



Project Apollo Data Centre (4-10 Talavera Road, Macquarie Park)

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

1-11 Hayes Road
Rosebery, NSW 2018

Prepared by:

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Basis of Report

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1.0 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Goodman Property Services Pty Ltd to undertake a noise impact assessment in support of a State Significant Development Application (SSDA) for a data centre at 4-10 Talavera Road, Macquarie Park.

SLR is suitably qualified and endorsed by the Planning Secretary to produce SSD noise impact assessments. SLR is a member of the Australian Acoustical Society (AAS) and a member firm of the Association of Australasian Acoustical Consultants (AAAC).

This report summarises the assessment of the potential construction and operational noise impacts associated with the proposal.

The following report uses specialist acoustic terminology. An explanation of common terms is provided in **Appendix A**.

1.1 Proposal Description

A State Significant Development Application (SSDA) has been prepared in support of a data centre at 4-10 Talavera Road, Macquarie Park. The site comprises four individual allotments totalling approximately 25,211 m² in area, is zoned E3 Productivity Support.

The proposal will include:

- Site preparation works including demolition, bulk excavation and removal of existing structures on the site, tree and vegetation clearing and bulk earthworks
- Construction, fit out and operation of five-storey, 135 MVA data centre tower with a maximum building height of 45 m and total gross floor area of approximately 29,668 m² comprising:
 - 60 at-grade parking spaces
 - Two (2) loading dock spaces
 - Four (4) levels of technical data hall floor space with two (2) data halls per floor
 - Ancillary office space and amenities on Lower Ground Level
 - Offices and amenities located from Mezzanine Level to Level 5
- Provision of required utilities including:
 - Eleven (11) in-ground diesel storage tanks
 - Five (5) above-ground water tanks
 - Three (3) 33kV switch-rooms on site
- Vehicle and pedestrian access provided via Talavera Road
- Associated landscaping and site servicing
- Installation of site services and drainage infrastructure
- A floor space ratio of approximately 1.18:1.

The site is located in Darug Land and is in Macquarie Park within the City of Ryde Local Government Area (LGA). It is bound by Talavera Road to the south, Lane Cove Road to the east, the Macquarie Technology Park to the west and the M2 Motorway to the north.



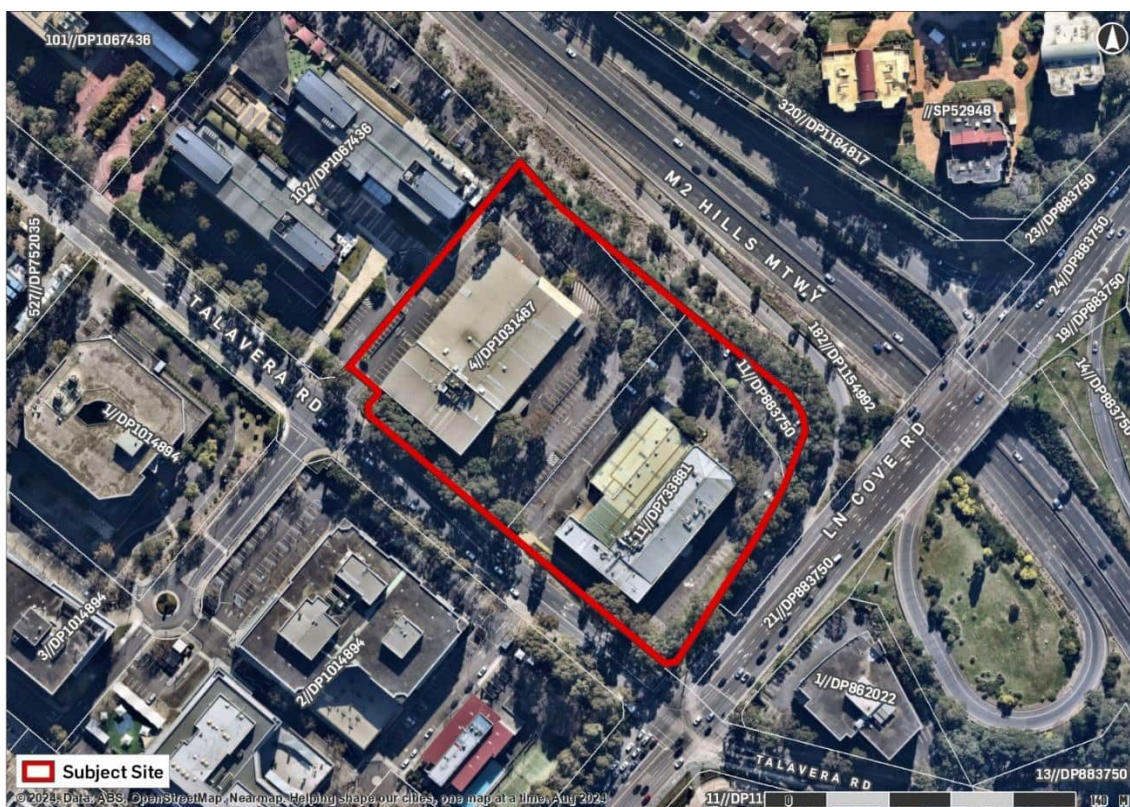
The site is located within the Macquarie Park Corridor which is a significant economic and employment precinct in Sydney's North District. The Macquarie Park Corridor contains a range of land uses including Abbot Laboratories medical device company, Ryde Resource Recovery Centre, Excelsia College, Macquarie Shopping Centre, North Ryde Meriton Suits and Macquarie University.

The site comprises four individual allotments totalling 25,111 m². It is currently occupied by two warehouse buildings with ancillary offices space that is utilised for storage and distribution purposes.

The closest residential uses to the site are approx. 100 m north of the site across the M2 Motorway and 115 m to the north-east of the site at Fontenoy Road, Macquarie Park.

The site is well serviced by transport and is within close proximity to Lane Cove Road and M2 Motorway. The site is approximately 430 m north of the Macquarie Park Metro station which is on the Sydney Metro City and Southwest line. This provides access to Chatswood, Sydney CBD and south-west beyond to Bankstown. The site and local context are shown in **Figure 1** and **Figure 2**. The proposed layout of the data centre is shown in **Figure 3** to **Figure 5**.

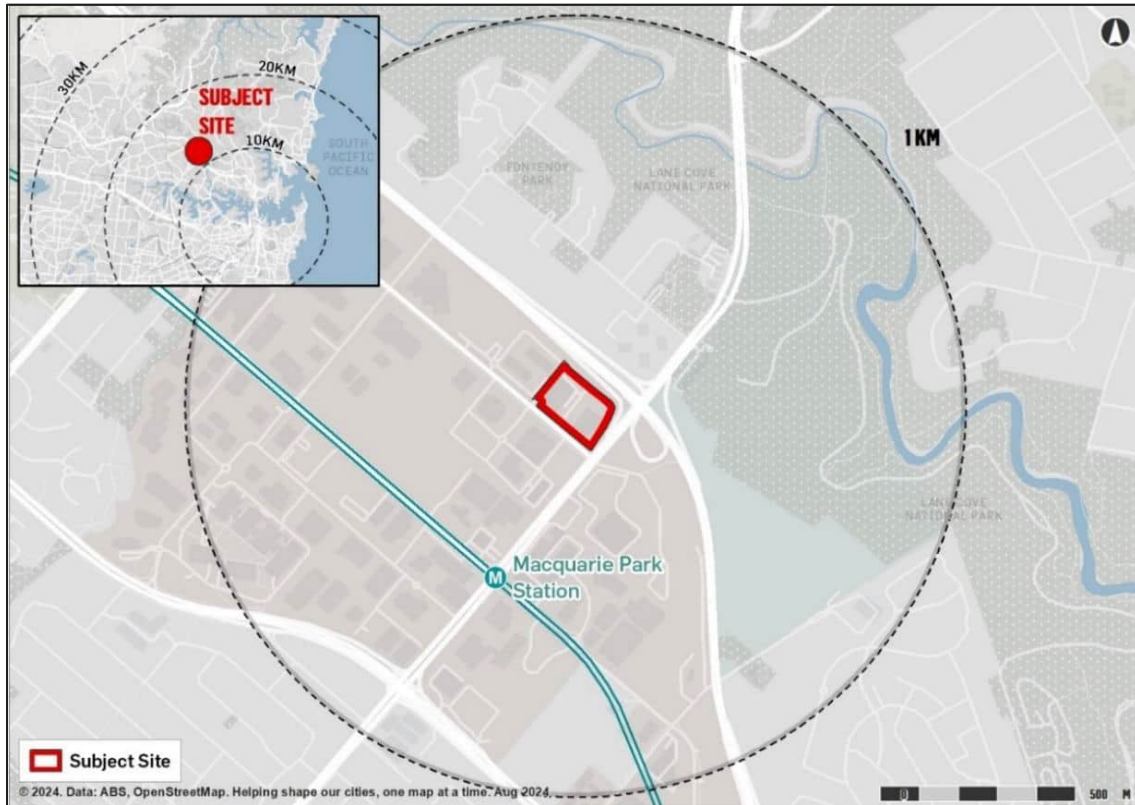
Figure 1 Site Aerial



Source: Urbis

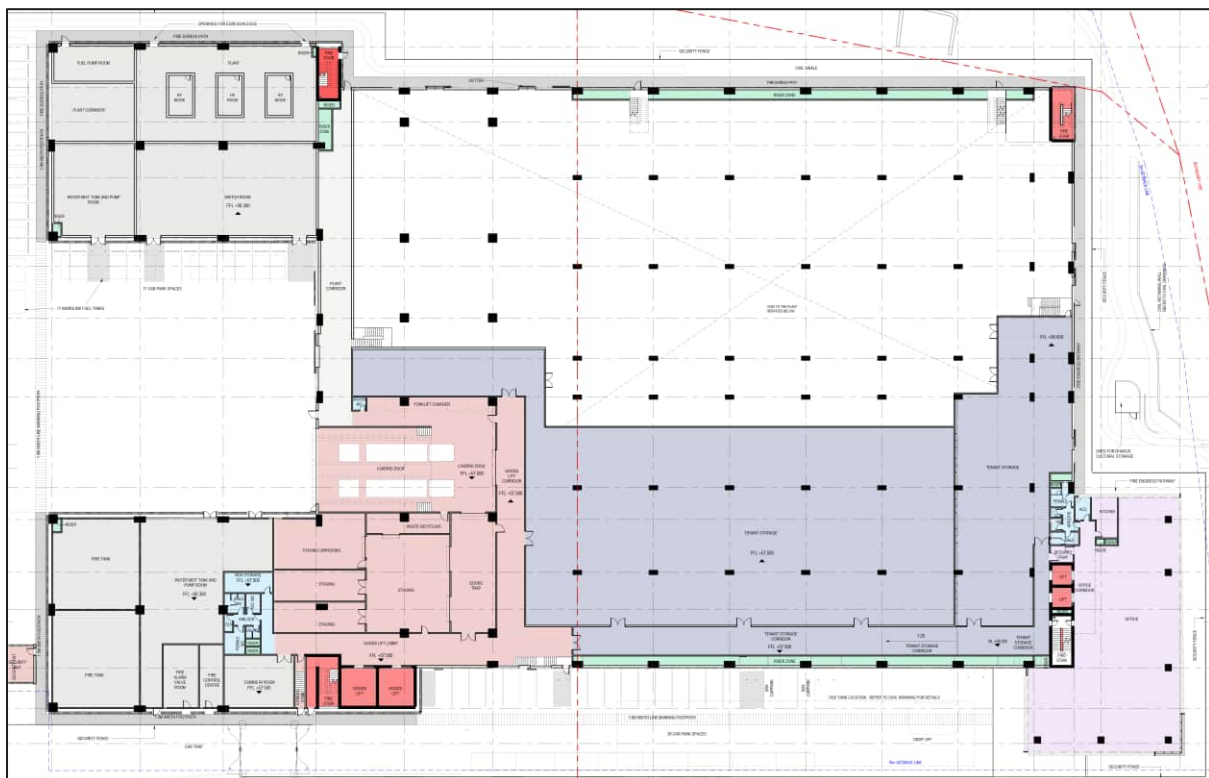


Figure 2 Site Context



Source: Urbis

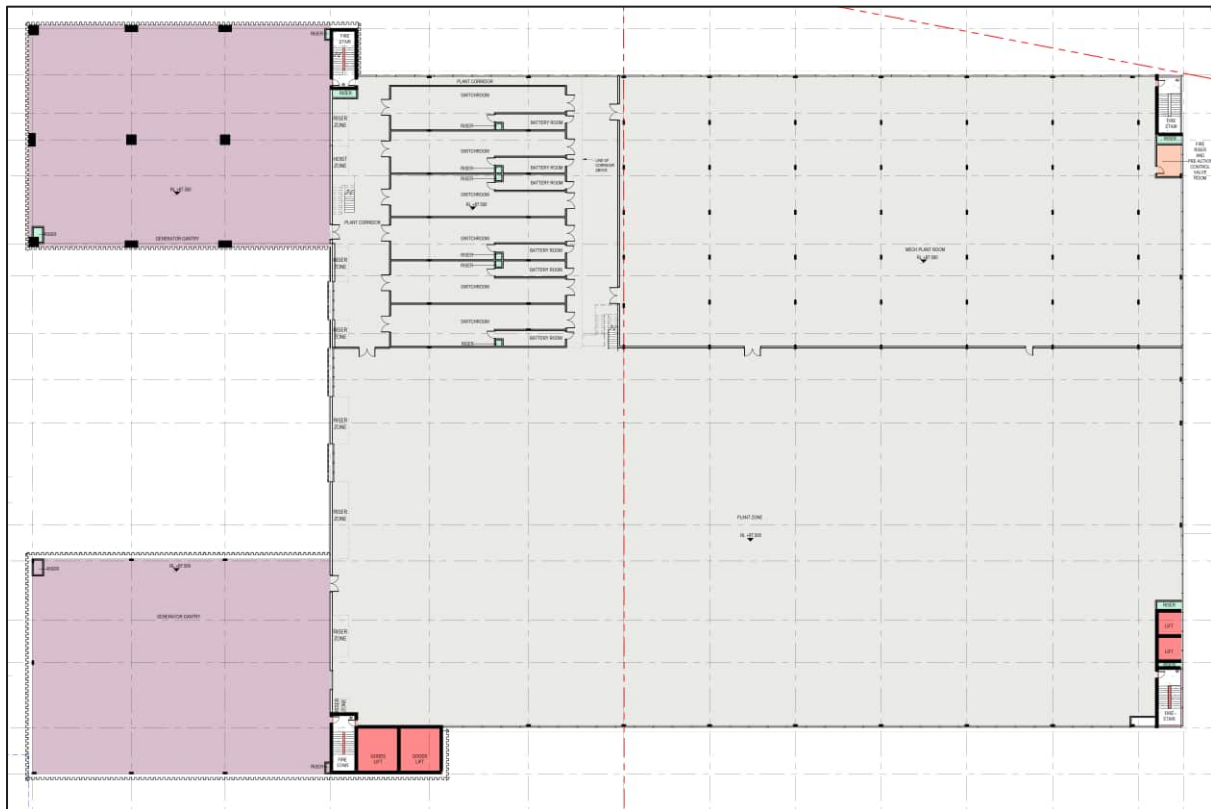
Figure 3 Proposed Development – Ground / Mezzanine Plan



Source: HDR

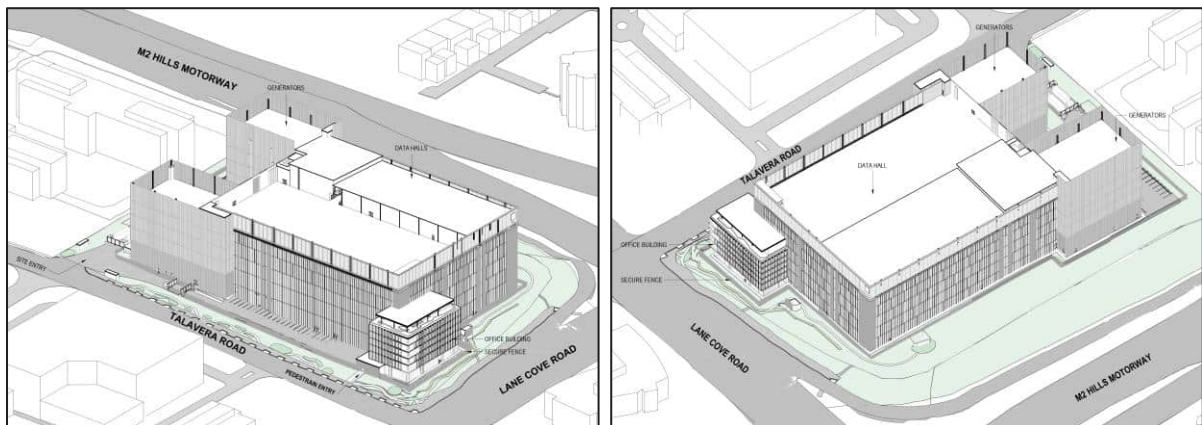


Figure 4 Proposed Development – Roof Plan



Source: HDR

Figure 5 Proposed Development – 3D Views



Source: HDR



1.2 Secretary’s Environmental Assessment Requirements

The Secretary’s Environmental Assessment Requirements (SEARs) for SSD 74069708, including additional assessment requirements detailed in the SEARs Cover Letter, were issued by the Department of Planning and Environment (DPE) in August 2024. The requirements relevant to noise and vibration are shown in **Table 1**.

Table 1 Secretary’s Environmental Assessment Requirements, SSD 74069708, August 2024

Noise and Vibration	Where Addressed
SEARs Cover Letter	
Provide details of noise monitoring survey, background noise levels and amenity noise levels at the potentially most-affected residential receptors (i.e. not necessarily the nearest residential receptor).	Noise Monitoring: Section 2.0 Amenity Noise Levels: Section 3.3
Include details of manufacturer specifications for plant and equipment and noise source inventory (demonstrating worst-case modelling of plant and equipment, including testing of any back-up power system and critical power failure scenario).	Noise Sources: Section 4.2.1 Manufacturer Specifications: Appendix D
Evaluate data centre operational noise for any potential annoying noise characteristics such as tonality and dominant low-frequency content.	Annoying Characteristics: Section 4.2.4
SEARs	
Provide a noise and vibration assessment prepared in accordance with the relevant EPA guidelines and Australian/International Standards. The assessment must detail construction and operational noise and vibration impacts (including testing of any back-up power system) on nearby sensitive receivers and structures, and outline the proposed mitigation, management and monitoring measures that would be implemented.	Criteria: Section 3.0 Impact Assessment: Section 5.0 Mitigation: Section 6.0

1.3 Ryde Development Control Plan 2014

The Ryde Development Control Plan 2014 (Ryde DCP) provides detailed development guidelines relevant to the siting and design of future development within the City of Ryde. A summary of the controls relevant to noise and vibration are shown in **Table 2**.

Table 2 Ryde DCP Noise Controls

Noise and Vibration	Where Addressed
An Acoustic Impact Assessment report prepared by a suitably qualified acoustic consultant is required to be submitted with all development applications for commercial, industrial, retail and community buildings, with the exception of applications minor building alterations. Development is to comply with all relevant statutory regulations.	This Report



1.4 Macquarie Park Rezoning

Macquarie Park is an Accelerated Precinct under the Transport Orientated Development Program (TOD). The Macquarie Park TOD Rezoning consists of Stage 1 and Stage 2, which were exhibited in 2023 and 2024, respectively. The combined Macquarie Park TOD Rezoning was finalised in November 2024.

The proposal is within the area covered by Stage 2 of the rezoning, in what is referred to as Neighbourhood 1 (Ngalawala). Therefore, the proposal is required to be consistent with the Macquarie Park Design Guide.

The rezoning does not propose to change the current E3 zoning of the site or any immediately adjacent zoning.

Proposed new mixed use (MU1) zoning areas as part of both Stage 1 and Stage 2 of the TOD are around 600 m or further from the proposal site. Therefore, noise impacts to any future residential receivers in the rezoned areas are expected to be less than the potentially most affected receivers included in this assessment. Further, any future residential developments would be designed to achieve appropriate internal noise levels based on the requirements of the NSW State Environmental Planning Policy (Transport and Infrastructure) 2021, the Ryde DCP, and AS2107:2016 as appropriate.

The assessment in this report includes predicted operational noise contours in the study area surrounding the proposal, which may be referenced to consider the potential noise contribution at future receivers. It is noted that any future high-rise developments built near to the proposal would act as a screen and reduce noise propagation to more distant receivers.

1.5 Nearest Receivers

The land to which this SSDA relates is recognised as 4-10 Talavera Road, Macquarie Park, within the City of Ryde local government area. The site is bound by Talavera Road to the south (primary frontage), Lane Cove Road to the east (secondary frontage), the Goodman Talavera Corporate Centre to the west and the M2 Motorway to the north.

The nearest receivers are commercial developments located to the west, south and east of the site at distances of around 3 to 50 m. The north of the site is bound by the M2 Motorway, with the nearest residential receivers located north of the motorway around 100 m from the site. Some residential buildings to the north are multistorey and overlook the M2 Motorway and proposal site.

Other sensitive receivers in Macquarie Park include a child care centre to the west of the site, a hotel to the south of the site, and an educational campus to the southwest of the site.

A review of recent potentially noise and vibration sensitive developments in the study area has been completed and the proposed residential development at 35 Waterloo Road (SSD-52947710) has indicatively been included in the operational noise assessment.

Representative receiver areas are detailed in **Table 3** and shown in **Figure 6**. The receiver areas have been selected to represent all nearby receiver types and include the locations potentially most noise affected by the proposal. The assessment presents the maximum result (ie worst-case) of all receivers in a given area. Where the assessment demonstrates compliance with the relevant criteria at the receiver assessment locations, compliance is also expected at all other surrounding receivers.



Table 3 Surrounding Sensitive Receivers

ID	Receiver	Type	Distance (m)	Direction
R01	Residences at 17-49 Fontenoy Road	Residential	150	Northwest
R02	Ground level residences at 1-15 Fontenoy Road	Residential	100	North
R03 ¹	Elevated (F1-F7) residences at 1-15 Fontenoy Road	Residential	100	North
R04	Residences at 37 Khartoum Road, Macquarie Park	Residential	500	Northwest
R05	35 Waterloo Road, Macquarie Park	Residential	250	South
R06 ²	North Ryde Early Learning Centre – 12/24 Talavera Road	Child Care	80	West
R07	Courtyard by Marriott Sydney – 7/11 Talavera Road	Hotel	130	South
R08	Excelsia College – 69-71 Waterloo Road	Educational	310	Southwest
R09 ²	Commercial buildings on Talavera Road	Commercial	5	West

Note 1: Elevated receivers at 1-15 Fontenoy Road are grouped under one receiver ID (R03). The assessment considers all floors and presents the results for the most affected floor (ie highest noise level).

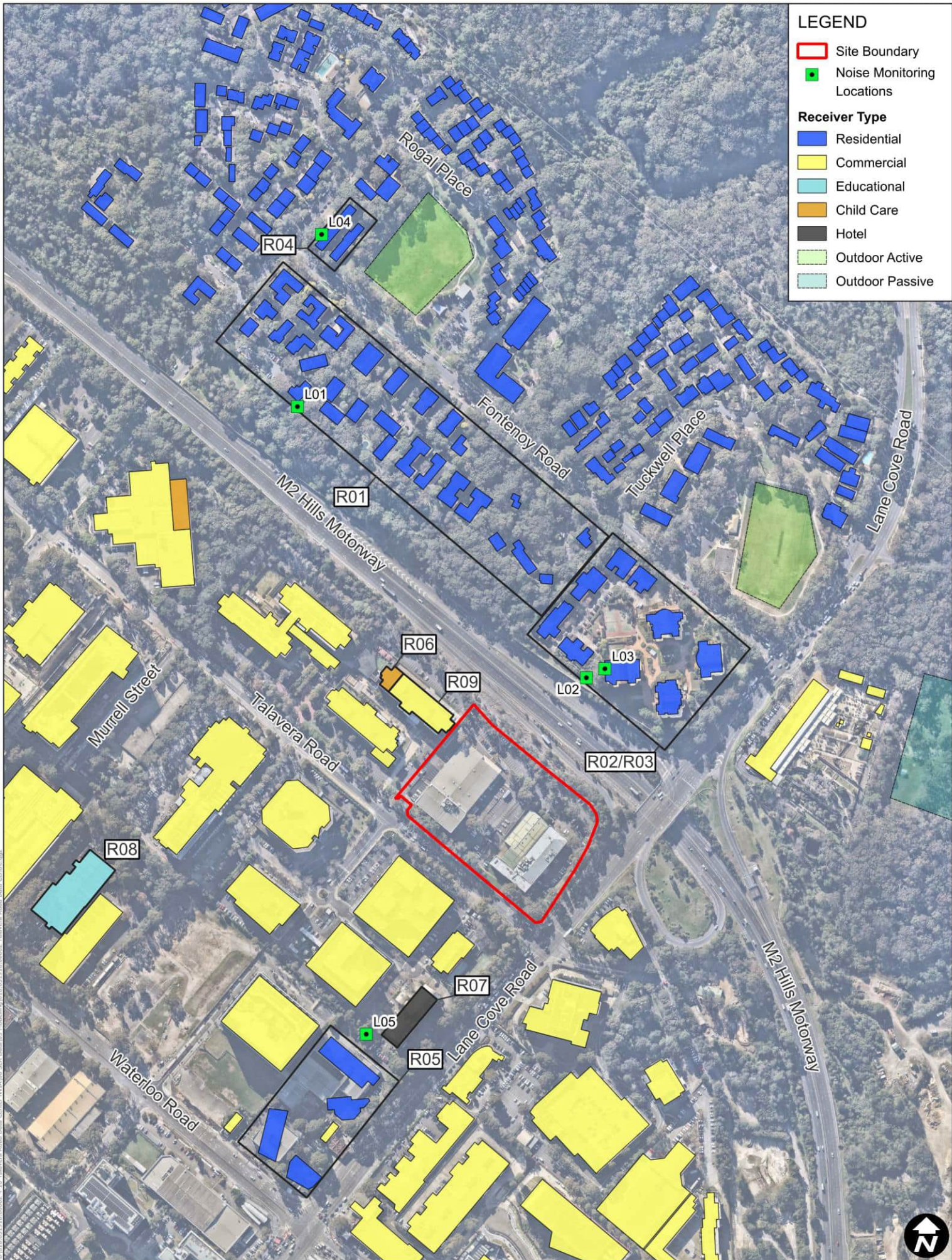
Note 2: The closest child care and commercial receivers (R05 and R09) are Goodman properties. The closest non-Goodman child care and commercial receivers (R06 and R10) are also included for reference.

The residences at 1-15 Fontenoy Road are grouped under two receiver IDs (R02 and R03). This is required to consider the different background noise environment, and associated criteria, based on the adjacent noise wall and varying exposure to traffic noise from the M2 Motorway.



LEGEND

- Site Boundary
 - Noise Monitoring Locations
- Receiver Type**
- Residential
 - Commercial
 - Educational
 - Child Care
 - Hotel
 - Outdoor Active
 - Outdoor Passive



H:\Projects\SLR\610-Sydney\610-Sydney\610-Sydney\4.10 Talavera Road Data Center\WVA\06_SLR_Data\05_Modeling\610_031910_00002_Talavera Road Data Center.dwg

0 100 200 m

Scale: 1:5,000 at A4
 Coordinate System: GDA2020 / MGA zone 56

Drawn Date: 05-Mar-2025
 Project Number: 610.031910.00002



Data Source:
 Nearmap Imagery

SITE LOCATION AND SURROUNDING RECEIVERS

FIGURE 6

2.0 Existing Noise Environment

Unattended noise monitoring was completed in the study area in June 2022. Additional noise monitoring was completed at 35 Waterloo Road (L05) in February 2025. The measured noise levels have been used to determine the existing noise environment and to set the criteria used to assess the potential impacts from the proposal.

The monitoring equipment was positioned to measure existing noise levels that are representative of receivers potentially most affected by the proposal, within constraints such as accessibility, security and landowner permission.

The noise monitoring equipment continuously measured existing noise levels in 15-minute periods during the daytime, evening and night-time. All equipment carried current National Association of Testing Authorities (NATA) or manufacturer calibration certificates and equipment calibration was confirmed before and after each measurement.

The measured data has been processed to exclude noise from extraneous events and periods affected by adverse weather conditions, such as strong wind or rain (measured at the Sydney Olympic Park Bureau of Meteorology (BOM) weather station), to establish representative existing noise levels in the study area.

The noise monitoring locations are shown in **Figure 6** and the results are summarised in **Table 4**. Details of the unattended monitoring together with graphs of the measured daily noise levels are provided in **Appendix B.1**. Justification for the selection of the noise monitoring locations is provided in **Appendix B.2**.

Table 4 Summary of Unattended Noise Monitoring Results

ID	Address	Measured Noise Levels (dBA) ¹					
		Background Noise (RBL)			Average Noise (LAeq)		
		Day	Evening	Night	Day	Evening	Night
L01	7 Tasman Place, Macquarie Park	55	53	43	59	58	54
L02	1-15 Fontenoy Road GF, Macquarie Park	56	54	44	60	59	55
L03 ²	1-15 Fontenoy Road L3, Macquarie Park	60	56	45	63	61	57
L04 ³	37 Khartoum Road, Macquarie Park	45	45	38	57	59	51
L05	35 Waterloo Road, Macquarie Park	53	51	45	60	58	55

Note 1: The assessment periods are the daytime which is 7 am to 6 pm Monday to Saturday and 8 am to 6 pm on Sundays and public holidays, the evening which is 6 pm to 10 pm, and the night-time which is 10 pm to 7 am on Monday to Saturday and 10 pm to 8 am on Sunday and public holidays. See the NSW EPA *Noise Policy for Industry*.

Note 2: Noise monitor deployed on balcony of unit on level 3 of the building, with view over M2 Motorway to the proposal site. Measured noise levels at this location have a -2.5 dB adjustment applied to reflect a 'free field' location.

Note 3: The measured noise levels at L04 have been taken from the Noise Impact Assessment for the Macquarie Park Data Centre (SSD-10467), which should be referenced for further information on the monitoring location.

Noise monitoring was completed at two different heights at 1-15 Fontenoy Road to determine the difference in background noise levels due to exposure to noise from the M2 Motorway. L02 was situated at ground level behind the existing noise wall on the eastbound M2 Motorway off-ramp to Lane Cove Road. L03 was situated on level 3 of 1-15 Fontenoy Road with line of site to the motorway.



Short-term attended noise monitoring was also completed. The attended measurements allow the contributions of the various noise sources at each location to be determined. Detailed observations from the attended measurements are provided in **Appendix B.1**.

The attended measurements were generally found to be consistent with the results of the unattended noise monitoring and show that existing ambient noise levels are typically dominated by road traffic noise from the surrounding road network and industrial noise from existing industrial developments.



3.0 Assessment Criteria

3.1 Construction Noise Criteria

The NSW *Interim Construction Noise Guideline* (ICNG) is used to assess and manage impacts from construction noise on residences and other sensitive land uses in NSW.

The ICNG contains procedures for determining project specific Noise Management Levels (NMLs) for sensitive receivers based on the existing background noise in the area. The 'worst-case' noise levels from construction of a proposal are predicted and then compared to the NMLs in a 15-minute assessment period to determine the likely impact of the proposal.

The NMLs are not mandatory limits, however, where construction noise levels are predicted or measured to be above the NMLs, feasible and reasonable work practices to minimise noise emissions are to be investigated.

3.1.1 Residential Receivers

The ICNG approach for determining NMLs at residential receivers is shown in **Table 5**.

Table 5 ICNG NMLs for Residential Receivers

Time of Day	NML LAeq(15minute)	How to Apply
Standard Construction Hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	Noise affected RBL ¹ + 10 dB	<ul style="list-style-type: none"> The noise affected level represents the point above which there may be some community reaction to noise Where the predicted or measured LAeq(15minute) 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 works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75 dBA	<ul style="list-style-type: none"> The Highly Noise Affected (HNA) 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 restructuring the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools or mid-morning or mid-afternoon for works near residences) If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Standard Construction Hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> A strong justification would typically be required for works 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 practises have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.

Note 1: RBL is the Rating Background Level and the ICNG refers to the calculation procedures in the NSW *Industrial Noise Policy* (INP). The INP has been superseded by the NSW EPA *Noise Policy for Industry* (NPfI).



3.1.2 Other Sensitive' Land Uses and Commercial Receivers

Non-residential land uses have been identified in the study area. The NMLs for 'other sensitive' receivers are shown in **Table 6**.

Table 6 Construction NMLs for ICNG 'Other Sensitive' Receivers

Land Use	Noise Management Level L _{Aeq} (15minute) (dBA) (applied when the property is in use)	
	Internal	External
ICNG 'other sensitive' receivers		
Classrooms at schools and other educational institutions	45	55 ¹
Hospital wards and operating theatres	45	65 ¹
Places of worship	45	55 ¹
Active recreation areas (characterised by sporting activities and activities which generate noise)	-	65
Passive recreation areas (characterised by contemplative activities which generate little noise)	-	60
Commercial	-	70
Industrial	-	75
Non-ICNG 'other sensitive' receivers		
Hotel – daytime and evening ²	50	70 ¹
Hotel – night-time ²	40	60 ¹
Child care centres – sleeping areas ³	35	55 ¹

Note 1: It is assumed that these receivers have fixed windows which conservatively results in internal noise levels being around 20 dB lower than the external noise level.

Note 2: Taken from AS2107.

Note 3: Taken from Association of Australian Acoustical Consultants *Guideline for Child Care Centre Acoustic Assessment*.

3.1.3 NML Summary

The construction NMLs for the proposal have been determined using the results from the unattended noise monitoring and are shown in **Table 7**.

Out of hours NMLs would be applicable should works be required to be undertaken outside ICNG standard construction hours.



Table 7 Project Specific Noise Management Levels

ID	Receiver Type	Monitoring Location	Noise Management Level (LAeq(15minute) – dBA)			
			Standard Construction (RBL +10 dB) ¹	Out of Hours (RBL +5 dB)		
			Daytime	Daytime ²	Evening	Night-time
R01	Residential	L01	65	60	58	48
R02	Residential	L02	66	61	59	49
R03	Residential	L03	70	65	61	50
R04	Residential	L04	55	50	50	43
R06	Child Care	-	55	55	-	-
R07	Hotel	-	70	70	70	60
R08	Educational	-	55	55	-	-
R09	Commercial	-	70	70	-	-

Note 1: RBL = Rating Background Level.

Note 2: Daytime out of hours is 7 am to 8 am and 1 pm to 6 pm on Saturday, and 8 am to 6 pm on Sunday and public holidays.

3.2 Construction Vibration Criteria

The effects of vibration from construction works can be divided into three categories:

- Those in which the occupants of buildings are disturbed (human comfort)
- Those where building contents may be affected (building contents)
- Those where the integrity of the building may be compromised (structural or cosmetic damage).

3.2.1 Human Comfort Vibration

People can sometimes perceive vibration impacts when vibration generating construction works are located close to occupied buildings.

Vibration from construction works tends to be intermittent in nature and the EPA's *Assessing Vibration: a technical guideline* (2006) provides criteria for intermittent vibration based on the Vibration Dose Value (VDV). The 'preferred' and 'maximum' VDV's for human comfort impacts are shown in **Table 8**.



Table 8 Vibration Dose Values for Intermittent Vibration

Building Type	Assessment Period	Vibration Dose Value ¹ (m/s ^{1.75})	
		Preferred	Maximum
Critical Working Areas (eg operating theatres or laboratories)	Day or night-time	0.10	0.20
Residential	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Note 1: The VDV accumulates vibration energy over the daytime and night-time assessment periods, and is dependent on the level of vibration as well as the duration.

3.2.2 Effects on Building Contents

People perceive vibration at levels well below those likely to cause damage to building contents. For most receivers, the human comfort vibration criteria are the most stringent and it is generally not necessary to set separate criteria for vibration effects on typical building contents.

Exceptions to this can occur when vibration sensitive equipment, such as electron microscopes, are located in buildings near to construction works. No such items of equipment have been identified in the proposal area.

3.2.3 Structural and Cosmetic Damage Vibration

If vibration from construction works is sufficiently high it can cause damage to structural elements of affected buildings. The levels of vibration required to cause cosmetic damage tend to be at least an order of magnitude (10 times) higher than those at which people can perceive vibration.

Examples of damage that can occur includes cracks or loosening of drywall surfaces, cracks in supporting columns and loosening of joints. Structural damage vibration limits are contained in British Standard BS 7385 and German Standard DIN 4150.

BS 7385

British Standard BS 7385 recommends vibration limits for transient vibration judged to give a minimal risk of vibration induced damage to affected buildings. The limits for residential and industrial buildings are shown in **Table 9**.



Table 9 BS 7385 Transient Vibration Values for Minimal Risk of Damage

Group	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note 1: Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%.

For heritage buildings, the standard states that “*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*”.

DIN 4150

German Standard DIN 4150 also provides guideline vibration limits for different buildings. Damage is not expected to occur where the values are complied with and the values are generally recognised to be conservative. The DIN 4150 values for buildings and structures are shown in **Table 10**.

Table 10 DIN 4150 Guideline Values for Short-term Vibration on Structures

Group	Type of Structure	Guideline Values Vibration Velocity (mm/s)				
		Foundation, All Directions at a Frequency of			Topmost Floor, Horizontal	Floor Slabs, Vertical
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	All frequencies	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	20
2	Residential buildings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20	15	20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified as Group 1 or 2 and are of great intrinsic value (eg heritage listed buildings)	3	3 to 8	8 to 10	8	20 ¹

Note 1: It may be necessary to lower the relevant guideline value markedly to prevent minor damage.

3.2.4 Minimum Working Distances for Vibration-intensive Works

Minimum working distances for typical vibration-intensive construction equipment are provided in the Transport for NSW *Construction Noise and Vibration Guideline* (CNVG) and are shown in **Table 11**. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from the NSW EPA Vibration Guideline). They are based on empirical data which suggests that where works are further from receivers than the quoted minimum distances then impacts are not considered likely.



Table 11 Recommended Minimum Working Distances from Vibration-intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (NSW EPA Guideline)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3) ¹	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	25 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m

Note 1: Minimum working distances for heritage items that have been identified as structurally unsound or otherwise particularly sensitive to vibration. These distances have been calculated based on the 2.5 mm/s PPV criterion from DIN 4150 and the cosmetic damage minimum working distances presented in the CNVG with reference to BS 7385. It is recommended that the 2.5 mm/s PPV criterion is considered at the foundation (rather than the highest floor as suggested in DIN 4150).

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions.

3.3 Operational Noise Criteria

The NSW *Noise Policy for Industry* (NPfl) was released in 2017 and sets out the requirements for the assessment and management of operational noise from industry in NSW.

The NPfl defines how to determine ‘trigger levels’ for noise emissions from industrial developments. Where a development is likely to exceed the trigger levels at existing noise-sensitive receivers, feasible and reasonable noise management measures are required to be considered to reduce the impacts.

