10 Dangar Street, Wickham

SSD Noise and Vibration Impact Assessment

UPG Wickham Pty Ltd

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TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

This noise and vibration impact assessment is submitted to the Department of Planning, Housing and Infrastructure (DPHI) on behalf Urban Property Group (UPG) (the Applicant), to support a State Significant Development Application (SSDA) and concurrent Rezoning Report for the construction of a 43-storey mixed-use development at 10 Dangar Street, Wickham (the site). The site is located within the Newcastle local government area (LGA) and occupies a prominent corner position immediately north of the Newcastle Interchange.

The project has been selected by the NSW Housing Delivery Authority (HDA) as a key development to help accelerate the delivery of well-located, diverse and affordable housing in New South Wales. Commencing in early 2025, the HDA plays a coordinating role across government agencies, focusing on unlocking complex sites through strategic planning, infrastructure coordination, and streamlined assessment pathways.

Following the Applicant's expression of interest (EOI 240837), the HDA considered and recommended to the Minister for Planning and Public Spaces (the Minister) that the project be declared SSD under Section 4.36(3) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) on 23 June 2025. Following this recommendation, the development was declared by the Minister to be SSD pursuant to the *State Significant Development Declaration Order 2025 (No 10),* Part 2, Section 1(a), dated 30 June 2025.

This assessment will address the following:

- Potential surrounding environmental noise intrusion impacts on the development (i.e., traffic, train and other noise external noise sources).
- Potential vibration impacts from the movement of trains using the Newcastle Interchange located to the south-west of the site.
- Noise emissions on nearby receivers from operation of the base building services (i.e., electrical, hydraulic and mechanical plant).
- Construction noise and vibration impact during the construction stage of the project.

This report will discuss the relevant acoustic criteria which have been adopted as well as the outcome of the assessment.

A list of acoustic terminology used in this report is included in Appendix A of this report.

1.1 Project SEARs

Acoustic criteria which have been adopted in this assessment include requirements from the local and state authorities and in the absence of any applicable criteria from these bodies, Australian and International Standards will be utilised, including those required to comply with the Industry SEARs which include the following:

10. Noise and Vibration • Provide a noise and vibration impact assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail construction and operational noise and vibration impacts on nearby sensitive receivers and structures and outline the proposed management and mitigation measures that would be implemented.	Noise and Vibration Impact Assessment

1.2 Relevant Guidelines

Acoustic criteria that have been adopted in this assessment include requirements from the following guidelines or legislative documents:

- NSW EPA Noise Policy for Industry (*NPfI*) 2017.
- NSW EPA Road Noise Policy (*RNP*) 2011.
- NSW EPA Interim Construction Noise Guideline (*ICNG*) 2009.
- State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP)
- Development near Rail Corridors and Busy Roads – Interim Guideline
- Transport Asset Standards Authority Airspace and External Developments 2021
- NSW EPA (formerly, Department of Environment and Climate Change) *Assessing Vibration: a technical guideline 2006 (AV-TG)*.
- Australian Standard AS 2670.2 1990 - *Evaluation of Human Exposure to Whole Body Vibration - Part 2: Continuous and Shock Induced Vibration in Buildings (1 Hz to 80 Hz).*
- British Standard BS 6472 - 2008 - *Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz).*
- German DIN 4150: Part 3 – 1999 "*Effects of Vibration on Structure*" (DIN 1999).

1.3 Project Background

The site was identified under the *Wickham Master Plan 2017* as a strategically significant location for increased development capacity, given its proximity to the Newcastle Interchange and its potential to support high-density, mixed-use development. The Master Plan proposed an uplift in planning controls, increasing the permissible building height from 45m to 60m, and the FSR from 5:1 to 6:1, subject to the delivery of public domain improvements, including a 3-metre southern setback adjacent to the transport interchange.

This strategic vision was subsequently reaffirmed in the *Wickham Master Plan 2021 Update* (PP-2021-1506) and further refined in the 2022 amendment, which supported additional incentive-based planning controls. The Community Infrastructure Incentives in Wickham Planning Proposal (PP-2022/1541), endorsed by Council in March 2022 (and subsequently approved 08 November 2022), proposed:

- An incentive FSR of 7:1 for Area E (the site),
- A maximum incentive building height of 60m, and
- Community infrastructure requirements.

In alignment with these strategies, the site has been subject to successive development consents as outlined in the Environmental Impact Statement (EIS) prepared by Beam Planning. These prior consents have been physically commenced through demolition and excavation works and establish the maximum envelope for basement structures. This SSDA will adopt and refine these commenced elements to expedite the assessment process, continue construction progress on the site, and ensure continuity with previously endorsed planning outcomes.

1.4 The Proposal

1.4.1 Rezoning Proposal

To facilitate the proposed development described in Section 1.4.2, a concurrent Rezoning Proposal is sought to make the following amendments to the *Newcastle Local Environmental Plan 2012* (Newcastle LEP 2012) in relation to the site:

- Amend Clause 7.9 to permit a maximum building height of 152m on the site; and,
- Amend the Clause 7.9A to permit a maximum FSR of 14.4:1 on the site.

1.4.2 State Significant Development Application

The proposed amendments to the Newcastle LEP 2012, as outlined above, will facilitate the following development, proposed via a concurrent SSDA. Specifically, the proposed works sought under the SSDA include:

- Construction of a 43-storey (+ plant) mixed-use tower, comprising:
  a. 245 residential apartments
  b. 95 co-living units
  c. Ground floor retail premises, to all three street frontages
  d. A hotel component within the podium
  e. Basement car parking
- Associated landscaping and public domain improvements, including the provision of a pedestrian through-site link that runs east/west adjacent to the Newcastle Interchange.

It is noted that the project will commit to providing 15% of the residential GFA as affordable housing for a minimum of 15 years, to be managed by a registered Community Housing Provider (CHP).

The proposed SSDA will seek consent for the use of basement structures and enabling works approved under DA2018/01197 (as modified).

For a detailed description of the proposed development, refer to the EIS prepared by Beam Planning, and the Architectural Drawings prepared by SJB Architecture and included in the submission of the project.

The site location in relation to the surrounding receivers, is shown in the figure below.

1.5 Site Description

The site is located at 10 Dangar Street, Wickham, within the Newcastle LGA. The site benefits from triple street frontages, with a primary street frontage of approximatley 64m to Dangar Street, and secondary street frontages of approximatley 61m to Hannell Street and 50m to Charles Street.

The surrounding locality comprises a diverse mix of land uses including residential, commercial, and light industrial uses, reflecting the area's ongoing transition. The site's frontage to Hannell Street, a major arterial road, supports high levels of connectivity to the broader metropolitan area. The site is located immediately north of the Newcastle Interchange, providing bus, rail and light rail services. Strategically, the site sits at the intersection of the Newcastle West End, Wickham, and Honeysuckle precincts, positioning it to support the city's transition to a higher-density, mixed use metropolitan centre.

The nearest sensitive receivers to the site have been identified below.

Receiver 1: Residential receivers located to the north of the site opposite on Dangar Street.

Receiver 2: Residential receivers located to the west of the site opposite on Charles Street.

Receiver 3: Commercial building located on Store Lane, adjacent to the Newcastle Interchange to the south

Receiver 4: Commercial building located to the west of the site opposite on Charles Street.

