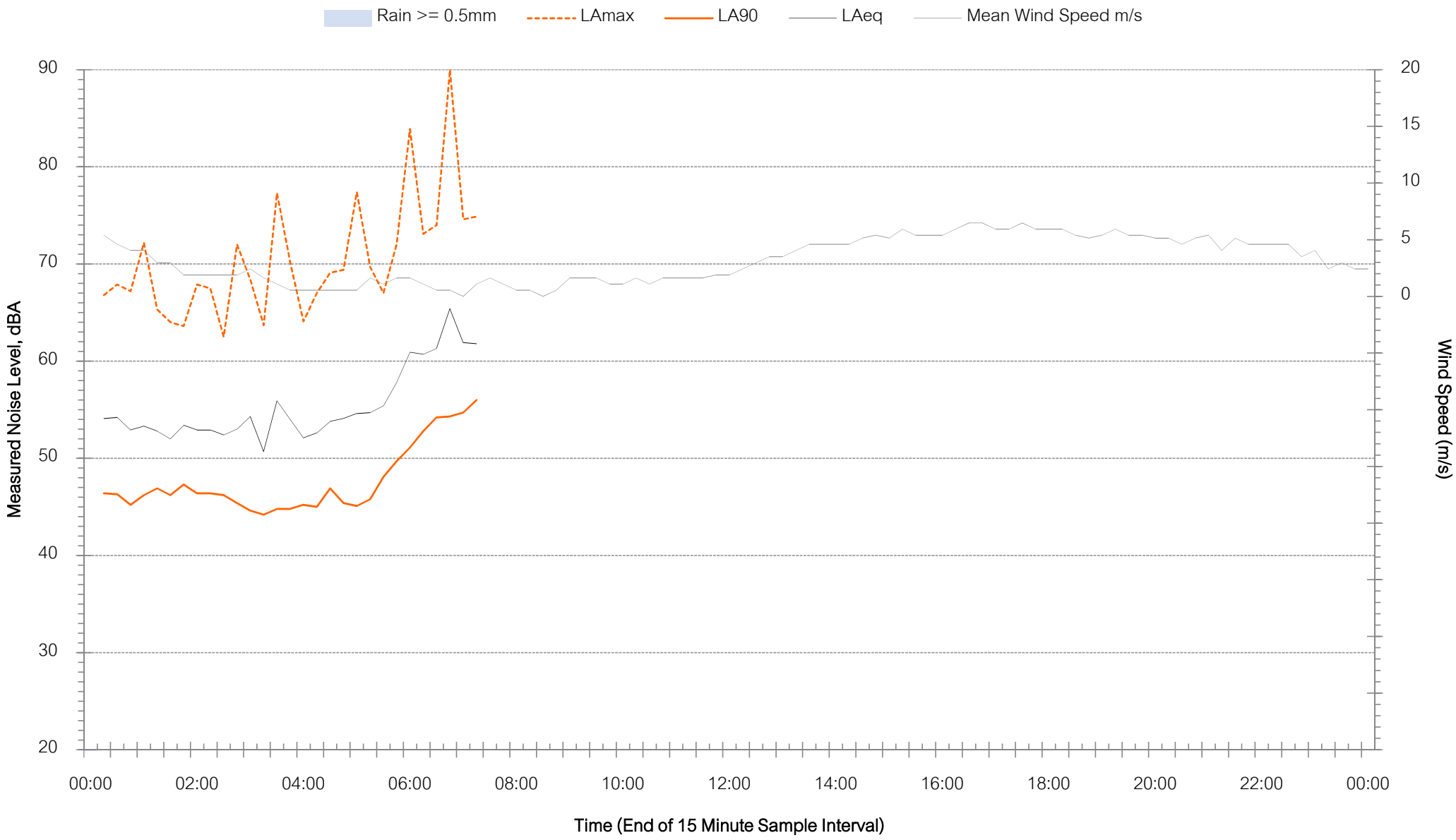
Background Noise Levels

35 Honeysuckle Drive, Newcastle - Wednesday 28 March 2018

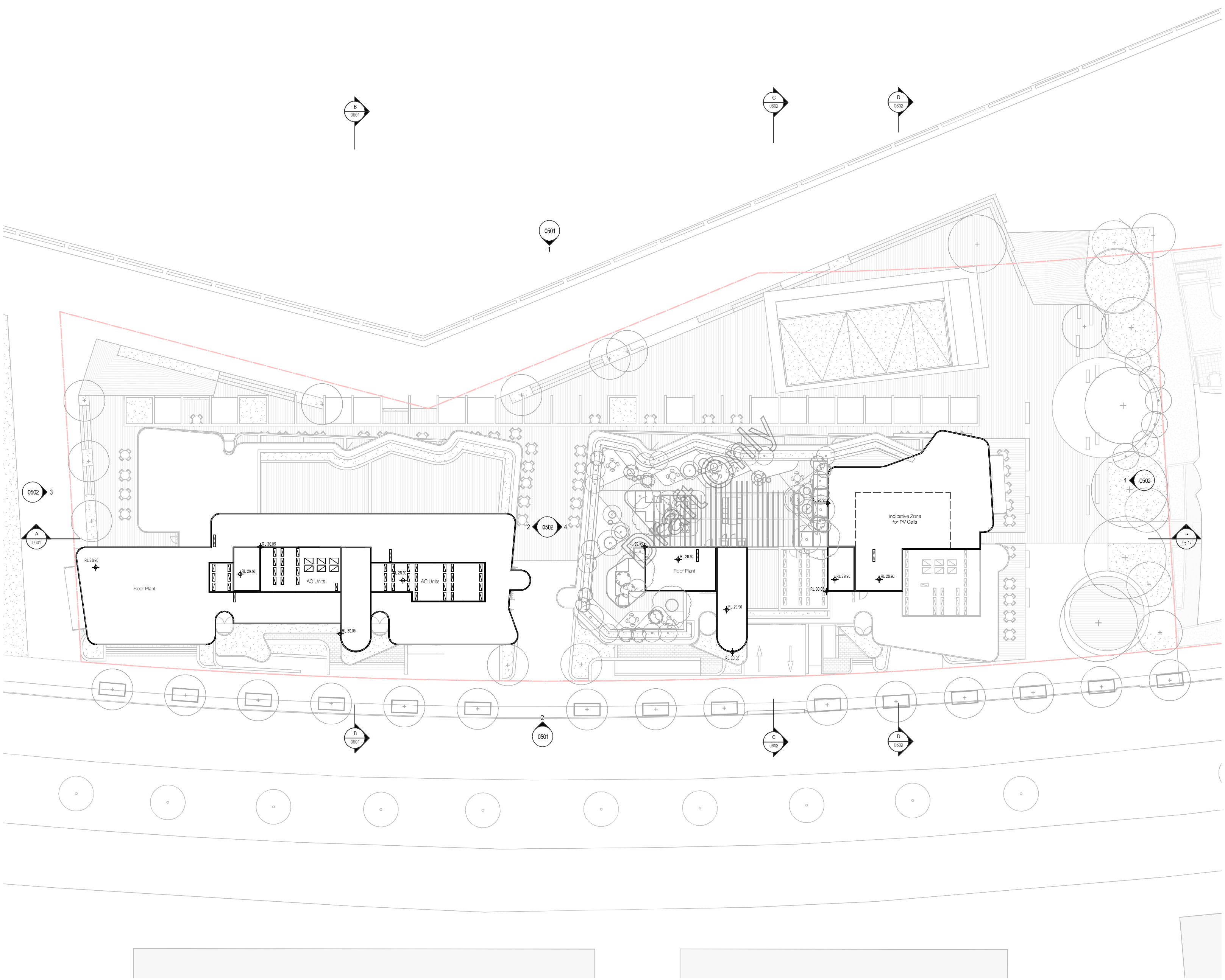


Background Noise Levels

35 Honeysuckle Drive, Newcastle - Thursday 29 March 2018



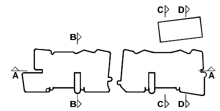
Appendix C – Site Plans



Nominated Architects: Adam Haddow-7188 | John Pradel-7004

FOR APPROVAL

Rev	Date	Revision	By	Chk.
01	04.05.18	Issued to Consultants	MJL	EW
02	11.05.18	Issued to Consultants	MJL	EW
03	06.06.18	Issued for Review	MJL	EW
04	09.07.18	Issued for Approval	MJL	AH



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Drawing Name
Roof Plan

Date	Scale	Sheet Size
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MJL	EW