There are two types of trigger levels – one to account for ‘intrusive’ noise impacts and one to protect the ‘amenity’ of particular land uses:



- The **intrusiveness** of an industrial noise source is generally considered acceptable if the LAeq noise level of the source, measured over a period of 15-minutes, does not exceed the representative background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended **amenity** levels specified in the NPfl for that particular land use.

Intrusive and amenity noise levels are not used directly as regulatory limits. They are used to assess the potential impact of noise, assess feasible and reasonable mitigation options and subsequently determine achievable noise requirements.

The NPfl provides guidance on assigning residential receiver amenity noise categories based on the site-specific features shown in **Table 12**.

Table 12 Residential Receiver Amenity

Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Rural	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime <40 dBA Evening <35 dBA Night <30 dBA	Rural – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime <45 dBA Evening <40 dBA Night <35dBA	Suburban – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.



Receiver Category	Typical Planning Land Use Zoning	Typical Existing Background Noise Levels (RBL)	Description
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime >45 dBA Evening >40 dBA Night >35 dBA	Urban – an area with an acoustical environment that: <ul style="list-style-type: none"> • Is dominated by ‘urban hum’ or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • Has through-traffic with characteristically heavy and continuous traffic flows during peak periods • Is near commercial districts or industrial districts • Has any combination of the above.

Amenity noise categories for the surrounding receivers have been determined with reference to the NPfI. The assessment is shown in **Table 13**.

Table 13 Residential Receiver Amenity Category Assessment

Area	Land Use Zoning	Existing Background Noise Levels RBL (dBA)			Resulting Amenity Classification	Discussion
		Day	Eve	Night		
R01	R4 high density residential	55	53	43	Urban	The residential area to the north is zoned as R4 – high density residential and the proposed 35 Waterloo Road development to the south is zoned as E2 – Commercial Core. Existing noise levels are controlled by road traffic noise and urban hum, therefore residences have been classified as urban.
R02		56	54	44		
R03 ¹		60	56	45		
R04		45	45	38		
R05	E2 Commercial Core	53	51	45		

Note 1: Background noise levels at elevated residential location, with view of the M2 Motorway.

3.3.1 Project Noise Trigger Levels

The trigger levels for industrial noise from the proposal are summarised in **Table 14**. They are based on the previously measured background noise levels, where appropriate. The Project Noise Trigger Levels (PNTL) are the most stringent of the intrusiveness and amenity trigger level for each period and are highlighted below.



Table 14 Project Noise Trigger Levels

ID	Receiver Type	Period	Amenity Noise Level LAeq (dBA)	Measured Noise Level (dBA)		Project Noise Trigger Levels LAeq(15minute) (dBA)	
				RBL ¹	LAeq(period)	Intrusiveness	Amenity ^{2,3}
R01	Residential	Day	60	55	59	60	58
		Evening	50	53	58	58	48
		Night	45	43	54	48	43
R02	Residential (Ground level)	Day	60	56	60	61	58
		Evening	50	54	59	59	48
		Night	45	44	55	49	43
R03	Residential (Elevated F1-F7)	Day	60	60	63	65	58
		Evening	50	56	61	61	49⁴
		Night	45	45	57	50	45⁴
R04	Residential	Day	60	45	57	50	58
		Evening	50	45	59	50	48
		Night	45	38	51	43	43
R05	Residential	Day	60	53	60	58	58
		Evening	50	51	58	56	48
		Night	45	45	55	50	43
R06	Child Care Playground ⁵	When in use	55	-	-	-	53
	Child Care Classroom ^{5,6}		40 (internal) 60 (external)	-	-	-	58
R07	Hotel	Day	65	-	-	-	63
		Evening	55	-	-	-	53
		Night	50	-	-	-	48
R08	Educational ⁶	When in use	40 (internal) 60 (external)	-	-	-	58
R09	Commercial	When in use	65	-	-	-	63

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been reduced by 5 dB, where appropriate, to give the project amenity noise levels due to other sources of industrial noise being present in the area, as outlined in the NPfl.

Note 3: The project amenity noise levels have been converted to a 15-minute level by adding 3 dB, as outlined in the NPfl.

Note 4: The measured LAeq noise level was dominated by existing road traffic noise and exceeds the recommended amenity noise level by 10 dB or more, therefore, the 'high traffic project amenity noise level' is the existing LAeq(traffic) noise level minus 15 dB, as outlined in the NPfl.

Note 5: The NPfl does not include a recommended amenity noise level for child care centres, so there are no defined criteria for industrial noise. The NPfl does include amenity noise levels for 'Active recreation area (eg school playground)' and 'School classroom – internal'. These amenity noise levels have been applied in the assessment of child care centres.

Note 6: The criterion is specified as an internal noise level for this receiver category. As the noise model predicts external noise levels, it has been assumed that receivers in this area have fixed windows and external noise levels are therefore 20 dB higher than the corresponding internal level.



3.3.2 Cumulative Noise Impacts

The NSW Government *Cumulative Impact Assessment Guidelines for State Significant Projects* requires that the potential combined effect of cumulative impacts on all nearby industrial developments to be considered when assessing potential noise impacts from state significant projects. The guideline references the NPfI when determining the approach to assessing the cumulative industrial noise impacts.

The NPfI states that it aims to limit continuing increases in cumulative industrial noise through the application of amenity noise levels, which are applicable to all industrial noise sources in an area.

The NPfI requires that the amenity noise levels which are applied to an individual project be reduced by 5 dB to allow for the potential cumulative impact from multiple sources of industrial noise in an area (including existing and new).

By doing this, the policy accounts for potential cumulative impacts by lowering the criteria for each individual development to ensure that the ambient noise level within an area from all industrial noise sources combined remains below the recommended amenity noise levels, where feasible and reasonable. The NPfI states that “*where the project amenity noise level applies and it can be met, no additional consideration of cumulative industrial noise is required*”.

The NPfI does include a methodology to further reduce the amenity noise level for individual projects where they are in a cluster of industry. This methodology is to be applied where a cluster of industry consisting of multiple new noise generating premises is proposed and the same receiver(s) are expected to be impacted by more than three to four individual industrial noise sources.

As discussed in **Section 4.1.3**, several surrounding developments in Macquarie Park have been considered for potential cumulative noise impacts. The proposed and approved developments include four other data centre sites, which are expected to be notable noise generating premises. However, the surrounding data centre sites are between 300 m and 1,200 m from the proposal. Further, due to the locations of the surrounding data centre sites they would generally be expected to potentially impact different facades of noise sensitive receivers rather than contribute to notable cumulative noise levels at the same facade.

Therefore, it is not expected that more than three to four developments, including the proposal, would contribute to similar industrial noise to the potentially most affected receivers considered in this assessment.

The potential cumulative impacts from the development and other sources of industrial noise in the area are therefore accounted for in the proposal-specific PNTLs (see **Table 14**).

3.3.3 Sleep Disturbance

The potential for sleep disturbance from maximum noise level events from the proposal during the night-time period is required to be considered. This is applicable only to residential receivers.

The NPfI defines the sleep disturbance screening level as 52 dBA LAF_{max} or the prevailing background level plus 15 dB, whichever is greater.

The sleep disturbance screening levels for the proposal are shown in **Table 15**.



Table 15 Sleep Disturbance Screening Levels

ID	Location	Noise Level (dBA)	
		Measured Prevailing Night-time Background Level	Sleep Disturbance Screening Level ¹
R01	Residences at 35-39 Fontenoy Road	43	58
R02	Ground level residences at 1-15 Fontenoy Road	44	59
R03	Elevated (F1-F7) residences at 1-15 Fontenoy Road	45	60
R04	Residences at 37 Khartoum Road	38	53
R05	35 Waterloo Road	45	60

Note 1: The sleep disturbance screening level as 52 dBA LAF_{max} or the prevailing background level plus 15 dB, whichever is greater

A detailed maximum noise level event assessment should be completed where the sleep disturbance screening level is exceeded. The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the RBL, and the number of times this happens during the night-time period.

The NPfI refers to the *Road Noise Policy* (RNP) for additional information regarding sleep disturbance. enHealth Council studies are referenced which indicate that for short-term or transient noise events, for good sleep over eight hours the indoor LAF_{max} sound pressure level should ideally not exceed around 45 dBA more than 10 or 15 times per night.

The RNP goes on to conclude that from the research on sleep disturbance to date:

- Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to awaken people from sleep
- One or two events per night with maximum internal noise levels of 65-70 dBA are not likely to affect health and wellbeing significantly.

3.3.4 Corrections for Annoying Noise Characteristics

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, intermittency or dominant low-frequency content. The NPfI specifies the following modifying factor corrections, shown in **Table 16**, which are to be applied where annoying characteristics are present. The corrections are to be added to the noise level at the receiver before comparison with the PNTLs.



Table 16 NPfl Modifying Factor Corrections

Factor	Assessment/ Measurement	When to Apply	Correction ¹
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by the levels defined in the NPfl.	5 dB ²
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	Measure/assess source contribution C and A weighted Leq,t levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level to which the thresholds defined in the NPfl are exceeded.	2 or 5 dB ²
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	<p>The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible.</p> <p>The NPfl further defines intermittent noise as noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB, for example, equipment cycling on and off.</p> <p>The EPA has confirmed that the intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms.⁴</p> <p>The intermittency correction is not intended to be applied to changes in noise level due to meteorology.</p>	5 dB ³
Maximum adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated.	Maximum correction of 10 dB ² (excluding duration correction)

Note 1: Corrections to be added to the measured or predicted levels.

Note 2: Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Adjustment to be applied to night-time only.

Note 4: *How to Apply the Noise Policy for Industry Intermittent Modifying Factor Corrections*, NSW Environment Protection Authority, Acoustics Australia Vol. 50, No. 3, September 2022.

Details of the modifying factor corrections applied in the assessment are provided in **Section 4.2.4**.



3.3.5 Residual Impacts

The NPfI defines residual noise impacts as exceedances of the Project Noise Trigger Levels which remain after all feasible and reasonable source and pathway mitigation measures have been considered.

The significance of residual noise impacts, as defined in the NPfI, is shown in **Table 17**. Examples of receiver-based treatments that can be used to mitigate residual impacts are shown in **Table 18**.

Table 17 NPfI Significance of Residual Noise Impacts

If the Predicted Noise Level minus the Project Noise Trigger Level is:	And the Total Cumulative Industrial Noise Levels is:	Then the Significance of the Residual Noise Level is:
≤ 2 dBA	Not applicable	Negligible
≥ 3 but ≤ 5 dBA	< recommended amenity noise level or > recommended amenity noise level, but the increase in total cumulative industrial noise level resulting from the development is less than or equal to 1dB	Marginal
≥ 3 but ≤ 5 dBA	> recommended amenity noise level and the increase in total cumulative industrial noise level resulting from the development is more than 1 dB	Moderate
> 5 dBA	≤ recommended amenity noise level	Moderate
	> recommended amenity noise level	Significant

Table 18 NPfI Examples of Receiver-based Treatments to Mitigate Residual Noise Impacts

Significance of Residual Noise Impact	Example of Potential Treatment
Negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver-based treatments or controls.
Marginal	Provide mechanical ventilation/comfort condition systems to enable windows to be closed without compromising internal air quality/amenity.
Moderate	As for 'marginal', but also upgraded facade elements, such as windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Significant	May include suitable commercial agreements where considered feasible and reasonable.



3.3.6 Traffic on Surrounding Roads

The potential impacts from proposal-related traffic on the surrounding public roads are assessed using the NSW EPA *Road Noise Policy* (RNP).

An initial screening test is first applied to evaluate if existing road traffic noise levels are expected to increase by more than 2.0 dB. Where this is considered likely, further assessment is required using the RNP criteria shown in **Table 19**.

Table 19 RNP Criteria for Assessing Traffic on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq(15hour) 60 (external)	LAeq(9hour) 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq(1hour) 55 (external)	LAeq(1hour) 50 (external)



4.0 Methodology

4.1 Construction Noise and Vibration Assessment

A noise model of the study area has been used to predict noise levels from the proposed construction work to all surrounding receivers. The model uses ISO 9613-2 algorithms in SoundPLAN software.

Local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding areas.

4.1.1 Construction Activities

Representative scenarios have been developed to assess the likely impacts from the various construction phases of the proposal. These scenarios are shown in **Table 20**.

The assessment uses 'realistic worst-case' scenarios to determine the impacts from the noisiest 15-minute period that are likely to occur for each work scenario, as required by the ICNG. The impacts represent construction noise levels without mitigation applied.

The sound power levels for the construction equipment used in each scenario are presented in **Appendix C**.

Table 20 Construction Equipment

Scenario	Works Activity	Equipment	Indicative Duration ¹
W.01	Vegetation clearing	Chainsaw, chipper, excavator, front end loader, dump truck, water truck	1 month
W.02	Demolition	Rockbreaker, dozer, front end loader, dump truck, water truck	3 months
W.03	Earthworks	Dozer, excavator, front end loader, vibratory roller, dump truck, water truck	6 months
W.04	Excavation of hard rock	Rockbreaker, dozer, excavator, front end loader, dump truck, water truck	12 months
W.05	Construction of pads and hardstands	Concrete pump, concrete truck/agitator, concrete vibrator	
W.06	Construction of structures and equipment installation	Elevated working platform, flatbed truck, hand tools, mobile crane	3 months

Note 2: Durations should be regarded as indicative and represent the total estimated duration of work at a typical worksite.

4.1.2 Hours of Construction

Construction activities for the proposal would only be undertaken during the following hours:

- 7:00 am to 6:00 pm, Mondays to Fridays
- 8:00 am to 1:00 pm on Saturdays
- At no time on Sundays or Public Holidays.



4.1.3 Cumulative Construction Noise

Assessing cumulative impacts involves the consideration of the proposed impact in the context of noise and vibration. The assessment of cumulative impacts also considers projects that are currently under development, or at the planning stage that may also influence the assessment of this proposal's potential impacts. Cumulative impacts can potentially arise from the interaction of the construction activities of the proposal and other future projects nearby.

The cumulative noise impact assessment in this report is prepared in accordance with the *Cumulative Impact Assessment Guidelines for State Significant Projects* (DPE, 2022). Projects with the potential for cumulative impacts with the proposal were identified through a review of publicly available information at the time of this assessment.

The projects considered for potential cumulative construction noise impacts are listed in **Table 21**.

Table 21 Considered Cumulative Projects

Address	Development Type	DA Reference	Current Status
1-5 Khartoum Road	Data Centre	SSD-63235720	Prepare EIS
11-17 Khartoum Road	Data Centre	SSD-10467 LDA2020/0229	Approved
17-23 Talavera Road	Data Centre	SSD-24299707	Approved / Modification Under Assessment
100-108 Talavera Road	Mixed Use Development	LDA2022/0021	Approved
45-61 Waterloo Road	Commercial Development	LDA2018/0172	Approved
269 Lane Cove Road	Data Centre	SSD-63168959	Response to Submissions
85-97 Waterloo Road and 2 Banfield Road	Build-to-rent Development	SSD-52604208	Under Assessment

4.2 Operational Noise Assessment

The potential operational noise levels from the proposal have been predicted to the surrounding receivers using the ISO 9613-2 algorithm in SoundPLAN V8.2, implemented in accordance with ISO 17534.

ISO 9613-2 is an industry standard algorithm that is considered suitable for use in the prediction of noise from industrial sources where intervening objects provide acoustic shielding, such as at the subject site and surrounding area.

The ISO 9613-2 algorithm predicts continuous A-weighted sound pressure levels under noise-enhancing meteorological conditions favourable to downwind propagation, or equivalently, propagation under a well-developed, moderate, ground-based temperature inversion, such as commonly occurs on clear calm nights.

Downwind propagation conditions include wind from source to receiver, with wind speeds of around 1 to 5 m/s, measured at a height of 3 to 11 m above the ground. These propagation conditions are consistent with the noise-enhancing weather conditions specified in *Fact Sheet D: Accounting for noise-enhancing weather conditions* of the NPfl.



ISO 9613-2 has been used extensively on industrial projects in Australia over several decades and has been accepted previously by NSW DPE (now DPHI) in numerous environmental noise assessments.

The noise model includes ground topography, ground type (ground absorption modelled at 0.5 in the residential area north of the M2 Motorway, 0.2 in the commercial area of Macquarie Park and 0.0 on the proposal site), buildings and representative noise sources from the proposal.

The potential impacts have been determined by comparing the predicted peak noise levels to the NPfI PNTLs in a 15-minute assessment period.

Noise levels have been assessed at the identified representative receiver locations with reference to the requirements of 'Section 2.6 – Assessment Locations' of the NPfI. This includes assessment of impacts at all floors of the identified multi-storey buildings. The assessment presents the highest noise level for each building to represent the potentially most affected location.

4.2.1 Operational Noise Sources

The proposal is in the early design stages and the future tenants are currently unknown. Several assumptions have been made regarding the future tenants and likely sources of noise. These assumptions have been used to develop representative peak noise scenarios that reflect the expected highest noise emissions that the development would likely emit.

The proposal is a speculative development with no tenants committed. The facility has been designed to accommodate typical data centre users.

The development comprises a multi-storey data centre building with associated data halls, plant rooms, backup generators, office area, vehicle access, loading dock and carparking.

Vehicle access would be from Talavera Road. The site would be in use 24 hours a day. Heavy vehicles larger than medium rigid trucks are currently not expected to be required at the site.

The main sources of operational noise at the development are expected to include:

- Rooftop cooling towers and other externally located items of mechanical plant
- Testing of backup generators
- On-site light and heavy vehicle movements
- Loading dock activities
- Off-site vehicle movements.

A summary of the expected noise sources and representative peak assessment scenarios associated with the operation of the development is provided below. The location of the modelled noise sources is shown in **Figure** .



Figure Modelled Noise Sources



The proposal includes a rooftop plant room of solid blockwork construction, which separates the cooling towers from sensitive receivers to the north. The rooftop rooms are proposed to have a minimum height of 8.5 m above roof level, with some rooms up to 10.5 m above roof level.

4.2.1.1 Mechanical Plant

The main sources of externally located mechanical plant noise at the development would be the rooftop cooling towers and maintenance testing of the backup generators.

The external mechanical plant used in the assessment, together with corresponding sound power levels, number of units and locations, are detailed in **Table 22**.



Table 22 Mechanical Plant

Noise Source	Example Unit	Sound Power Level (dBA)	Locations and Operations
Cooling towers	BAC XES3E-1424-12P ENDURA/H	Each unit includes two motors at 87 dBA each ¹ Sound pressure levels at 15 m: Air Inlet: 51 dBA End: 45 dBA Top: 55 dBA	36 cooling towers on roof of data centre with top of unit 7.86 m above roof height, including consideration of a 1.5 m gantry. Assumed to operate 24/7. Cooling towers are modelled as 'industrial building' objects in the noise model, which are equivalent to a 3D box with a noise source on each face. The noise sources were calibrated based on the manufacturers data to achieve the stated sound pressure levels at a distance of 15 m.
Backup generators	Rolls Royce mtu 20V4000G94F	Air Intake SWL 83 dBA	66 backup generators located gantries on the western side of the data centre. Generators would be located in 6 levels, across Level 1 to Upper Roof. Generators contained in individual enclosures. Air intake and discharge noise sources are modelled as point sources at the centroid of the enclosure side faces. Generator exhaust stacks rise up individually and terminate at an elevation of 96 m for the southern gantry and 102 m for the northern gantry (equivalent to top of screen height, 8.5 m above the roof and upper roof levels). Generator exhausts are modelled as point sources at the exhaust locations. The six generators in the northwest most corner of the gantries are assumed to have manufacturer 40 dB exhaust silencers. All other generators are assumed to have manufacturer 30 dB exhaust silencers (see Section 6.2). The backup generators would be tested during daytime hours (see Table 25 below).
		Air Discharge SWL 83 dBA	
		Exhaust stack SWL 134 dBA (unsilenced) SWL 104 dBA (with manufacturer 30 dBA silencer) SWL 94 dBA (with manufacturer 40 dBA silencer)	
Air conditioning units	Mitsubishi PUZ-RP170	79 dBA	Four units on the office roof. Assumed to operate 24 hours a day.

Note 1: Sound power level based on unit operating at 73.5% speed based on advice from the manufacturer and includes an additional 3 dB safety factor.

Various items of mechanical plant would also be located internally within the data centre. This includes items within the various data halls, electrical plant rooms and mechanical services areas. Details regarding these internal items of equipment are not currently available at this early stage in the development, however, breakout noise from these items is expected to be insignificant compared to noise from externally located cooling towers and backup generators.



Internal plant would include a 4 MVA load bank used during generator testing and located in an enclosed switchroom on the Mezzanine level. The noise level of the example unit is 91 dBA at 1 m based on the manufacturer's specification. Given that the unit would be enclosed in the switchroom, it is expected the external noise emissions from the loadbank would be at least 20 dB below the source level. Therefore, noise from the load bank is expected to be insignificant compared to the external generators and loading dock activity, and has not been included in the modelling. The switchroom facade construction would be reviewed during detailed design to confirm an appropriate level of noise reduction is achieved.

A 3 dB safety factor has been added to the manufacturers specified sound power level for the example cooling tower units. This safety factor represents an allowance for potential uncertainty and increased noise emissions from the proposal that may occur due to:

- Selection of different cooling tower units
- Increases to cooling tower noise due to variable frequency drives
- Inclusion of minor additional external mechanical plant that are not known at this stage.

4.2.1.2 Acoustic Louvres

The perimeter of the data centre building roof includes a mechanical louvre screen. The louvre screen on the south edge of the building has been modelled as an acoustic louvre wall with a height of 8.5 m (see **Figure 7**).

The acoustic louvre modelling methodology is described below:

- The acoustic louvre wall is represented as a solid noise wall
- The acoustic louvre wall is dissected into a high resolution grid and incident noise levels from the cooling towers are calculated for the inside face of the wall
- A grid of area sources is applied to the outside face of the wall, emitting the incident noise levels minus the transmission loss of the example acoustic louvre.

The mechanical louvre screen around other areas of the building is not currently proposed to be acoustically rated and it has been conservatively assumed to provide no noise attenuation.

4.2.1.3 On-Site Traffic

On-site vehicles have been modelled using the data provided by the project's traffic consultant in **Table 23**. The volumes are representative of the expected peak 15-minute period for the daytime, evening and night-time.

Heavy vehicle deliveries would be limited to rigid trucks. Light vehicle movements are assumed to be distributed amongst the parking areas proportionately to the number of parking spaces in each area.



Table 23 Vehicle Traffic Data – Worst-case 15-Minute Period

Vehicle Type	Location	Sound Power Level (dBA)	Vehicle Speed (km/h)	Number of Vehicles in Worst-case 15-Minute Period ¹		
				Daytime (7am to 6pm)	Evening (6pm to 10pm)	Night-time (10pm to 7am)
Medium trucks	Vehicle entry and hardstand	95 ²	5	1	0	1
Light vehicles	Vehicle entry and carpark	90 ²	5	8	3	6

Note 1: Total vehicles, includes both inbound and outbound vehicles.

Note 2: Sound power level based on SLR measurement data.

4.2.1.4 Loading Dock

Details of the loading dock noise sources are shown in **Table 24**. The various sources have been modelled with the listed durations based on one heavy vehicle movement in the peak 15-minute daytime and night-time assessment periods. The loading dock is recessed and no forklifts are expected to operate externally.

Table 24 Typical Hardstand and Loading Dock Noise Sources

Noise Source	Sound Power Level (dBA) ¹	Typical Duration of Use in Worst-case 15-minute Period
Truck reversing alarm	107 ^{2,3}	30 seconds
Forklift reversing alarm	102 ^{2,3}	90 seconds
Air brakes	118	1 second
Roller door	94	15 seconds
Electric forklift	84	900 seconds

Note 1: SWLs based on measurement data, where appropriate.

Note 2: SWL based on recommendation to use broadband reversing alarms, see **Section 6.2**.

Note 3: SWL includes a -3 dB reduction due to alarms being discrete events.

4.2.2 Operational Noise Scenarios

4.2.2.1 Maintenance Testing of Backup Generators

The backup generators would require scheduled maintenance and would be tested during daytime business hours (ie 7 am to 5 pm) from Monday to Friday. The maintenance testing schedule would be quarterly with the runtime for each individual engine being one 45 minutes.

Details regarding the backup generator testing are shown in **Table 25**.



Table 25 Backup Generator Maintenance Testing

Parameter	Value
Number of generators	66
Frequency of test per generator	Quarterly
Run time per test	45 minutes
Number of generators per test	One
Number of tests per day	Up to two
Testing schedule	Monday to Friday (7 am to 5 pm)
Total testing time for all generators	198 hours per annum (or less)

4.2.2.2 Emergency Power Failure

The generators are required to operate on the loss of utility mains. Major power interruptions requiring the simultaneous operation of all standby generators are expected occur infrequently and for a limited time. Therefore, it is not considered reasonable for the development to be required to meet the operational noise criteria during this infrequent emergency scenario when all generators may operate simultaneously.

4.2.2.3 Representative Operational Scenarios

Representative scenarios have been developed to assess the likely impacts from the operation of the proposal. These scenarios are shown in **Table 26**.

The noise scenarios include consideration of all cooling towers operating concurrently at the highest expected fan speed for the example unit. This represents a conservative worst-case scenario including consideration of high ambient temperature conditions. It is expected that actual noise emissions from the cooling towers would frequently be lower depending on the number of units in use, their load, and the ambient temperature.



Table 26 Operational Assessment Scenarios

Scenario	Name	Period	Description
OP.01	Typical Peak Operation	<ul style="list-style-type: none"> Daytime Evening Night 	<ul style="list-style-type: none"> All mechanical plant operating at full capacity, except for backup generators. Peak vehicle movements and loading dock activity.
OP.02	Typical Peak Operation and Generator Maintenance / Testing	<ul style="list-style-type: none"> Daytime 	<ul style="list-style-type: none"> All mechanical plant operating at full capacity and concurrent testing of one backup generator (the worst-case generator is considered for each receiver). Peak vehicle movements and loading dock activity.
OP.03	Typical Peak Operation and All Generator Emergency Scenario	-	<ul style="list-style-type: none"> All mechanical plant operating at full capacity and concurrent operation of all backup generators.

The NPfl applies to industrial noise sources from activities listed in Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act). Schedule 1 of the POEO Act includes electricity generation, however, it excludes “the generation of electricity by means of electricity plant that is emergency stand-by plant operating for less than 200 hours per year.”

The use of all generators in an emergency scenario is not expected to exceed 200 hours per year, therefore, the use of all generators is outside the application of the NPfl. Noise level predictions for an emergency scenario with all generators operating concurrently (OP.03) are presented in the assessment for information purposes and are not compared to the NPfl criteria.

4.2.3 Noise Source Inventory

A noise source inventory which includes the details of the various operational noise sources at the development is shown in **Table 27**. Mechanical plant data sheets for the example units are shown in **Appendix D**.

Table 27 Noise Source Inventory

Category	Noise Source	Usage	Reference for Noise Data
Mechanical plant	Cooling towers	Cooling towers would be used to expel heat from the data centre operations. Indicative cooling tower requirements are 36 two cell towers. These units would operate 24 hours a day and have been modelled on the data centre roof shown in Figure using the details in Table .	Sound power level taken from manufacturers specifications for the indicative units, supplied by the project team.



Category	Noise Source	Usage	Reference for Noise Data
	Backup generators	<p>Backup generators would be used to provide power to the data centre in the event of loss of mains power.</p> <p>66 backup generators have been modelled in six levels in the west area of the site shown in Figure using the details in Table .</p> <p>Backup generators would be operated as detailed in Section 4.2.2.</p>	<p>The generators would be housed in custom built containers with exhaust stacks that terminate above roof level. Design sound power levels were supplied by the project team based on manufacturers specifications and indicative attenuator and silencer designs to meet the design sound power levels.</p>
	Load bank	<p>A load bank would be used during the testing of backup generators. The load bank is located in an enclosed switchroom on the mezzanine level.</p> <p>The load bank would be operated only during testing of backup generators.</p>	<p>The load bank would be housed in a ventilated container, within an enclosed switchroom.</p> <p>Sound power level considered based on manufacturers specifications for the indicative unit, supplied by the project team.</p> <p>The load bank has not been included in the assessment of external mechanical plant since it would be in an enclosed room and the potential noise breakout is expected to be insignificant in comparison to external noise sources (see Section 4.2.1.1).</p>
	Typical data centre activities	<p>Internal noise-generating activities would be associated with typical data centre activities, including mechanical plant in the various data halls, electrical plant rooms and mechanical services areas.</p>	<p>Details regarding these internal items of equipment are not currently available at this early stage in the development, however, breakout noise from these items is expected to be relatively minor (compared to noise from externally located mechanical plant and testing of backup generators) given the internal plant areas are generally separated from the external facades by service corridors and/or have no external louvres.</p>



Category	Noise Source	Usage	Reference for Noise Data
On-site traffic	Light vehicles	Light vehicles would access the development and park in the car park. Modelled in the location shown in Figure using vehicle volumes in Table .	Sound power level taken from measurement data of various light vehicle types and models at speeds of up to around 40 km/h, including vehicle acceleration.
	Medium trucks	Deliveries to the development would be via medium trucks. Trucks would access the development via Talavera Road and travel to the loading dock on the western side of the development. Modelled on the heavy vehicle route shown in Figure using vehicle volumes in Table .	Sound power level taken from historical measurement data of various medium rigid truck types and models in approximate 5 to 15 tonne range.
Loading dock	Forklifts, air brakes, roller doors	Heavy vehicle deliveries would be unloaded via the recessed loading docks. No forklifts would be operated externally. Modelled in the loading dock shown in Figure using the durations in Table .	Sound power level taken from historical measurement data of typical loading dock activities at various warehousing and distribution facilities.

The average noise source spectra for the various sources included in the model are shown in **Table 28**.

Table 28 Modelled LAeq Sound Power Level Spectra

Source	Octave Band Sound Power Level (dB) ¹								Total Sound Power Level (dBA)
	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz	
Mechanical Plant									
Cooling Tower (per 2xcell tower) ²	97	95	90	85	85	82	79	71	90
Generator Enclosure Air Intake and Discharge ³	60	68	73	72	75	76	74	80	83
Generator Exhaust (30 dB Silencer) ³	96	106	106	97	99	97	89	73	104
Generator Exhaust (40 dB Silencer) ³	86	96	96	87	89	87	79	63	94
Air Conditioning Unit	96	106	106	97	99	97	89	73	96



Source	Octave Band Sound Power Level (dB) ¹								Total Sound Power Level (dBA)
	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz	
On-site Traffic and Loading Dock									
Medium Truck	103	97	93	91	91	87	83	80	95
Light Vehicle	98	92	88	86	86	82	78	75	90
Truck Reversing Alarm	-	-	-	-	105	102	95	-	107
Forklift Reversing Alarm	-	-	-	-	100	97	90	-	102
Air Brakes	111	111	111	111	111	111	111	111	118
Roller Door	92	90	88	90	90	87	84	77	94
Electric Forklift	77	77	77	77	77	77	77	77	84

Note 1: Noise sources are modelled based on 1/3 octave band data where available and converted to 1/1 octave bands for information purposes in this table.

Note 2: Cooling towers include an additional 3 dB safety factor added to the manufacturers specified sound power levels as discussed in **Section 4.2.1.1**. Individual faces of the cooling towers are modelled with spectrum based on the example unit manufacturer's data sheet (see **Appendix D**).

Note 3: Generator source spectra are based on the manufacturer's data for surface radiated noise and undamped exhaust noise. The generator enclosures and exhaust silencers would influence the spectrum of noise emissions from the generator and would likely reduce any potentially tonal components. Therefore, the modelled source spectra are considered conservative.

4.2.4 Corrections for Annoying Noise Characteristics

The potential annoying noise characteristics and modifying factor corrections relevant to the proposal are:

- **Tonality** – the only source identified with potential tonal characteristics is truck reversing alarms. However, when considering broadband reversing alarms have been recommended as a noise mitigation measure (see **Section 6.2**), it is unlikely that this noise source would result in tonal noise impacts at the receivers and no corrections have been applied.
- **Low frequency noise** – noise levels from development-related mechanical plant are not expected to result in low frequency noise impacts at residential receivers and no corrections have been applied.
- **Intermittent noise** – the NPfI defines intermittent noise as noise heard at the receiver where the level suddenly drops or increases several times during the assessment period, with a noticeable change of at least 5 dB. The intermittent correction does not apply to short-term events that emerge above the general industrial noise level and is therefore not applicable to industrial or commercial sites that have vehicle or plant movements at night, including audible reversing alarms. While testing of the backup generators may be intermittent, the testing is only undertaken during the daytime when no correction is applicable. No other sources have been identified with potential intermittent characteristics.

The operational noise sources have been modelled with the spectrum shown in **Table 28**. The receiver results have been reviewed to confirm that no tonal or low frequency noise corrections are applicable.



Appendix E.1 summarises additional review of the potential for tonal and low frequency noise from the proposed cooling towers and generators. The review concludes that modifying factor corrections are not expected to be required based on the manufacturers' data available at this stage. The potential for annoying noise characteristics would be reviewed during detailed design.

4.2.5 Noise Sources with Potential for Sleep Disturbance

As the development is proposed to operate 24-hours a day, noise emissions during the night-time require assessment for potential sleep disturbance at the nearest residential receivers. The details of typical activities with the potential to cause sleep disturbance are shown in **Table 29**.

Table 29 Sleep Disturbance Noise Events – L_{Amax} Sound Power Levels

Noise Source	Sound Power Level L _{Amax} (dBA)
Truck movement	111
Truck airbrake	118
Truck reversing alarm	110
Roller door	94

4.2.6 Off-site Road Traffic

Traffic associated with the development is planned to enter and exit the development from the south via Talavera Road, with the majority of traffic travelling directly to Lane Cove Road around 200 m to the east.

The potential noise impacts from development related traffic on public roads are expected to be negligible given there are no sensitive receivers on this route and the route is a major arterial road with high existing traffic volumes.

4.2.7 Weather Conditions

Fact Sheet D of the NPfI requires noise assessments to consider the potential effects of noise-enhancing weather conditions, such as wind from the source to the receiver and/or temperature inversions.

The nearest sensitive receivers are within 200 m of the proposal site and the effects of weather on noise levels are expected to be minimal. Notwithstanding, the noise prediction modelling uses ISO 9613-2 algorithms which include noise-enhancing weather conditions including downwind propagation, or equivalently, propagation under a well-developed moderate ground-based temperature inversion.

As such, the assessment has conservatively applied noise-enhancing weather conditions for all periods as per Option 1 of Fact Sheet D of the NPfI.



5.0 Assessments of Impacts

5.1 Construction Noise

The predicted noise levels at the most-affected sensitive receivers surrounding the site are shown in **Table 30** and exceedances of the NMLs are shown in **Table 31**. Receivers which are further away from the work and/or shielded from view would likely experience lower noise levels and impacts.

The predictions represent a realistic worst-case scenario where the equipment in each scenario is working concurrently at the nearest location to each receiver. It is expected that noise levels would frequently be lower than the worst-case levels presented.

Table 30 Predicted Construction Noise Levels – Standard Daytime Construction Hours

ID ¹	Receiver Location	Type	NML	Predicted Noise Level – LAeq(15minute) (dBA)					
				Vegetation Clearing	Demolition	Earthworks	Excavation of Hard Rock	Construction of Pads & Hardstands	Construction of Structures & Equipment Installation
R01	Residences at 17-49 Fontenoy Road	Residential	65	65	66	62	69	56	57
R02	Ground level residences at 1-15 Fontenoy Road	Residential	66	68	69	65	72	59	60
R03	Elevated (F1-F7) residences at 1-15 Fontenoy Road	Residential	70	71	72	68	75	62	63
R04	Residence at 37 Khartoum Road, Macquarie Park	Residential	55	53	54	50	57	44	45
R06	North Ryde Early Learning Centre – 12/24 Talavera Road	Child Care	55	70	71	67	74	61	62
R07	Courtyard by Marriott Sydney – 7/11 Talavera Road	Hotel	70	71	72	68	75	62	63
R08	Excelsia College – 69-71 Waterloo Road	Educational	55	60	61	57	64	51	52
R09	Commercial buildings on Talavera Road	Commercial	70	87	88	84	91	78	79



Table 31 Predicted Exceedance at Nearest Receivers

ID ¹	Receiver Location	Type	NML	Predicted Exceedance – LAeq(15minute) (dBA)					
				Vegetation Clearing	Demolition	Earthworks	Excavation of Hard Rock	Construction of Pads & Hardstands	Construction of Structures & Equipment Installation
R01	Residences at 17-49 Fontenoy Road	Residential	65	-	1	-	-	4	-
R02	Ground level residences at 1-15 Fontenoy Road	Residential	66	2	3	-	6	-	-
R03	Elevated (F1-F7) residences at 1-15 Fontenoy Road	Residential	70	1	2	-	5	-	-
R04	Residence at 37 Khartoum Road, Macquarie Park	Residential	55	-	-	-	2	-	-
R06	North Ryde Early Learning Centre – 12/24 Talavera Road	Child Care	55	15	16	12	19	6	7
R07	Courtyard by Marriott Sydney – 7/11 Talavera Road	Hotel	70	1	2	-	5	-	-
R08	Excelsia College – 69-71 Waterloo Road	Educational	55	5	6	2	9	-	-
R09	Commercial buildings on Talavera Road	Commercial	70	17	18	14	21	8	9

The above worst-case predictions show the following:

- Noise levels are expected to exceed the NMLs at the nearest receivers during certain noisy works.
- The highest impacts are predicted during ‘vegetation clearing’ when a chainsaw/chipper is in use, and during ‘demolition’ and ‘excavation of hard rock’ when a rockbreaker is in use.
- The NMLs are predicted to be exceeded at receivers on Fontenoy Road by up to 5-6 dB.
- No residential receivers are predicted to be highly noise affected (≥ 75 dBA) during any of the construction work.
- Construction noise levels are predicted to exceed the NMLs by up to 19 dB, 5 dB and 8 dB at the closest child care, hotel and educational facility, respectively.
- Construction noise levels are also predicted to exceed the commercial NML by up to 21 dB at the nearest existing commercial receivers.



The presented impacts would only be expected to occur when noisy work is being completed close to the site boundaries, relative to each receiver. When work is in central areas of the site, or when less noise intensive equipment is being used, the noise levels are expected to reduce.

Feasible and reasonable construction noise mitigation measures should be applied where exceedances of the NMLs are predicted. Construction noise mitigation and management measures are discussed in **Section 6.1**.