A map showing the site location and all measurement locations as well as nearest receivers is provided in Figure 1 below.

Figure 1 Site Map, Measurement Locations and Surrounding Receivers

2 ACOUSTIC NOISE AND VIBRATION SURVEY

This section of the report details the acoustic survey which has been undertaken at the site.

2.1 Onsite Noise Measurements

Measured noise levels from both the unattended and attended noise surveys are outlined below.

2.1.1 Unattended Noise Monitoring

An unattended noise survey was undertaken at the site between 24 October and 12 November 2025, with the receiver located to the east of the site on Hannell Street, as detailed in Figure 1 above. All data in the graphs presented in Appendix B have not been corrected (i.e., raw data presented).

Instrumentation for the survey comprised one Rion NL-42 sound level meter (serial number 00998081). Calibration of the logger was checked prior to and following the measurements. Drift in calibration did not exceed ±0.5 dB. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates. Charts presenting summaries of the measured daily noise data are attached in Appendix B. The charts present each 24-hour period and show the L_{A10}, L_{Aeq} and L_{A90} noise levels for the corresponding 15-minute periods. This data has been filtered to remove periods affected by adverse weather conditions based on weather information.

Based on the unattended noise measurements, the results of the survey have been presented below.

2.1.1.1 Results in accordance with the NSW *EPA Noise Policy for Industry (NPI) 2017* (RBL's)

In order to assess the acoustical implications of the development at nearby noise sensitive receivers, the measured background noise data of the logger was processed in accordance with the NSW EPA's *Noise Policy for Industry* (NPI, 2017). The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes at the nearest potentially affected receiver. It is the 90th percentile of the daily background noise levels during each assessment period, being day, evening and night. RBL $L_{A90\ (15minute)}$ and L_{Aeq} noise levels are presented in Table 1

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events have been excluded from the results, and also excluded from the data used to determine the noise emission criteria. Meteorological information has been obtained from the Bureau of Meteorology station at Newcastle's Nobby Head.

Table 1 Measured Ambient Noise Levels corresponding to the NPI's Assessment Time Periods

Measurement Location	Daytime[1] 7:00 am to 6:00 pm		Evening[1] 6:00 pm to 10:00 pm		Night-time[1] 10:00 pm to 7:00 am	
	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)	L_{A90}[2] (dBA)	L_{Aeq}[3] (dBA)
East of the site – See Figure 1.	58	55	47	68	66	63

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am

Note 2: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

Note: Rating background noise levels will be adopted for the project based on the attended noise survey.

2.1.1.2 Results in accordance with the NSW Department of Planning "Development near Rail Corridors and Busy Roads – Interim Guideline"

In determining the required façade construction for the proposed building in accordance with the internal noise level requirements of NSW Department of Planning, Housing and Infrastructure (DPHI) "Development near Rail Corridors and Busy Roads – Interim Guideline" measured noise levels are shown based on the time periods defined by the Transport and Infrastructure SEPP below.

Data affected by adverse meteorological conditions and by spurious and uncharacteristic events have been excluded from the results, and also excluded from the data used to determine the noise emission criteria.

Table 2 Measured Ambient Noise Levels corresponding to the "Development near Rail Corridors and Busy Roads – Interim Guideline" Assessment Time Periods

Measurement Location	Daytime [1] 7:00 am to 10:00 pm	Night-time [1] 10:00 pm to 7:00 am
	$L_{Aeq\ (whole\ period)}$ [2] (dBA)	$L_{Aeq\ (whole\ period)}$ [2] (dBA)
Hannell Street	68	63

Note 1: For Monday to Sunday, Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am.

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

2.1.2 Attended Noise Measurements

In addition to the unattended noise survey, an attended noise survey was carried out to establish levels at key locations within and surrounding the site. These are summarised below.

The attended noise measurements were conducted using a Brüel & Kjær Type 2250 sound level meter (serial number 2709757). Calibration of the sound level meter was checked prior to and following the measurements using a Brüel & Kjær Type 4231 sound calibrator (serial number 3009148). The calibrator emitted a calibration tone of 94 dB at 1 KHz. The drift in calibration did not exceed ±0.5 dB. All equipment carries appropriate and current NATA (or manufacturer) calibration certificates.

Attended noise measurements were undertaken on 12th November 2025 and included typical peak periods at the site. Results of the attended noise measurements are outlined in Table 3 below.

Table 3 Measured Results of the Attended Noise Survey

Measurement Location	Date and Time	Measured Noise Level (dBA)		Comments
		$L_{A90\ (15\text{-}min)}$[1]	$L_{Aeq\ (15\text{-}min)}$[2]	
Location 1: East of the site on Hannell Street	12th November, 2025, between 4:00pm to 5:30pm	68	59	Noise dominated from traffic movements on surrounding Roadways as well as train and light rail movements associated with the Newcastle Interchange
Location 2: North of the site on Dangar Street		62	50	
Location 3: South of the site facing Newcastle Interchage		64	54	

Note 1: The L_{A90} noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

3 ACOUSTIC CRITERIA (NOISE AND VIBRATION)

The acoustic criteria which have been adopted for this assessment are outlined below. All criteria have been separated into the relevant assessment type, these are *Noise Intrusion Criteria* (Assessment of building envelope), *Noise Emission Criteria* (Assessment of noise to surrounding receivers) and *Acoustic Separation Criteria* (Assessment of acoustic privacy within the building).

3.1 Noise Intrusion Criteria

External noise intrusion into the building will generally be via the building envelope (External wall, glazing or external roof). The design of the building envelope should be such that the requirements listed below are achieved.

3.1.1 NSW Government Legislation – State Environmental Planning Policy (Transport and Infrastructure) 2021

Section – 2.120 Impact of road noise or vibration on non-road developments states the following regarding road noise:

2.120 Impact of road noise or vibration on non-road development

1) This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transitway or any other road with an annual average daily traffic volume of more than 20,000 vehicles (based on the traffic volume data published on the website of RMS) and that the consent authority considers is likely to be adversely affected by road noise or vibration—

- *Residential accommodation,*
- *A place of public worship,*
- *A hospital,*
- *An educational establishment or centre-based childcare facility.*

2) Before determining a development application for development to which this clause applies, the consent authority must take into consideration any guidelines that are issued by the Secretary for the purposes of this clause and published in the Gazette.

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

- *In any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,*
- *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.*

4) In this clause, freeway, tollway and transitway have the same meanings as they have in the Roads Act 1993.

Clause 2.100 outlines indoor noise level requirements for non-rail developments that are for residential use. Clause 2.100 states the following:

2.100 Impact of rail Noise or Vibration on non-rail development

1. *This section applies to development for any of the following purposes that is on land in or adjacent to a rail corridor and that the consent authority considers is likely to be adversely affected by rail noise or vibration—*

    a) *residential accommodation,*

    b) *a place of public worship,*

    c) *a hospital,*

    d) *an educational establishment or centre based childcare facility.*

2. *Before determining a development application for development to which this section applies, the consent authority must take into consideration any guidelines that are issued by the Planning Secretary for the purposes of this section and published in the Gazette.*

3. *If the development is for the purpose of residential accommodation, the consent authority must not grant consent to the development unless it is satisfied that appropriate measured will be taken to ensure that the follow LAeq levels are not exceeded-*

    a) *In any bedroom in the residential accommodation – 35 dB(A) at any time between 10:00 pm and 7:00 am,*

    b) *Anywhere else in the residential accommodation (other than a garage, kitchen, bathroom, or hallway) – 40 dB(A) at any time.*

3.1.2 NSW Government Legislation – State Environmental Planning Policy (Transport and Infrastructure) 2021

Figure 2 shows the location of the proposed development relative to the nearest surrounding busy roads.