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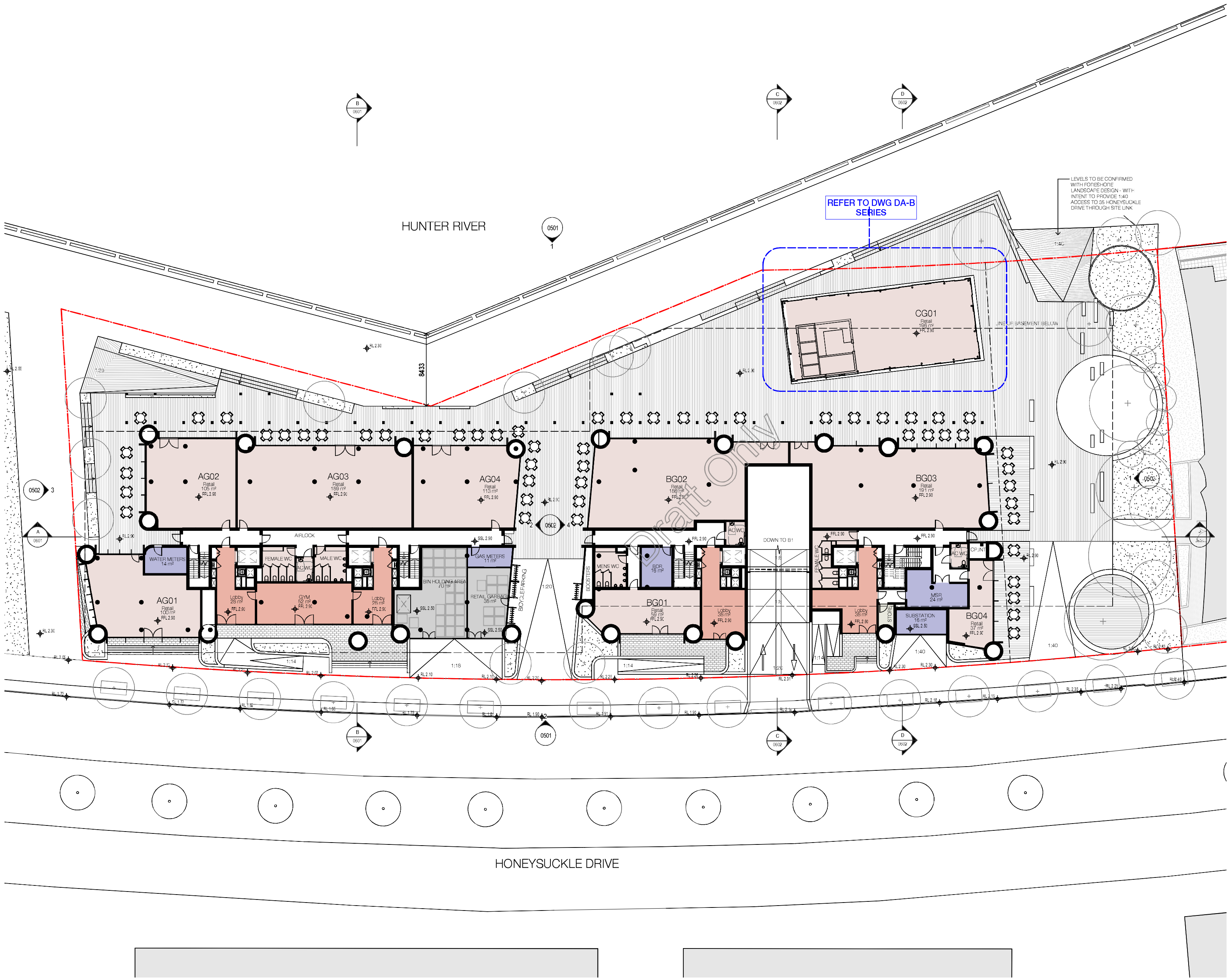

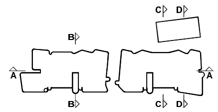

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Drawing Name
Floor Plan - Ground Floor

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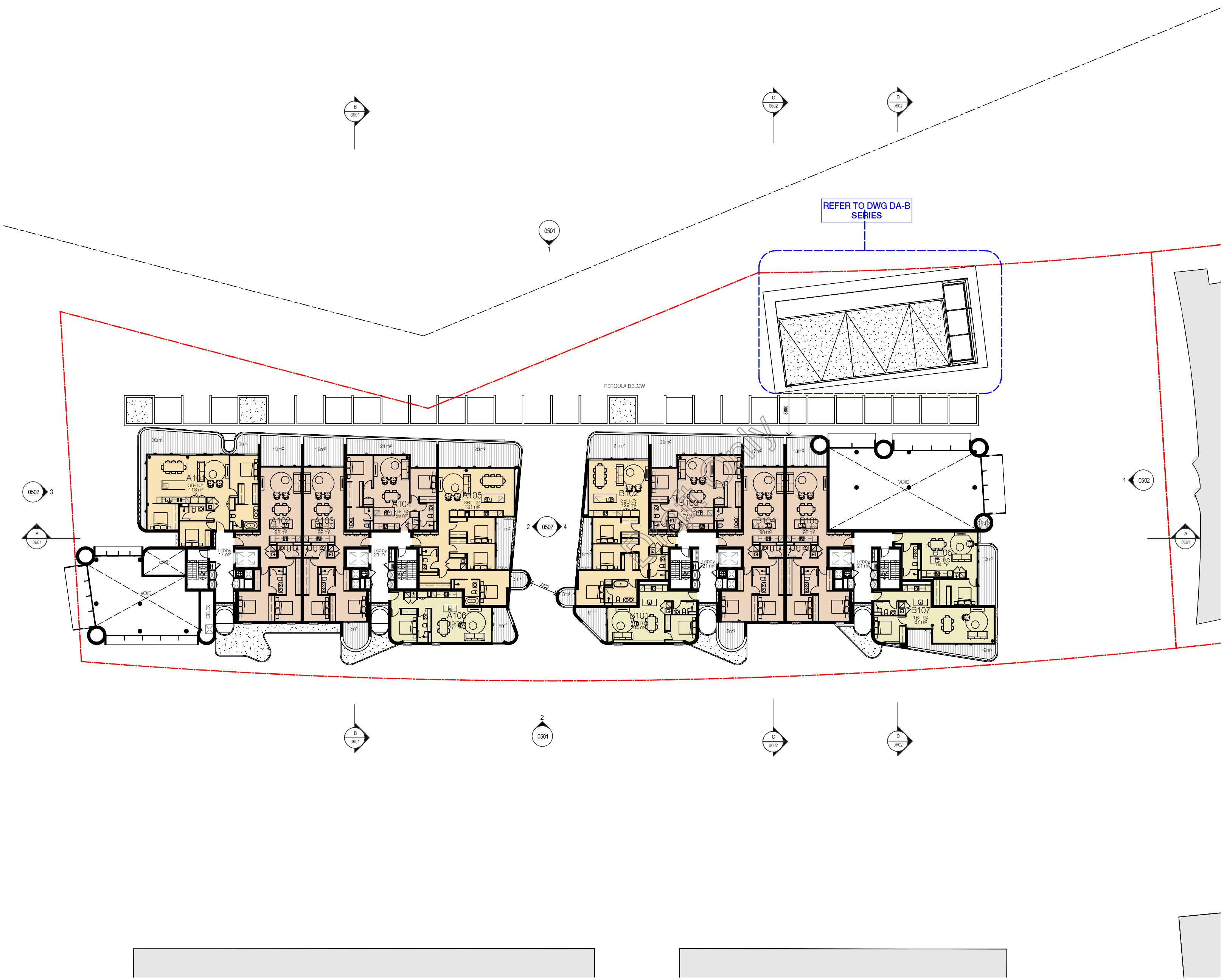