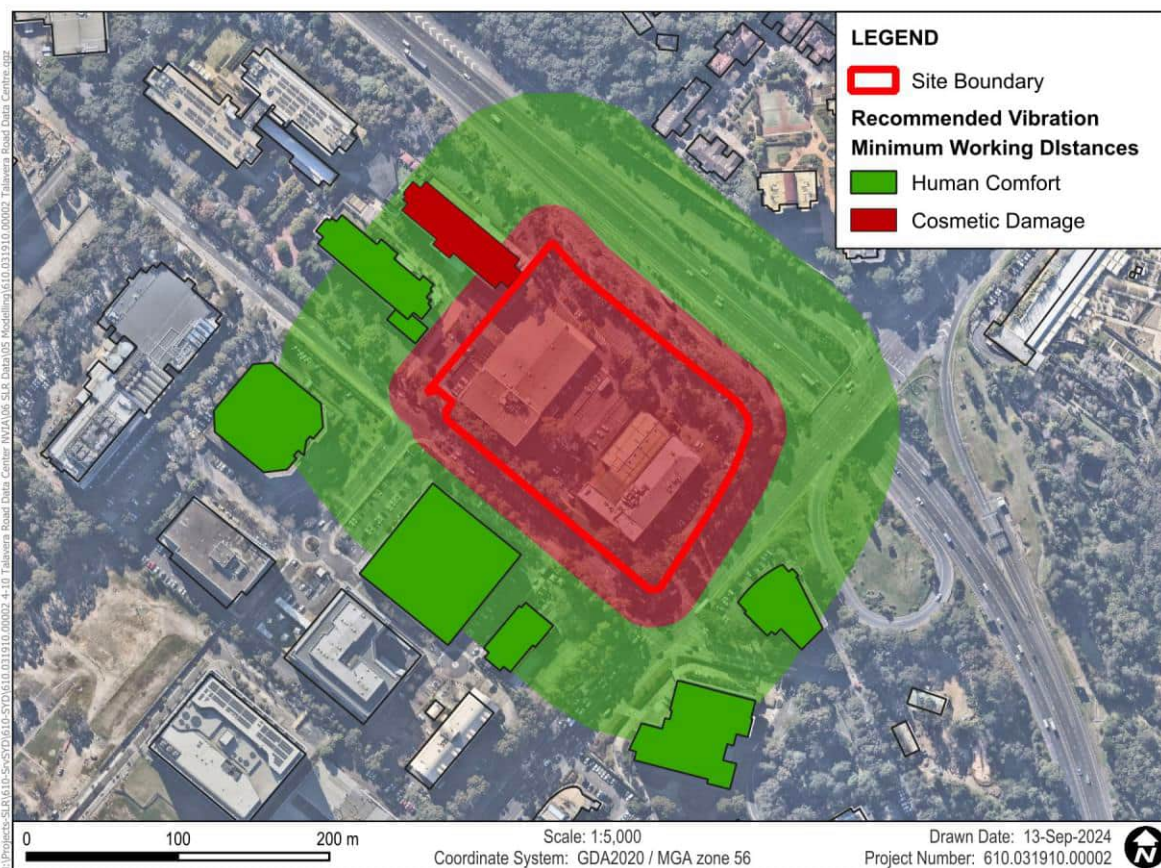
5.2 Construction Vibration

The major potential sources of vibration from the proposed construction activities would likely be during:

- 'Earthworks' when vibratory rollers are being used
- 'Demolition' and 'excavation of hard rock' when rockbreakers are being used.

Vibration offset distances have been determined from the CNVG minimum working distances for cosmetic damage and human comfort (see **Table**) and the assessment is summarised in **Figure 7** for the potential worst-case scenario, which is during the use of a large vibratory roller. Buildings within the minimum working distances are highlighted in the figure.

Figure 7 Construction Vibration – Large Vibratory Roller



5.2.1 Cosmetic Damage Assessment

The above figure show that the distance between the construction work and the nearest sensitive receivers is generally sufficient for most receiver buildings to be outside of the cosmetic damage minimum working distance for vibration intensive equipment.

The adjacent commercial buildings at 12-24 Talavera Road are within the recommended minimum working distance, noting that the assessment represent a worst-case situation where a large vibratory roller is in use at the site boundary and is in close proximity to the potentially affected buildings. In reality, smaller equipment or alternative methodologies would likely be used as the work gets near to adjacent structures which would control the potential impacts. It is also noted that the potentially impacted buildings are owned by Goodman.

5.2.2 Human Comfort Vibration Assessment

The above figures indicate that several commercial receivers are within the human comfort minimum working distance and occupants of these buildings may be able to perceive vibration impacts at times when vibration intensive equipment is in use nearby. Where impacts are perceptible, they would likely only be apparent for relatively short durations when vibration intensive equipment is in use.

Feasible and reasonable construction vibration mitigation measures should be applied where vibration intensive works are required within the minimum working distances. Construction mitigation and management measures are discussed further in **Section 6.1**.

5.2.3 Cumulative Construction Noise

A detailed review of each project and its potential interface with the proposal in terms of construction noise is shown in **Table 32**. The projects are considered in terms of the following potential noise impacts:

- **Cumulative construction noise**

Where concurrent construction work is being completed near to a particular area, the worst-case noise levels could theoretically increase by around 3 dB (ie a logarithmic adding of two sources of noise at the same level). The likelihood of worst-case noise levels being generated by two different work activities at the same time is, however, considered low and rather than increase construction noise levels, the impact of concurrent construction work would generally be limited to a potential increase in the duration, and annoyance, of noise impacts on the affected receivers.

- **Consecutive construction noise**

The successive work in a particular area may result in consecutive impacts (ie 'construction fatigue') at the surrounding receivers due to construction work being in the area for an extended period. Mitigation measures aimed at short-term construction work may be less effective where receivers are affected by longer duration impacts from several projects.



Table 32 Potential Cumulative Construction Noise Impacts

Project	Approximate Distance	Proposed Construction Timing	Potential Impact
100-108 Talavera Road	1,100 m	2022-2025	Cumulative impacts are not expected due to the distance of the project.
11-17 Khartoum Road	400 m	2021-2025 (major construction of structures complete)	Major construction phases at both the proposal and the cumulative project are not expected to overlap. Therefore, no cumulative impacts are expected. Consecutive noise impacts may occur at other sensitive receivers in Macquarie Park.
17-23 Talavera Road	200 m	2024-2025	
1-5 Khartoum Road	500 m	Unknown	Cumulative impacts at residential receivers north of the M2 Motorway are not expected due to the distance of the project.
45-61 Waterloo Road	300 m	Unknown (likely commencing 2024)	Cumulative and/or consecutive impacts at other sensitive receivers in Macquarie Park are possible and would depend on the construction timing of both projects.
269 Lane Cove Road	600 m	2025-2027	
85-97 Waterloo Road and 2 Banfield Road	700 m	Stage 1 2024-2027 Stage 2 2028-Unknown	

The above indicates that there is potential for cumulative construction noise impacts from certain nearby developments if construction occurs at the same time as the proposal. The likelihood of cumulative and/or consecutive construction noise impacts will be reviewed as the proposal progresses and detailed construction schedules are available for all projects considered for cumulative impacts.

5.3 Operational Noise

The predicted peak noise levels are compared to the PNTLs to determine the potential impact from the proposal.

Feasible and reasonable mitigation measures have been investigated for the development with the aim of reducing noise levels to the PNTLs. A detailed investigation of feasible and reasonable mitigation is provided in **Section 6.2**.

The following key measures have been applied to reduce noise emissions:

- Solid rooftop plant room screening the cooling towers from receivers to the north (see **Figure**)
- Acoustic louvre wall screening the cooling towers from receivers to the south (see **Section 6.2.2**)
- Generator enclosures and exhaust silencers
- Use of broadband and/or ambient noise sensing reversing alarms to minimise potentially annoyance.



A summary of the operational noise assessment at the representative receivers surrounding the proposal is shown in **Table 33**, including feasible and reasonable mitigation. Noise contours of the predicted worst-case operational noise impacts at ground level and roof height are shown in **Appendix E.2**.

Table 33 Operational Noise Assessment

ID	Receiver Location	Type	Period	Noise Level LAeq(15minute) (dBA)			Compliance
				Criteria	OP.01 ¹	OP.02 ²	
R01	Residences at 17-49 Fontenoy Road	Residential	Day	58	38	49	Yes
			Evening	48	36		Yes
			Night	43	38		Yes
R02	Ground level residences at 1-15 Fontenoy Road	Residential	Day	58	39	54	Yes
			Evening	48	38		Yes
			Night	43	39		Yes
R03	Elevated (F1-F7) residences at 1-15 Fontenoy Road	Residential	Day	58	41	53	Yes
			Evening	49	41		Yes
			Night	45	41		Yes
R04	Residences at 37 Khartoum Road, Macquarie Park	Residential	Day	50	31	39	Yes
			Evening	48	31		Yes
			Night	43	31		Yes
R05	Residences at 35 Waterloo Road, Macquarie Park	Residential	Day	58	43	48	Yes
			Evening	48	43		Yes
			Night	43	43		Yes
R06	North Ryde Early Learning Centre – 12/24 Talavera Road	Child Care Playground	When in use	53	35	47	Yes
		Child Care Classroom		58	44	54	Yes
R07	Courtyard by Marriott Sydney – 7/11 Talavera Road	Hotel	Day	63	44	50	Yes
			Evening	53	44		Yes
			Night	48	44		Yes
R08	Excelsia College – 69-71 Waterloo Road	Educational	When in use	58	36	47	Yes
R09	Commercial buildings on Talavera Road	Commercial	When in use	63	56	62	Yes

Note 1: OP.01 – Typical Peak Operation.

Note 2: OP.02 – Typical Peak Operation and Generator Maintenance/Testing.

The above assessment indicates that the noise levels predicted with the proposed mitigation comply with the PNTLs at the receiver assessment locations and are expected to be compliant at all surrounding receivers.



Predicted operational noise levels at all nearby receivers are shown in **Appendix E.3** and confirm that the assessment locations above are representative of the most affected location for each receiver area.

It is noted that the details of the mechanical plant used in this assessment are indicative, including the unit types, sound power levels, number of units and locations of equipment. An additional 3 dB has been added to the assessment of cooling tower noise to account for potential changes that may result from final unit selection, variable frequency drives and other external plant items (see **Section 4.2.1**). All mechanical plant items should be reviewed during the detailed design stage of the project to confirm compliance with the PNTLs.

5.3.1 Emergency Scenario

The predicted operational noise levels during an indicative emergency scenario with all generators operating concurrently at full capacity are shown in **Table 34** for the representative receivers surrounding the proposal. It is noted that this scenario is outside the application of the NPfl and it is not considered reasonable for this scenario to be required to meet the operational noise criteria.

Table 34 Emergency Scenario Noise

ID	Receiver Location	Type	OP.03 Noise Level L _{Aeq} (15minute) (dBA)
R01	Residences at 17-49 Fontenoy Road	Residential	65
R02	Ground level residences at 1-15 Fontenoy Road	Residential	69
R03	Elevated (F1-F7) residences at 1-15 Fontenoy Road	Residential	67
R04	Residences at 37 Khartoum Road, Macquarie Park	Residential	55
R05	Residences at 35 Waterloo Road, Macquarie Park	Residential	62
R06	North Ryde Early Learning Centre – 12/24 Talavera Road	Child Care Playground	61
		Child Care Classroom	64
R07	Courtyard by Marriott Sydney – 7/11 Talavera Road	Hotel	64
R08	Excelsia College – 69-71 Waterloo Road	Educational	59
R09	Commercial buildings on Talavera Road	Commercial	73

5.3.2 Sleep Disturbance

The predicted night-time maximum noise levels at the nearest residential receivers are shown in **Table 35**. The assessment includes consideration of heavy vehicle airbrakes, although it is noted that the heavy vehicles accessing the development are expected to be rigid trucks which generally do not use airbrakes. The predicted maximum noise levels include the mitigation measures specified in **Section 6.2**.



Table 35 Sleep Disturbance Assessment

ID	Receiver Location	Source	Maximum Noise Level L _{Amax} (dBA)			Below Screening Level
			Sleep Dist. Screening Level	Predicted	Exceedance	
R01	Residences at 17-49 Fontenoy Road	Truck movement	58	42	-	Yes
		Truck airbrake		55	-	Yes
		Truck reversing alarm		53	-	Yes
		Roller door		<30	-	Yes
R02	Ground level residences at 1-15 Fontenoy Road	Truck movements	59	43	-	Yes
		Truck airbrake		48	-	Yes
		Truck reversing alarm		50	-	Yes
		Roller door		<30	-	Yes
R03	Elevated (F1-F7) residences at 1-15 Fontenoy Road	Truck movements	60	48	-	Yes
		Truck airbrake		58	-	Yes
		Truck reversing alarm		58	-	Yes
		Roller door		31	-	Yes
R04	Residences at 37 Khartoum Road, Macquarie Park	Truck movements	53	31	-	Yes
		Truck airbrake		40	-	Yes
		Truck reversing alarm		39	-	Yes
		Roller door		<30	-	Yes
R05	Residences at 35 Waterloo Road, Macquarie Park	Truck movements	60	39	-	Yes
		Truck airbrake		37	-	Yes
		Truck reversing alarm		35	-	Yes
		Roller door		<30	-	Yes

The above shows that maximum noise levels are expected to comply with the sleep disturbance screening level at all residential receivers.



6.0 Mitigation and Management Measures

6.1 Construction Mitigation

The impacts during construction of the proposal are predicted to be consistent with major construction work near sensitive receivers. No works outside of Standard Construction Hours are currently proposed.

The use of standard mitigation measures to minimise the impacts is considered sufficient to control the majority of the impacts. Examples of measures that could be applied to the work are provided in the ICNG and the Transport for NSW *Construction Noise and Vibration Guideline* (see **Appendix F**).

Recommended universal work practices and standard mitigation measures for the proposal construction include:

- Regular toolbox notification and training of workers and contractors to be aware of nearby noise sensitive receivers and use equipment in ways to minimise noise.
- Use the minimum sized equipment necessary to complete the work and where possible, use alternative, low-impact construction techniques
- Long term stationary noise sources should be enclosed or shielded from nearby sensitive receivers where possible
- Where rockbreakers or other pneumatic equipment is required, select silenced and dampened equipment where possible
- Implement community consultation to provide surrounding receivers with information such as the total construction time, what works are expected to be noisy, their duration and mitigation measures that are being applied to minimise the noise
- Consultation should include nearby 'other sensitive' receivers such as educational institutions. Noise intensive work that is predicted to impact 'other sensitive' receivers will be scheduled outside of particularly sensitive periods, such as exams, where possible.

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared before any work begins. The plan would:

- Identify nearby sensitive receivers
- Describe the activities, construction equipment and work that will be completed and quantify resulting impacts at sensitive receivers
- Include noise and vibration management criteria and relevant licence and approval conditions
- Include measures to manage noise and vibration and minimise the potential for impacts during construction, aligned with the results of community consultation and feedback during the approval process
- Set out requirements for noise and vibration verification monitoring
- Set out procedures for handling complaints.

AS 2436 provides further guidance on the control of construction noise and vibration and includes the nominal noise reduction possible from various mitigation strategies summarised in **Table 36**.



Table 36 Nominal Construction Noise Reductions

Control	Example	Nominal Noise Reduction (AS 2436)
Distance	Maximising the offset distance between noisy plant and adjacent sensitive receivers.	6 dB per doubling of distance
Screening	Use of structures (ie site shed, earth bund, temporary hoarding) to shield adjacent sensitive receivers from noisy plant and activities.	5-10 dB
Enclosure	Construct a solid enclosure around generators, compressors, pumps or similar long-term plant.	15-25 dB
Silencing	Fit muffler, silenced or dampened bit to relevant noise intensive equipment.	5-10 dB

Construction impacts are expected during certain work activities at the nearest sensitive receivers even with the implementation of all feasible and reasonable mitigation measures. The CNVMP would review the predicted residual construction noise impacts when more detailed planning information is available and confirm the mitigation measures which would be implemented to minimise construction noise impacts as much as practicable.

6.2 Operational Mitigation

Where operational noise impacts from the development are predicted to exceed the relevant noise criteria, feasible and reasonable operational noise mitigation and management measures should be considered, with the aim of reducing noise emissions to the relevant criteria.

The typical hierarchy for mitigation and management of industrial noise sources is as follows:

- Reducing noise emissions at the source (ie noise source control)
- Reducing noise in transmission to the receiver (ie noise path control)
- Reducing noise at the receiver (ie at-receiver control).

A detailed assessment of potential feasible and reasonable mitigation measures that can be applied to the development to minimise the operational noise impacts has been completed and is summarised in **Table 37**.

The measures will be further refined during detailed design and in an Operational Noise and Vibration Management Plan when the specific tenant operations are known.



Table 37 Operational Noise Mitigation Options

Ref.	Mitigation Option	Noise Impact/Benefit	Feasible and Reasonable to Apply
Source Control			
S1	Optimised site layout to minimise noise emissions from the site	Where possible, the site layout has been designed so that the buildings screen the noisier areas of the development from the nearest receivers.	Yes – applied during design of the concept
S2	Limit vehicle movements	A reduction in concurrent vehicle movements across the site by staggering delivery/pickup times and/or employee shift change times could reduce noise emissions. In practice, this would occur naturally due to operational requirements.	No – vehicle volumes used in this assessment are likely needed to meet tenant’s requirements. Additionally, vehicle movements are not predicted to be a dominant contributor to noise emissions from the development.
S3	Use broadband and/or ambient sensing alarms on heavy vehicles where they are required to reverse during the night-time.	Reduce potential for annoying noise emissions during the night-time.	Yes – encourage use of broadband and/or ambient sensing alarms on heavy vehicles where they are required to reverse during the night-time.
S4	Appropriate specification and location of mechanical plant during detailed design.	The following mitigation measures have been used in the assessment: - Backup generators are contained in enclosures and include manufacturer’s exhaust silencer with 30 dB or 40 dB attenuation. - The final selection of all mechanical plant would be reviewed with consideration of minimising the potential for tonal and low frequency noise impacts at sensitive receivers.	Yes – the specified mitigation measures minimise noise impacts from mechanical plant. The noise impacts from all items of mechanical plant would be reviewed during detailed design stage to confirm mitigation requirements.
S5	Roller doors kept closed when loading/unloading is not occurring.	Reduce potential for noise breakout from internal activity.	Yes – roller doors should be kept closed when not in use for loading/unloading.
S6	Appropriate design of site layout to minimise the need for trucks to stop or brake outside of loading docks with line of sight to residential receivers.	Minimise noise emissions, particularly from truck airbrakes.	Yes – recessed loading dock minimises line of site to residential receivers.



Ref.	Mitigation Option	Noise Impact/Benefit	Feasible and Reasonable to Apply
S7	Production of an Operational Noise Management Plan.	This would detail the measures that could be used by the various tenants to minimise general noise emissions from the site. Reference can be made to the Best Management Practice (BMP) measures listed in the NPfl (see Appendix G).	Yes – the ONMP would detail any operational requirements for the development.
Path Control			
P1	Rooftop layout	Rooftop plant room to mitigate noise from the cooling towers.	Yes – design includes plant rooms of solid construction to the north of the cooling tower area with a minimum height of 8.5 m above roof level.
P2	Acoustic louvre wall	An acoustic louvre wall along the southern edge of the data centre roof has been used in this assessment.	Yes - an acoustic louvre wall at a height of 8.5 m minimises noise impacts from cooling towers. The louvre wall would indicatively use Construction Specialties Model A12350 acoustic louvres or similar (manufacturer data sheet supplied by the project team). The rSection requirements for this would be confirmed during the detailed design stage of the project.
Receiver Control			
R1	Not required	n/a	n/a
Verification Monitoring			
V1	Noise Monitoring	Verify post-construction operational noise levels are in-line with predictions and the mitigation is working as intended.	Yes

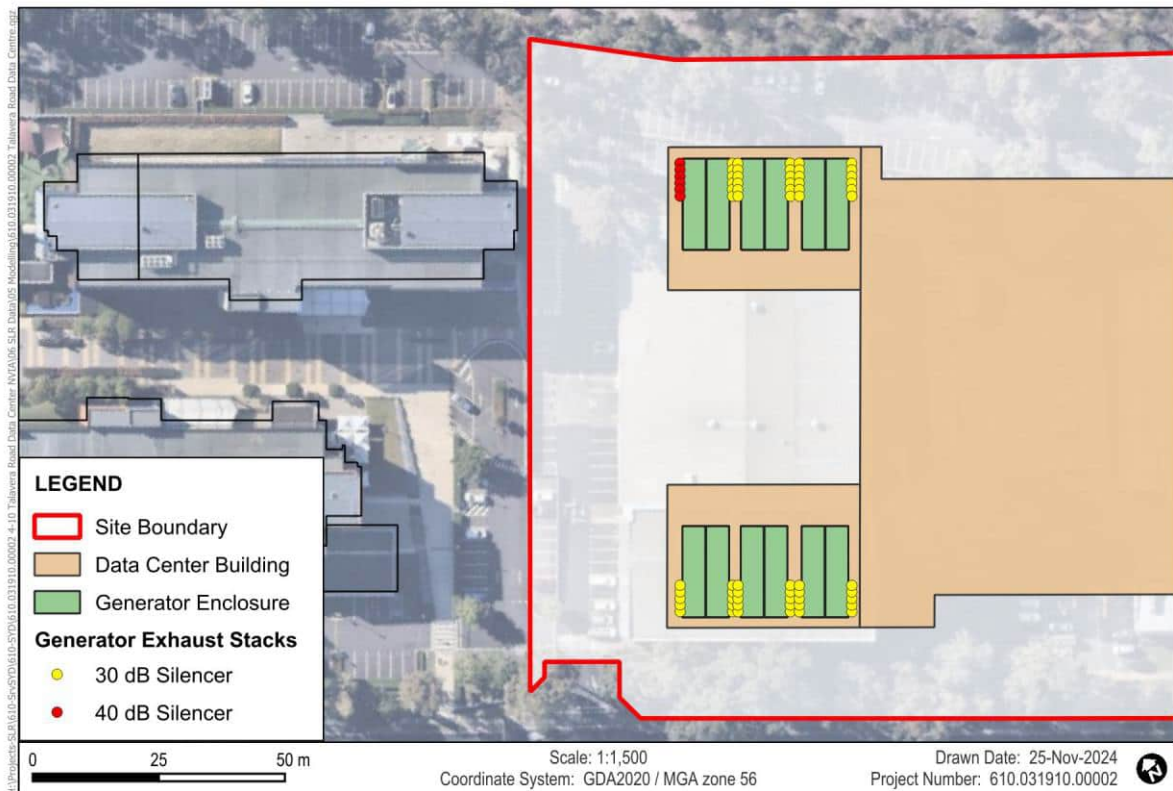
The proposal does not have tenants committed and the exact operational procedures of the site are not known at the time of this assessment. Several assumptions have been made regarding the likely future uses and sources of noise. The noise predictions in this report represent the expected peak operational emissions based on currently available information for planning purposes and will be reviewed at a later stage when detailed information is available.

6.2.1 Generator Exhaust Silencers

The assumed 30 dB and 40 dB generator exhaust silencers are shown in **Figure 8**.



Figure 8 Generator Exhaust Silencers



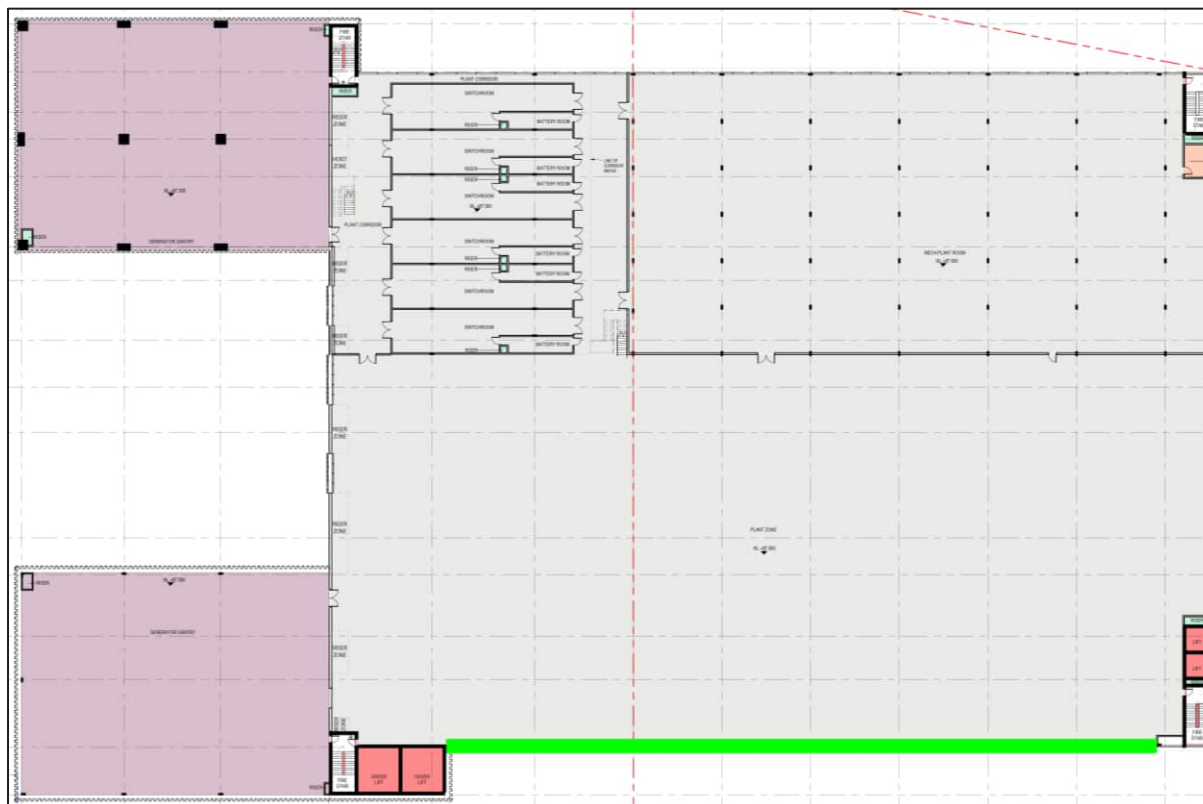
6.2.2 Acoustic Louvre Wall

The modelled location of the acoustic louvre wall is shown in green in **Figure 9** and **Figure 10**.

Figure 9 Acoustic Louvre Wall – Section View



Figure 10 Acoustic Louvre Wall – Plan View



The acoustic louvre wall has been included primarily to mitigate noise from the cooling towers to the proposed residential development at 35 Waterloo Road. The effectiveness of the acoustic louvre wall is limited due to the proposed buildings at 35 Waterloo being a greater height than the proposed data centre, resulting in a wall height of 8.5 m required to meet the Project Noise Trigger levels.

It is noted that the Project Noise Trigger Levels of the Noise Policy for industry apply to existing noise sensitive receivers. Since the 35 Waterloo Road development is in the planning and approval stages, potential noise from the proposed data centre could be considered in the detailed facade design of the future residential spaces to ensure appropriate noise reduction and internal levels are achieved. This process could reduce or remove the requirement for an acoustic louvre wall on the data centre.

The mitigation requirements will be reviewed as both projects progress and detailed planning information becomes available.



7.0 Conclusion

SLR has been engaged to assess the potential construction and operational noise emissions from the proposed development at 4-10 Talavera Road, Macquarie Park. The proposal includes the operation of a multi-storey data centre, which would be in use 24/7.

The potential impacts from the proposal have been assessed against the noise and vibration specific Secretary's Environmental Assessment Requirements and additional assessment requirements detailed in the SEARs Cover Letter.

Construction noise levels are predicted to exceed the management levels at the nearest sensitive receivers. Exceedances are predicted at residential receivers to the north of the proposal and commercial receivers surrounding the proposal, however, this would only be expected to occur when noisy work is being completed close to the site boundary. Standard mitigation measures have been recommended to address the potential construction impacts.

The operational noise assessment indicates that feasible and reasonable mitigation measures are likely required to control potential impacts from the proposal. The proposed measures include a rooftop plant rooms and an acoustic louvre wall to screen the cooling towers and silencers on backup generator exhausts. Operational noise levels are predicted to comply with the trigger levels at the nearest receivers with the proposed mitigation.

The potential operational impacts and requirements for mitigation would be confirmed during further acoustic assessments completed during detailed design.

Based on the predicted levels and indicative mitigation measures, the proposal is considered appropriate from an acoustic standpoint.





Appendix A Acoustic Terminology

Project Apollo Data Centre (4-10 Talavera Road, Macquarie Park)

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

6 March 2025

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

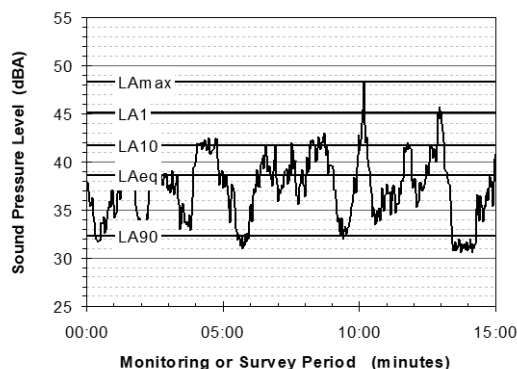
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

- LA1 The noise level exceeded for 1% of the 15 minute interval.
- LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.
- LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.
- LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

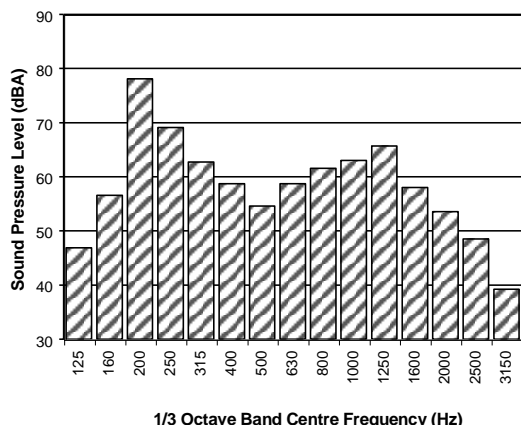
The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)



The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V , expressed in mm/s can be converted to decibels by the formula $20 \log (V/V_0)$, where V_0 is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

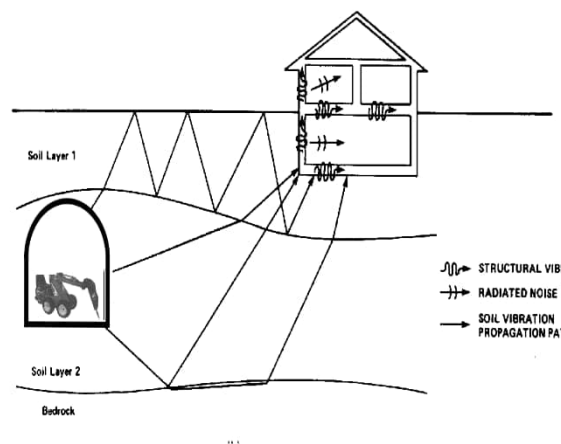
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.





Appendix B Existing Noise Environment

Project Apollo Data Centre (4-10 Talavera Road, Macquarie Park)

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

6 March 2025

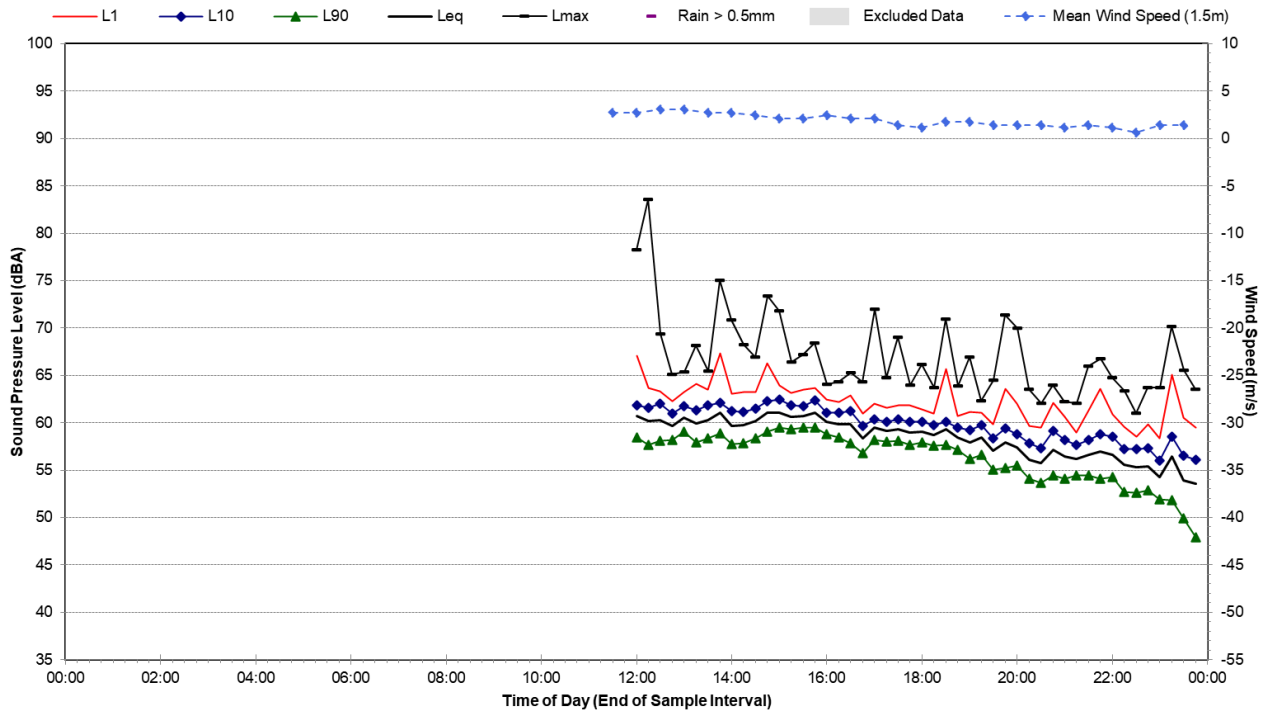
B.1 Noise Monitoring Results

Noise Monitoring Location		L.01			Map of Noise Monitoring Location
Noise Monitoring Address		7 Tasman Place, Macquarie Park			
Logger Device Type: Brüel and Kjær 2250L, Logger Serial No: 3004637 Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636 Ambient noise logger deployed south of boundary fence at residential address 7 Tasman Place, Macquarie Park. Logger located with view of M2 Motorway existing noise wall to the south. Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from the M2 Motorway.					
Recorded Noise Levels (LAmax) 9/06/2022: Traffic on Mulgoa Road: 56-61 dBA Birds: 67 dBA Wind: 50-55 dBA					
Ambient Noise Logging Results – ICNG Defined Time Periods					
Monitoring Period	Noise Level (dBA)				
	RBL	LAeq	L10	L1	
Daytime	55	59	60	63	
Evening	53	58	59	64	
Night-time	43	54	55	57	
Ambient Noise Logging Results – RNP Defined Time Periods					
Monitoring Period	Noise Level (dBA)				
	LAeq(period)	LAeq(1hour)			
Daytime (7am-10pm)	59	60			
Night-time (10pm-7am)	54	56			
Attended Noise Measurement Results					
Date	Start Time	Measured Noise Level (dBA)			
		LA90	LAeq	LAmax	
9/06/2022	11:53	58	60	67	
Photo of Noise Monitoring Location					



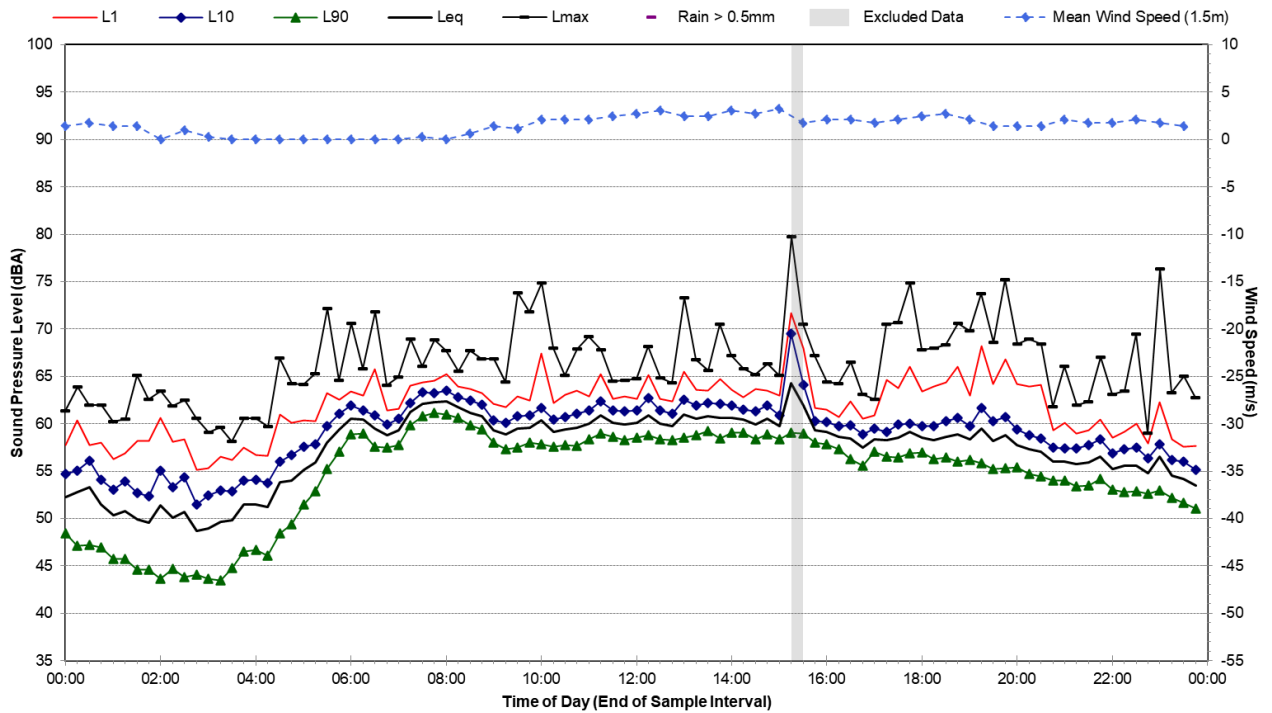
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Thursday, 9 June 2022



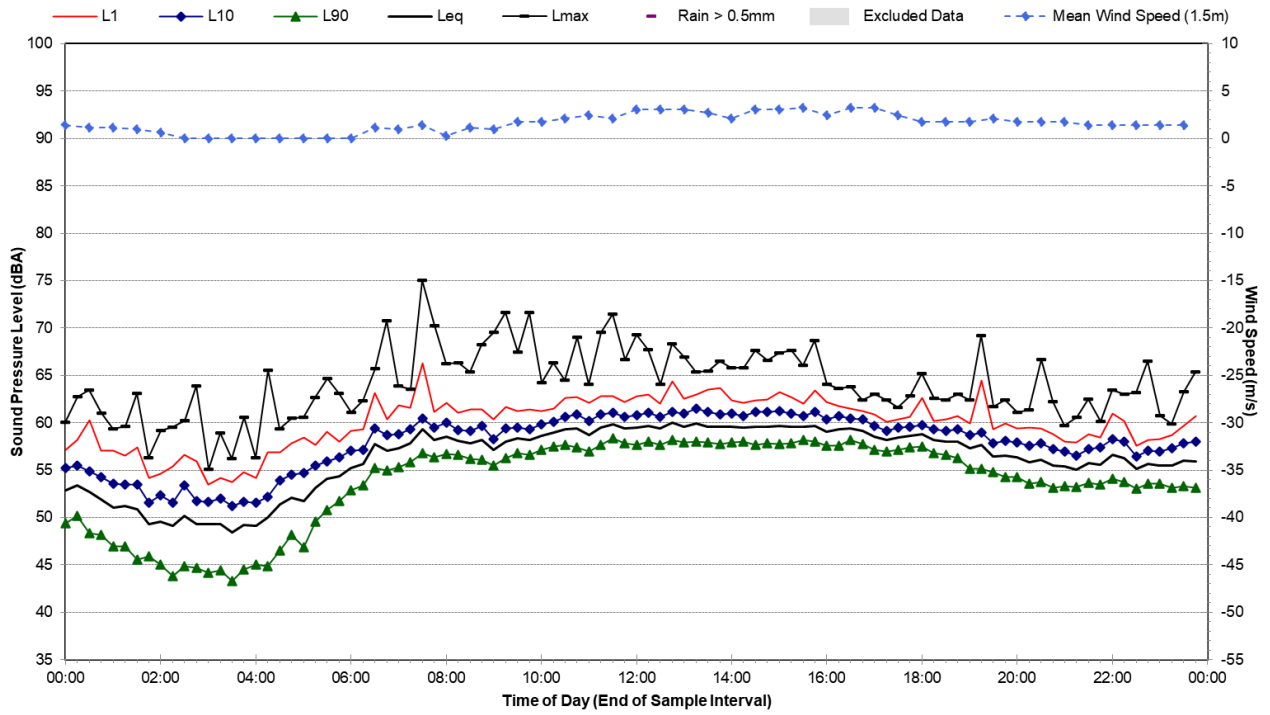
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Friday, 10 June 2022