Figure 2 RMS Traffic volume map 5A – Extract.

As evident in Figure 2 above, the project site is not located on a busy road (featuring an AADT of >20,000 vehicles), as such, assessment in accordance with the Department of Planning, Housing and Infrastructure (DPHI) *Development Near Rail Corridor and Busy Roads – Interim Guideline* (DNRCBR) is not required, however as the site is located with Church Street to the east of the site the requirement of the DNRCBR have been applied as the acoustic requirements of the project.

3.1.3 NSW Department of Planning and Environments Development Near Rail Corridors and Busy Roads – Interim Guideline 2008

NSW Department of Planning, Housing and Infrastructure (DPHI) document DNRCBR adopts the same internal noise criteria outlined in the SEPP infrastructure identified above. Table 3.1 from the DNRCBR requires the following airborne noise levels resulting from surrounding road network.

Figure 3 Extract - DNRCBR - Table 3.1.

Table 3.1: Noise criteria		
Residential Buildings		
Type of occupancy	Noise Level dBA	Applicable time period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)	40	At any time
Non–Residential Buildings		
Type of occupancy		Recommended Max Level dBA
Educational Institutions including child care centres		40
Places of Worship		40
Hospitals	- Wards	35
	- Other noise sensitive areas	45

Note: airborne noise is calculated as L_{eq} (9h) (night) and L_{eq} (15h)(day). Groundborne noise is calculated as L_{max} (slow) for 95% of rail pass-by events.

3.1.4 Australian / New Zealand Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors - (AS/NZS 2107:2016)

Recommended ambient noise levels and reverberation times for internal spaces are given in a number of publications including Table 1 of Australian / New Zealand Standard 2107:2016 "*Acoustics - Recommended design sound levels and reverberation times for building interiors*". Unlike the previous version of this Standard, this latest edition recommends a range with lower and upper levels (rather than "satisfactory" and "maximum" internal noise levels) for building interiors based on room designation and location of the development relative to external noise sources. This change has occurred due to the fact that sound levels below 'satisfactory' could be interpreted as desirable, but the opposite may in fact be the case. Levels below those which were listed as 'satisfactory' can lead to inadequate acoustic masking resulting in loss of acoustic isolation and speech privacy.

Internal noise levels due to the combined contributions of external noise intrusion and mechanical ventilation plant should not exceed the maximum levels recommended in this Standard. The levels for areas relevant to this development are given in Table 4 below. The mid to maximum points of the internal noise level ranges are generally adopted as the internal design noise criteria for the combined effect of mechanical services and external noise intrusion. In this report we will confine our recommendations to dBA levels, however, where the background noise appears to be unbalanced, AS/NZS 2107:2016 provides direction in terms of suitable diagnostic tools that can be used to assess the spectrum distribution of the background noise.

Table 4 Recommended Design Sound Levels

Type of Occupancy/Activity	Design sound level range dBA ($L_{Aeq,t}$)	Project Design Noise Level [1]
Residential Buildings		
Houses and apartments in inner city areas or entertainment districts or near major roads-		
Apartment common areas (e.g foyer, lift lobby)	45 to 50	50 dB(A) $L_{eq\ (15\ hours)}$
Living areas	35 to 45	40 dB(A) $L_{eq\ (15\ hours)}$
Sleeping areas (night time)	35 to 40	35 dB(A) $L_{eq\ (9\ hours\ 10pm\ to\ 7am)}$
Work areas	35 to 40	40 dB(A) $L_{eq\ (15\ hours)}$
Retail Areas	<50	50 dB(A) $L_{eq\ (15\ hours)}$
Commercial Areas	40 to 45	45 dB(A) $L_{eq\ (15\ hours)}$

Note 1: Overall recommended level for mechanical services noise and intrusive noise, combined.

Section 6.18 of AS/NZ 2107:2016 notes that the presence of discrete frequencies or narrow band signals may cause the sound level to vary spatially within a particular area and be a source of distraction for occupants. Where this occurs, the sound level shall be determined as the highest level measured in the occupied location(s).

If tonal components are significant characteristics of the sound within a measurement time interval, an adjustment shall be applied for that time interval to the measured A-weighted sound pressure level to allow for the additional annoyance. If the background sounds include spectral imbalance, then the RC (Mark II) levels indicated in the Standard should be referenced (see also Appendix D of AS/NZ 2107:2016 for additional guidance).

Generally, where the final noise levels are within +/- 2 dB of the specified level given above, the design criteria will be considered met. Both the upper and lower limits will need to be satisfied especially where privacy is important or where noise intrusion to be avoided.

3.1.5 Project Airborne Noise Requirements

Based on the details included in the section above, the project internal noise levels requirements are summarised in Table 5 below.

Table 5 Project Airborne Internal Noise Level Requirements

Room Type	Internal Environmental Noise Levels (Traffic and Airborne Train Noise) – dB(A) $L_{Aeq\ (period)}$
Residential Buildings	
Apartment common areas (e.g., foyer, lift lobby)	50 dB(A) $L_{Aeq\ (15\ hours)}$
Living areas	40 dB(A)$L_{Aeq\ (15\ hour)}$
Sleeping areas (nighttime)	35 dB(A)$L_{Aeq\ (9\ hour)}$
Work areas	40 dB(A)$L_{Aeq\ (15\ hours)}$
Hotel Areas	
Hotel Guest Rooms	Day time - 40 dB(A)$L_{Aeq\ (15\ hour)}$ Night time - 35 dB(A)$L_{Aeq\ (9\ hour)}$
Hotel Common Areas	45 dB(A)$L_{Aeq\ (15\ hour)}$
Commercial / Retail	
Commercial Areas	45 dB(A)$L_{Aeq\ (15\ hours)}$
Retail areas	50 dB(A)$L_{Aeq\ (15\ hours)}$

3.2 Ground Borne and Vibration criteria (Train Pass Byes)

3.2.1 Ground-Borne Noise

NSW Department of Planning's document DNRCBR adopts the same internal noise criteria outlined in the Transport and Infrastructure SEPP identified above. Table 3.1 from the DNRCBR requires the following airborne noise levels from the operation of the adjacent rail corridors.

Figure 4 Extract - DNRCBR - Table 3.1.

Table 3.1: Noise criteria

Residential Buildings			
Type of occupancy		Noise Level dBA	Applicable time period
Sleeping areas (bedroom)		35	Night 10 pm to 7 am
Other habitable rooms (excl. garages, kitchens, bathrooms & hallways)		40	At any time
Non–Residential Buildings			
Type of occupancy			Recommended Max Level dBA
Educational Institutions including child care centres			40
Places of Worship			40
Hospitals	- Wards		35
	- Other noise sensitive areas		45

Note: airborne noise is calculated as L_{eq} (9h) (night) and L_{eq} (15h)(day) Groundborne noise is calculated as L_{max} (slow) for 95% of rail pass-by events.