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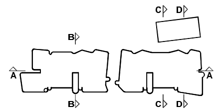

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Drawing Name
Floor Plan - Level 01

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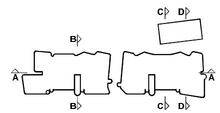

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Drawing Name
Floor Plan - Level 02

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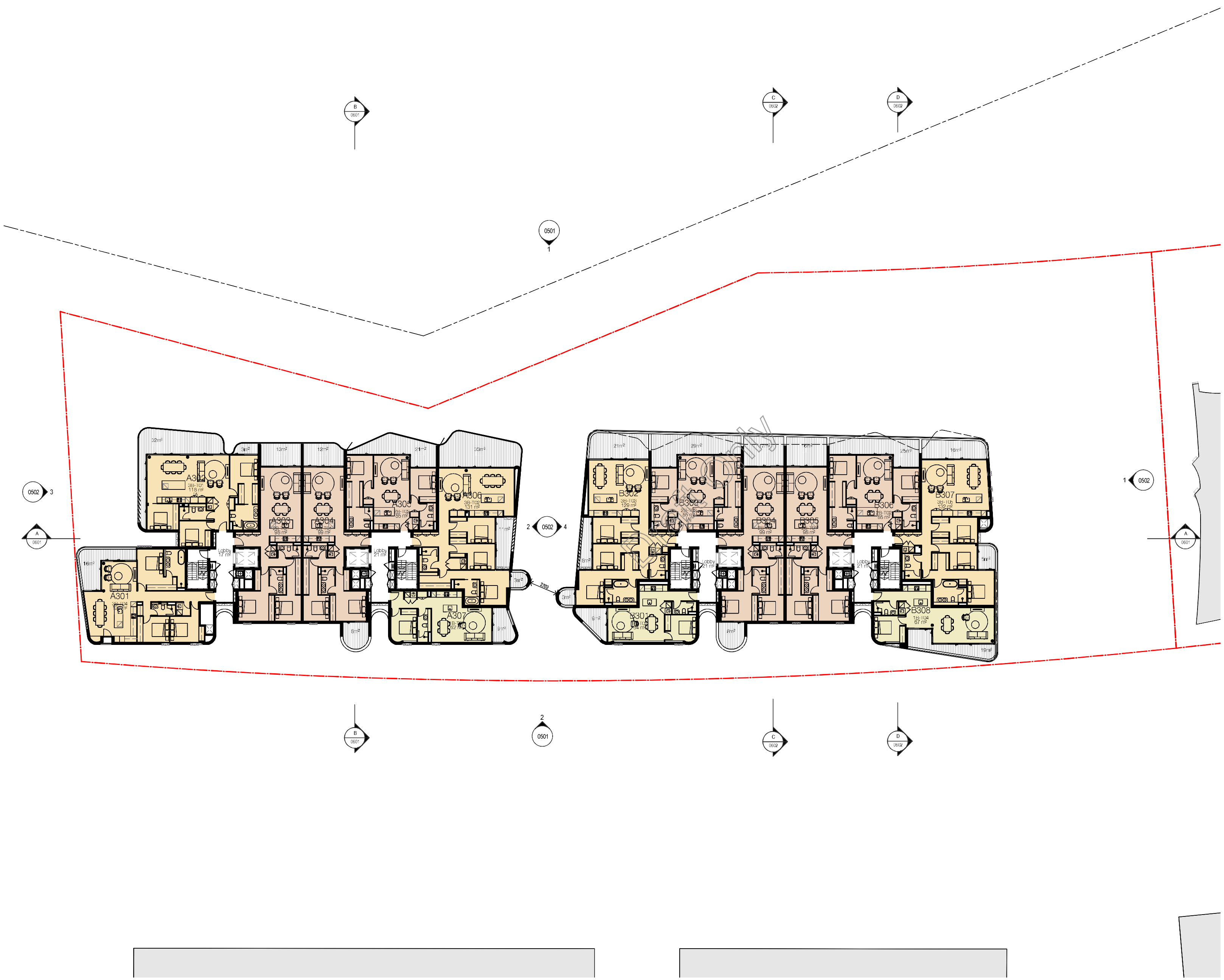