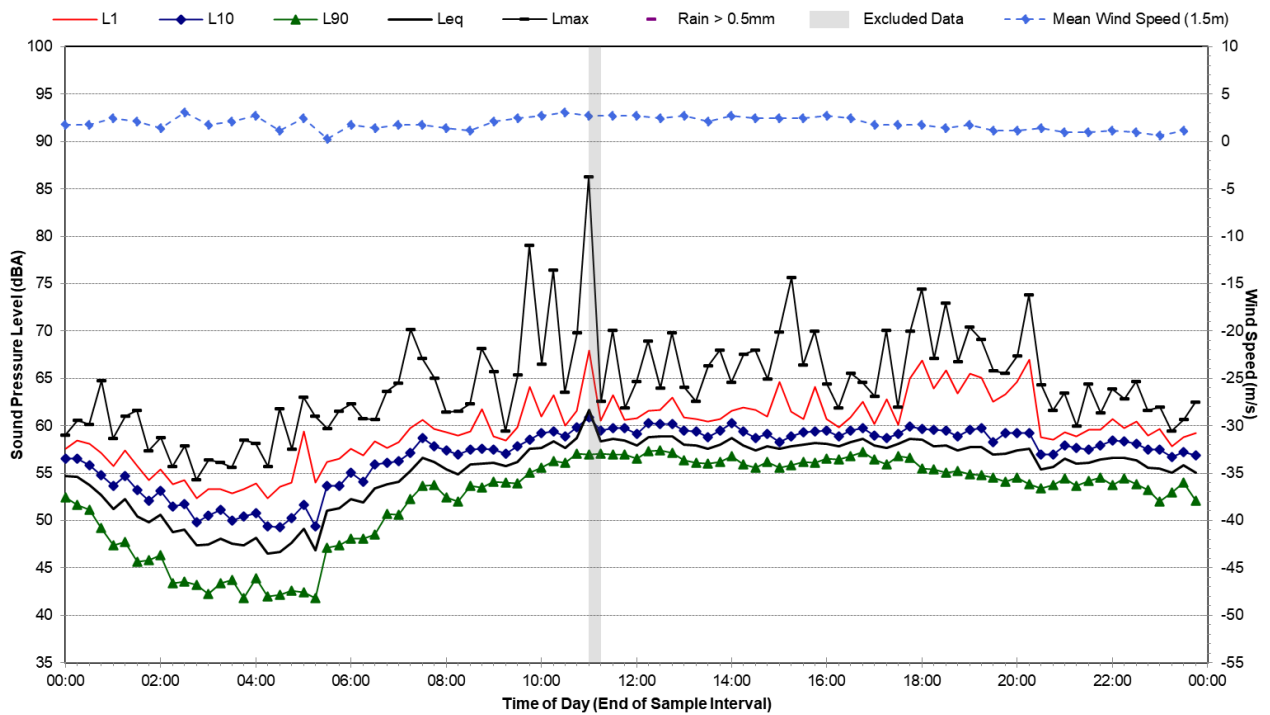
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Saturday, 11 June 2022



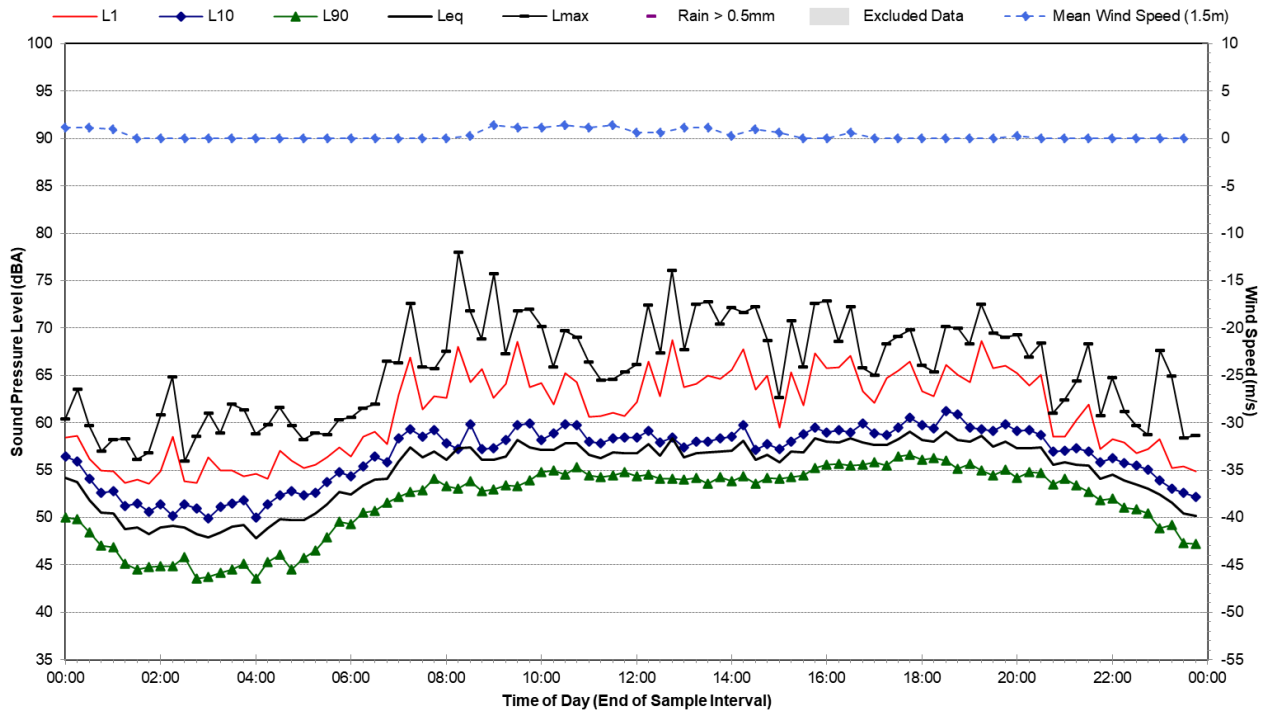
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Sunday, 12 June 2022



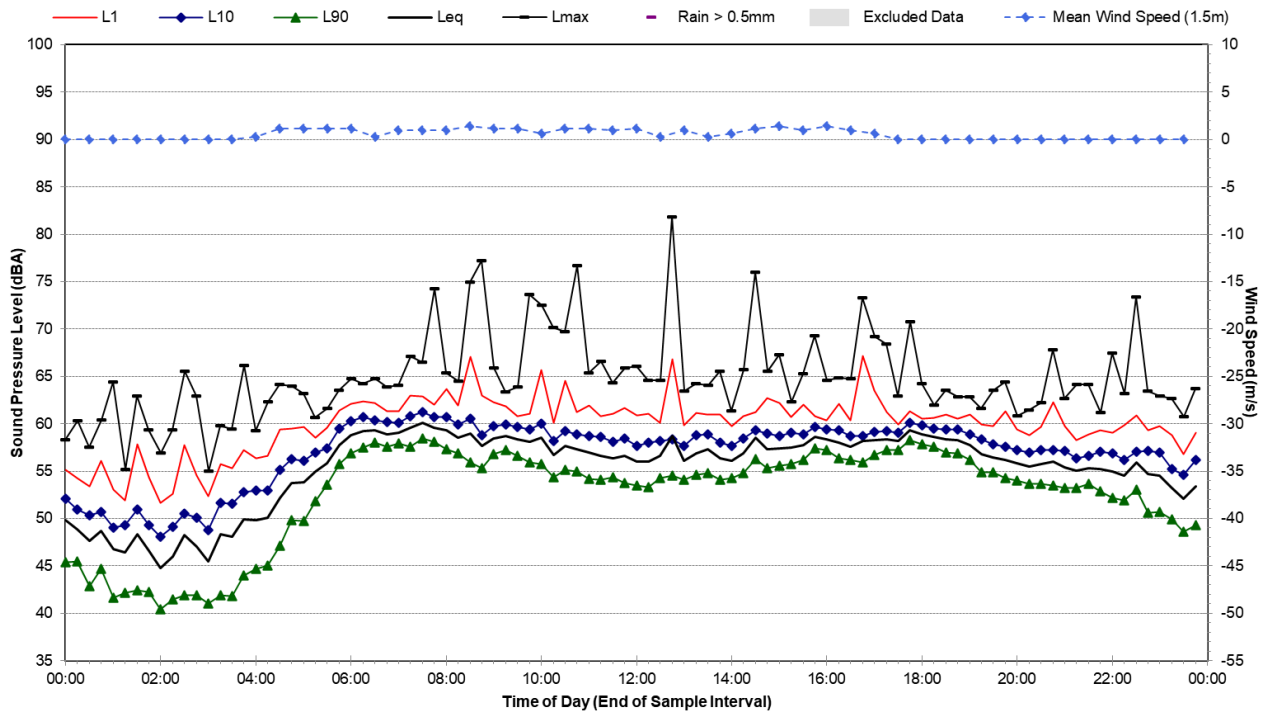
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Monday, 13 June 2022



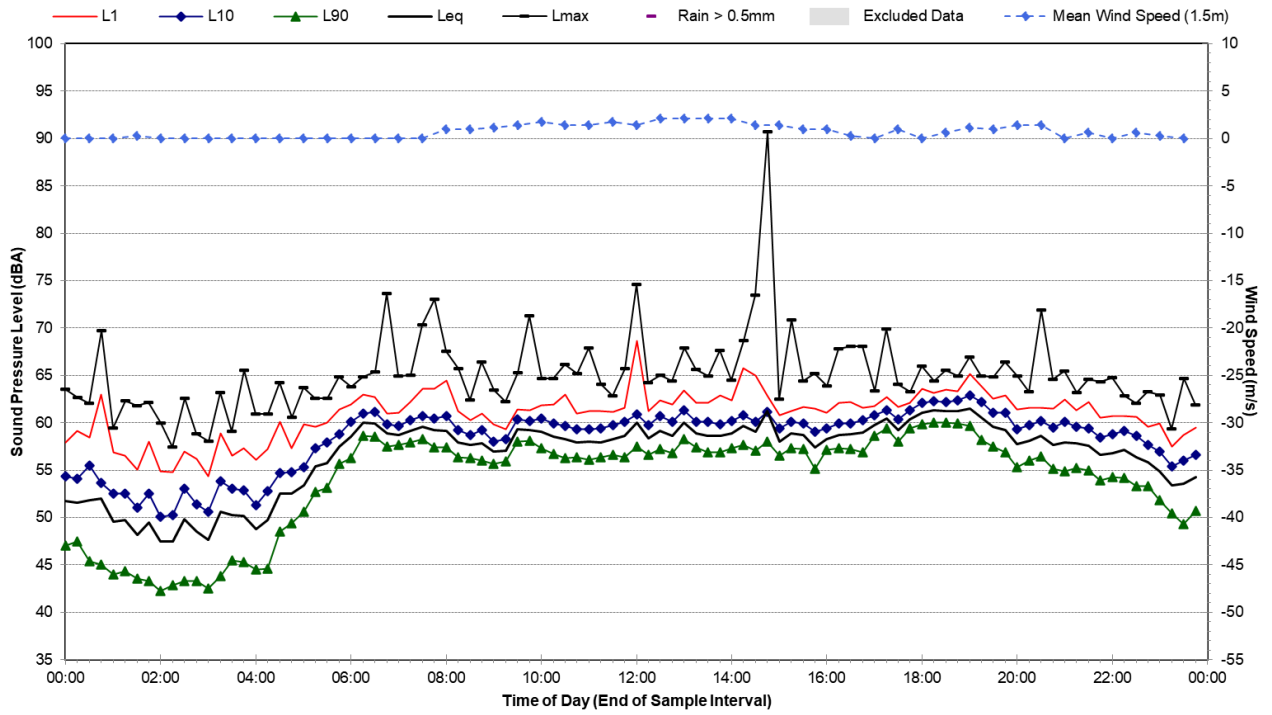
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Tuesday, 14 June 2022



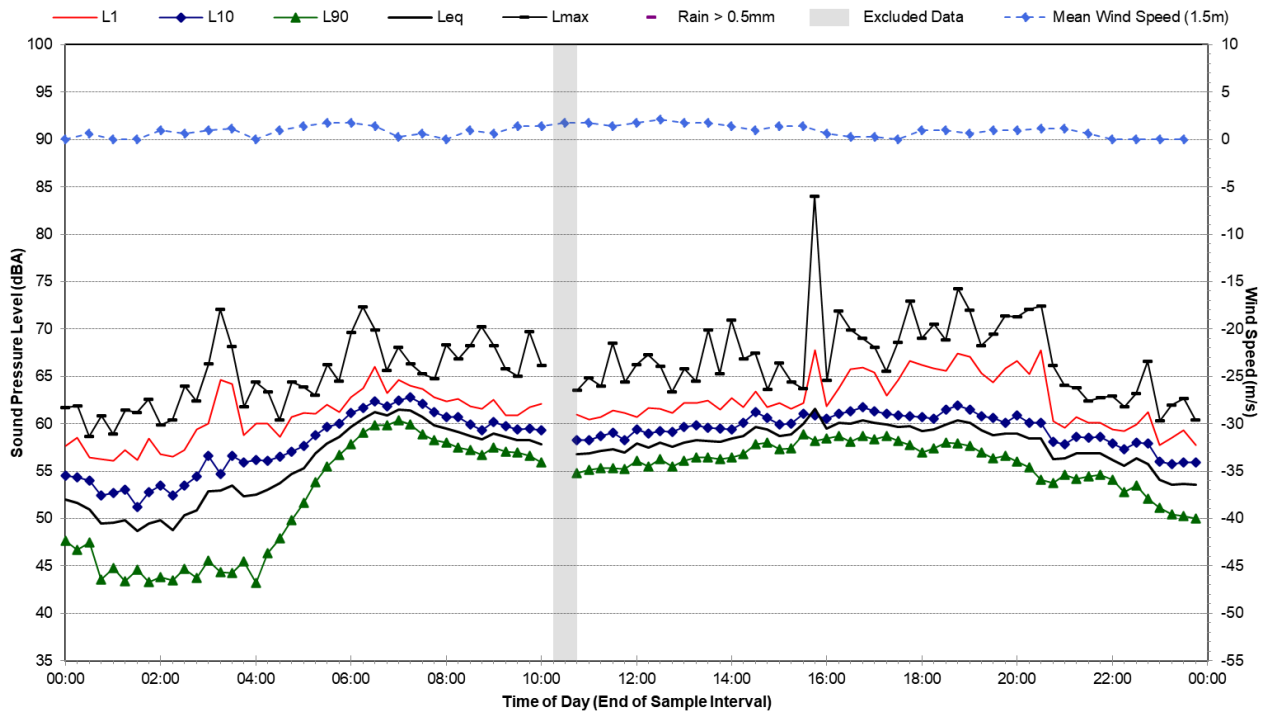
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Wednesday, 15 June 2022



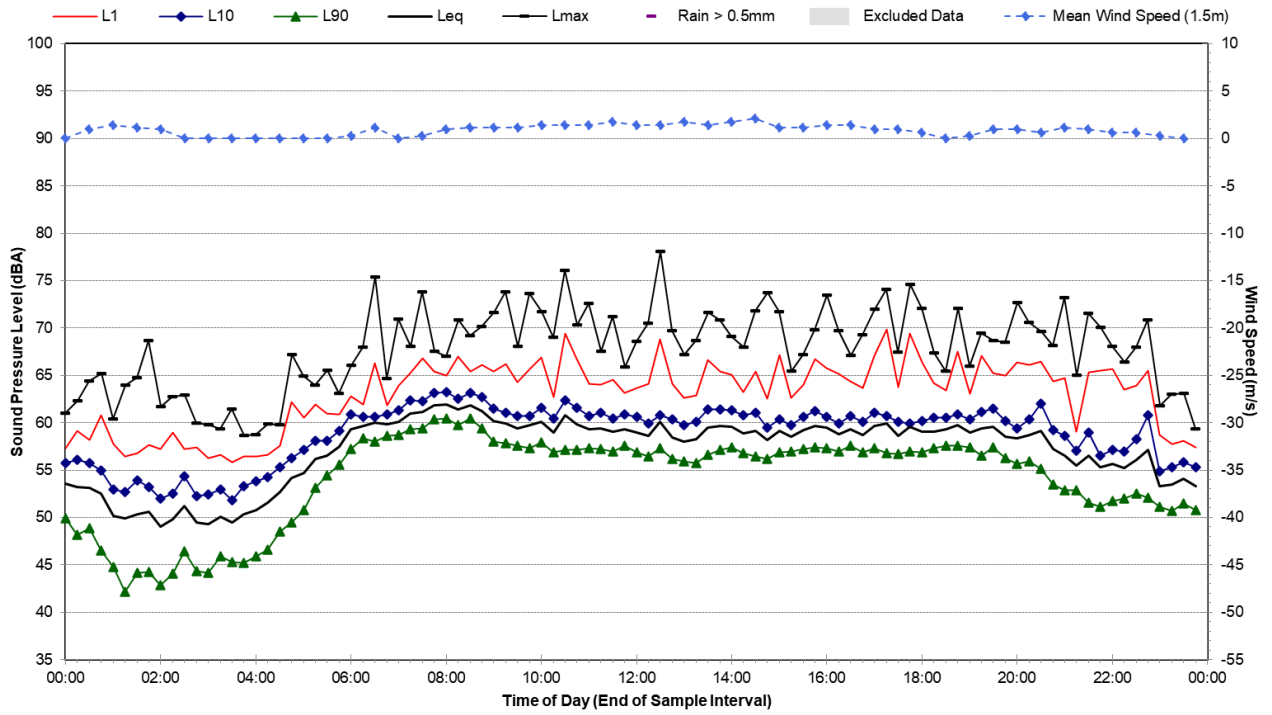
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Thursday, 16 June 2022



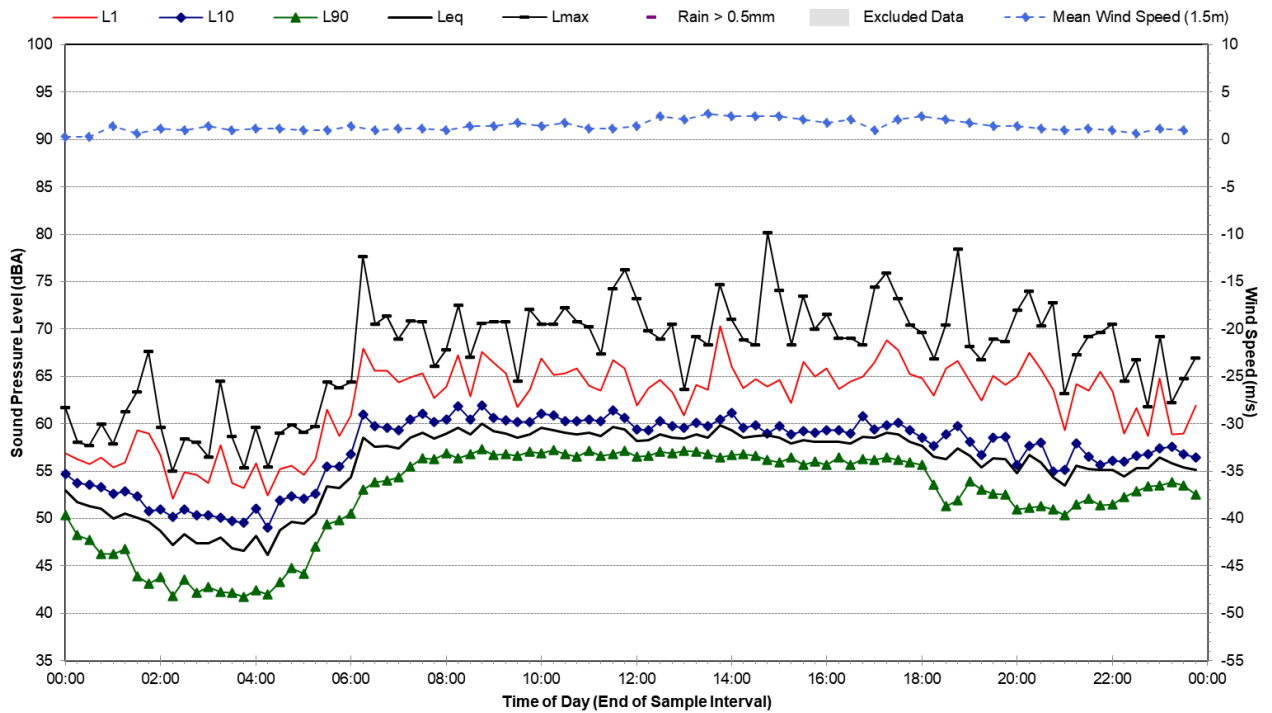
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Friday, 17 June 2022



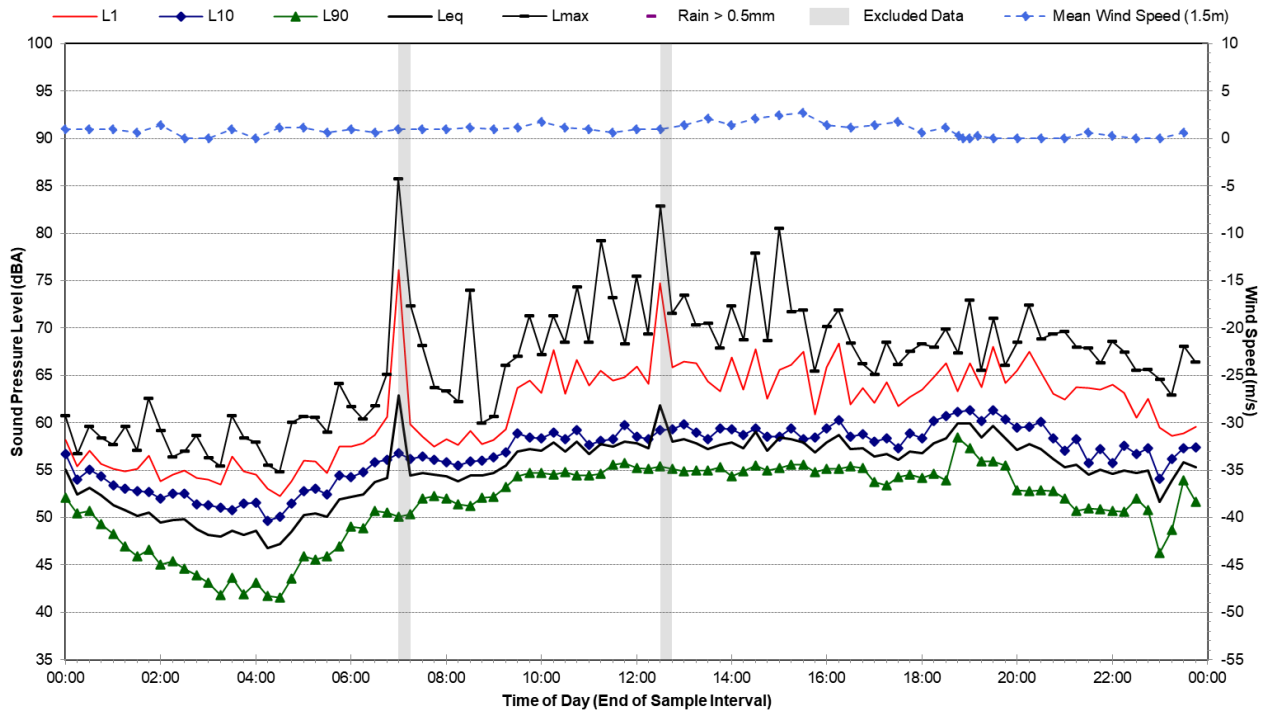
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Saturday, 18 June 2022



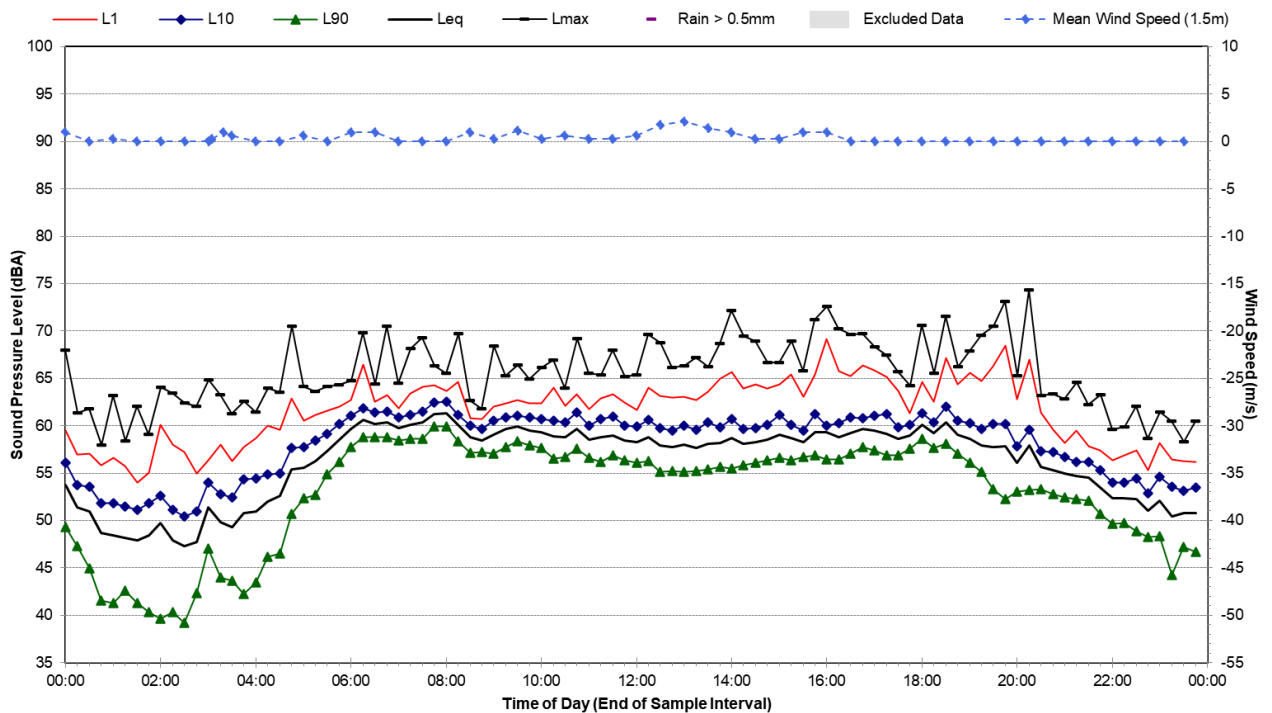
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Sunday, 19 June 2022



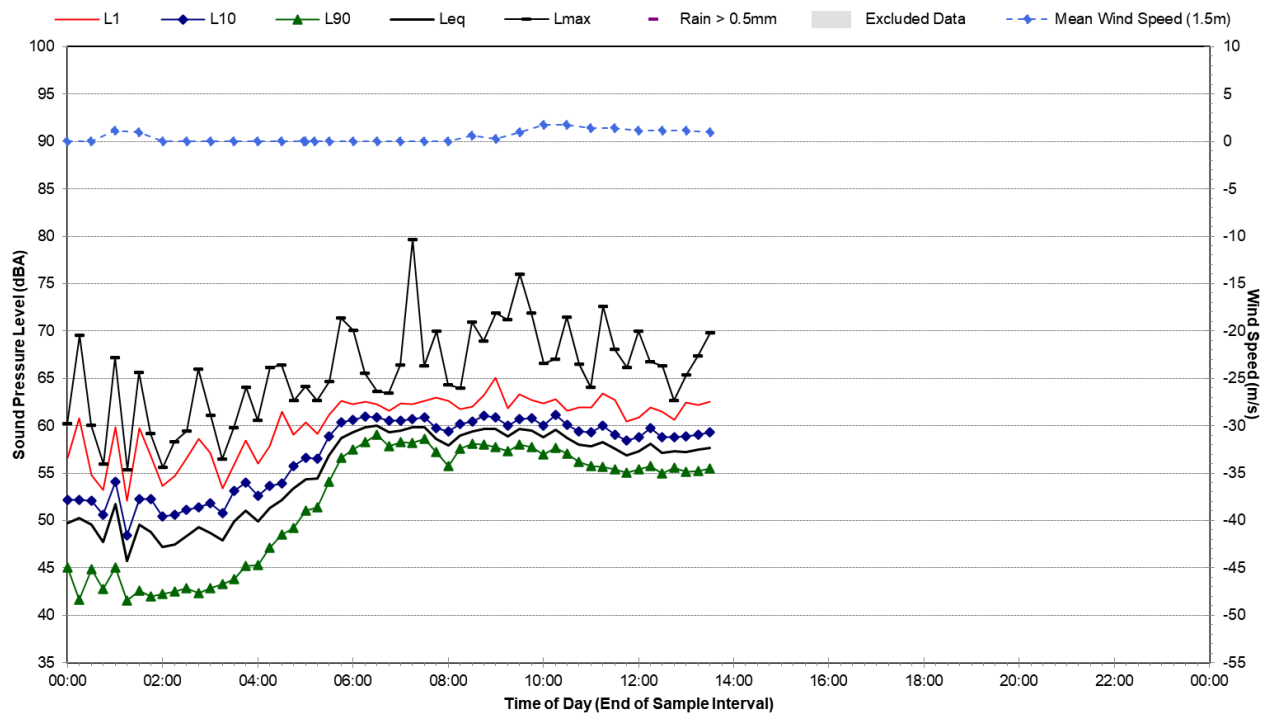
Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Monday, 20 June 2022



Statistical Ambient Noise Levels

L01 - 7 Tasman Place, Macquarie Park - Tuesday, 21 June 2022

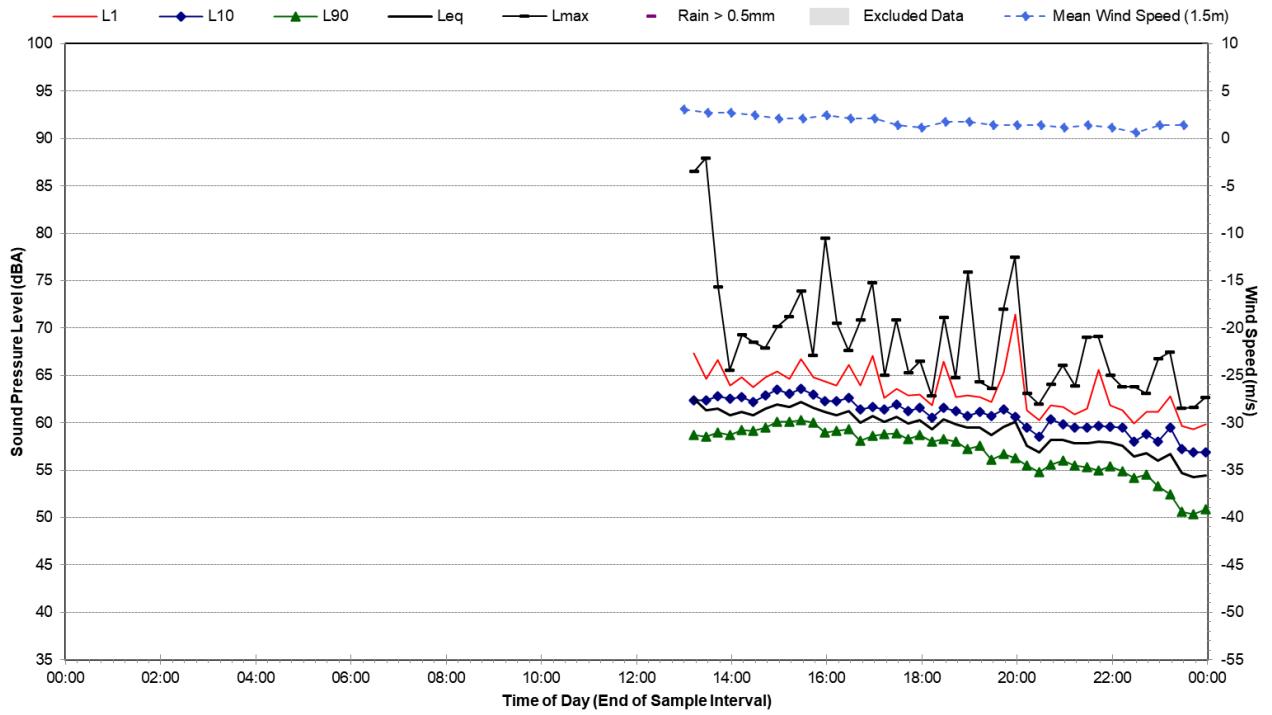


Noise Monitoring Location		L.02			Map of Noise Monitoring Location
Noise Monitoring Address		1-15 Fontenoy Road, Macquarie Park (Ground Level)			
Logger Device Type: Svantek 957, Logger Serial No: 20665 Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004636 Ambient noise logger deployed in outdoor area at residential address 1-15 Fontenoy Road, Macquarie Park. Logger located on the property fence line with view of existing M2 Motorway noise wall to the south. Attended noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from the M2 Motorway.					
Recorded Noise Levels (LAmax) 9/06/2022: Traffic on M2 Motorway: 57-64 dBA					
Ambient Noise Logging Results – ICNG Defined Time Periods					
Monitoring Period	Noise Level (dBA)				
	RBL	LAeq	L10	L1	
Daytime	56	60	61	65	
Evening	54	59	61	66	
Night-time	44	55	56	59	
Ambient Noise Logging Results – RNP Defined Time Periods					
Monitoring Period	Noise Level (dBA)				
	LAeq(period)		LAeq(1hour)		
Daytime (7am-10pm)	60		61		
Night-time (10pm-7am)	55		58		
Attended Noise Measurement Results					
Date	Start Time	Measured Noise Level (dBA)			
		LA90	LAeq	LAmax	
9/06/2022	13:02	59	61	76	



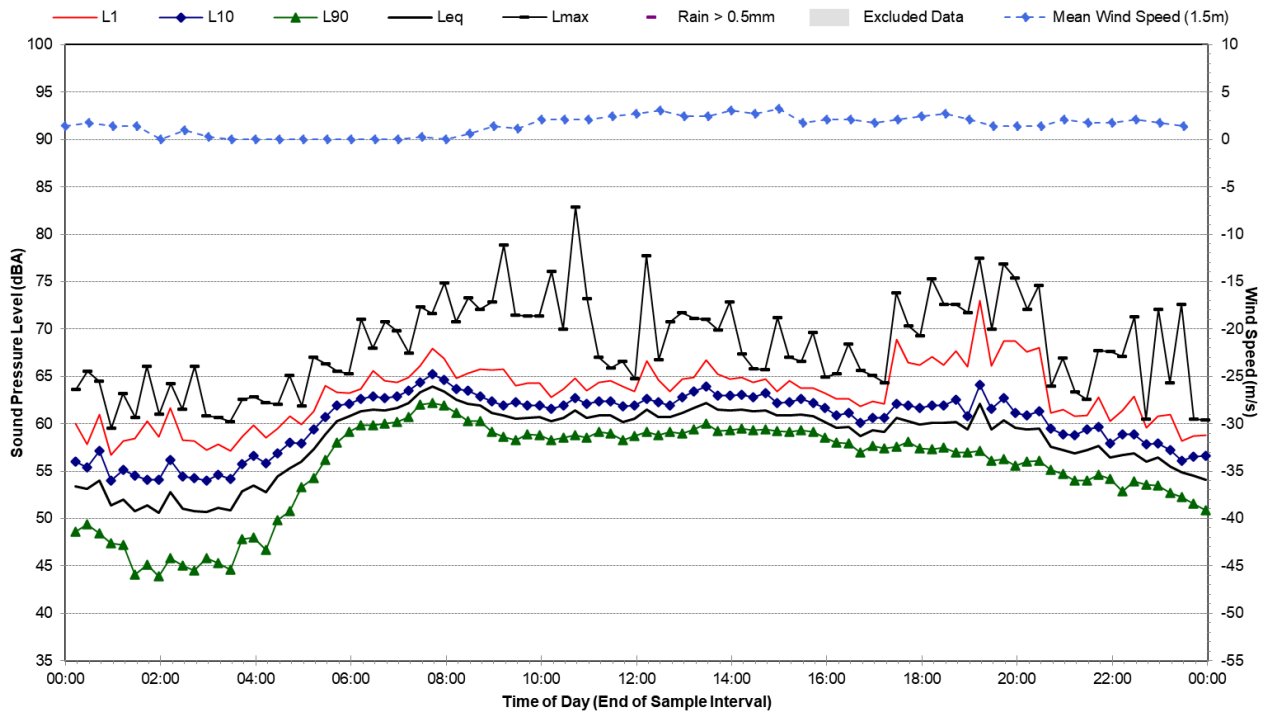
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Thursday, 9 June 2022