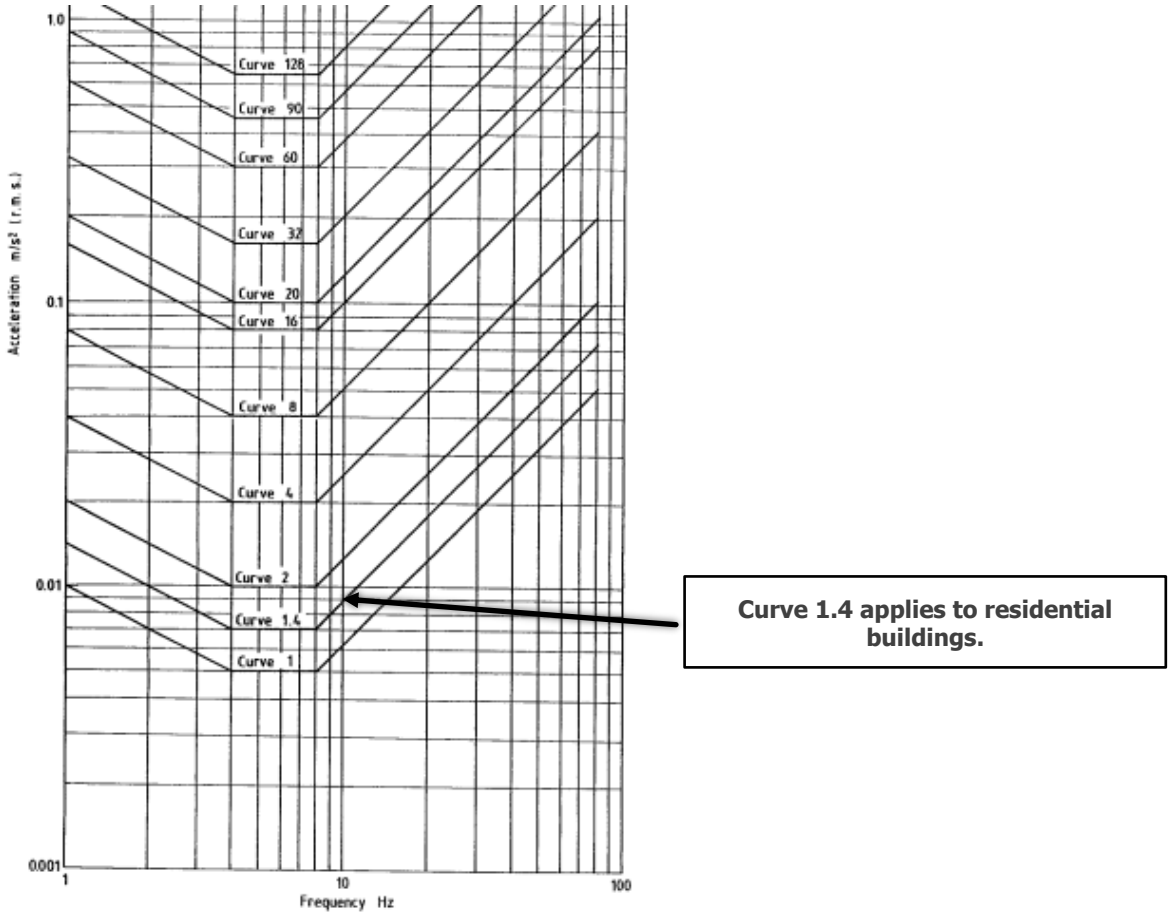
3.2.2 Rail Tactile Vibration

Section 3.6.3 of the DoP Guideline provides recommended vibration criteria in accordance with the German Standard DIN4150 Part 3 1999 and British Standards BS 7385 Part 2 1993. Human comfort is normally assessed with reference to the above British Standard or Australian Standard AS 2670.2 1990.

After reviewing the aforementioned documents, the standards for evaluating the impact of train passby, tactile vibration on the proposed development have been determined and measured according to the Assessing Vibration: A technical guideline (Department of Environment and Conservation, 2006) and British Standard BS6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)

Table 6 displays the standards outlined in the British Standard BS6472:1992 for consistent vibration in residential areas, office spaces, and commercial workshops.

Table 6 Building vibration z-axis curves from acceleration (R.M.S).



The Department of Planning Development Near Rail Corridor and Busy Roads – Interim Guideline (DNRCBR) references to "*Assessing Vibration – A Technical Guideline*".

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled "Assessing Vibration – A Technical Guideline". (AVTG). The AVTG recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)".

The British Standard details suitable criteria for the assessment of intermittent vibrations to prevent advise impacts on future residence.

Table 7 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz, Vibration Dose Values (VDV).

Measurement Location	Daytime		Night-Time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	**0.20**	0.40	**0.13**	0.26

For the purpose of this assessment the *Preferred Values* detailed in the standard have been used as the criteria used in this assessment.

3.3 Noise Emission Criteria (Operational Criteria)

Noise emissions from the operation of the site impacting on the adjacent land users are outlined below. Noise emissions expected from the use of the site include, basement carpark and associated driveway and building service (including mechanical equipment).

3.3.1 NSW EPA Noise Policy for Industry (NPI) 2017

In NSW, the control of noise emissions is the responsibility of Local Governments and the NSW Environment Protection Authority (NSW EPA).

The NSW EPA has recently released a document titled *Noise Policy for Industry* (NSW NPI) which provides a framework and process for determining external noise criteria for the assessment of noise emission from industrial developments. The NSW NPI criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity of particular land uses for residents and sensitive receivers in other land uses.

3.3.1.1 Intrusive Noise Impacts (Residential Receivers)

The NSW NPI states that the noise from any single source should not intrude greatly above the prevailing background noise level. Industrial noises are generally considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (L_{Aeq}), measured over a 15-minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB(A). This is often termed the Intrusiveness Criterion.

The 'Rating Background Level' (RBL) is the background noise level to be used for assessment purposes and is determined by the methods given in the NSW NPI. Using the rating background noise level approach results in the intrusiveness criterion being met for 90% of the time. Adjustments are to be applied to the level of noise produced by the source that is received at the assessment point where the noise source contains annoying characteristics such as tonality or impulsiveness.

3.3.1.2 Protecting Noise Amenity (All Receivers)

To limit continuing increase in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.2 of the NSW NPI. That is, the ambient L_{Aeq} noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the 'Background Creep' or Amenity Criterion.

The amenity assessment is based on noise criteria specified for a particular land use and corresponding sensitivity to noise. The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. These criteria relate only to other continuous industrial-type noise and do not include road, rail or community noise. If the existing (measured) industrial-type noise level approaches the criterion value, then the NSW NPI sets maximum noise emission levels from new sources with the objective of ensuring that the cumulative levels do not significantly exceed the criterion.

Project amenity noise level for industrial developments is specified as the recommended amenity noise level (Table 2.2 of the NPI) minus 5 dB(A). To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the $L_{Aeq,15min}$ will be taken to be equal to the $L_{Aeq,period}$ + 3 decibels (dB).

Where the resultant project amenity noise level is 10 dB or more lower than the existing traffic noise level, the project amenity noise levels can be set at 15 dB below existing traffic noise levels (i.e. *$L_{Aeq,period(traffic)}$ minus 15 dBA*).