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Newcastle, NSW 2300

Drawing Name
Floor Plan - Level 03

Date	Scale	Sheet Size
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Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0206	04

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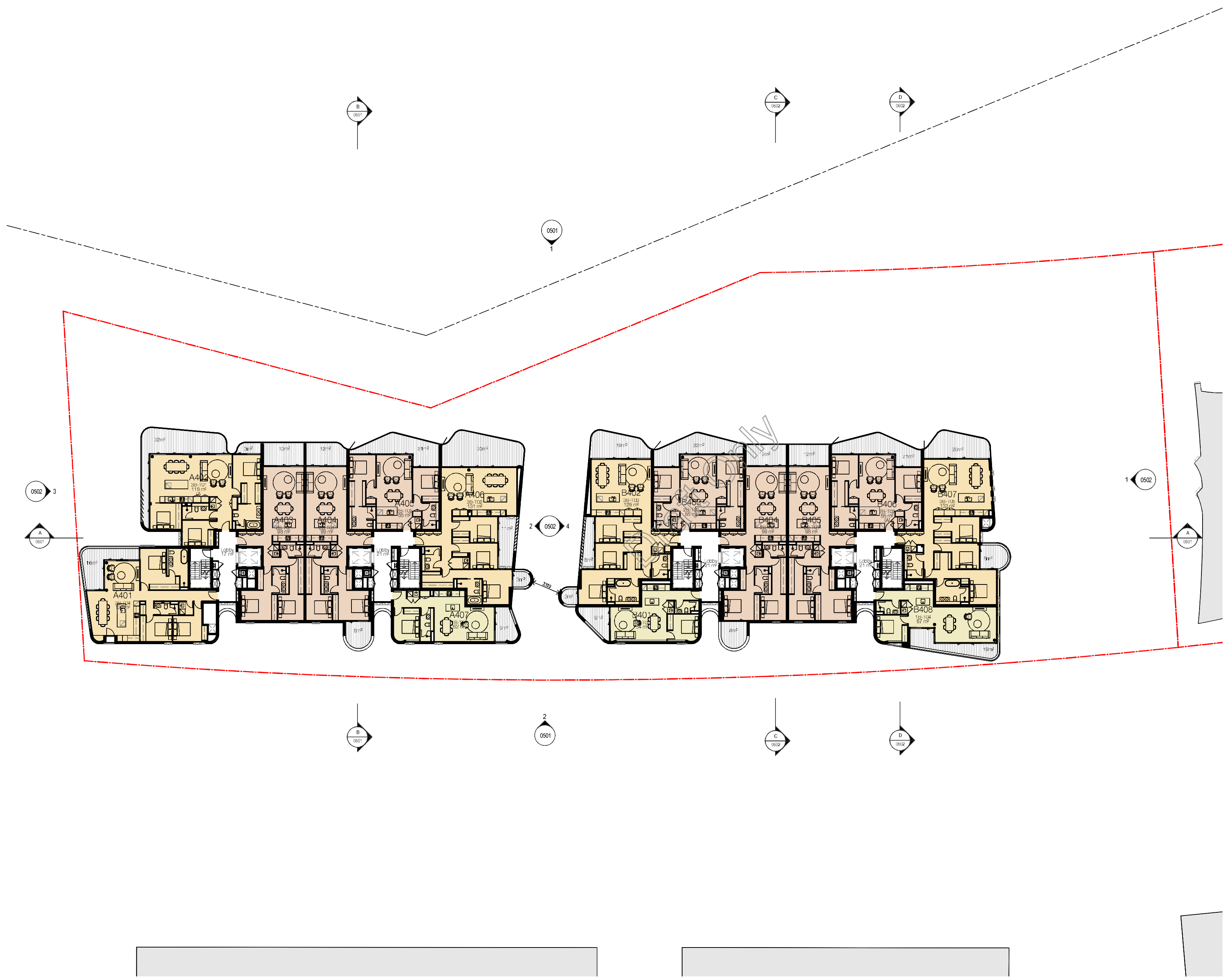
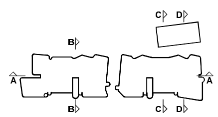


Nominated Architects: Adam Haddow-7188 | John Pradel-7004

FOR APPROVAL

Rev	Date	Revision	By	Chk.
01	04.05.18	Issued to Consultants	MJL	EW
02	11.05.18	Issued to Consultants	MJL	EW
03	06.06.18	Issued for Review	MJL	EW
04	09.07.18	Issued for Approval	MJL	AH



Structural Engineer
Northrop Consulting Engineers

Mechanical / Hydraulic Engineer
S4B / WPFD

Electrical Engineer
S4B

Fire Engineer
WPFD

Access Consultant
Phillip Chun

Basix
David Gradwell

Client
DOMAGROUP

Project
35 Honeysuckle

35 Honeysuckle Drive
Newcastle, NSW 2300

Drawing Name
Floor Plan - Level 04-06

Date	Scale	Sheet Size
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Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0207	04