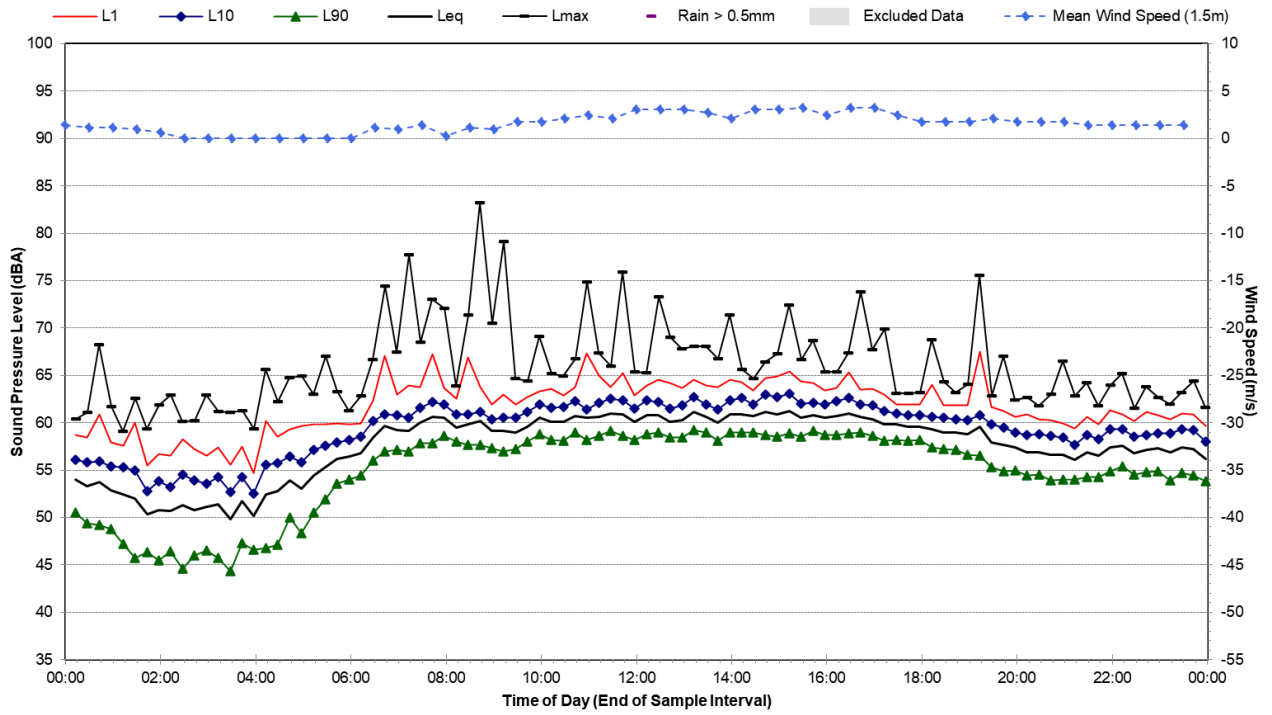
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Friday, 10 June 2022



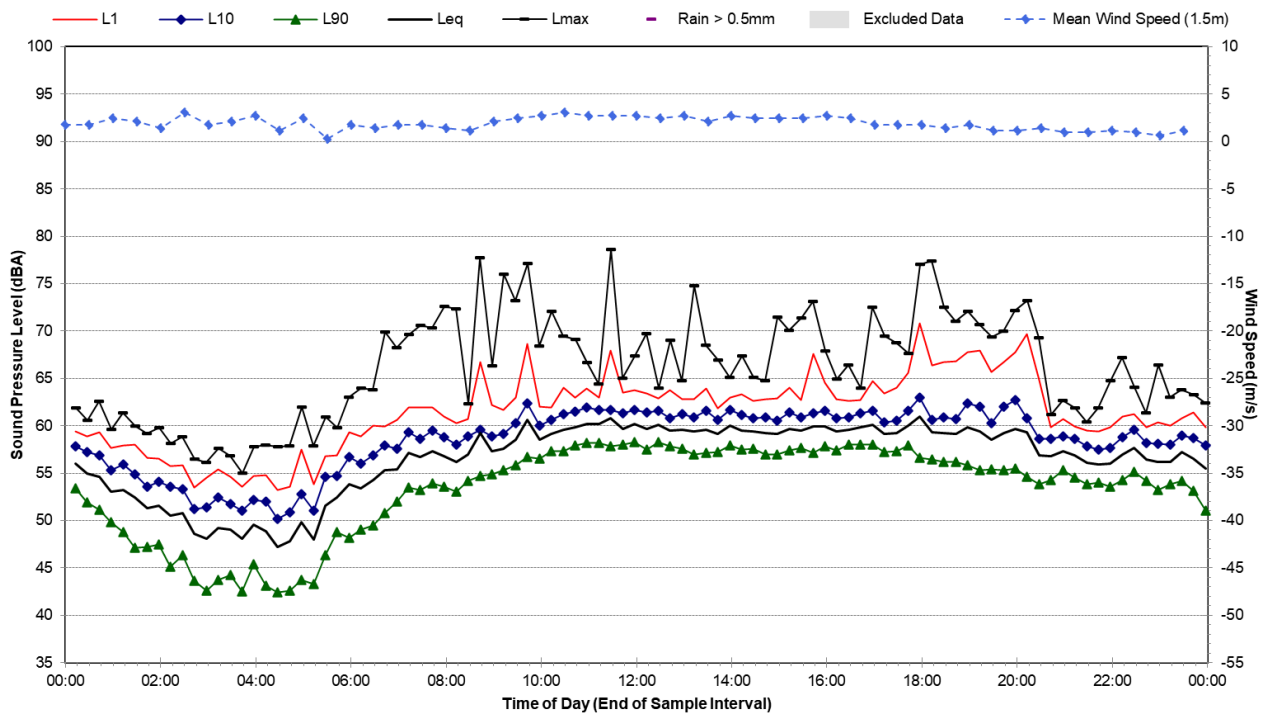
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Saturday, 11 June 2022



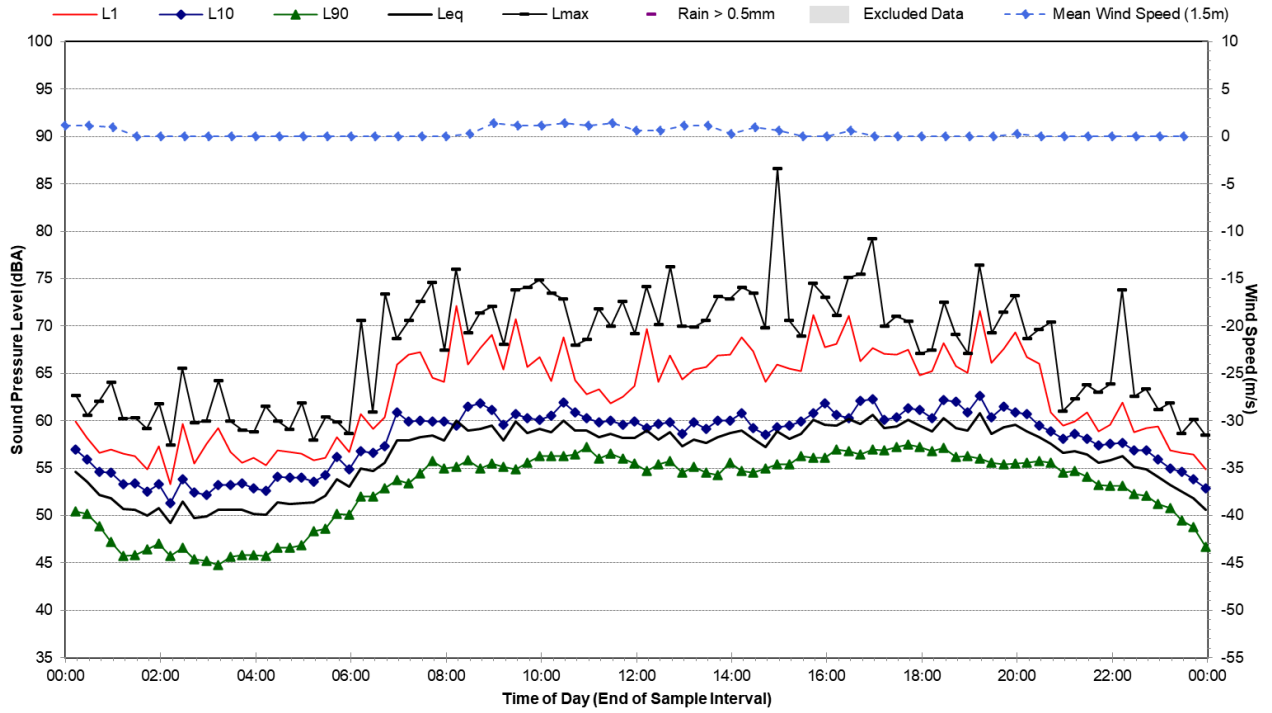
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Sunday, 12 June 2022



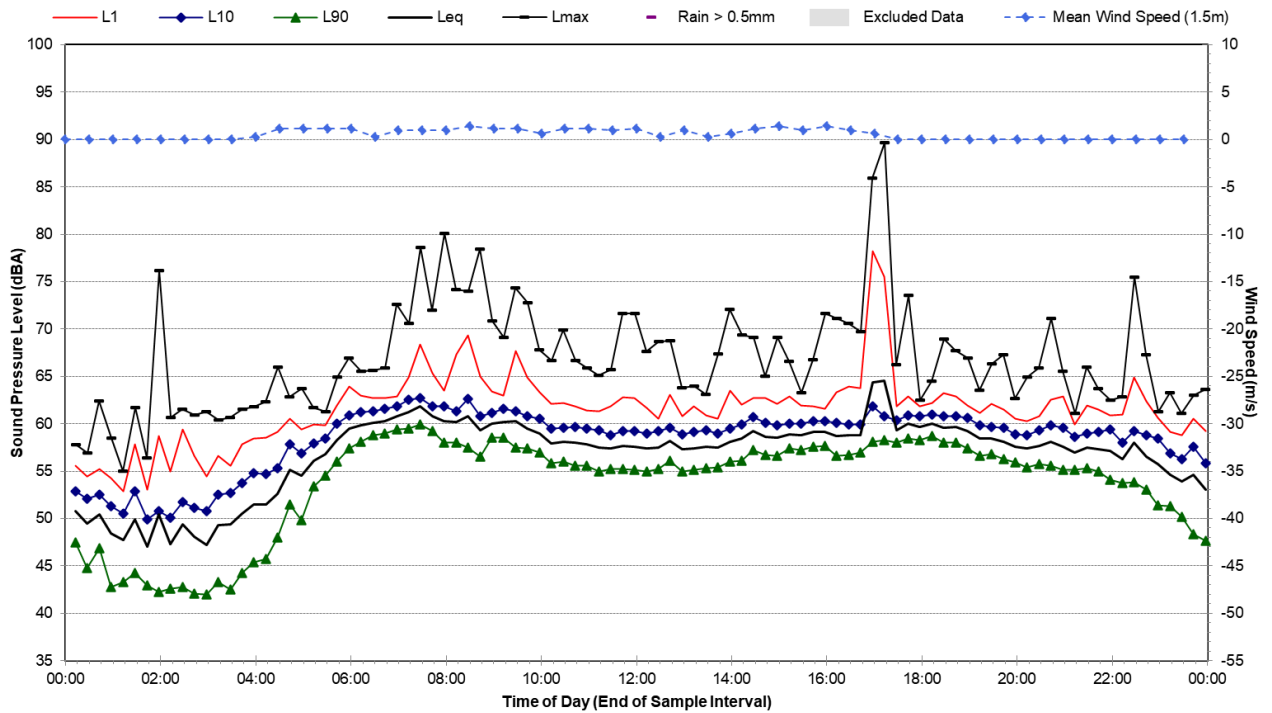
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Monday, 13 June 2022



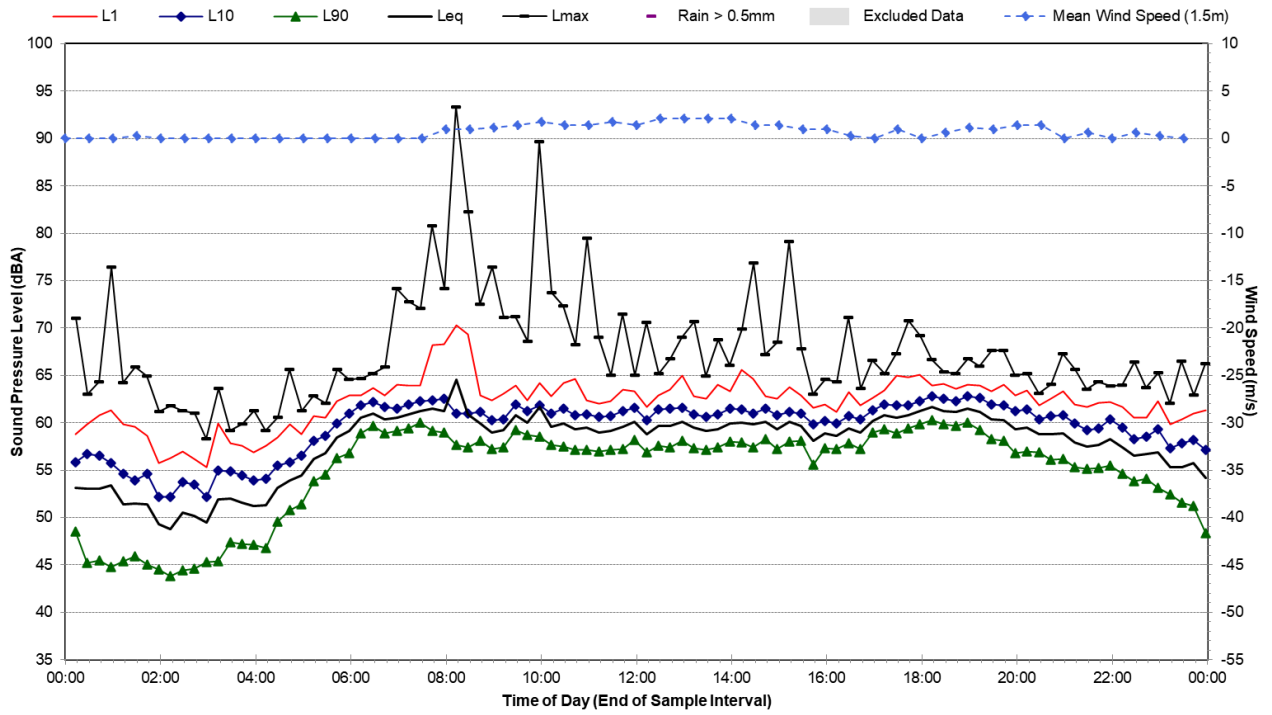
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Tuesday, 14 June 2022



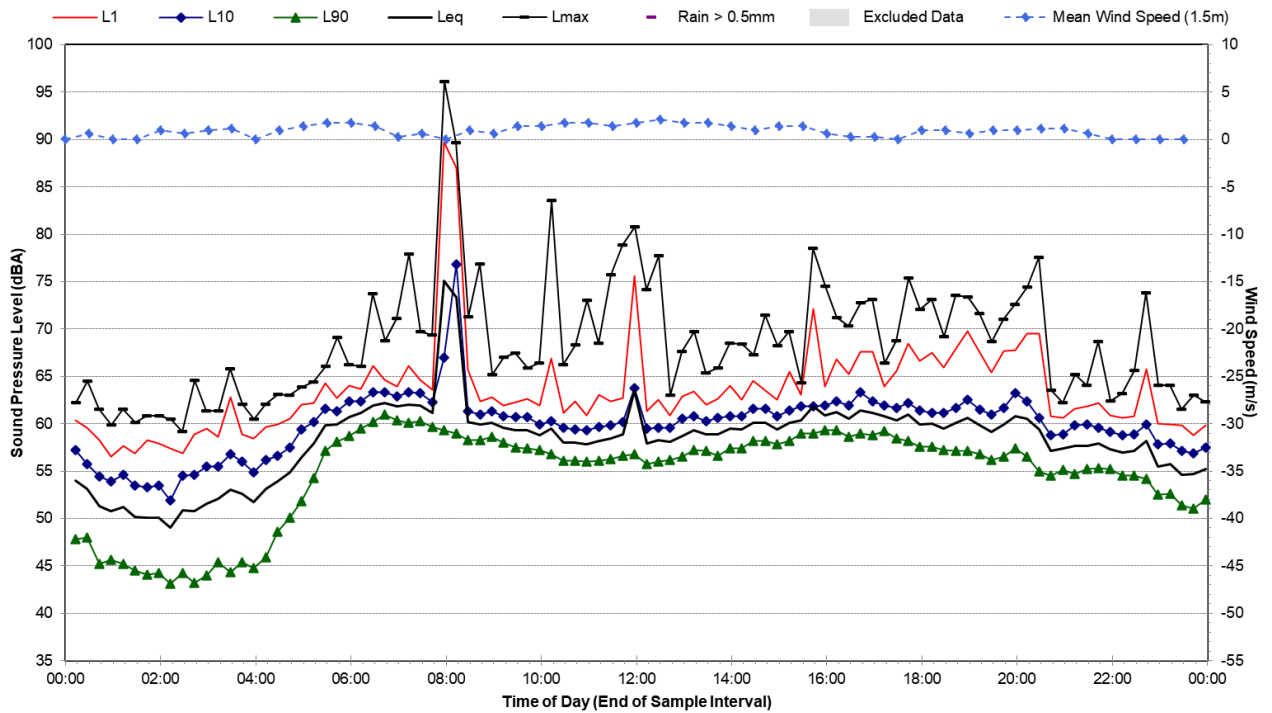
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Wednesday, 15 June 2022



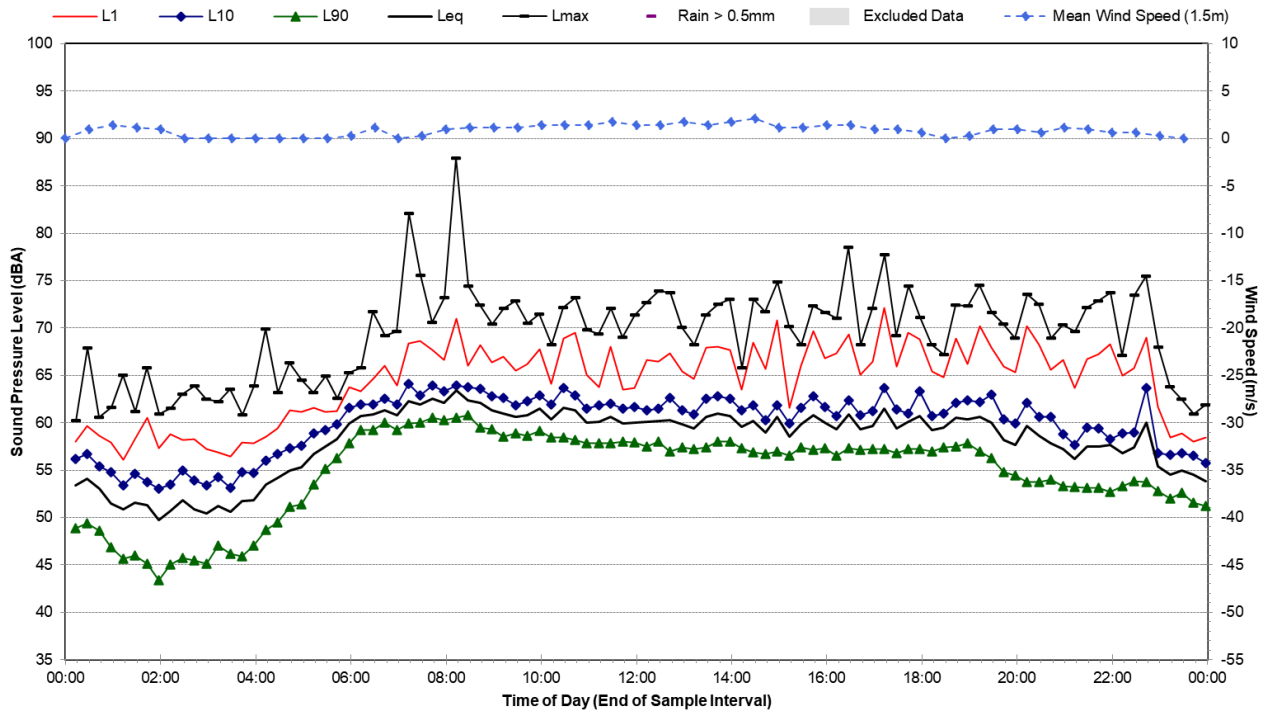
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Thursday, 16 June 2022



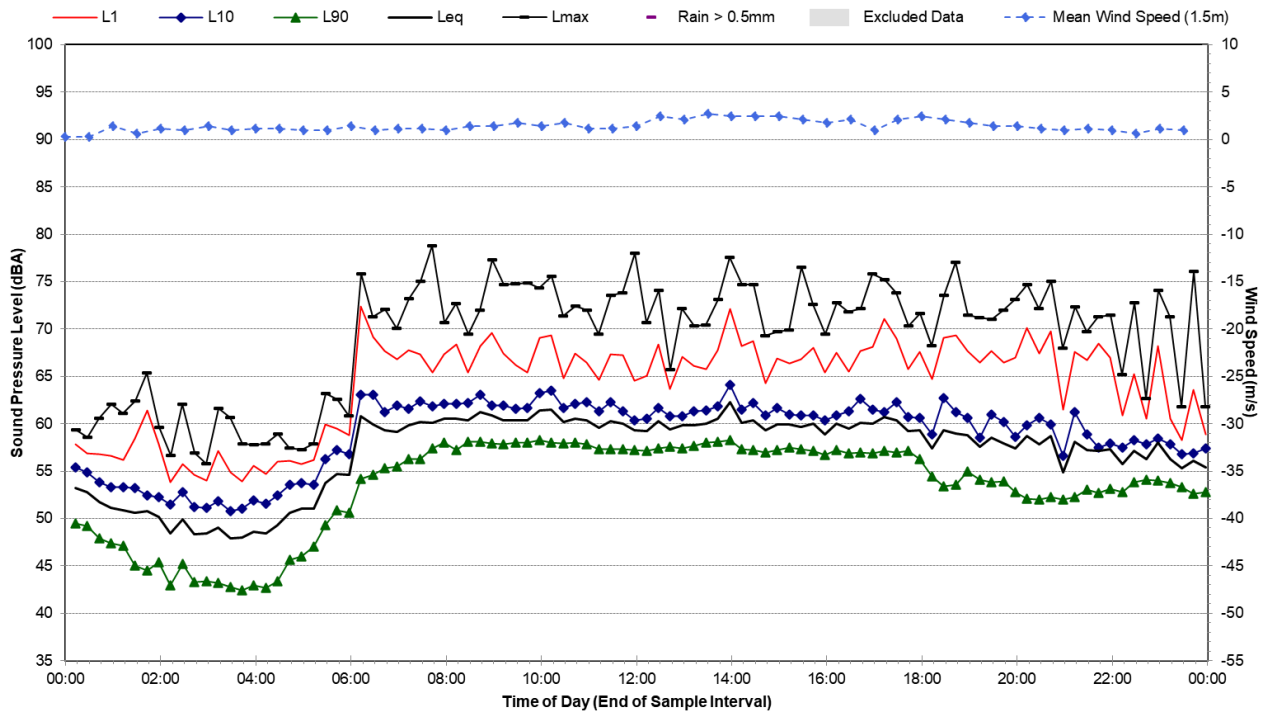
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Friday, 17 June 2022



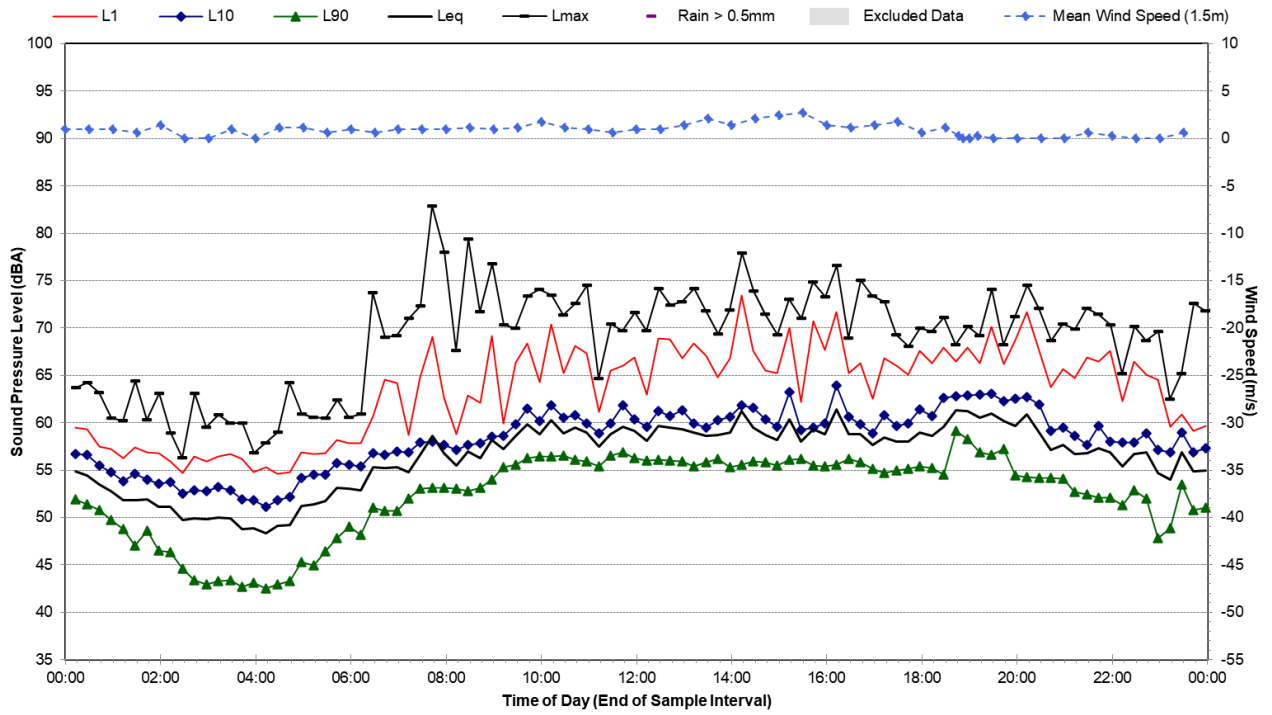
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Saturday, 18 June 2022



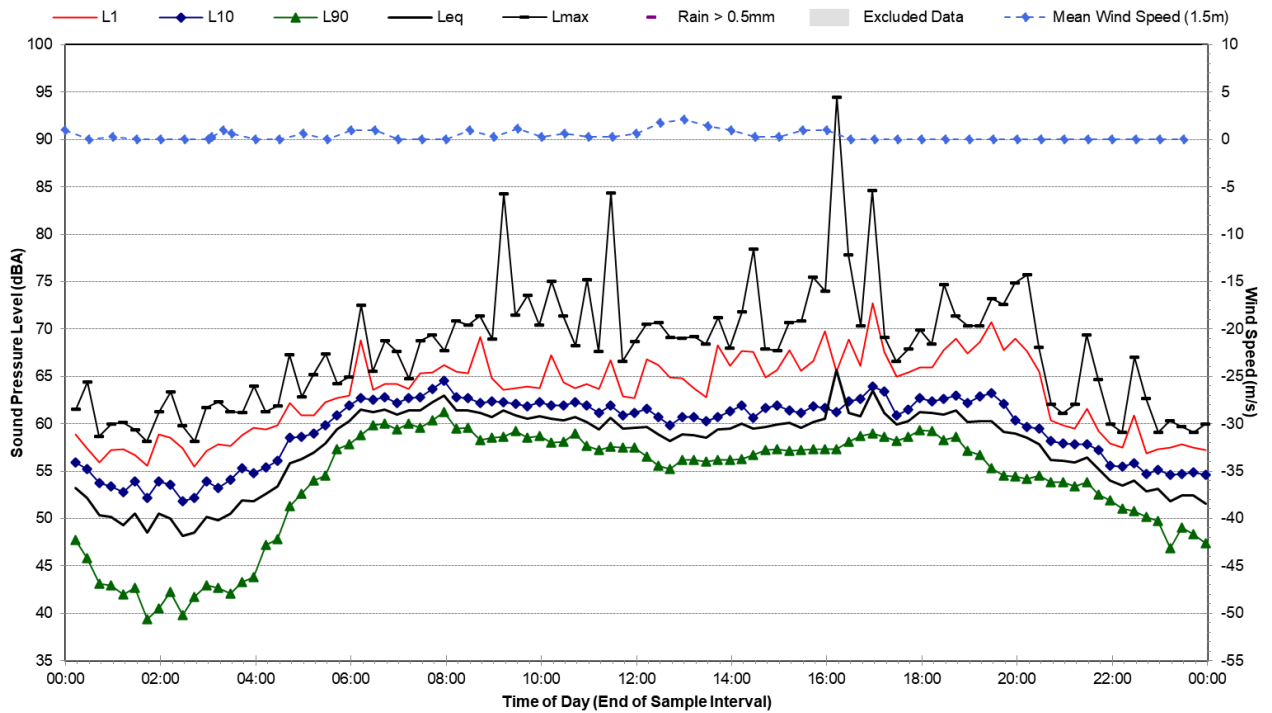
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Sunday, 19 June 2022



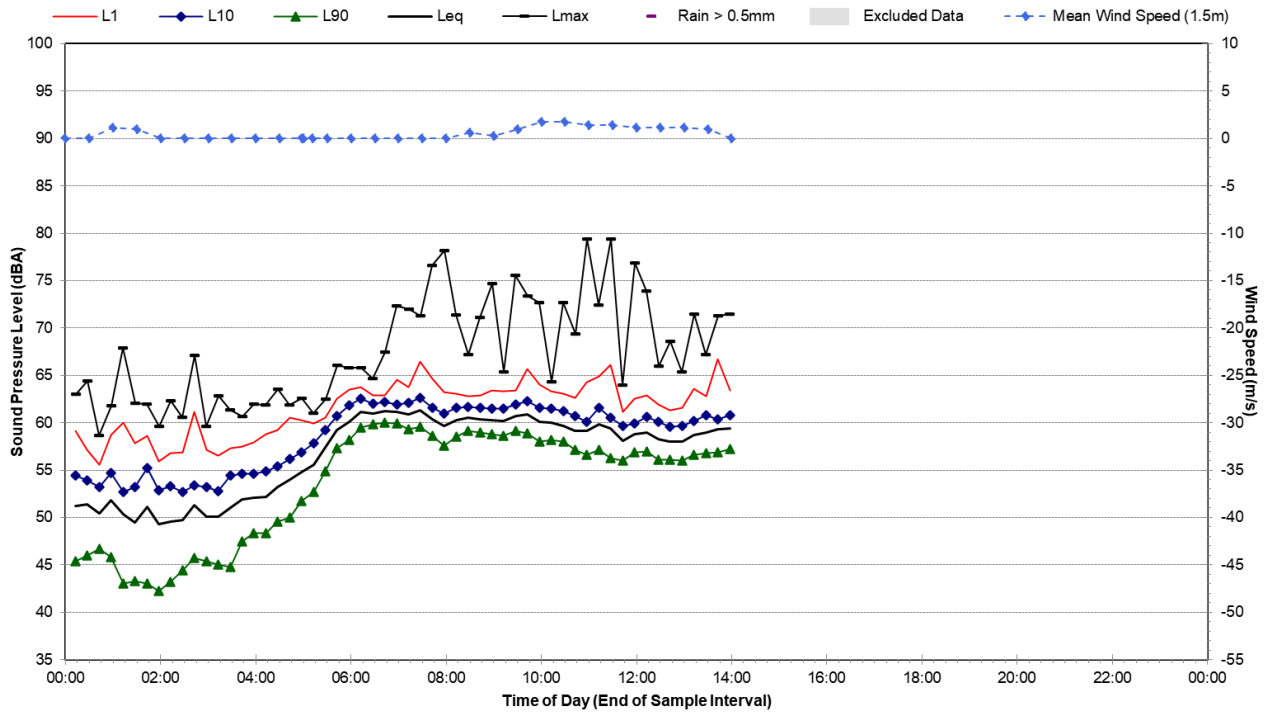
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Monday, 20 June 2022




Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road Ground Level - Tuesday, 21 June 2022



Noise Monitoring Location		L.03				Map of Noise Monitoring Location																								
Noise Monitoring Address		1-15 Fontenoy Road, Macquarie Park (L3)																												
<p>Logger Device Type: Svantek 977, Logger Serial No: 98070 Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3004635</p> <p>Ambient noise logger deployed at level 3 residential address 1-15 Fontenoy Road, Macquarie Park. Logger located on balcony of unit within residential complex with view over the M2 Motorway.</p> <p>Noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from the M2 Motorway.</p> <p>The noise statistics at this location have a -2.5 dB adjustment applied to reflect a 'free field' location.</p>																														
<p>Ambient Noise Logging Results – ICNG Defined Time Periods</p> <table border="1"> <thead> <tr> <th rowspan="2">Monitoring Period</th> <th colspan="4">Noise Level (dBA)</th> </tr> <tr> <th>RBL</th> <th>LAeq</th> <th>L10</th> <th>L1</th> </tr> </thead> <tbody> <tr> <td>Daytime</td> <td>60</td> <td>63</td> <td>64</td> <td>67</td> </tr> <tr> <td>Evening</td> <td>56</td> <td>61</td> <td>62</td> <td>65</td> </tr> <tr> <td>Night-time</td> <td>45</td> <td>57</td> <td>58</td> <td>62</td> </tr> </tbody> </table>							Monitoring Period	Noise Level (dBA)				RBL	LAeq	L10	L1	Daytime	60	63	64	67	Evening	56	61	62	65	Night-time	45	57	58	62
Monitoring Period	Noise Level (dBA)																													
	RBL	LAeq	L10	L1																										
Daytime	60	63	64	67																										
Evening	56	61	62	65																										
Night-time	45	57	58	62																										
<p>Ambient Noise Logging Results – RNP Defined Time Periods</p> <table border="1"> <thead> <tr> <th rowspan="2">Monitoring Period</th> <th colspan="2">Noise Level (dBA)</th> </tr> <tr> <th>LAeq(period)</th> <th>LAeq(1hour)</th> </tr> </thead> <tbody> <tr> <td>Daytime (7am-10pm)</td> <td>62</td> <td>63</td> </tr> <tr> <td>Night-time (10pm-7am)</td> <td>57</td> <td>61</td> </tr> </tbody> </table>						Monitoring Period	Noise Level (dBA)		LAeq(period)	LAeq(1hour)	Daytime (7am-10pm)	62	63	Night-time (10pm-7am)	57	61														
Monitoring Period	Noise Level (dBA)																													
	LAeq(period)	LAeq(1hour)																												
Daytime (7am-10pm)	62	63																												
Night-time (10pm-7am)	57	61																												
<p>Photo of Noise Monitoring Location</p>																														

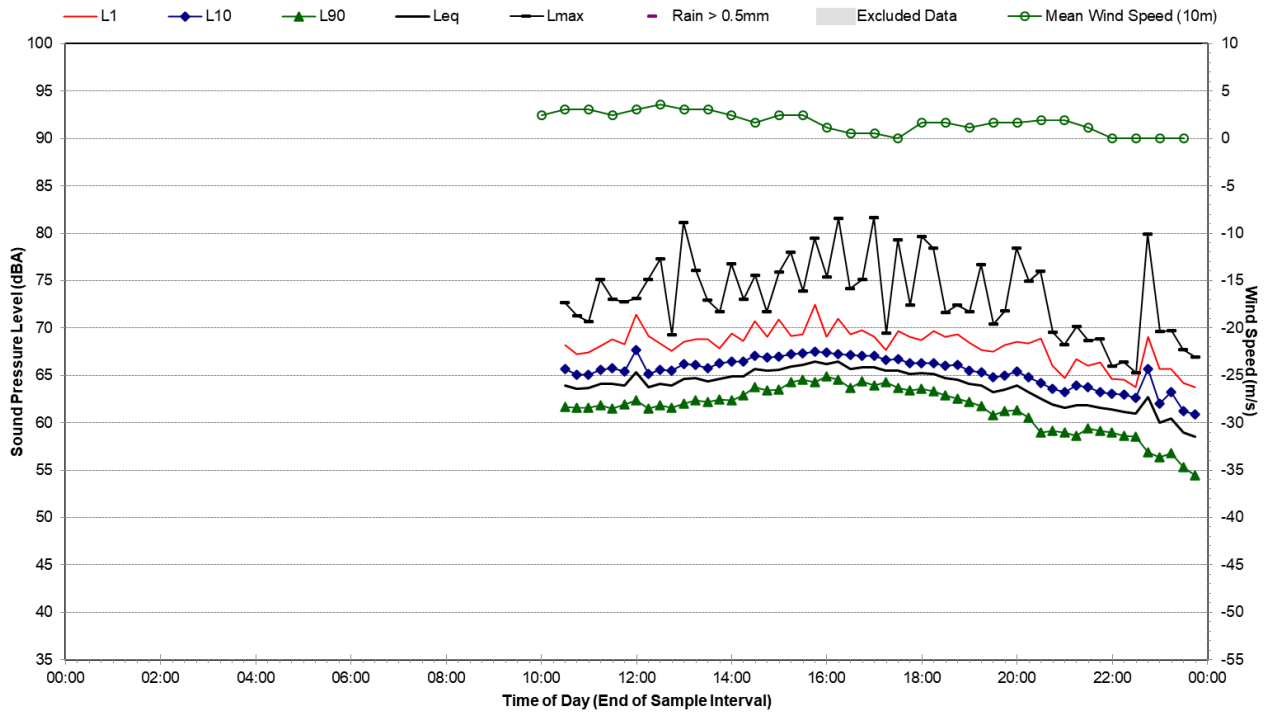


Noise Monitoring Location	L.03	Map of Noise Monitoring Location
		



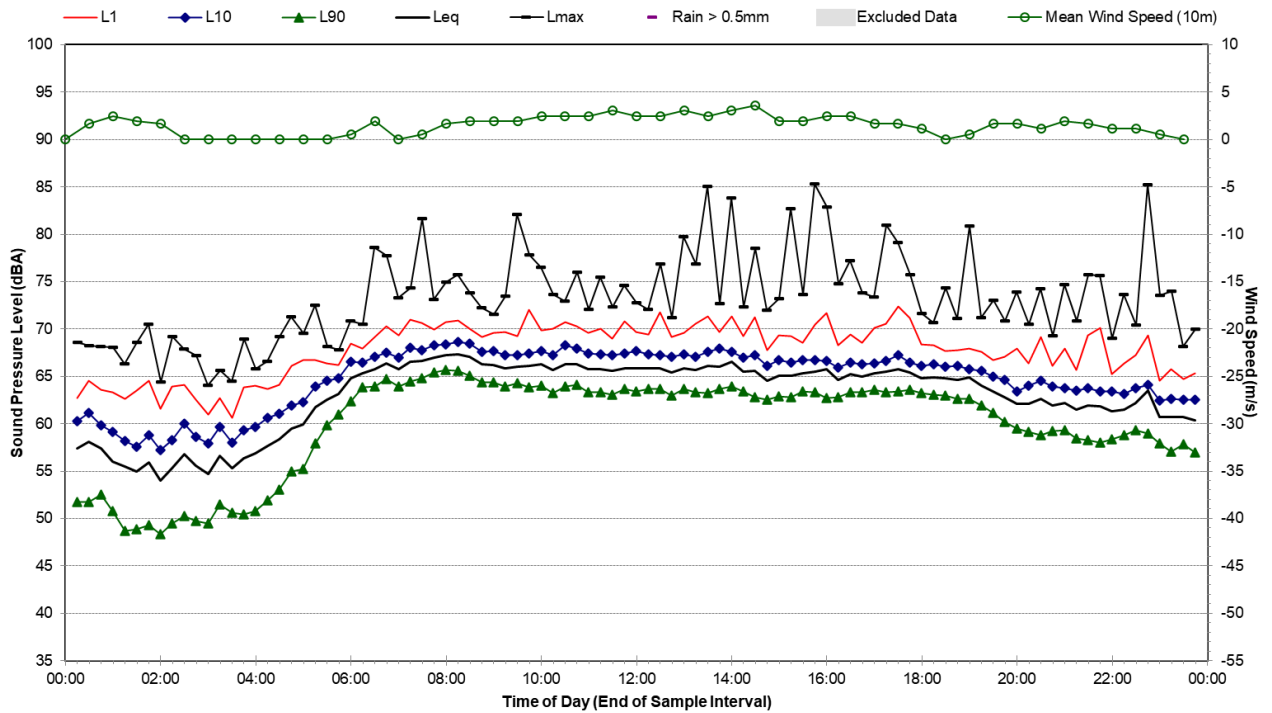
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road GF - Thursday, 16 June 2022