3.3.1.2.1 Area Classification

The NSW NPI characterises the "Residential Suburban" noise environment as an area that has the following characteristics:

- An acoustical environment that:
    - *has through-traffic with characteristically heavy and continuous flows during peak periods*
    - *has any combination of the above.*

For residential and non-residential receivers in an residential suburban area, the recommended amenity criteria are shown in Table 8 below.

Table 8 NSW NPI – Recommended L_{Aeq} Noise Levels from Noise Sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day[1]	Recommended Amenity Noise Level ($L_{Aeq, period}$)[2] (dBA)
Residence	Suburban	Day	55
		Evening	45
		Night	40
Commercial		When in use	65

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am.

Note 2: The L_{Aeq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

3.3.1.3 Project Trigger Noise Levels

The intrusive and amenity criteria for industrial noise emissions, derived from the measured data, are presented in Table 9. These criteria are nominated for the purpose of determining the operational noise limits for mechanical plant associated with the development which can potentially affect noise sensitive receivers.

For each assessment period, the lower (i.e., the more stringent) of the amenity or intrusive criteria are adopted, which are shown in bold text in Table 9.

Table 9 External noise level criteria in accordance with the NSW NPI

Location	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq, period}$ [2] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [3] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)	Amenity $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)
Residences	Day	50	58	68	63	**53**
	Evening	40	55	66	60	**43**
	Night	35	47	63	52	**38**
Commercial	When in use	60	-	-	-	**63**

Note 1: For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 1:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 1:00 am.

Note 2: Project Amenity Noise Levels corresponding to "Suburban" areas, equivalent to the Recommended Amenity Noise Levels minus 5 dBA.

Note 3: L_{A90} Background Noise or Rating Background Level.

Note 4: Project Noise Trigger Levels are shown in bold.

Note 6: According to Section 2.2 of the NSW NPI, the $L_{Aeq, 15\ minutes}$ is equal to the $L_{Aeq, period}$ + 3 dB.

4 BUILDING ACOUSTIC ASSESSMENT

In addressing all of the criteria which are shown above, each component of the development is assessed and presented below.

4.1 Building Envelope Assessment

This section of the report details the assessment of the building envelope to ensure internal noise level requirements comply with the criteria detailed in this report.

Details of the proposed required construction to ensure acoustic requirement are achieved, including all surrounding environmental noise levels are detailed in the following sections.

4.1.1 Glazing Recommendations

The recommended sound transmission loss requirement required to satisfy the specified internal noise level criteria outlined above are summarised in Table 10.

Table 10 External Façade Elements Recommendations

Level	Façade Orientation	Occupancy Type	Minimum Glazing Performance Requirements	Recommended Glass Construction
Podium Levels Ground floor to Level 5	East (facing Hannell Street)	Retail or Commercial	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Bedrooms	Rw (C;Ctr): 36 (0;-3)	12.38mm Laminated or; 6/12/10
		Living Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel Rooms	Rw (C;Ctr): 36 (0;-3)	12.38mm Laminated or; 6/12/10
		Hotel common areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Common Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
	South (Facing Newcastle Interchange)	Retail or Commercial	Rw (C;Ctr): 35 (0;-3)	12.38mm Laminated or; 6/12/10
		Bedrooms	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Living Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel Rooms	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel common areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Common Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10

Level	Façade Orientation	Occupancy Type	Minimum Glazing Performance Requirements	Recommended Glass Construction
	North and west orientations	Retail or Commercial	Rw (C;Ctr): 30 (0;-3)	6.38mm Laminated or; 6/12/6
		Bedrooms	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Living Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel Rooms	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel common areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Common Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
Level 5 and above	All Orientations	Bedrooms	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Living Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel Rooms	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Hotel common areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10
		Common Areas	Rw (C;Ctr): 35 (0;-3)	10.38mm Laminated or; 6/12/10

Please note for windows, this performance is not only subject to the glazing selection but also to the construction of the window frame and the frame seal selection. Therefore, it is recommended that the window manufacturer should confirm that the required sound insulation can be achieved. It is anticipated that the window system should comprise Q-Lon (or equivalent) or fin seals with deep C channels as part of the window track (i.e., Performance levels outlined above need to be achieved with glazed panels + frame + seals).

4.1.2 External Wall Construction

External wall constructions will be constructed either from masonry/concrete or a lightweight cladding system. For the external walls which are constructed from a masonry/concrete construction, no further acoustic upgrading is required.

However, for the external walls constructed from a lightweight cladding system, the following construction is recommended.

Table 11 Recommended Light Weight External Wall Construction

Façade	Occupancy Area [1]	External Lining	Studwork System	Internal Lining
All Orientations	All Areas – Rw 45	Architectural Cladding + 1 x 9mm Fibre Cement Sheeting	Minimum 92mm Steel Studwork + 75mm thick 14kg/m^3 insulation	13mm Standard Plasterboard OR 1 x 9mm Fibre Cement Sheeting
		Masonry Elements	No additional acoustic mitigations required	

Note 1: Recommended constructions are identical for each level.

Note 2: These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are approved.

All façade elements constructed from masonry or concrete construction will not require additional acoustic treatments to ensure internal noise levels are achieved.

Any penetrations through any external skin which are required must ensure all gaps remaining in the penetration are filled with an acoustic grade sealant which provides an equal or better performance to the system being penetrated.

4.1.3 External Roof Construction

External roofs will be constructed from a concrete construction. In the event the external roof is constructed from a concrete construction, no further acoustic upgrading is required. If penetrations through any external skin are required, all gaps remaining in the penetration are to be filled with an acoustic grade sealant which provides an equal or better performance to the system being penetrated.

4.2 Alternative Ventilation Requirements

The internal design sound levels to the residential dwellings within the project detailed above are achieved with the external building openings closed, including the operable elements of the façade.

Based on the requirements of the Department of Planning *Development Near Rail Corridor and Busy Roads – Interim Guideline* (road traffic noise) the trigger for the requirement of an alternative outside air source on this project, is required for all residential façade elements to the east and south of the project including all levels on the podium of the project including ground level to level 5 all other orientations and levels of the building will not trigger the requirements for an alternative outside air source. The method of providing an alternative method of outside air ventilation is required to be provided in accordance with relevant regulations including the Building Code of Australia and AS1668.

As part of the proposed development the provision for an alternative outside air source to all residential dwellings is required. The options for the proposed alternative source of ventilation are discussed below:

1. The acoustic design of the building includes performance of glass and solid façade elements which will ensure internal noise levels with operable windows closed will achieve internal noise level requirements and ensure a suitable acoustic amenity for future residence.
    a. The use of the operable windows and doors could be used to provide ventilation/cross ventilation to the units. This can be undertaken by opening the operable elements of the façade at the discretion of the future occupants.
2. In the event occupants choose to keep the windows closed, an alternative source of outside air will be provided to the residential dwellings. The method of providing an alternative outside air will include a design which is in accordance with AS1668 and does not reduce the acoustic performance of the building's external façade. Possible methods of providing an alternative outside air source include one of the following:
    a. The use of a mechanical system to provide outside air such as a dedicated fan or the use of the fan within a units FCU including an outside air source (which would not be required to condition air to provide outside air to the unit).
    b. Provision of an outside air source to the intake air side of the Fan Coil Units (FCU) located in the ceiling space of each apartment. The outside air is mixed with the return air in the return air plenum and provided to the dwelling using the fan of the FCU which can operate with or without air conditioning being functional.
    c. Provision of outside air via a dedicated supply air fan which can be operated at the discretion of future occupants.
    d. The use of a positively charged corridor air plenum to common corridors with supply air accessing units via fir dampers within the above ceiling voids to residential units. The design of such as system is to be undertaken such that the minimum requirements for the separation of corridor walls is not less than Rw 50 as required by Part F7 of the BCA.
    e. Other methods of outside air supply which are compliant with the requirements of the Australian Standard AS1668.2.