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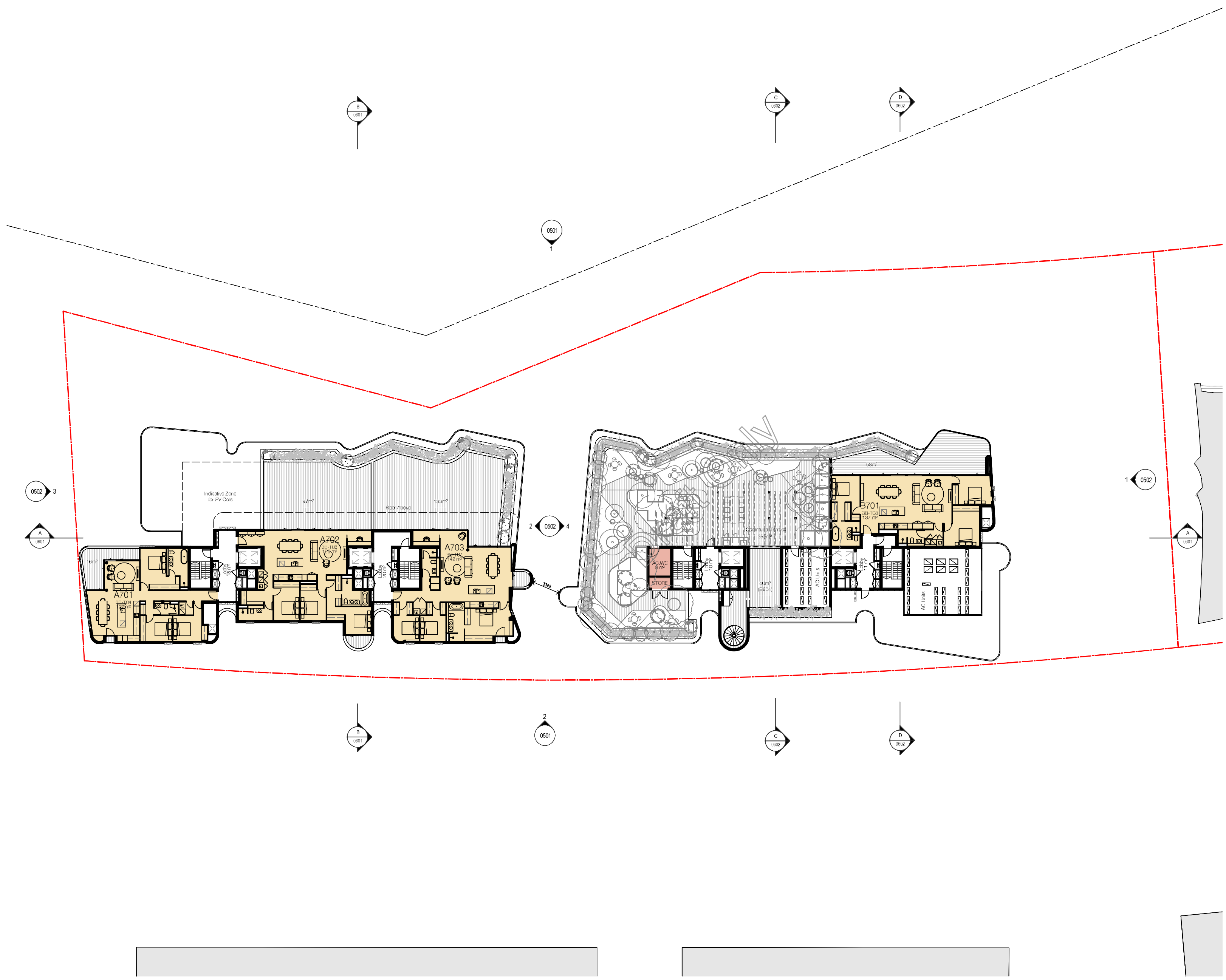

Nominated Architects: Adam Haddow-7188 | John Pradel-7004

FOR APPROVAL

Rev	Date	Revision	By	Chk.
01	04.05.18	Issued to Consultants	MJL	EW
02	11.05.18	Issued to Consultants	MJL	EW
03	06.06.18	Issued for Review	MJL	EW
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Structural Engineer
Northrop Consulting Engineers

Mechanical / Hydraulic Engineer
S4B / WPFD

Electrical Engineer
S4B

Fire Engineer
WPFD

Access Consultant
Phillip Chun

Basix
David Gradwell

Client

DOMAGROUP

Project
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Newcastle, NSW 2300

Drawing Name
Floor Plan - Level 07

Date	Scale	Sheet Size
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Drawn	Chk.
MJL	EW