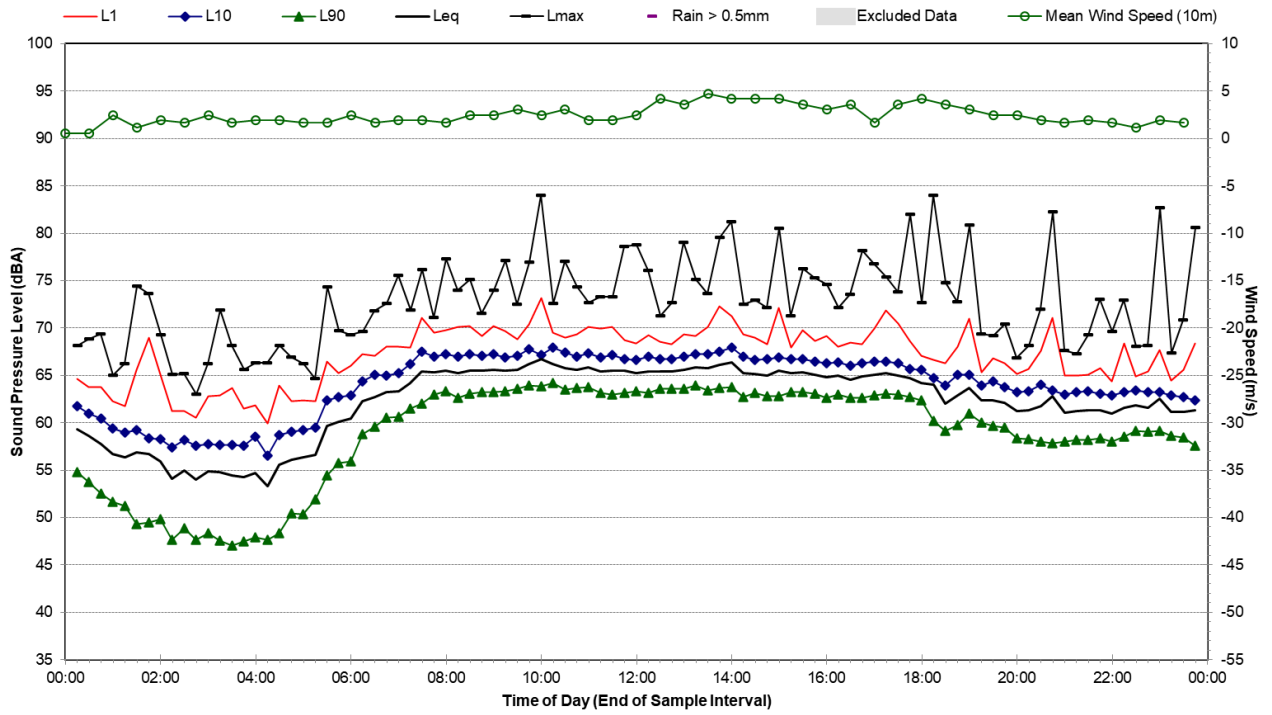
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road GF - Friday, 17 June 2022



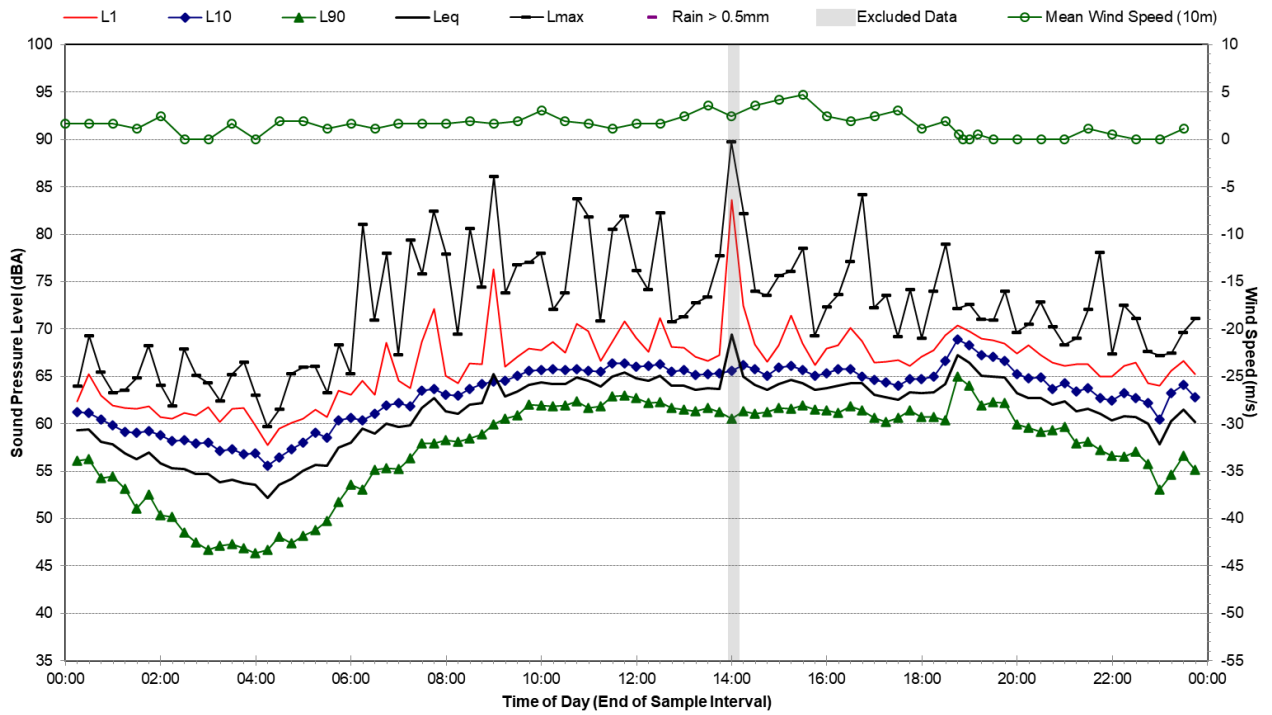
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road GF - Saturday, 18 June 2022



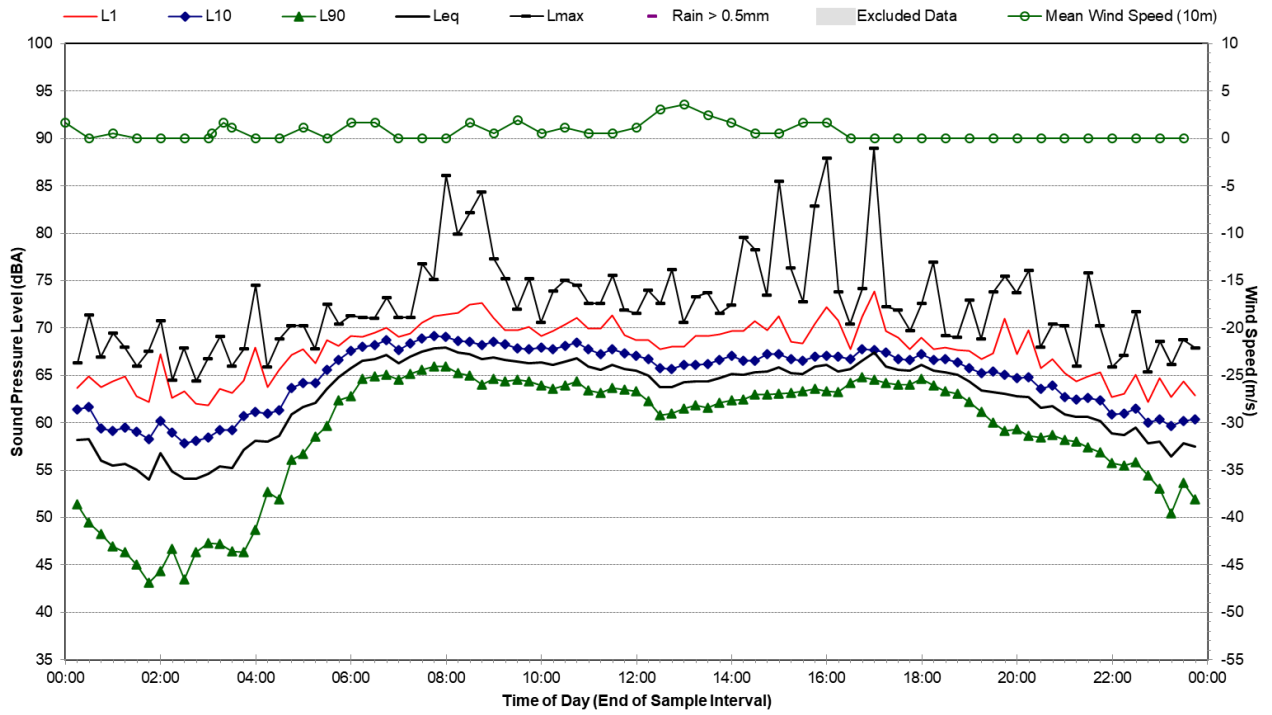
Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road GF - Sunday, 19 June 2022



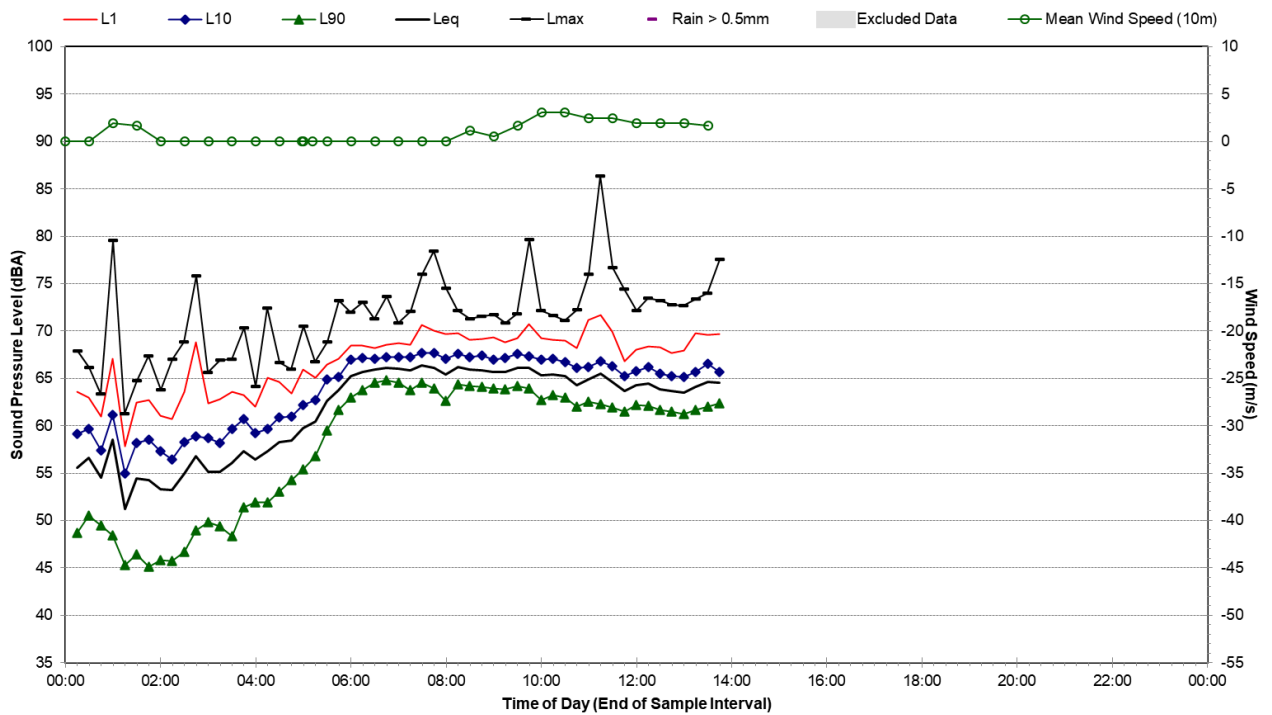
Statistical Ambient Noise Levels

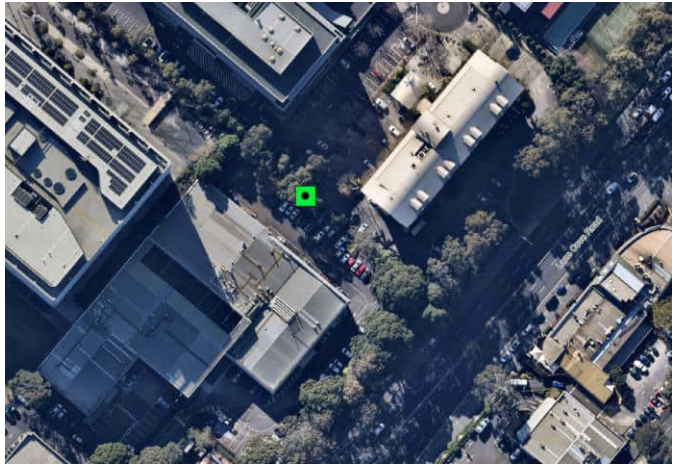


L02 - 1-15 Fontenoy Road GF - Monday, 20 June 2022




Statistical Ambient Noise Levels

L02 - 1-15 Fontenoy Road GF - Tuesday, 21 June 2022



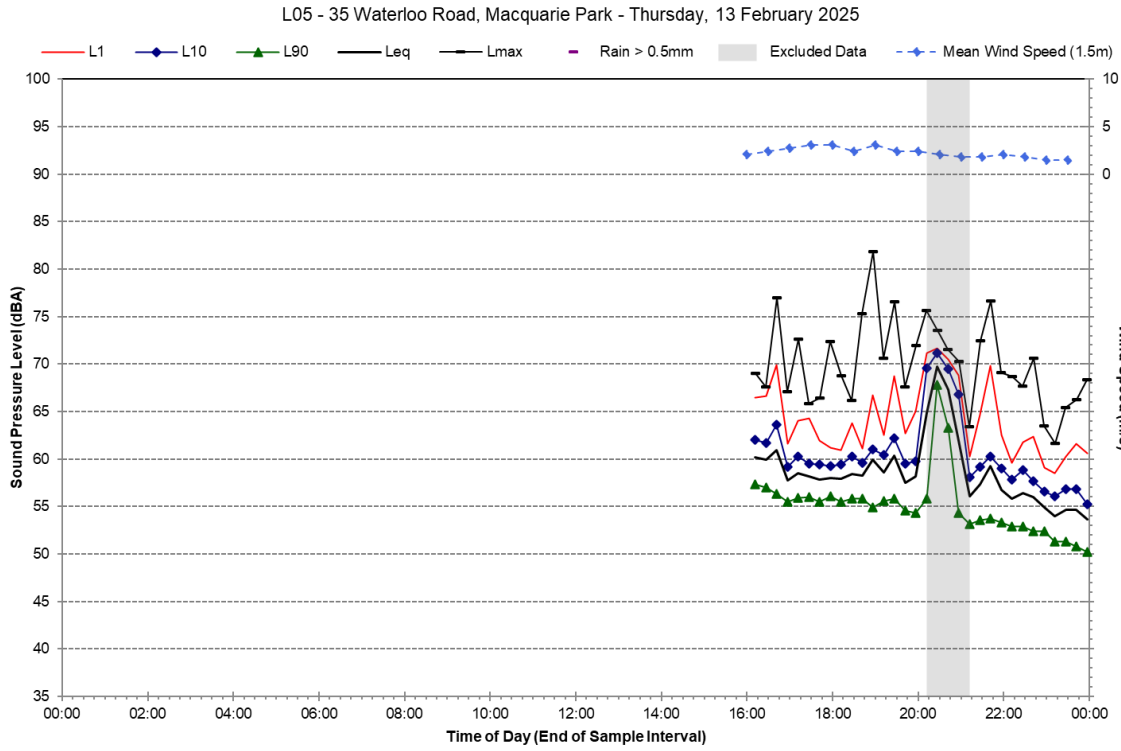
Noise Monitoring Location		L.05			Map of Noise Monitoring Location	
Noise Monitoring Address		35 Waterloo Road, Macquarie Park				
Logger Device Type: Svantek 977, Logger Serial No: 92631 Sound Level Meter Device Type: Brüel and Kjær 2250L, Sound Level Meter Serial No: 3029485						
Ambient noise logger deployed at 35 Waterloo Road, Macquarie Park. Logger located at northeast boundary fence of the address. Noise measurements indicate the ambient noise environment at this location is dominated by road traffic noise from Lane Cove Road.						
Ambient Noise Logging Results – ICNG Defined Time Periods					Photo of Noise Monitoring Location	
Monitoring Period	Noise Level (dBA)					
	RBL	LAeq	L10	L1		
Daytime	53	60	61	66		
Evening	51	58	60	64		
Night-time	45	55	55	60		
Ambient Noise Logging Results – RNP Defined Time Periods						
Monitoring Period	Noise Level (dBA)					
	LAeq(period)	LAeq(1hour)				
Daytime (7am-10pm)	59	60				
Night-time (10pm-7am)	55	57				
Attended Noise Measurement Results						
Date	Start Time	Measured Noise Level (dBA)				



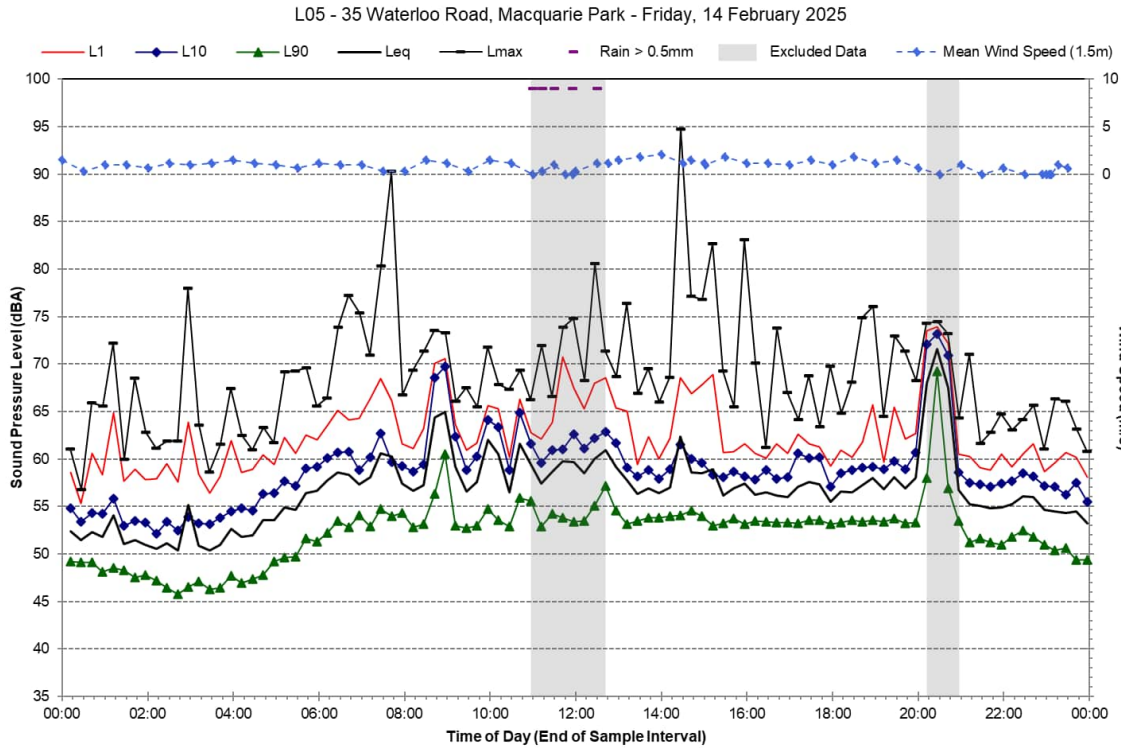
Noise Monitoring Location		L.05			Map of Noise Monitoring Location
		LA90	LAeq	LAmx	
13/2/2025	15:53	57	60	69	



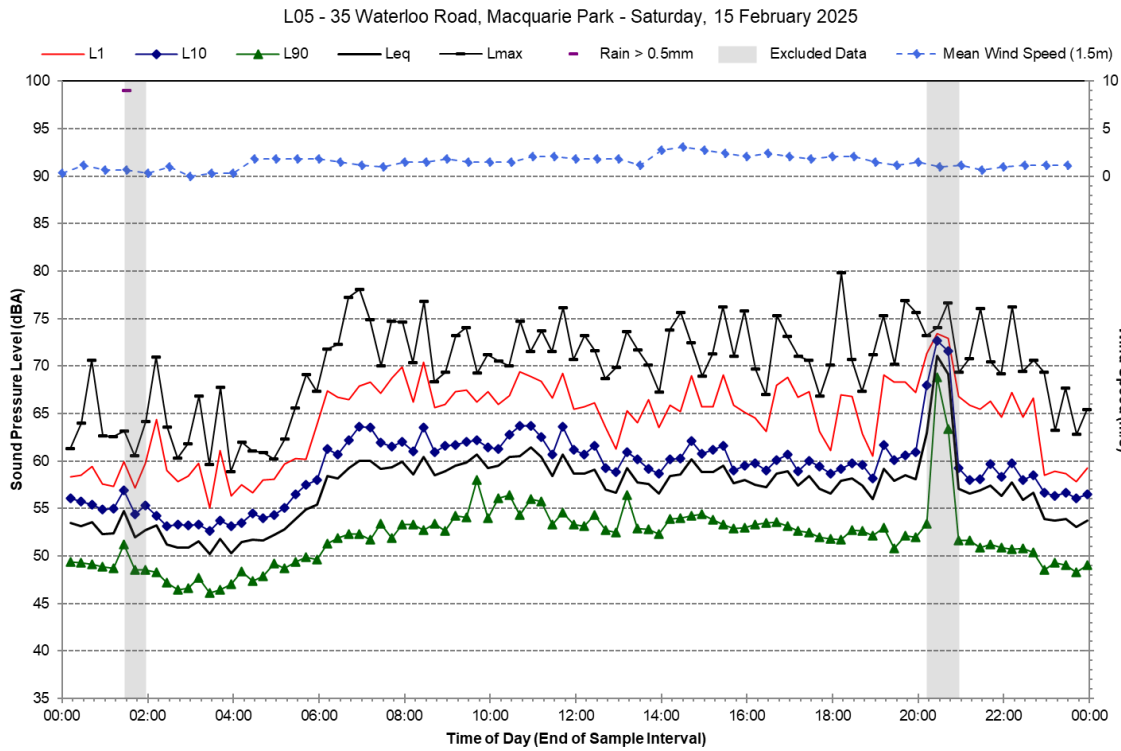
Statistical Ambient Noise Levels



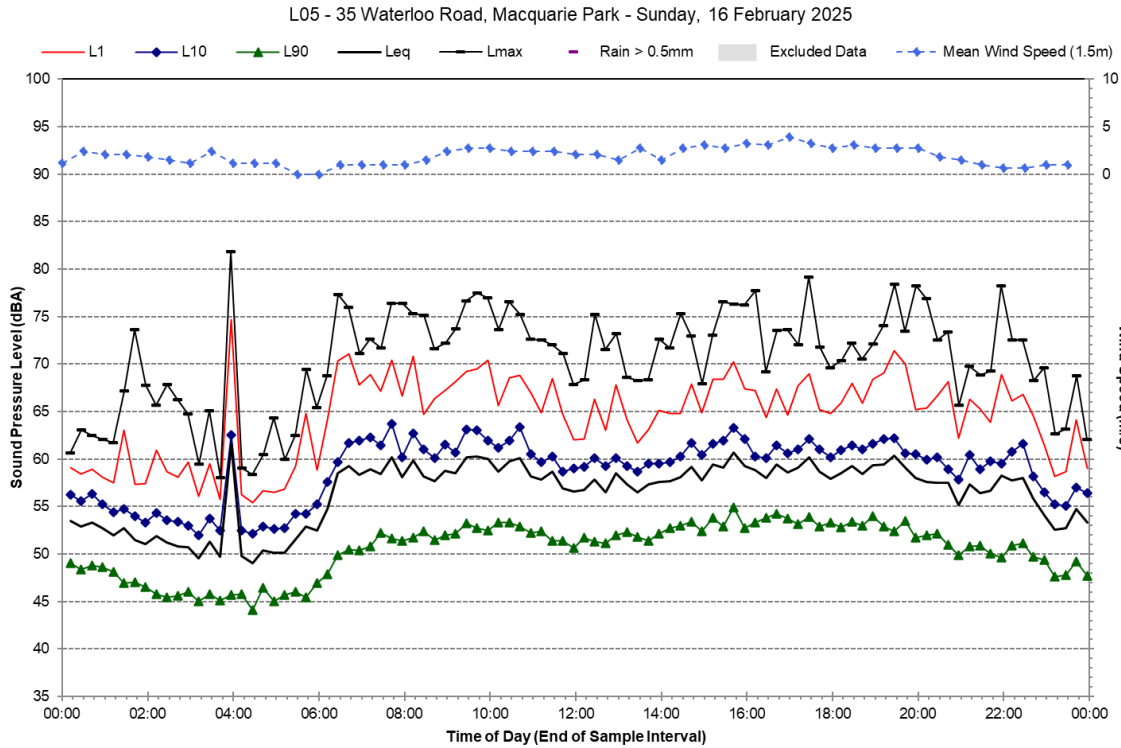
Statistical Ambient Noise Levels



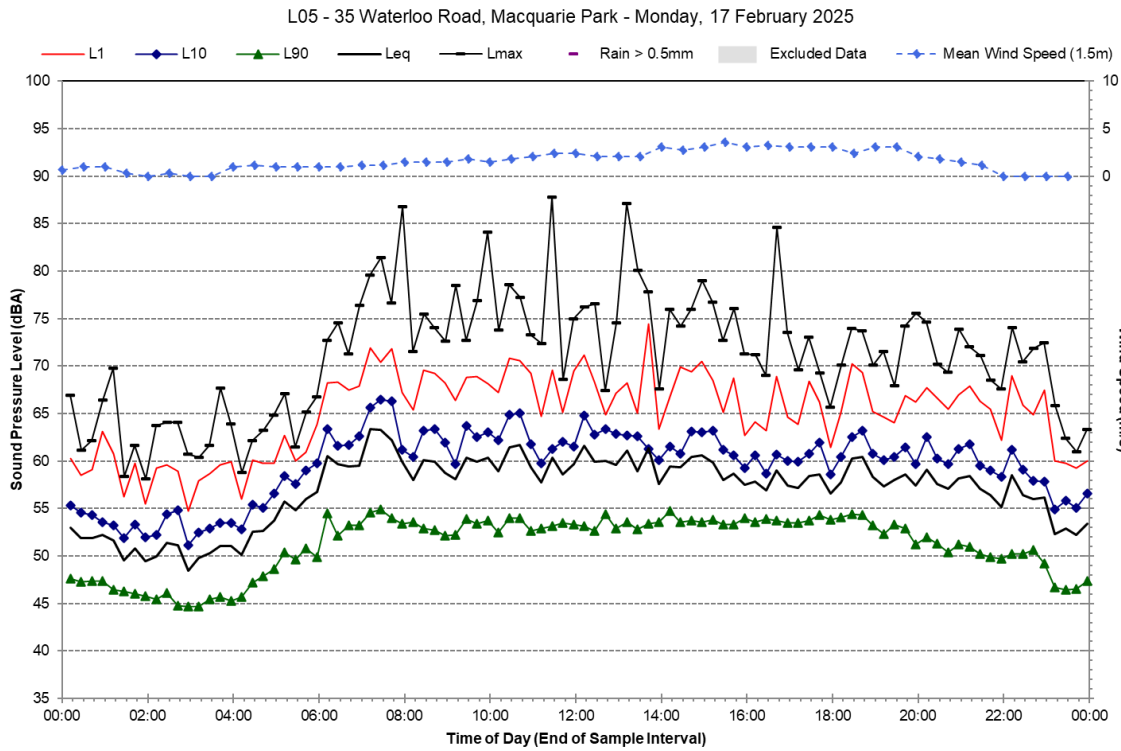
Statistical Ambient Noise Levels



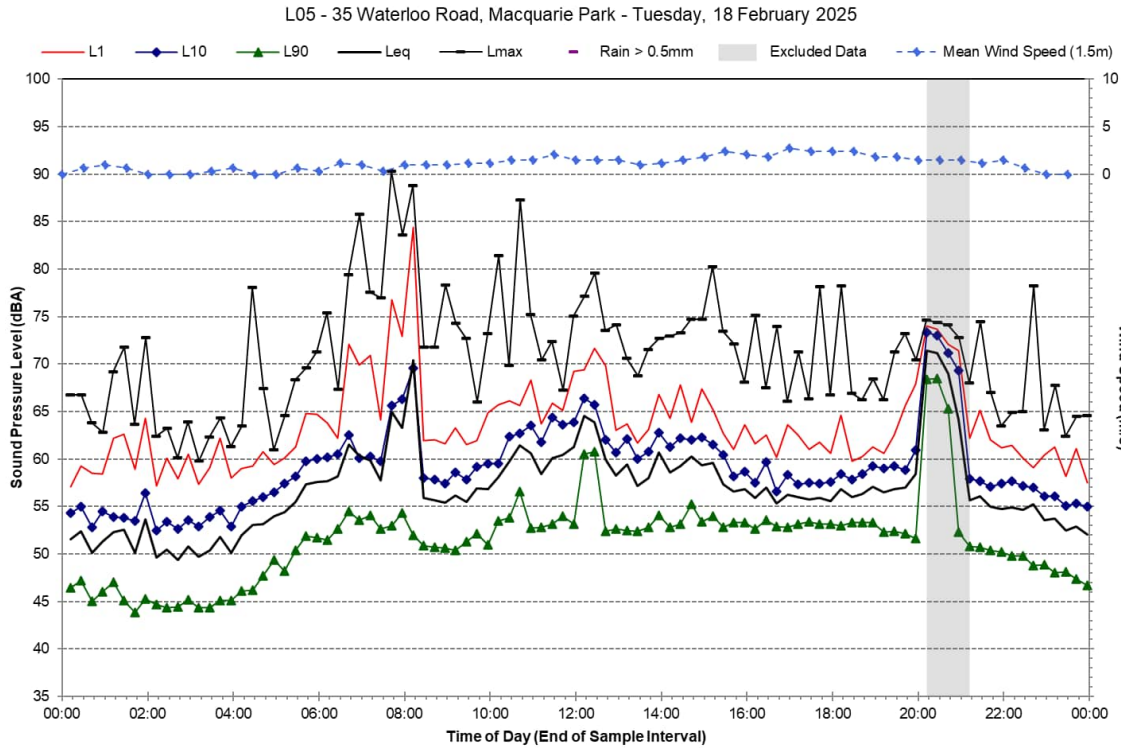
Statistical Ambient Noise Levels



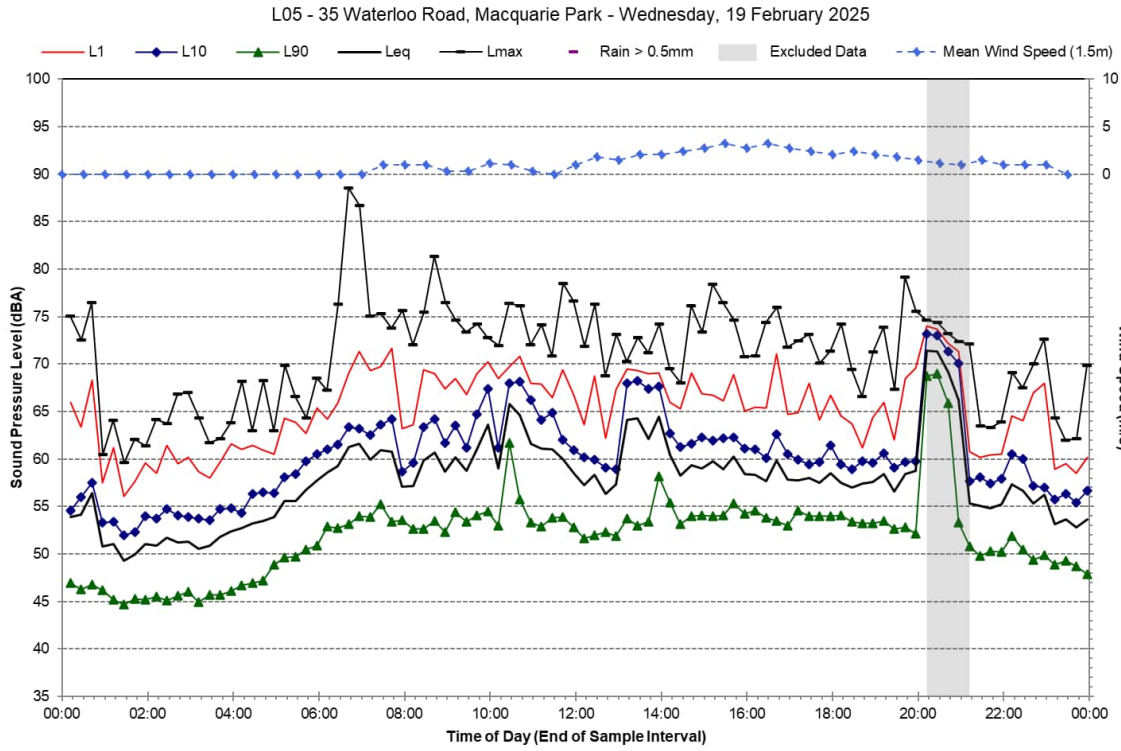
Statistical Ambient Noise Levels



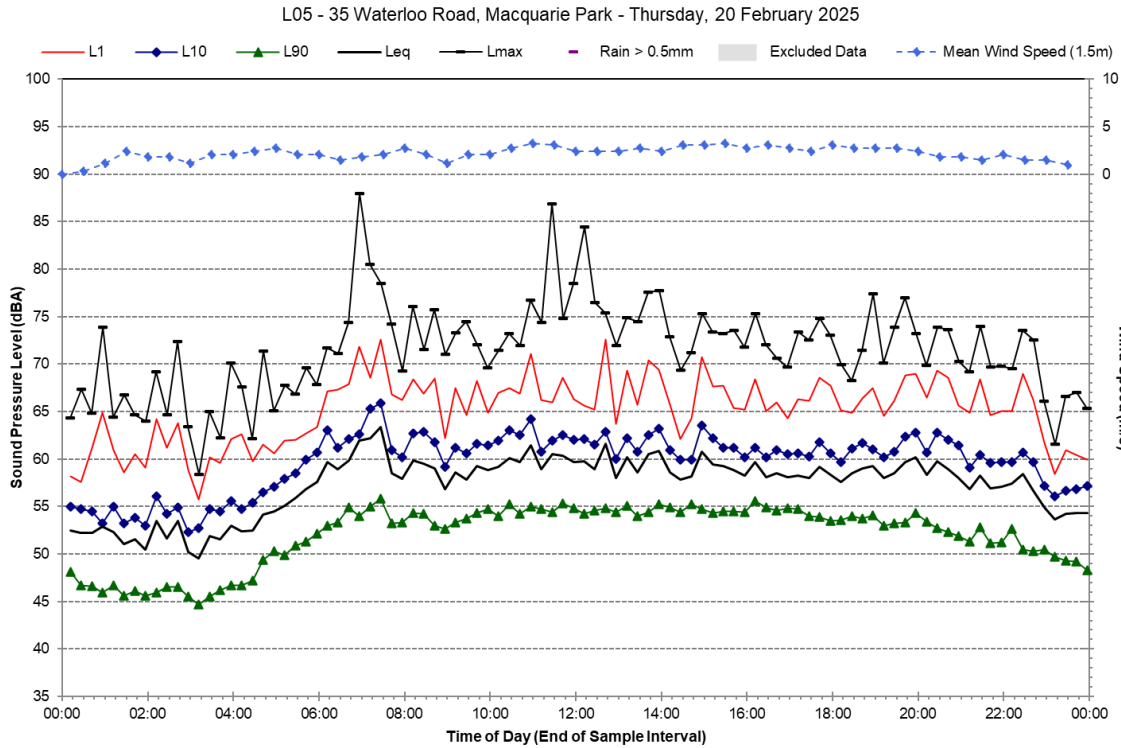
Statistical Ambient Noise Levels



Statistical Ambient Noise Levels

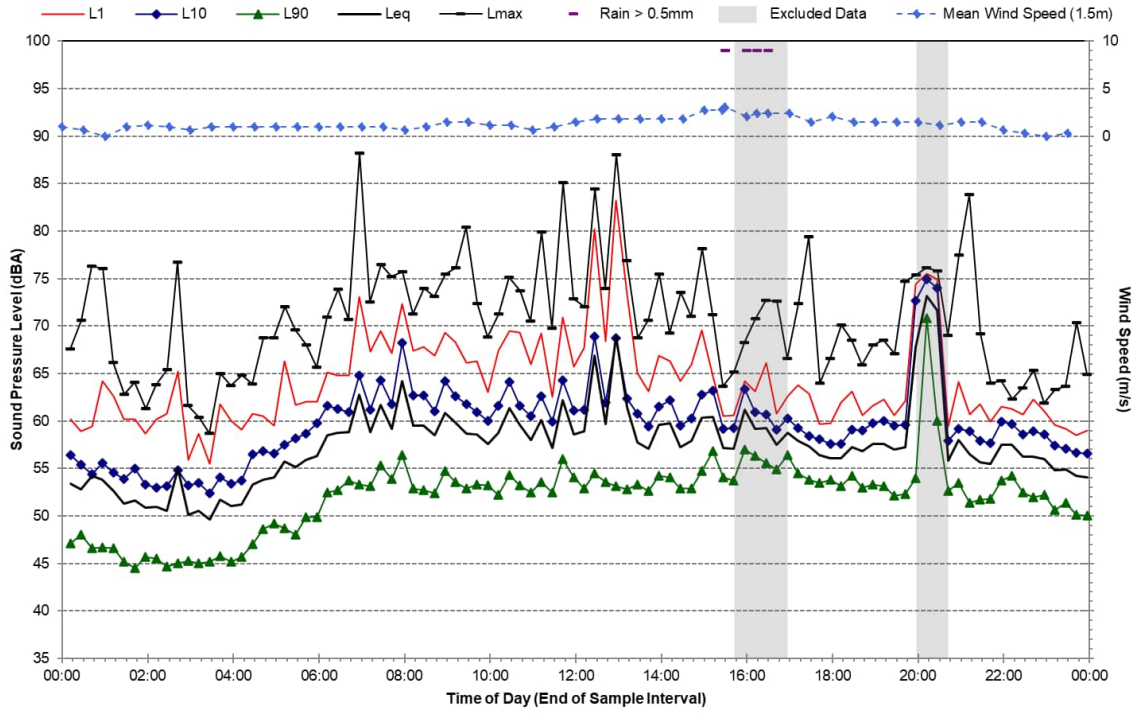


Statistical Ambient Noise Levels



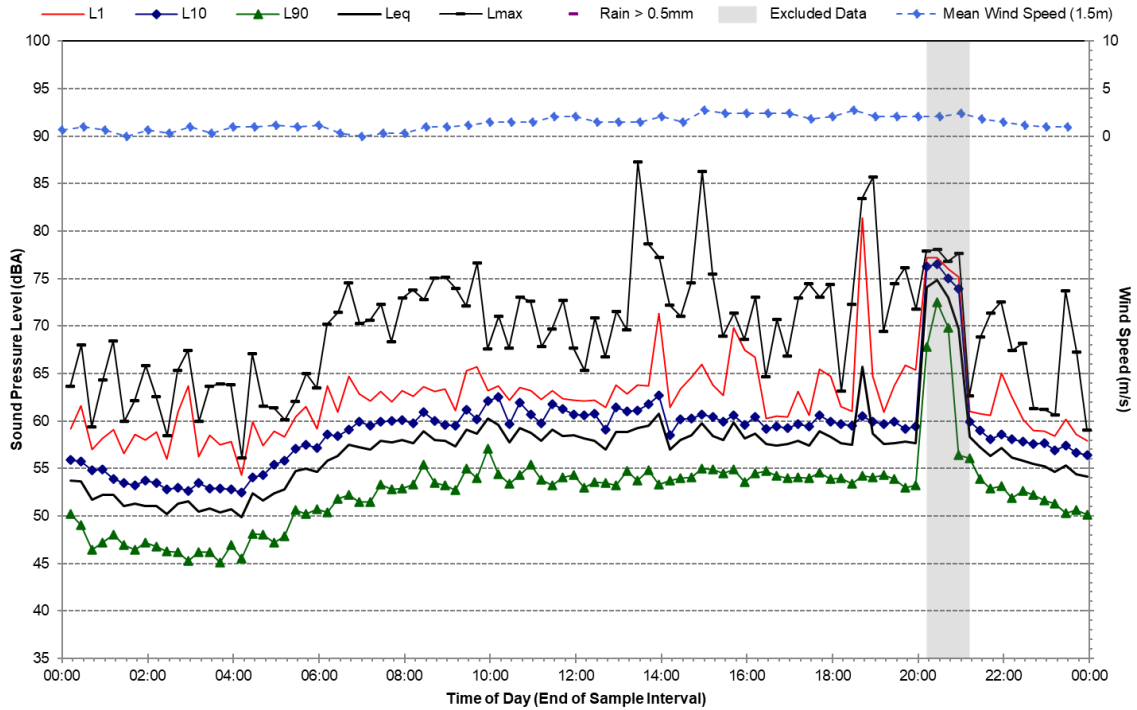
Statistical Ambient Noise Levels

L05 - 35 Waterloo Road, Macquarie Park - Friday, 21 February 2025



Statistical Ambient Noise Levels

L05 - 35 Waterloo Road, Macquarie Park - Saturday, 22 February 2025



B.2 Justification for Noise Monitoring Locations

Background noise monitoring locations were selected in accordance with NPfI Fact Sheet A, which requires noise monitoring locations to be at the “*reasonably most- or potentially most affected residence(s)*”. Fact Sheet A provides further guidance that “*often several locations will be affected by noise from the development. In these cases, locations that can be considered representative of the various affected areas should be monitored*”.