4.3 Train Vibration Assessment

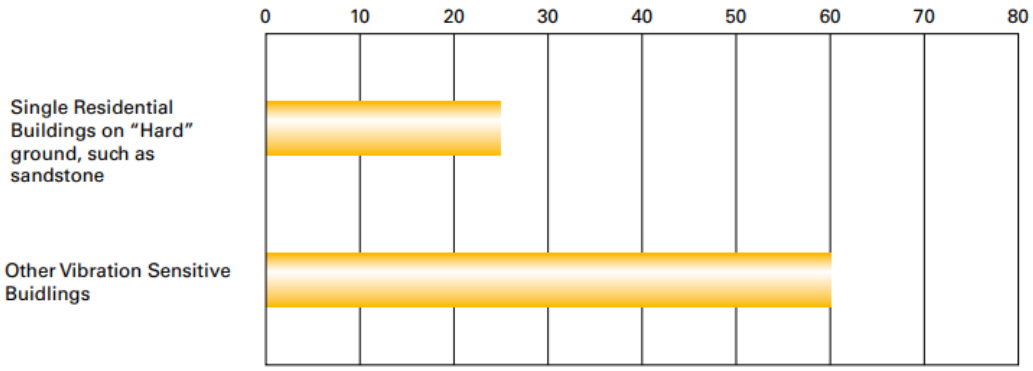
As outlined in the site description sections above, the site is adjacent to the Newcastle Interchange which includes train movements to the south of the site, as such assessment of vibration from the train (and light rail) has been undertaken.

4.3.1 Rail Corridor

This section of the report details the consideration for possible impacts from the future above ground train lines including train lines and light train associated with the Newcastle Interchange.

The distance from the proposed site boundary to the railway line indicates that the site is within the distances required for a vibration assessment based on Section 3.5.1 of the *Development Near Rail Corridors and Busy Roads – Interim Guideline*. The distance requirement for a vibration assessment is shown in Figure 5 below.

Figure 5 Vibration Assessment Zones based on Distance (m) of Sensitive Development from Operational Track (Not Corridor)



4.3.2 Vibration Impact Criteria

The potential for vibration impact from a rail pass-bys on the line to the south of the site has been assessed for both tactile vibration impact as well as ground borne vibration resulting in structure borne noise.

The suitable criteria for the assessment of tactile vibration and structure borne noise are detailed in Sections 3 of this report.

4.3.3 Structure Borne Noise

The borne vibration is the potential for audible noise to be generated as the result of vibration transferred through the building structure and emanating from the building surfaces (such as walls, ceilings and the like) as audible noise within the future residential dwellings within the development.

Potential structure borne noise impacts as a result of the proposed light rail have been assessed in accordance with the criteria detailed within the DNRCBR which includes the following:

> *Generally, ground borne noise is associated more closely with rail operations than roads. Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise.*
>
> *In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne LAmax noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.*

As the railway line located to the south of the site is an above ground line and not within a tunnel the requirements for ground borne vibration is not required to be assessed based on the DNRCBR as detailed above.

As existing rail is above ground the impact of airborne noise on the future residence will be greater than the potential for structure borne noise levels. Providing suitable treatments for airborne noise impacts are included in the design of the project and tactile vibration levels comply with the relevant criteria then all relevant acoustic requirements will be achieved.

4.4 Rail Pass Bye Vibration Measurements

As part of the assessment measurements of vibration impacts from a rail pass bye on the railway line to the south of the site has been conducted.

To assess potential noise and vibration impacts on the proposed development measurements of train movements (including light rail) pass byes (at a representative location of the future building façade) has been conducted in this assessment including the vibration measurement location detailed in Figure 1 above.

4.4.1 Vibration Measurements

The assessment included attended vibration measurements conducted on the 12th November, 2025 between 4.30pm and 5.30pm. Vibration levels were undertaken using a Svan 958 type vibration meter and analyzer fitted with a triaxial accelerometer and included a minimum of 8 rail pass byes.

Obtained vibration levels included a number of pass beys which have been used to determine the period vibration exposure for the daytime and night-time periods Vibration Dose Values (VDV).

The results of the vibration level measurements including the calculations for VDV are detailed in the table below.

Table 12 Calculated VDV

Location	Period	Criteria VDV m/s1.75	Calculated VDV m/s1.75
Future Residential Dwellings	Daytime	0.20	<0.12
	Night-Time	0.13	<0.09

Based on the results of the assessment of tactile vibration no additional acoustic treatment (or building vibration isolation) is required to comply with the relevant standards and ensure a suitable acoustic amenity for future occupants of the development.

5 EXTERNAL NOISE EMISSION ASSESSMENT

5.1 Noise from Engineering Services

At this stage of the project, the exact locations of key plant items have not been selected, and/or the selection of items to be installed. As such, a detailed assessment of noise associated with engineering services cannot be undertaken.

However, to ensure that future selections of plant items meet external noise levels at neighbouring properties a proof-of-concept approach has been considered.

In our experience, for this type of development the following mechanical systems would be installed, and their associated sound power levels are outlined below.

- Basement Exhaust fans – 85dBA (Lw)
- Air conditioning condensers – 70dBA (Lw)
- Apartment toilet or kitchen ventilation fans – 55dBA (Lw)

It is anticipated that basement ventilation fans will discharge on roof level utilising an inline fan. It is recommended that internally lined ductwork or inline attenuators are used on both the intake and discharge side of the fan. On this assumption, compliance would be achieved.

Air conditioning condensers are proposed to be installed on the balconies of dwellings within the project. Based on a typical sound power level of a condenser unit, the following acoustic treatments are recommended to be installed.

- Condenser plant are to be isolated from the base building structure with a rubber pad.
- Night operation mode must be in operation between 10:00pm and 7:00am and provide a minimum of 4-5dBA.
- Screening to plant and equipment may be required, details to be provided once detailed selections are undertaken as part of the design stage of the project.

For apartment ventilation fans exhausting air from kitchen rangehoods or bathrooms/ensuites/laundries these will be individually discharging on apartment balconies. To ensure compliance the following is recommended:

- Ventilation plant are to be isolated from the base building structure with a vibration isolation include rubber or neoprene pads.

5.2 Noise Associated with Retail/Commercial Tenancies

At this stage the exact uses of the ground floor retail and commercial tenancies are not known, therefore it is recommended that once details of each proposed tenancy are known an acoustic assessment is conducted assessing the individual impacts of each tenancy.

However, based on the location of the project and the façade constructions it is unlikely noise impacts associated with the tenancy would not affect the existing acoustic amenity of the surrounding residential receivers.