Job No.	Drawing No.	Revision
5711	DA-A-0210	04

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Appendix D – Contours

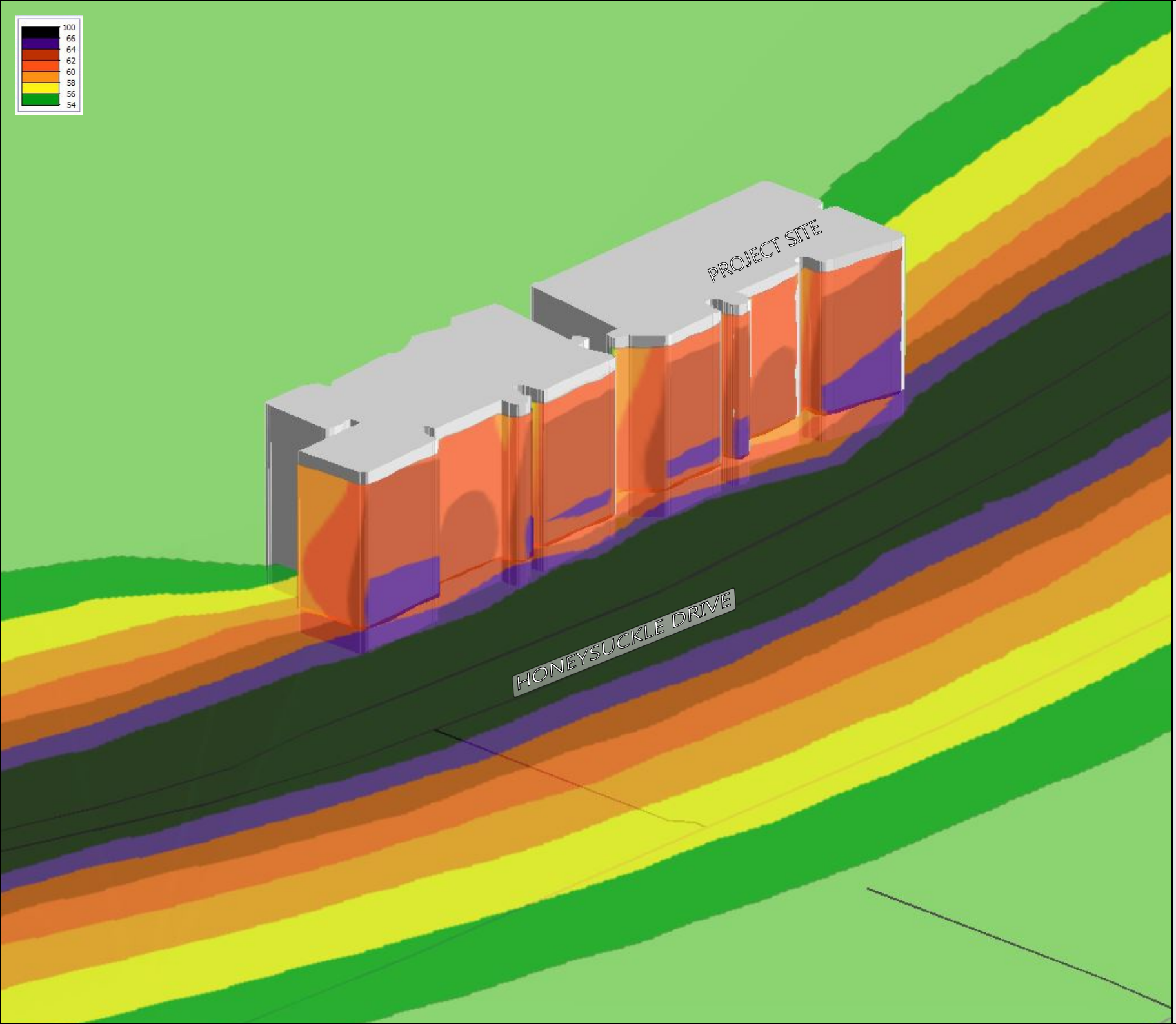

FIGURE D1

DAYTIME ROAD NOISE CONTOURS

LAeq15hr, dBA

REF: MAC170597

MAC
Muller Acoustic Consulting

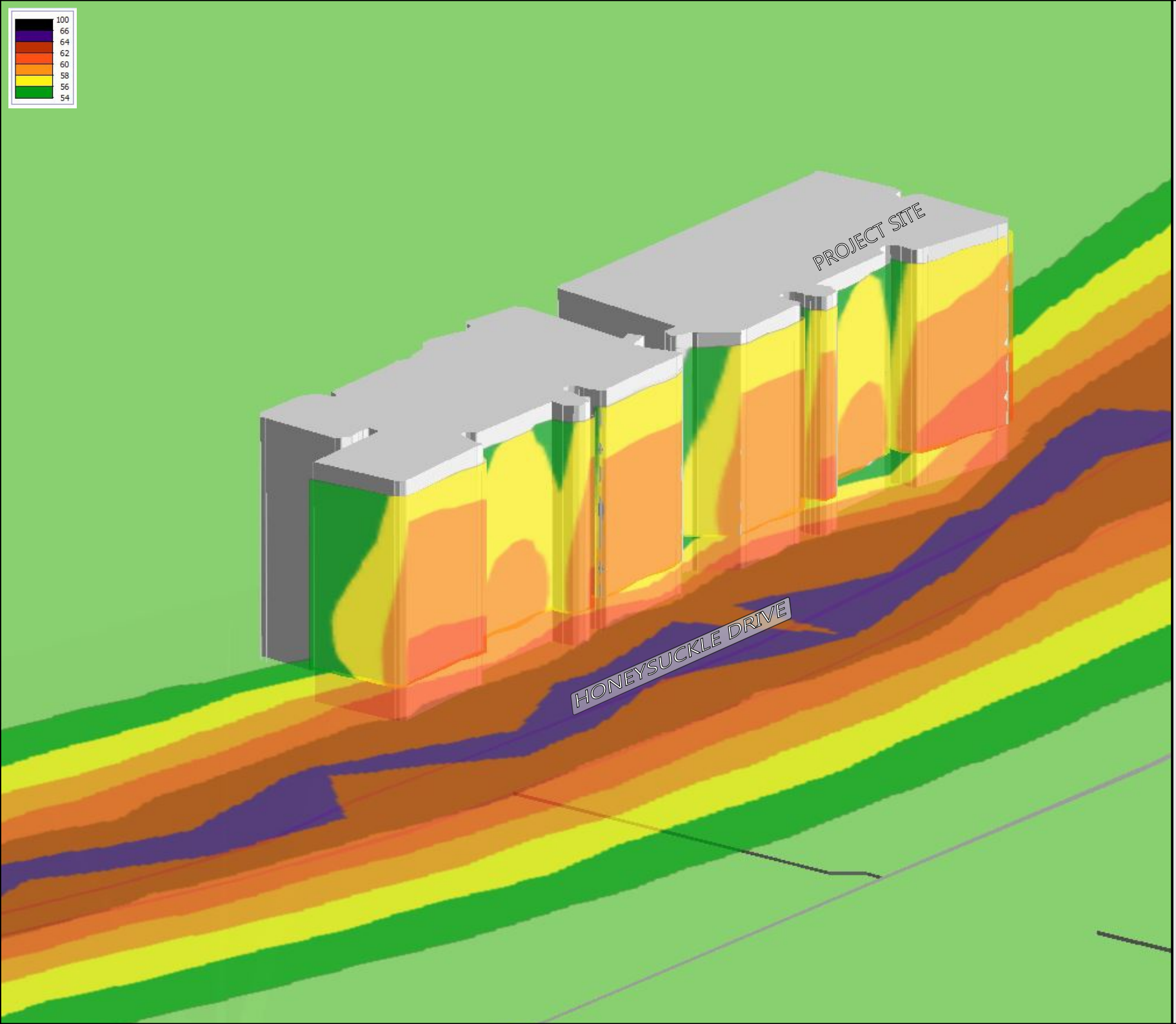

FIGURE D2

NIGHT ROAD NOISE CONTOURS

LAeq9hr, dBA

REF: MAC170597

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Appendix E – Category 1, 2 and 3

Construction Materials

Appendix C – Acoustic Treatment of Residences

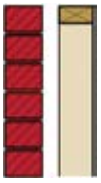
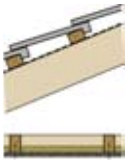
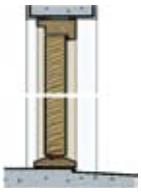
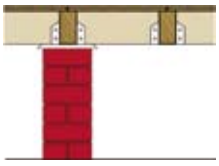
The following table sets out standard (or deemed-to-satisfy) constructions for each category of noise control treatment for the sleeping areas and other habitable areas of single / dual occupancy residential developments only. The assumptions made in the noise modelling are as follows:

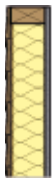
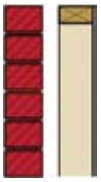
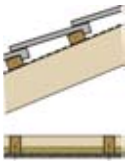
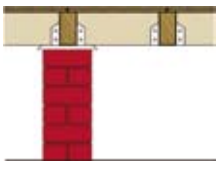