On this basis the noise monitoring locations were selected to represent the background noise environment of the residential areas potentially most affected by the proposal. Detailed justification of each location is provided in **Table B-38**.

Table B-38 Justification for Noise Monitoring Locations

ID	Address	Detail
L01	7 Tasman Place, Macquarie Park	Representative of receivers on Fontenoy Road, west of 1-15 Fontenoy Road. Front row receivers in this area are located at a consistent set back distance from the M2 Motorway which was found to control the ambient noise environment. Therefore, the monitoring location is considered representative of the receivers in this area which are also potentially most affected by the proposal.
L02	1-15 Fontenoy Road GF, Macquarie Park	1-15 Fontenoy Road is the closest residential receiver to the proposal. It includes eight floor residential buildings which overlook the M2 Motorway towards the proposal. The ground level is generally shielded from the M2 Motorway due to the road being in a cutting at this location and the noise wall adjacent to the eastbound off ramp to Lane Cove Road.
L03	1-15 Fontenoy Road L3, Macquarie Park	<p>Noise monitoring at this location was completed at two different heights, to determine the difference in background noise levels due to exposure to the M2 Motorway. The potential for noise monitoring above ground level was limited due to access arrangements involving strata management and private residential balconies.</p> <p>The elevated noise monitoring location is on the facade which is predicted to be most affected by the proposal and is considered representative of elevated floors which have line of site to the proposal location.</p> <p>It is noted that buildings more distant from major roads (ie the northern most building at 1-15 Fontenoy Road) are expected to experience lower existing road traffic noise levels compared to the monitoring locations at the “front row” building. However, the M2 Motorway and Lane Cove Road have a wide angle of view to receivers in this area. Comparatively, receivers set further back generally have a more limited angle of view to the proposal site due to the intervening front row buildings. For increasing distances from the M2 Motorway and the proposal site, noise from the proposal is expected to attenuate more quickly than the road traffic noise. Therefore, the monitoring location at the building nearest to the proposal site is considered representative of the reasonably most affected residences in this area.</p> <p>The noise assessment for the proposal also shows that the worst-case predicted levels 1-15 Fontenoy Road are below the base amenity criteria before corrections for road traffic noise are applied (see Appendix E.3). Therefore, the risk of unforeseen noise impacts due deriving Project Noise Trigger Levels from the front row monitoring location is considered low.</p>



ID	Address	Detail
L04	37 Khartoum Road, Macquarie Park	<p>This monitoring location is taken from Macquarie Park Data Centre SSDA (SSD-10467), which was approved in 2021. The location is set further back from major roads and is representative of similarly located residential receivers north of the M2 Motorway.</p> <p>It is noted that this location is not expected to be reasonably most affected by the proposal, however, DPHI requested its inclusion in the previous warehouse and distribution centre SSDA application for the proposal site. It has therefore been included in the assessment of the current data centre proposal for consistency.</p>
L05	35 Waterloo Road, Macquarie Park	<p>The proposed development at 35 Waterloo Road represents a future residential receiver to the south of the proposal. Noise monitoring at this location was completed at the northern facade of the building nearest to the proposal based on the currently available plans for the development.</p> <p>The monitoring location was selected based on the location which is predicted to be potentially most affected by the proposal. The location was also selected with consideration of the set back from Lane Cove Road, such that it may have experience lower road traffic noise levels compared to locations on the eastern side of the site.</p>





Appendix C Construction Noise Sources

Project Apollo Data Centre (4-10 Talavera Road, Macquarie Park)

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

6 March 2025



Table C-1 Construction Equipment and Sound Power Levels

Equipment		Total Sound Power Level (dBA)	Chainsaw ¹	Chipper	Concrete Pump	Concrete Truck	Concrete Vibrator	Crane - Mobile (100t)	Dozer	Elevated Working Platform	Excavator (20t)	Excavator (30t) + Hydraulic Hammer ¹	Front End Loader	Hand Tools	Roller - Vibratory ¹	Truck - Dump	Truck - Flatbed	Water Truck
			119	120	109	109	113	113	116	97	105	127	112	104	114	110	103	107
Sound Power Level ²			119	120	109	109	113	113	116	97	105	127	112	104	114	110	103	107
Estimated on-time in any 15 minutes			5	15	10	15	5	15	10	15	10	5	10	15	15	10	10	10
ID	Activity																	
W.01	Vegetation clearing	122	X	X							X		X			X		X
W.02	Demolition	123							X			X	X			X		X
W.03	Earthworks	119							X		X		X		X	X		X
W.04	Excavation of hard rock	126							X		X	X	X			X		X
W.05	Construction of pads and hardstands	113			X	X	X											
W.06	Construction of structures and equipment installation	114						X		X				X			X	

Note 1: Equipment classed as 'annoying' in the ICNG and requires a 5 dB correction.

Note 2: Sound power level data is taken from the TfNSW *Construction Noise and Vibration Strategy* (CNVG-R and CNVG-PTI), AS2436-2010 and DEFRA Noise Database.





Appendix D Mechanical Plant Data Sheets

Project Apollo Data Centre (4-10 Talavera Road, Macquarie Park)

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

6 March 2025

Cooling Towers



Baltimore Aircoil Company Cooling Tower Selection Report

Version: 8.11.19 ANZ
 Product data correct as of: December 07, 2021

Project Name:
 Selection Name:
 Project State/Province: NSW
 Project Country/Region: Australia
 Date: February 19, 2025

Model Information

Product Line: Series 3000 (2021 WQF)
 Model: XES3E-1424-12P ENDURA/H
 Number of Units: 2
 Intake Option: None
 Internal Option: None
 Discharge Option: None

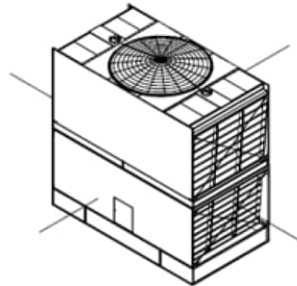
This model includes the ENDURADRIIVE® Fan System.

Fan Type: Whisper Quiet Fan (2021)
 Fan Motor: (1) 29.84 = 29.84 kW/Unit
 Total Standard Fan Power: 73.48% of Full Speed, 11.84 BkW/Unit

Octave band and A-weighted sound pressure levels (Lp) are expressed in decibels (dB) reference 0.0002 microbar. Sound power levels (Lw) are expressed in decibels (dB) reference one picowatt. Octave band 1 has a center frequency of 63 Hertz.

Top Sound Pressure (dB)		
Octave Band	Distance	
	1.5 m	15 m
1	69	61
2	68	60
3	63	55
4	59	50
5	59	50
6	56	48
7	52	44
8	46	35
A-wgtd	64	55

Air Inlet Sound Pressure (dB)		
Octave Band	Distance	
	1.5 m	15 m
1	70	61
2	68	58
3	63	51
4	60	48
5	57	47
6	44	39
7	38	29
8	45	34
A-wgtd	62	51



End Sound Pressure (dB)		
Octave Band	Distance	
	1.5 m	15 m
1	62	60
2	63	54
3	57	46
4	52	40
5	48	38
6	42	35
7	38	27
8	32	19
A-wgtd	54	45

End Sound Pressure (dB)		
Octave Band	Distance	
	1.5 m	15 m
1	62	60
2	63	54
3	57	46
4	52	40
5	48	38
6	42	35
7	38	27
8	32	19
A-wgtd	54	45

Total Sound Power (dB)		
Octave Band	Center Frequency (Hertz)	Lw
1	63	94
2	125	92
3	250	87
4	500	82
5	1000	82
6	2000	79
7	4000	76
8	8000	68
A-wgtd		87

Air Inlet Sound Pressure (dB)		
Octave Band	Distance	
	1.5 m	15 m
1	70	61
2	68	58
3	63	51
4	60	48
5	57	47
6	44	39
7	38	29
8	45	34
A-wgtd	62	51

Note: The use of frequency inverters (variable frequency drives) can increase sound levels.
Extra Notes: Sound data provided by CTI ATC-128 sound test code revision 2019



Generators



Diesel Generator Set

mtu 20V4000 DS3600

400 V - 11 kV/50 Hz/standby power/NEA (ORDE) + Tier 2 optimized
20V4000G94F/water charge air cooling



Optional equipment and finishing shown. Standard may vary.

Product highlights

Benefits

- Approved for renewable fuels (e.g. HVO)
- Low fuel consumption
- Optimized system integration ability
- High reliability
- High availability of power
- Long maintenance intervals

Support

- Global product support offered

Standards

- Engine-generator set is designed and manufactured in facilities certified to standards ISO 2008:9001 and ISO 2004:14001
- Generator set complies to ISO 8528
- Generator meets EC 60034-1, ISO 8528-3; IEC 60044-1; Declaration of conformity; EN55011, group 1, cl. B
- NFPA 110*

Power rating

- System ratings: 3580 kVA - 3730 kVA
- Accepts rated load in one step per NFPA 110*
- Generator set complies to G3 according to ISO 8528-5
- Generator set exceeds load steps according to ISO 8528-5*

Performance assurance certification (PAC)

- Engine-generator set tested to ISO 8528-5 for transient response
- 85% load factor
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

Complete range of accessories available

- Control panel
- Power panel
- Fuel system
- Fuel connections with shut-off valve mounted to base frame
- Starting/charging system
- Exhaust system
- Electrical driven radiators
- Medium and oversized voltage alternators
- Low voltage alternator

Emissions

- Tier 2 optimized engine
- NEA (ORDE) optimized

Certifications

- CE certification option
- Unit certificate acc. to VDE-AR-N 4110

* Changes to the standard parameter sets (alternator-regulator and genset-controller) are necessary



Application data ¹⁾

Engine		mtu	Liquid capacity (lubrication)	
Manufacturer			Total oil system capacity: l	390
Model	20V4000G94F		Engine jacket water capacity: l	260
Type	4-cycle		Intercooler coolant capacity: l	50
Arrangement	20V			
Displacement: l	95.4		Combustion air requirements	
Bore: mm	170		Combustion air volume: m ³ /s	4.5
Stroke: mm	210		Max. air intake restriction: mbar	30
Compression ratio	16.4			
Rated speed: rpm	1500		Cooling/radiator system	
Engine governor	ECU 9		Coolant flow rate (HT circuit): m ³ /hr	80
Max power: kWm	3088		Coolant flow rate (LT circuit): m ³ /hr	44
Air cleaner	dry		Heat rejection to coolant: kW	1140
			Heat radiated to charge air cooling: kW	890
			Heat radiated to ambient: kW	105
			Fan power for electr. radiator (40°C): kW	105
Fuel system				
Fuel specification	EN 590, Grade No.1-D/2-D (ASTM D975-00), EN 15940 (e.g. HVO)			
Maximum fuel lift: m		5	Exhaust system	
Total fuel flow: l/min		27	Exhaust gas temp. (after engine, max.): °C	550
			Exhaust gas temp. (before turbocharger): °C	642
Fuel consumption ²⁾			Exhaust gas volume: m ³ /s	11.1
At 100% of power rating:	l/hr	g/kwh	Maximum allowable back pressure: mbar	50
At 75% of power rating:	756	203	Minimum allowable back pressure: mbar	-
At 50% of power rating:	578	207		
	402	216		

Standard and optional features

System ratings (kW/kVA)

Generator model	Voltage	NEA (ORDE) optimized		
		without radiator		
		kWe ¹	kVA*	AMPS
Leroy Somer LSA54.2 ZL17 (LV Leroy Somer standard)	400 V	2960	3700	5340
Leroy Somer LSA54.2 XL11 (Med. volt. Leroy Somer)	11 kV	2864	3580	188
Leroy Somer LSA54.2 ZL12 (MV Leroy Somer oversized)	11 kV	2864	3580	188
Leroy Somer LSA54.2 ZL12 (Engine output optimized)	11 kV	2984	3730	196

* cos phi = 0.8

1 All data refers only to the engine and is based on ISO standard conditions (25°C and 100m above sea level).

2 Values referenced are in accordance with ISO 3046-1. Conversion calculated with fuel density of 0.83 g/ml. All fuel consumption values refer to rated engine power.



Standard and optional features

Engine

- 4-cycle
- Standard single stage air filter
- Oil drain extension & shut-off valve
- Closed crankcase ventilation
- Governor-electronic isochronous
- Common rail fuel injection
- Tier 2 optimized engine
- NEA (ORDE) optimized engine

Generator

- 4 pole three-phase synchronous generator
- Brushless, self-excited, self-regulating, self-ventilated
- Digital voltage regulator
- Anti condensation heater
- Stator winding Y-connected, accessible neutral (brought out)
- Protection IP23
- Insulation class H, utilization acc. to H
- Radio suppression EN 55011, group 1, cl. B
- Short circuit capability 3xIn for 10sec
- Winding and bearing RTDs (without monitoring)
- Excitation by AREP + PMI
- Mounting of CT's: 3x 1 core CT's
- Winding pitch: 127° pitch
- Voltage setpoint adjustment ± 5%
- Meets NEMA MG-1, BS 5000, IEC 60034-1, VDE 0530, DIN EN 12601, AS 1359 and ISO 8528-3 requirements
- Leroy Somer low voltage generator
- Oversized generator
- Leroy Somer medium voltage generator
- Engine output optimized generator
- Excitation by PMG, subtransient reactance X"d: Saturated <12%

Oil system

- Automatic oil refilling system
- Extended test run kit (including pre-lubrication pump)

Cooling system

- Jacket water pump
- Thermostat(s)
- Water charge air cooling
- Mechanical radiator
- Electrical driven front-end cooler
- Jacket water heater
- Jacket water heater with plate heat exchanger
- Pulley for fan drive

Control panel

- Unit cabling with coded plugs for easy connection of customer-specific controls (V0)
- Pre-wired control cabinet for easy application of customized controller (V1+)
- Island operation (V2)
- Automatic mains failure operation with ATS (V3a)
- Automatic mains failure operation incl. control of generator and mains breaker (V3b)
- Island parallel operation of multiple gensets (V4)
- Automatic mains failure operation with short (< 10s) mains parallel overlap synchronization (V5)
- Mains parallel operation of a single genset (V6)
- Mains parallel operation of multiple gensets (V7)
- Basler controller
- Deif controller
- Complete system metering
- Digital metering
- Engine parameters
- Generator protection functions
- Engine protection
- SAE J1939 engine ECU communications
- Parametrization software
- Multilingual capability
- Multiple programmable contact inputs
- Multiple contact outputs
- Event recording
- IP 54 front panel rating with integrated gasket
- Remote annunciator
- Daytank control
- Generator winding- and bearing temperature monitoring
- Modbus TCP-IP

- Represents standard features
- Represents optional features



Standard and optional features

Connectivity

The engine system automatically collects and transfers engine data to the manufacturer from time to time. The data is used by the

manufacturer for the purposes of product development and improvement as well as service optimization.

Users can log in or register via <https://mtu-go.com> and also gain insight into the data.

Power panel

- Supply electrical driven radiator from 45kW – 75kW

Fuel system

- Flexible fuel connectors mounted to base frame
- Fuel filter with water separator
- Fuel filter with water separator heavy-duty
- Switchable fuel filter with water separator
- Switchable fuel filter with water separator heavy-duty
- Seperate fuel cooler
- Fuel cooler integrated into cooling equipment

Starting/charging system

- 24V starter
- Redundant starting system
- Starter batteries, cables, rack, disconnect switch (lockable)
- Battery charger
- Alternator

Mounting system

- Welded base frame
- Resilient engine and generator mounting
- Modular base frame design
- Base frame mounting on foundation/base plate with using clamping brackets
- Spring mounts with 95% degree of isolation

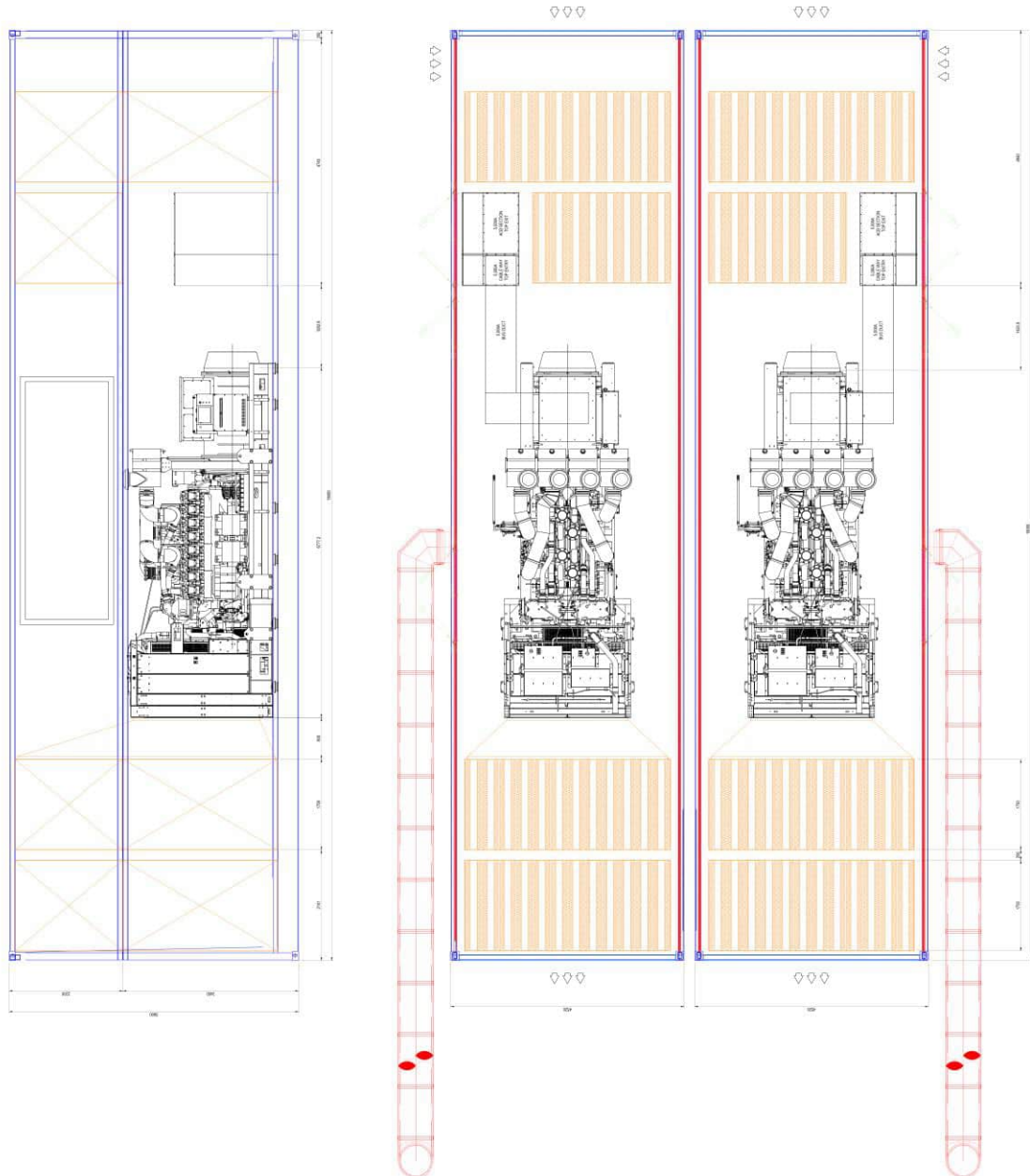
Exhaust system

- Exhaust bellows with connection flange
- Exhaust silencer with 10 dB(A) sound attenuation
- Exhaust silencer with 30 dB(A) sound attenuation
- Exhaust silencer with 40 dB(A) sound attenuation
- Y-connection-pipe

- Represents standard features
- Represents optional features

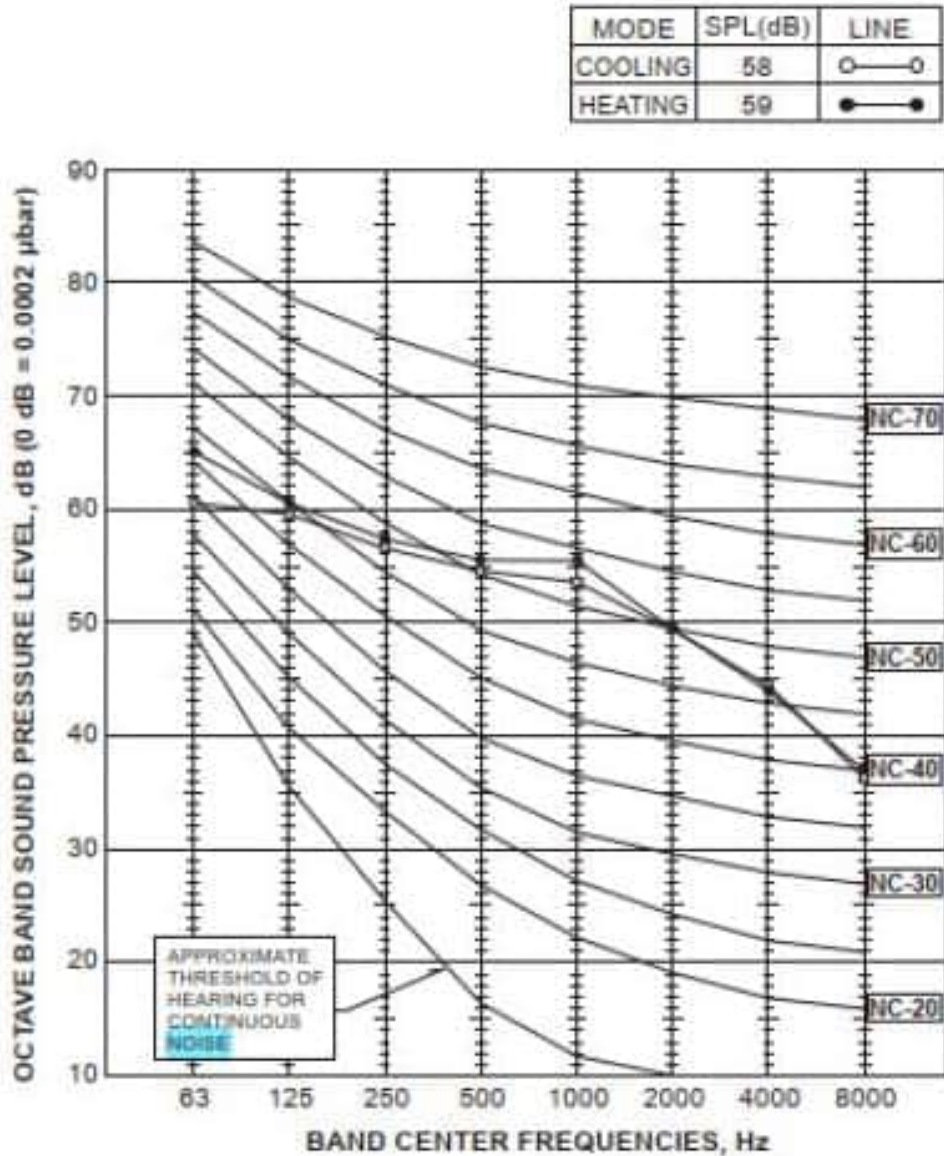


Generator Enclosure



Air Conditioning Units

PUZ-RP170VKA-A.TH
PUZ-RP170YKA-A.TH
PUZ-RP200YKA-A.TH



Acoustic Louvre

ARCHITECTURAL PRODUCT SOLUTIONS

PRODUCT DATA SHEET

Model A12350 12" (304.8 mm) Sightproof Fixed Acoustical Louver

Material:

Material:	1100 Aluminum Alloy, Fiberglass Insulation protected by woven (self-extinguishing) 100% Polyester sheeting
Nominal Thickness (heads, sills, jambs, & mullions):	0.081" (2.06 mm)
Nominal Blade Thickness:	0.081" (2.06 mm)
Furnished With:	Birdscreen: ½" (12.7mm) intercrimp aluminum mesh, 0.063" (1.60 mm) diameter wire removeable aluminum bird screen in an aluminum frame
Additional Options (at additional cost):	Insect screen (in lieu of bird screen), Continuous clip angles for attachment Sheet blank off, Insulated blank off Sill pans, Flange frames Integrated glazing frames



**Test Summary:
 For a 4 Foot by 4 Foot Unit.**

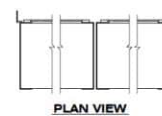
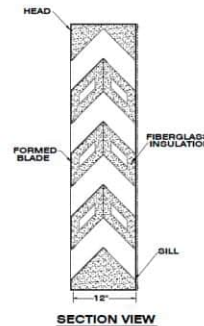
Tested with mill finish and no screen

- Free area = 3.73 ft² (0.35 m²)
- Percent free area = 23.3%
- Free area velocity at the point of beginning water penetration (@ 0.01oz. / ft² of free area based on a 15 minute interval test) = 1096 FPM (5.57 m/s)
- Intake pressure drop at 1096 FPM free area velocity = 0.256 in H₂O (63.7 Pa)

Acoustical Data:

The louvre manufacturer shall submit test data from an accredited acoustical laboratory in accordance with ASTM Standard E90-90. The minimum acceptable performance through all octave bands is as follows: STC = 19

Frequency (hz)	63	125	250	500	1000	2000	4000	8000
Transmission Loss	9	7	10	14	22	24	23	22
Noise Reduction	15	13	16	20	28	30	29	28





Appendix E Operational Noise Information

**Project Apollo Data Centre (4-10 Talavera Road, Macquarie
Park)**

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

6 March 2025

E.1 Potential for Tonal and Low Frequency Noise

The NSW EPA *Noise Policy for Industry* (NPfI) requires consideration of annoying characteristics in noise sources that may be experienced at receiver locations (ie tonality, low frequency, and intermittency). NPfI Fact Sheet C details specific tests to determine when annoying noise characteristics are present and appropriate corrections to be added to the overall measured or predicted noise levels.

The NPfI Fact Sheet C procedure for determining when to apply corrections for annoying noise characteristics requires at-receiver noise levels including 1/3 octave band frequency data between 10 Hz and 10 kHz (or high resolution audio data for narrow band analysis). Manufacturers' noise data for mechanical plant rarely include the information required by NPfI Fact Sheet C.

In lieu of suitable manufacturers' data, NSW EPA suggest that measurement data is gathered at an equivalent existing facility and used in the assessment of proposed developments¹. The suggested method, however, requires that an equivalent existing facility exists and is reasonably accessible by the proponent of the new proposal.

Noise emissions from data centre operations are variable and dependant on many factors, including:

- Type, model, load (size) and number of the plant items
- The location and orientation of the plant items relative to sensitive receivers
- The operating conditions of the plant items
- The design and construction of enclosures and buildings that house the plant items
- Noise mitigation integrated into the plant design.

It is considered unlikely that at-receiver measurements adjacent to an existing data centre would be representative of the noise emissions from a proposed development. Therefore, the only available method to strictly follow the NPfI Fact Sheet C procedure is to conduct 'at-source' measurements near to individual equivalent plant items at an existing data centre in order to determine sound power level data.

Given the range of potential mechanical plant, it is not considered feasible to require noise source measurement of equivalent existing items at the environmental assessment stage. Further, it is noted that the units listed in this assessment are example units based on current planning and may be subject to change.

Where source measurement data is not available, the manufacturers' specified noise level data is considered the most reasonable and reliable source of information. Evaluation of the potential for at-receiver tonal or low frequency noise from the proposed cooling towers and generators is summarised in **Table E-2** based on the available manufacturers' noise data.

The mitigation measures recommended for the project also include that the final equipment selection would consider minimising the potential for tonal or low frequency noise impacts at sensitive receivers (see **Section 6.2**). Equipment selection would be reviewed at the detailed design stage.

¹ News Item. *Acoust Aust* **48**, 170–172 (2020).



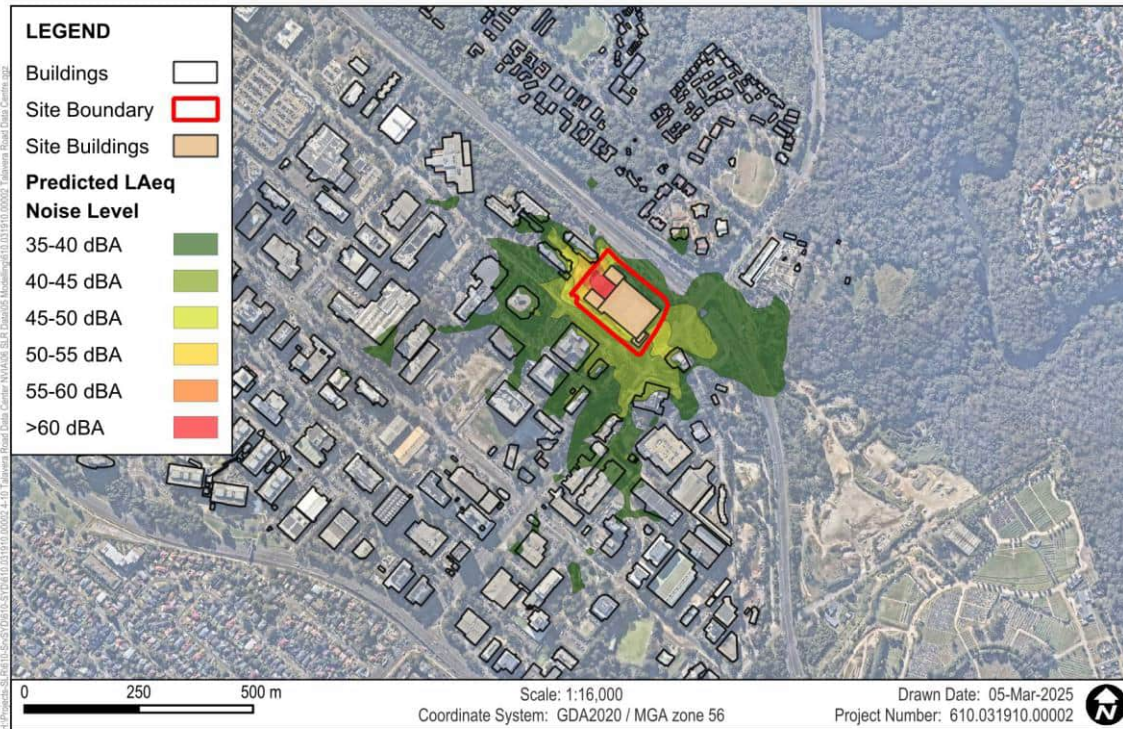
Table E-2 Cooling Tower and Generator Potential for Tonal and Low Frequency Noise

Noise Source	Potential Annoying Noise Characteristics	
	Tonal Noise	Low Frequency Noise
<p>Cooling towers</p> <p>Example unit: BAC XES3E-1424-12P ENDURA/H</p>	<p>The available manufacturers' data for the example unit does not include the 1/3 octave bands required for the NPfl tonality test, however, the available data does not indicate likely tonal noise.</p> <p>Propeller type cooling towers produce noise at the blade passage frequency, however, this effect generally does not stand out as audible tones when operating within appropriately designed conditions. Potential tonality issues are generally a result of incorrect operating conditions (ie choked flow / high backpressure) causing turbulence at the blade tips, which would be considered in the detailed design of the project.</p> <p>Further, the example unit includes wide chord forward swept fan blades, designed to reduce blade pass noise.</p>	<p>The available manufacturers' data for the example unit does not include the 1/3 octave bands required for the NPfl low frequency test, however, the available data does not indicate low frequency noise is likely.</p> <p>A screening test has been conducted conservatively assuming that noise in the frequency bands below the lowest supplied by the example unit manufacturer (63 Hz) remain equal down to 10 Hz. Note that in reality, mechanical plant noise source spectrum would likely reduce in the low frequency range of interest.</p> <p>The screening test shows that the assumed overall C-weighted minus A-weighted level is less than 15 dB at the potentially most affected receiver, therefore no low frequency noise correction is expected to be required.</p>
<p>Backup generators</p> <p>Example unit: Rolls Royce mtu 20V4000G94F</p>	<p>The available manufacturers' data for the example unit includes the 1/3 octave bands required for the NPfl tonality test.</p> <p>The predicted noise at the potentially most affected receiver does not require a tonal correction based on the predicted noise levels.</p> <p>The sound power level data for the example unit indicates a potential tone at 6.3 kHz, based on the generator surface noise. However, the generator surface noise would be reduced to a component of the external noise at the intake and discharge points of the generator enclosures, which will be designed to achieve a sound pressure level of 75 dBA at one metre distance.</p> <p>The predicted generator noise at the potentially most affected receiver is less than 20 dB at 6.3 kHz, which is expected to be inaudible relative to the existing noise environment which was measured to be around 38 dB at this frequency.</p>	<p>The available manufacturers' data for the example unit does include some of the 1/3 octave bands required for the NPfl low frequency test but not all. However, the available data does not indicate low frequency noise is likely.</p> <p>The predicted noise contribution from the lowest frequency band supplied by the example unit manufacturer of 25 Hz is around 24 dB at the potentially most affected receiver. This is significantly below the NPfl low frequency threshold of 69 dB for 25 Hz.</p> <p>Further, the profile of the available 1/3 octave band spectrum exhibits a decline in low frequency noise below 200 Hz, which suggest that low frequency noise issues are not likely in the frequency range continuing below 25 Hz.</p>



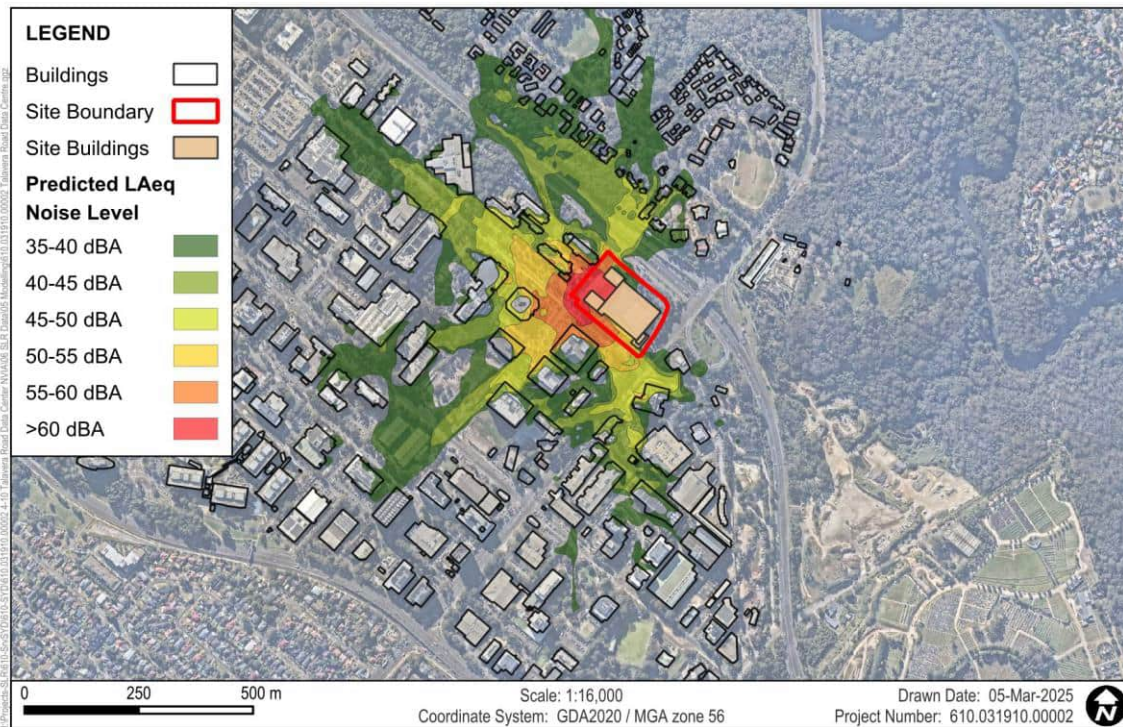
E.2 Operational Noise Contours

Figure E-1 Predicted Operational Noise Contours – OP.01 Day – Ground Level



Note: Contours are calculated at 1.5 m above ground level.