In the event uses are to include those with the potential to generate noise level with the potential to affect residential receivers (including those within the development) a detailed acoustic assessment will be required to be undertaken as part of the normal approval process for the tenancies.

5.3 Waste and Garbage Collections

Noise resulting from the removal of waste and garbage from the site, including garbage trucks and the like will be undertaken in accordance with council's waste management requirements.

Noise resulting from the collection of waste from the site will include intermittent collection using approved waste collection vehicles. The resulting noise impact resulting from the site will be similar to noise levels currently experienced by existing receivers from current waste collection services, train noise and vehicle movements on surrounding roadways.

The recommended acoustic treatments to the building facade detailed in this report include those required to ensure internal noise levels within the future dwellings of the project from the collection of waste will be acoustically acceptable and compliant with the recommended internal noise levels.

6 CONSTRUCTION NOISE AND VIBRATION IMPACTS

Relevant construction noise and vibration criteria for construction activities are detailed below.

6.1 Construction Noise Criteria

6.1.1 NSW EPA Interim Construction Noise Guideline (ICNG) – DECC 2009

Noise criteria for construction and demolition activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for residential receivers have been reproduced from the guideline and are listed in the table below.

Table 13 NMLs for quantitative assessment at residences.

Time of Day	Noise Management Level $L_{Aeq(15minute)}$[1,2]	How to Apply
Recommended standard hours or approved working hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	***"Noise Affected Level"*** RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15minute)}$ 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.
Outside recommended standard hours	Noise affected RBL + 5 dB	• 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 practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.
	"Highly Noise Affected Level" 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. 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. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Note 1 *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Noise Policy for Industry (EPA 2017).*

The ICNG also provides NMLs for non-residential land uses. Unlike residential receivers, these criteria are fixed levels, independent of local background noise levels. Presented in Table 14 below are the NMLs for non-residential land uses.

Table 14 Construction noise management levels – other receivers.

Land use	Location applied	Noise management level, $L_{Aeq,15min}$
Classrooms at school and other educations institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level	65 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level	60 dB(A)
Community centres	Refer to the recommended "maximum" internal levels in AS2107 for specific uses	
Industrial premises	External noise level	75 dB(A)
Offices, retail outlets	External noise level	70 dB(A)

Based on the measured background noise levels summarised in Section 2.1, and the NMLs outlined above the construction noise criteria to be used in this assessment are listed in Table 15 below.

Table 15 NMLs as basis for the acoustic assessment.

Receiver Types	NML, dB $L_{Aeq(15minute)}$ Standard Hours – including approved working hours
Residential Receivers	**68** / *HNAL* = 75
Commercial Receivers	**70** / *HNAL* = 75
Note 1: The L_{Aeq} and L_{A90} levels from the daytime period have not been used to determine any noise level criteria due to the presence of construction noise occurring across the road.	

6.1.2 Construction Traffic Noise Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW *Road Noise Policy (RNP)* states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.

6.2 Vibration Criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 6.2.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 6.2.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 6.2.2.

6.2.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (refer to Table 16).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 17).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 18 below).

Table 16 Continuous vibration acceleration criteria (m/s²) 1 Hz-80 Hz.

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 17 Impulsive vibration acceleration criteria (m/s²) 1 Hz-80 Hz.

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 18 Intermittent vibration impacts criteria (m/s$^{1.75}$) 1 Hz-80 Hz.

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

6.2.2 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed against international standards as follows:

- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 *"Effects of Vibration on Structure"* (DIN 1999).

6.2.2.1 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 19 and illustrated in Figure 6 below.

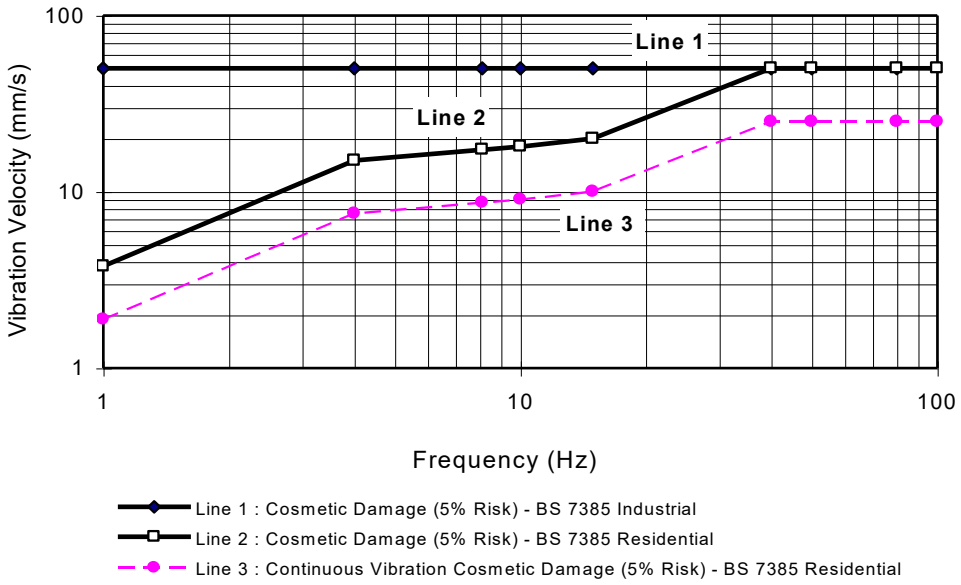
Table 19 Transient vibration criteria as per standard BS 7385 Part 2 – 1993.

Line in Figure 6	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

Standard BS 7385 Part 2 – 1993 states that the values in Table 19 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 19 may need to be reduced by up to 50% (refer to Line 3 in Figure 4 below).

Figure 6 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage.



In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 19, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 19 should not be reduced for fatigue considerations.

6.2.2.2 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 20. The criteria are frequency dependent and specific to particular categories of structures.

Table 20 Structural damage criteria as per standard DIN 4150 Part 3 – 1999.

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
Note 1: For frequencies above 100 Hz, at least the values specified in this column shall be applied.				

6.3 Ground-Borne Noise Criteria

According to the NSW EPA *Interim Construction Noise Guideline* (ICNG) 2009, the criteria for ground-borne noise at residences is defined as follows:

- Maximum internal noise levels of 40 dB $L_{Aeq(15mins)}$ between 6:00pm and 10:00pm.

It is noted that the ground borne criteria will apply for construction works undertaken outside of standard hours.

6.4 Project Vibration Criteria

Based on the details included in the points above, the project specific construction vibration criteria is recommended to include the following:

1. Neighbouring buildings – 8 mm/s.

6.5 Noise and vibration assessment

6.5.1 Construction Noise Assessment

Sound power levels have been predicted for the construction tasks identified in the project program. The equipment anticipated for use in each task is based on previous project experience. The sound power levels for the equipment likely to be used for each of the listed tasks are provided in Table 21 below.

Table 21 Summary of predicted sound power levels.