- Typical layout of a modern dwelling taken from a recent large residential development in an outer Sydney suburb
- Bedrooms and other habitable rooms are exposed to road noise

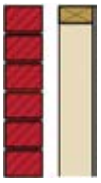
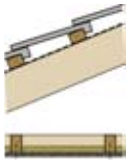
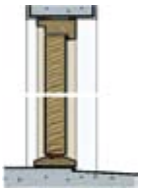
ACOUSTIC PERFORMANCE OF BUILDING ELEMENTS

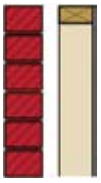
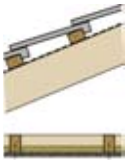
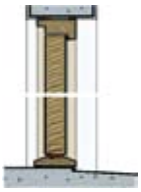
The acoustic performances assumed of each building element in deriving the Standard Constructions for each category of noise control treatment presented in the preceding Table, are presented below in terms of Weighted Sound Reduction Index (Rw) values, which can be used to find alternatives to the standard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

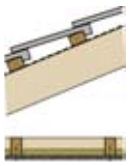
Category of Noise Control Treatment	R_w of Building Elements (minimum assumed)				
	Windows/Sliding Doors	Frontage Facade	Roof	Entry Door	Floor
Category 1	24	38	40	28	29
Category 2	27	45	43	30	29
Category 3	32	52	48	33	50
Category 4	35	55	52	33	50
Category 5	43	55	55	40	50

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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