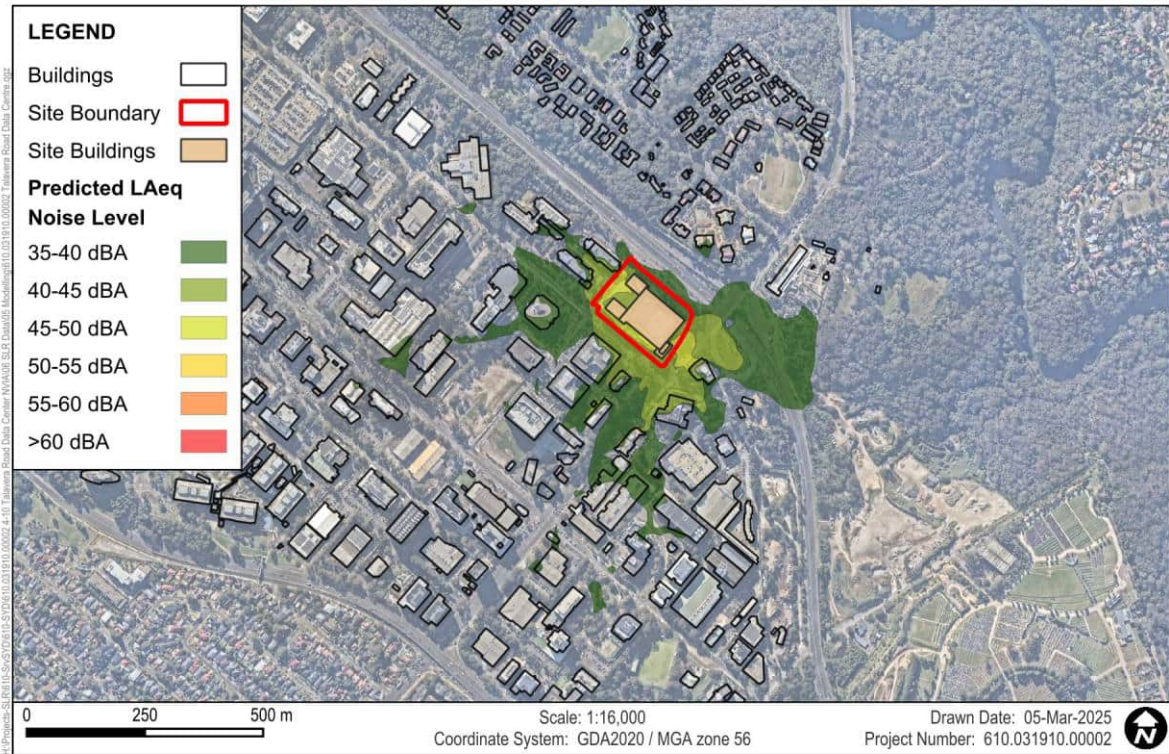
Figure E-2 Predicted Operational Noise Contours – OP.02 Day – Ground Level



Note: Contours are calculated at 1.5 m above ground level. Testing of the southwestern most generator on Level 1 is included in the contours.

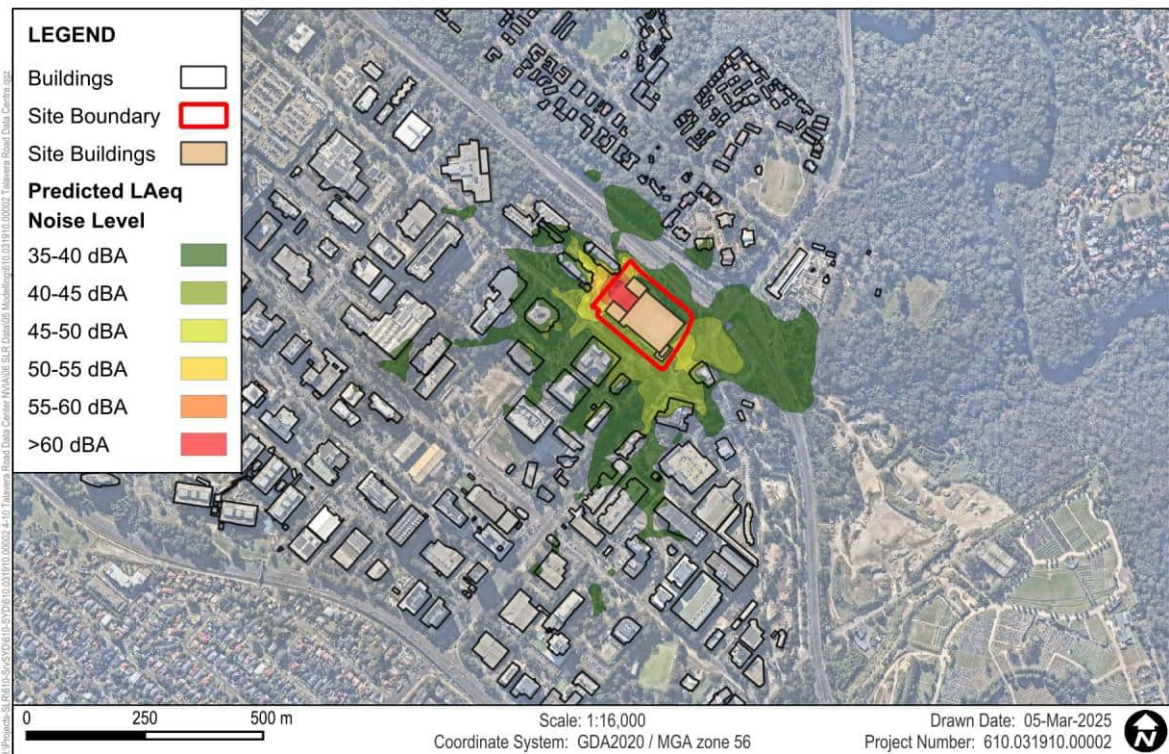


Figure E-3 Predicted Operational Noise Contours – OP.01 Evening – Ground Level



Note: Contours are calculated at 1.5 m above ground level.

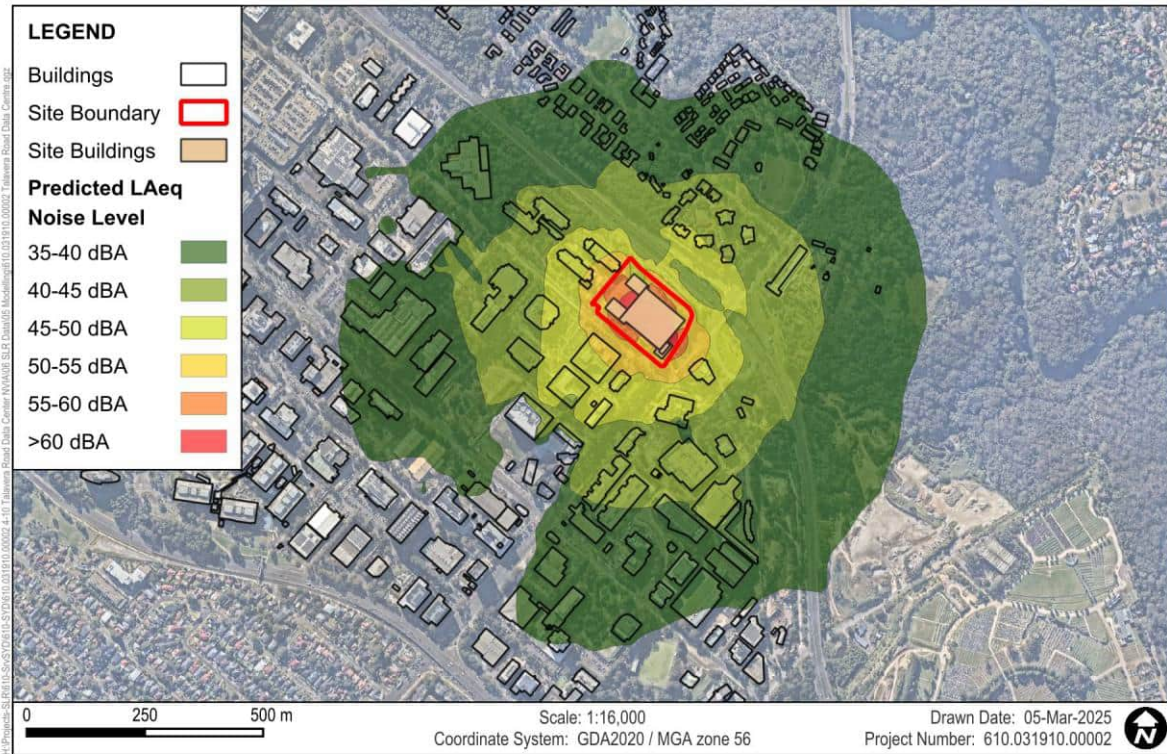
Figure E-4 Predicted Operational Noise Contours – OP.01 Night-time – Ground Level



Note: Contours are calculated at 1.5 m above ground level.

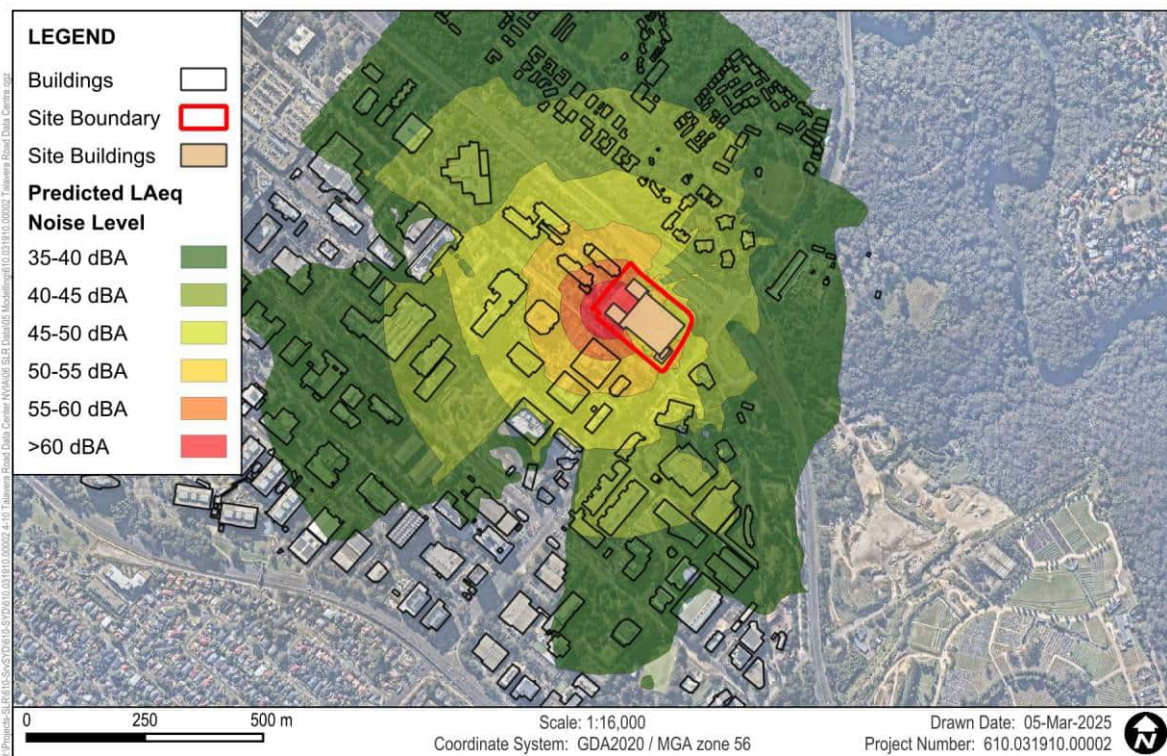


Figure E-5 Predicted Operational Noise Contours – OP.01 Day – Roof Level



Note: Contours are calculated at 40 m above ground level.

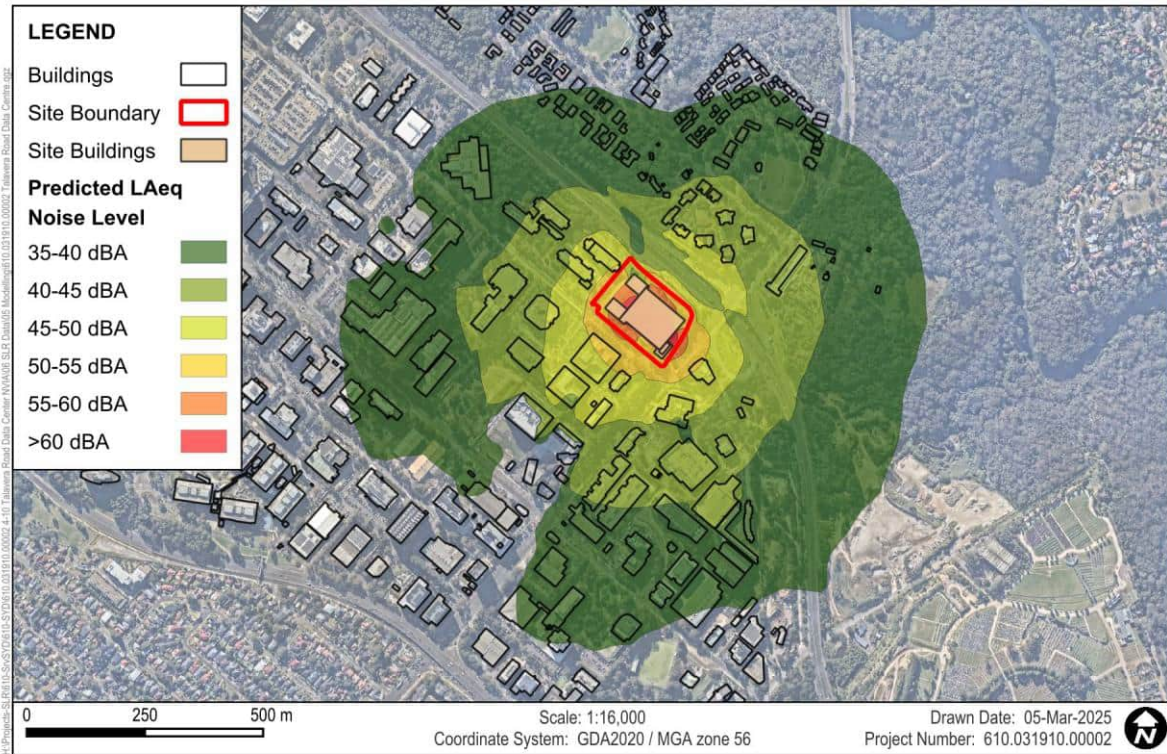
Figure E-6 Predicted Operational Noise Contours – OP.02 Day – Roof Level



Note: Contours are calculated at 40 m above ground level. Testing of the southwestern most generator on Roof Level is included in the contours.

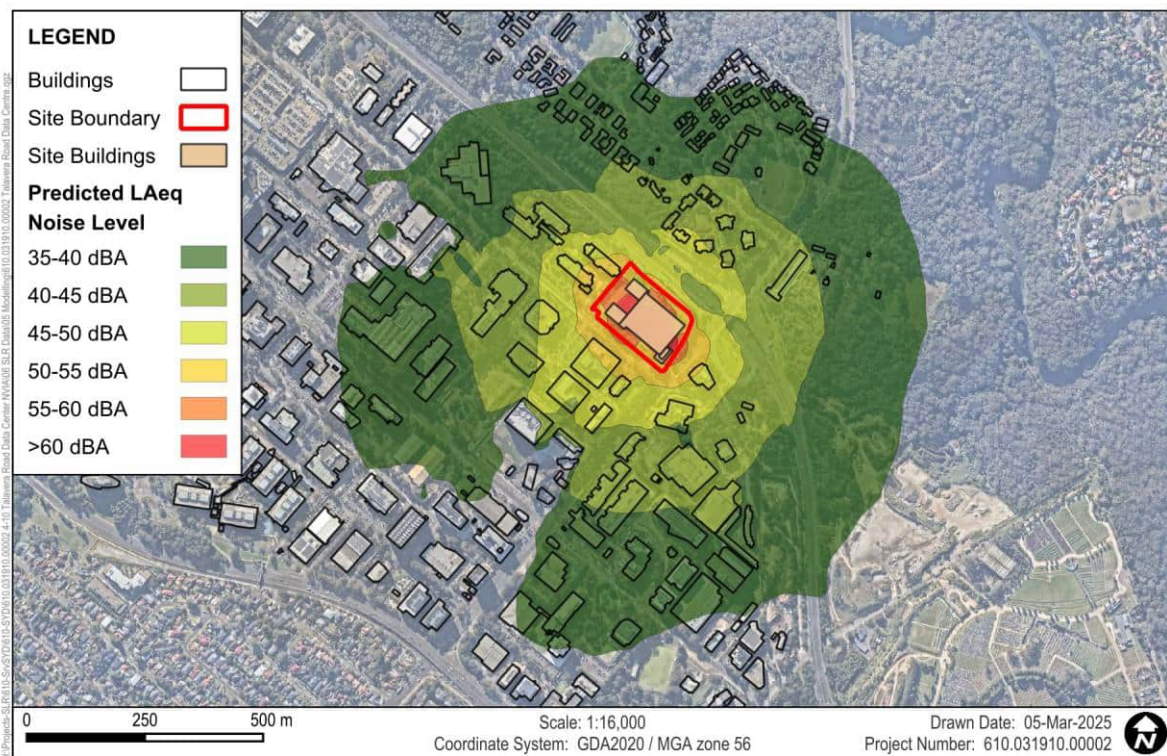


Figure E-7 Predicted Operational Noise Contours – OP.01 Evening – Roof Level



Note: Contours are calculated at 40 m above ground level.

Figure E-8 Predicted Operational Noise Contours – OP.01 Night-time – Roof Level



Note: Contours are calculated at 40 m above ground level.



E.3 Additional Operational Noise Results

The operational noise assessment in this report is presented based on the potentially most affected receivers adjacent to the proposal in various directions (R01-R09). The representative receivers were determined based on the background noise monitoring locations, receiver use types, and operational noise predictions from the proposal.

The predicted operational noise levels at additional surrounding receivers are tabulated in **Table E-1** for information purposes and show the highest predicted level for all facades and floors of each buildings. The results demonstrate that the assessment has considered all receivers potentially affected by the proposal.

The “Map IDs” in **Table E-1** are shown in **Figure E-1**.

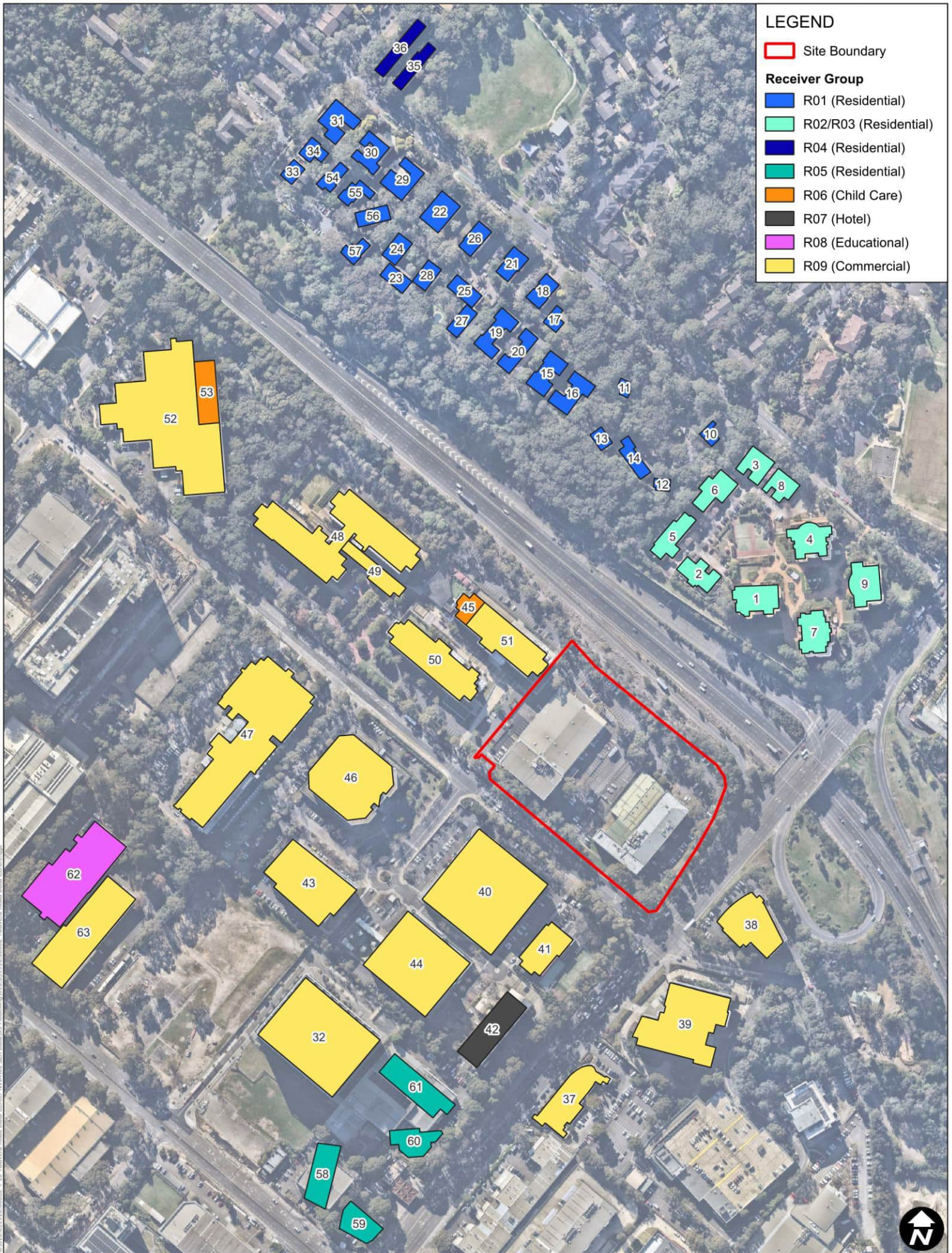


LEGEND

Site Boundary

Receiver Group

- R01 (Residential)
- R02/R03 (Residential)
- R04 (Residential)
- R05 (Residential)
- R06 (Child Care)
- R07 (Hotel)
- R08 (Educational)
- R09 (Commercial)



0 100 200 m

Scale: 1:4,000 at A4
Coordinate System: GDA2020 / MGA zone 56

Drawn Date: 05-Mar-2025
Project Number: 610.031910.00002



Data Source:
Nearmap Imagery

**Additional Operational Noise
Results - Receiver IDs**

H:\Projects\610.031910.00002_4-10 Tallavera Road Data Center\NVA\05_SLR_Data\05_Modeling\610.031910.00002_Tallavera Road Data Center.mxd

Table E-1 Operational Noise – Additional Receiver Results

Map ID	Receiver Group	Receiver Type	Project Noise Trigger Level (dBA)			Predicted Noise Level LAeq(15minute) (dBA)			
			Day	Evening	Night	OP.01 ¹			OP.02 ²
						Day	Evening	Night	Day
1	R02/R03	Residential	58	49	45	41	41	41	53
2	R02/R03	Residential	58	49	45	38	36	39	53
3	R02/R03	Residential	58	49	45	39	38	39	50
4	R02/R03	Residential	58	49	45	40	40	40	49
5	R02/R03	Residential	58	49	45	38	36	38	54
6	R02/R03	Residential	58	49	45	36	36	36	51
7	R02/R03	Residential	58	49	45	40	40	40	50
8	R02/R03	Residential	58	49	45	38	37	38	49
9	R02/R03	Residential	58	49	45	38	38	38	48
10	R01	Residential	58	48	43	34	33	34	47
11	R01	Residential	58	48	43	33	31	34	48
12	R01	Residential	58	48	43	34	33	35	49
13	R01	Residential	58	48	43	33	31	33	48
14	R01	Residential	58	48	43	31	30	32	49
15	R01	Residential	58	48	43	36	34	36	46
16	R01	Residential	58	48	43	37	35	37	48
17	R01	Residential	58	48	43	36	35	36	46
18	R01	Residential	58	48	43	32	31	32	42
19	R01	Residential	58	48	43	38	36	38	47



Map ID	Receiver Group	Receiver Type	Project Noise Trigger Level (dBA)			Predicted Noise Level LAeq(15minute) (dBA)			
						OP.01 ¹			OP.02 ²
			Day	Evening	Night	Day	Evening	Night	Day
20	R01	Residential	58	48	43	34	33	34	44
21	R01	Residential	58	48	43	31	31	31	42
22	R01	Residential	58	48	43	33	33	33	42
23	R01	Residential	58	48	43	35	35	35	44
24	R01	Residential	58	48	43	34	34	34	43
25	R01	Residential	58	48	43	31	30	31	42
26	R01	Residential	58	48	43	31	31	31	40
27	R01	Residential	58	48	43	35	34	35	44
28	R01	Residential	58	48	43	36	36	36	45
29	R01	Residential	58	48	43	33	33	33	41
30	R01	Residential	58	48	43	31	31	31	40
31	R01	Residential	58	48	43	34	34	34	42
32	R09	Commercial	63 (when in use)			43	43	43	48
33	R01	Residential	58	48	43	33	33	33	41
34	R01	Residential	58	48	43	32	32	32	41
35	R04	Residential	50	48	43	31	31	31	39
36	R04	Residential	50	48	43	27	27	27	36
37	R09	Commercial	63 (when in use)			40	40	40	47
38	R09	Commercial	63 (when in use)			48	48	48	49
39	R09	Commercial	63 (when in use)			49	49	49	52
40	R09	Commercial	63 (when in use)			44	44	44	59



Map ID	Receiver Group	Receiver Type	Project Noise Trigger Level (dBA)			Predicted Noise Level LAeq(15minute) (dBA)			
						OP.01 ¹			OP.02 ²
			Day	Evening	Night	Day	Evening	Night	Day
41	R09	Commercial	63 (when in use)			42	42	42	53
42	R07	Hotel	63	53	48	44	44	44	51
43	R09	Commercial	63 (when in use)			44	44	44	53
44	R09	Commercial	63 (when in use)			43	43	44	52
45	R06	Child Care	58 (when in use)			44	39	45	54
45	R06 (external)	Child Care (external)	53 (when in use)			35	32	35	47
46	R09	Commercial	63 (when in use)			44	43	44	55
47	R09	Commercial	63 (when in use)			43	42	43	52
48	R09	Commercial	63 (when in use)			46	43	46	53
49	R09	Commercial	63 (when in use)			37	36	37	48
50	R09	Commercial	63 (when in use)			50	44	50	61
51	R09	Commercial	63 (when in use)			56	48	56	62
52	R09	Commercial	63 (when in use)			36	36	36	45
53	R06	Child Care	58 (when in use)			33	33	33	40
53	R06 (external)	Child Care (external)	53 (when in use)			27	27	27	38
54	R01	Residential	58	48	43	34	34	34	42
55	R01	Residential	58	48	43	32	32	32	41
56	R01	Residential	58	48	43	34	34	34	43
57	R01	Residential	58	48	43	35	35	35	44
58	R05	Residential	58	48	43	37	37	37	44
59	R05	Residential	58	48	43	36	36	36	39



Map ID	Receiver Group	Receiver Type	Project Noise Trigger Level (dBA)			Predicted Noise Level LAeq(15minute) (dBA)			
			Day	Evening	Night	OP.01 ¹			OP.02 ²
						Day	Evening	Night	Day
60	R05	Residential	58	48	43	40	40	40	41
61	R05	Residential	58	48	43	43	43	43	48
62	R08	Educational	58 (when in use)			36	36	36	47
63	R09	Commercial	63 (when in use)			36	36	36	45

Note 1: OP.01 – Typical Peak Operation.

Note 2: OP.02 – Typical Peak Operation and Generator Maintenance/Testing.





Appendix F CNVG Mitigation Measures

**Project Apollo Data Centre (4-10 Talavera Road, Macquarie
Park)**

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

6 March 2025

Table F-1 CNVG Standard Mitigation and Management Measures

Action Required	Applies To	Details
Management measures		
Implementation of any project specific mitigation measures required.	Airborne noise	Implementation of any project specific mitigation measures required.
Implement community consultation or notification measures.	Airborne noise Ground-borne noise & vibration	Notification detailing work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the works (where applicable) and contact telephone number. Notification should be a minimum of 7 calendar days prior to the start of works. For projects other than maintenance works more advanced consultation or notification may be required. Please contact Roads and Maritime Communication and Stakeholder Engagement for guidance. Website (If required) Contact telephone number for community Email distribution list (if required) Community drop-in session (if required by approval conditions).
Site inductions	Airborne noise Ground-borne noise & vibration	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: <ul style="list-style-type: none"> • all project specific and relevant standard noise and vibration mitigation measures • relevant licence and approval conditions • permissible hours of work • any limitations on high noise generating activities • location of nearest sensitive receivers • construction employee parking areas • designated loading/unloading areas and procedures • site opening/closing times (including deliveries) • environmental incident procedures.
Behavioural practices	Airborne noise	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Verification	Airborne noise Ground-borne noise & vibration	Where specified under Appendix C of the CNVG a noise verification program is to be carried out for the duration of the works in accordance with the Construction Noise and Vibration Management Plan and any approval and licence conditions.
Attended vibration measurements	Ground-borne vibration	Where required attended vibration measurements should be undertaken at the commencement of vibration generating activities to confirm that vibration levels are within the acceptable range to prevent cosmetic building damage.



Action Required	Applies To	Details
Update Construction Environmental Management Plans	Airborne noise Ground-borne noise & vibration	The CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.
Building condition surveys	Vibration Blasting	Undertake building dilapidation surveys on all buildings located within the buffer zone prior to commencement of activities with the potential to cause property damage
Source controls		
Construction hours and scheduling	Airborne noise Ground-borne noise & vibration	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.
Construction respite period during normal hours and out-of-hours work	Ground-borne noise & vibration Airborne noise	See Appendix C of the CNVG for more details on the following respite measures: <ul style="list-style-type: none"> • Respite Offers (RO) • Respite Period 1 (R1) • Respite Period 2 (R2) • Duration Respite (DR)
Equipment selection.	Airborne noise Ground-borne noise & vibration	Use quieter and less vibration emitting construction methods where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts. Similarly, diaphragm wall construction techniques, in lieu of sheet piling, will have significant noise and vibration benefits. Ensure plant including the silencer is well maintained.
Plant noise levels.	Airborne-noise	The noise levels of plant and equipment must have operating Sound Power or Sound Pressure Levels compliant with the criteria in Appendix H of the CNVG. Implement a noise monitoring audit program to ensure equipment remains within the more stringent of the manufacturers specifications or Appendix H of the CNVG.
Rental plant and equipment.	Airborne-noise	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 2 of the CNVG.
Use and siting of plant.	Airborne-noise	The offset distance between noisy plant and adjacent sensitive receivers is to be maximised. Plant used intermittently to be throttled down or shut down. Noise-emitting plant to be directed away from sensitive receivers. Only have necessary equipment on site.



Action Required	Applies To	Details
Plan worksites and activities to minimise noise and vibration.	Airborne noise Ground-borne vibration	<p>Locate compounds away from sensitive receivers and discourage access from local roads.</p> <p>Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.</p> <p>Where additional activities or plant may only result in a marginal noise increase and speed up works, consider limiting duration of impact by concentrating noisy activities at one location and move to another as quickly as possible.</p> <p>Very noise activities should be scheduled for normal working hours. If the work can not be undertaken during the day, it should be completed before 11:00pm.</p> <p>Where practicable, work should be scheduled to avoid major student examination periods when students are studying for examinations such as before or during Higher School Certificate and at the end of higher education semesters.</p> <p>If programmed night work is postponed the work should be re-programmed and the approaches in this guideline apply again.</p>
Reduced equipment power	Airborne noise Ground-borne vibration	Use only the necessary size and power.
Non-tonal and ambient sensitive reversing alarms	Airborne noise	<p>Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work.</p> <p>Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.</p>
Minimise disturbance arising from delivery of goods to construction sites.	Airborne noise	<p>Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers.</p> <p>Select site access points and roads as far as possible away from sensitive receivers.</p> <p>Dedicated loading/unloading areas to be shielded if close to sensitive receivers.</p> <p>Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.</p> <p>Avoid or minimise these out of hours movements where possible.</p>
Engine compression brakes	Construction vehicles	<p>Limit the use of engine compression brakes at night and in residential areas.</p> <p>Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.</p>



Action Required	Applies To	Details
Path controls		
Shield stationary noise sources such as pumps, compressors, fans etc.	Airborne noise	Stationary noise sources should be enclosed or shielded where feasible and reasonable whilst ensuring that the occupational health and safety of workers is maintained. Appendix D of AS 2436:2010 lists materials suitable for shielding.
Shield sensitive receivers from noisy activities.	Airborne noise	Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when situating plant.
Receptor control		
Structural surveys and vibration monitoring	Ground-borne vibration	Pre-construction surveys of the structural integrity of vibration sensitive buildings may be warranted. At locations where there are high-risk receptors, vibration monitoring should be conducted during the activities causing vibration.
See Appendix C of the CNVG for additional measures	Airborne noise Ground-borne vibration	In some instances, additional mitigation measures may be required.



Appendix G NPfI Mitigation Measures

Project Apollo Data Centre (4-10 Talavera Road, Macquarie Park)

SSD-74069708 Noise and Vibration Impact Assessment

Goodman Property Services (Aust) Pty Ltd

SLR Project No.: 610.031910.00002

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Best Management Practice (BMP)

Best management practice (BMP) is the application of particular operational procedures that minimise noise while retaining productive efficiency.

Where applied, these measures and practices are often documented in a noise management plan so that operational practices and undertakings are clearly understood and applied at all levels of an industrial operation. Application of BMP can include the following types of practice:

- Using the quietest plant that can do the job
- Scheduling the use of noisy equipment at the least-sensitive time of day
- Not operating, or reducing operations at night
- Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise
- Where there are several noisy pieces of equipment, scheduling operations so they are used separately rather than concurrently
- Keeping equipment well-maintained and operating it in a proper and efficient manner
- Using 'quiet' practices when operating equipment, for example, positioning idling trucks in appropriate areas
- Running staff-education programs and regular tool box talks on the effects of noise and the use of quiet work practices.

For many industries there are a wide range of factors that can restrict the feasibility and reasonableness of applying BMP measures on a particular site. Work health and safety considerations must also be taken into account as well as any other regulatory and process requirements.



Best Available Technology Economically Achievable (BATEA)

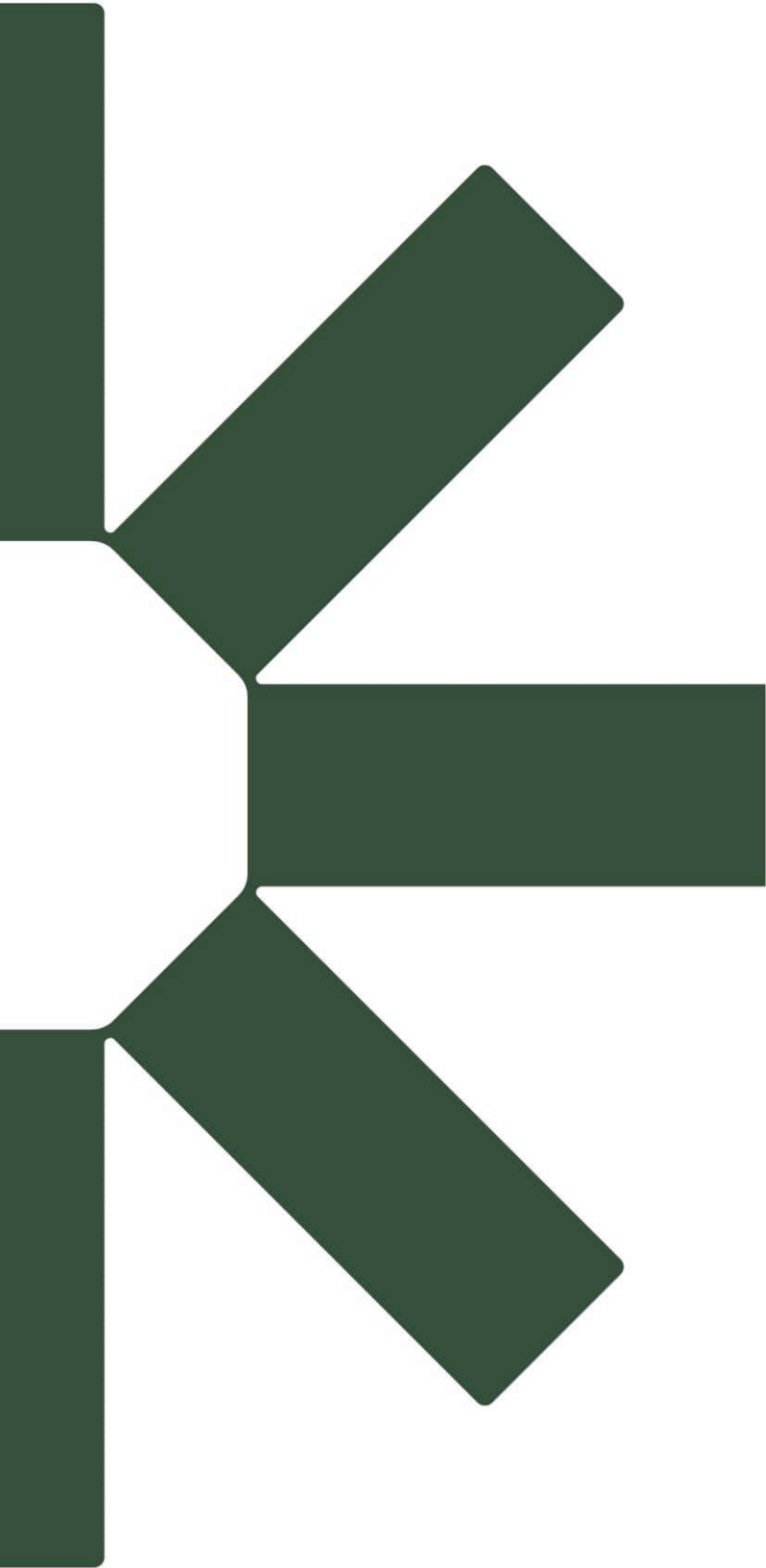
With 'Best available technology economically achievable' (BATEA), equipment, plant and machinery that produce noise incorporate the most advanced and affordable technology to minimise noise output. Affordability is not necessarily determined by the price of the technology alone. Increased productivity may also result from using more advanced equipment, offsetting the initial outlay, for example, using 'quieter' equipment that can be operated over extended hours. Old or badly-designed equipment can often be a major source of noise.

Where BMP fails to achieve the required noise reduction by itself, the BATEA approach should then be considered. Examples of uses of BATEA include:

- Considering alternatives to tonal reversing alarms (where work health and safety is appropriately considered)
- Using equipment with efficient muffler design
- Using quieter engines, such as electric instead of internal combustion
- Fitting and maintaining noise reduction packages on plant and equipment
- Using efficient enclosures for noise sources
- Damping or lining metal trays or bins
- Active noise control.

For many industries there are a wide range of factors that can restrict the feasibility and reasonableness of applying BMP or BATEA measures on a particular site. Work health and safety considerations must also be taken into account as well as any other regulatory and process requirements.





Making Sustainability Happen