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Sound Power Level per Task (dBA re 1pW)
Site Establishment Works	Mobile crane	110	113
	Power hand tools	109	
	Semi Rigid Vehicle [1]	105	
Ground Works	Excavator	112	121
	Hydraulic Hammer	118	
	Piling Rig	110	
	Handheld jack hammer [1]	111	
	Dump truck [1]	104	
	Concrete saw [1]	114	
	Skid steer	110	
	Power hand tools	109	
Structure	Handheld jack hammer [1]	106	115
	Concrete saw [1]	114	
	Power hand tools	109	
	Welder	101	
	Concrete pump truck	110	
	Concrete agitator truck	108	
Internal Works	Power hand tools	109	104
Common and External Works	Concrete agitator truck	108	114
	Saw cutter [1]	104	
	Dump truck [1]	104	
	Concrete saw [1]	114	
	Power hand tools	109	

Note 1: An assumed time correction has been applied, this being 5 minutes of operation in any 15-minute interval.

Table 22 Receiver – 01 – Residential– Summary of preliminary predicted construction noise levels.

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	65 to 76	68 to 78	Standard Construction Hours: **Noise Management Level** **68** **Highly Noise Affected Level** **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG + 10 dB(A)), and above the Highly Noise Affected Level of 75 dB(A) during peak standard construction hours.
	Power hand tools		64 to 75			
	Semi Rigid Vehicle		55 to 66			
Ground Works and Demolition	Excavator	121	67 to 78	72 to 82		
	Hydraulic Hammer		73 to 84			
	Piling Rid		65 to 76			
	Handheld jack hammer		61 to 72			
	Dump truck		54 to 65			
	Concrete saw		64 to 75			
	Skid steer		65 to 76			
	Power hand tools		64 to 75			
Structure	Handheld jack hammer	115	56 to 67	70 to 81		
	Concrete saw		64 to 75			
	Power hand tools		64 to 75			
	Welder		56 to 67			
	Concrete pump truck		65 to 76			
	Concrete agitator truck		63 to 74			
Internal Works	Power hand tools	104	59 to 70	59 to 70		
Common and External Works	Concrete agitator truck	114	63 to 74	69 to 79		
	Saw cutter		54 to 65			
	Dump truck		54 to 65			
	Concrete saw		64 to 75			
	Power hand tools		64 to 75			

Table 23 Receiver – 02 – Residential – Summary of preliminary predicted construction noise levels.

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	65 to 76	68 to 78	Standard Construction Hours: **Noise Management Level** **68** **Highly Noise Affected Level** **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG + 10 dB(A)), and above the Highly Noise Affected Level of 75 dB(A) during peak standard construction hours.
	Power hand tools		64 to 75			
	Semi Rigid Vehicle		55 to 66			
Ground Works and Demolition	Excavator	121	67 to 78	72 to 82		
	Hydraulic Hammer		73 to 84			
	Piling Rid		65 to 76			
	Handheld jack hammer		61 to 72			
	Dump truck		54 to 65			
	Concrete saw		64 to 75			
	Skid steer		65 to 76			
	Power hand tools		64 to 75			
Structure	Handheld jack hammer	115	56 to 67	70 to 81		
	Concrete saw		64 to 75			
	Power hand tools		64 to 75			
	Welder		56 to 67			
	Concrete pump truck		65 to 76			
	Concrete agitator truck		63 to 74			
Internal Works	Power hand tools	104	59 to 70	59 to 70		
Common and External Works	Concrete agitator truck	114	63 to 74	69 to 79		
	Saw cutter		54 to 65			
	Dump truck		54 to 65			
	Concrete saw		64 to 75			
	Power hand tools		64 to 75			

Table 24 Receiver – 03 – Commercial – Summary of preliminary predicted construction noise levels.

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	60 to 71	63 to 73	Standard Construction Hours: **Noise Management Level** **70** **Highly Noise Affected Level** **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG + 10 dB(A)), and above the Highly Noise Affected Level of 75 dB(A) during peak standard construction hours.
	Power hand tools		59 to 70			
	Semi Rigid Vehicle		50 to 61			
Ground Works and Demolition	Excavator	121	62 to 73	67 to 78		
	Hydraulic Hammer		68 to 79			
	Piling Rid		60 to 71			
	Handheld jack hammer		56 to 68			
	Dump truck		49 to 60			
	Concrete saw		59 to 70			
	Skid steer		60 to 71			
	Power hand tools		59 to 70			
Structure	Handheld jack hammer	115	51 to 62	65 to 76		
	Concrete saw		59 to 70			
	Power hand tools		59 to 70			
	Welder		59 to 62			
	Concrete pump truck		60 to 71			
	Concrete agitator truck		58 to 69			
Internal Works	Power hand tools	104	54 to 65	54 to 65		
Common and External Works	Concrete agitator truck	114	58 to 69	64 to 74		
	Saw cutter		49 to 60			
	Dump truck		49 to 60			
	Concrete saw		59 to 70			
	Power hand tools		59 to 70			

Table 25 Receiver – 04 – Commercial – Summary of preliminary predicted construction noise levels.

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Criteria dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	65 to 76	68 to 78	Standard Construction Hours: **Noise Management Level** **70** **Highly Noise Affected Level** **75**	Works indicatively predicted to be non-compliant with the Noise Management Level (BG + 10 dB(A)), and above the Highly Noise Affected Level of 75 dB(A) during peak standard construction hours.
	Power hand tools		64 to 75			
	Semi Rigid Vehicle		55 to 66			
Ground Works and Demolition	Excavator	121	67 to 78	72 to 82		
	Hydraulic Hammer		73 to 84			
	Piling Rid		65 to 76			
	Handheld jack hammer		61 to 72			
	Dump truck		54 to 65			
	Concrete saw		64 to 75			
	Skid steer		65 to 76			
	Power hand tools		64 to 75			
Structure	Handheld jack hammer	115	56 to 67	70 to 81		
	Concrete saw		64 to 75			
	Power hand tools		64 to 75			
	Welder		56 to 67			
	Concrete pump truck		65 to 76			
	Concrete agitator truck		63 to 74			
Internal Works	Power hand tools	104	59 to 70	59 to 70		
Common and External Works	Concrete agitator truck	114	63 to 74	69 to 79		
	Saw cutter		54 to 65			
	Dump truck		54 to 65			
	Concrete saw		64 to 75			
	Power hand tools		64 to 75			

6.6 Construction Traffic Noise Assessment

It is proposed that the construction traffic would access the site on surrounding roadways including Hannel Street, Danger Street and Charles Street.

From the criteria discussed in Section 6.1.2, it is noted that vehicle numbers on surrounding roads would need to increase by around 60% from existing traffic flows, for a 2 dB increase in road traffic noise to occur. As noted previously, a 2 dB increase in road traffic noise is not considered to be noticeable.

Based on the likely number of vehicles projected over each of the phases, it is concluded that noise impacts from construction traffic is unlikely to have an impact at the nearest affected properties. As a result, no further assessment is required.

6.7 Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in Section 6.2, it is recommended that the indicative safe distances listed in Table 26 should be maintained. These indicative safe distances should be validated at the start of construction works by undertaking measurements of vibration levels generated by construction and demolition equipment to be used on site if required to be used within the distances detailed in the table below.

If applicable, the criteria for scientific or medical equipment (should any of these exist close to the site) can be more stringent than those required for human comfort. Vibration validating measurements should be conducted at each site to determine the vibration level and potential impact to this sensitive equipment.

Additionally, any vibration levels should be assessed in accordance with the criteria discussed in Section 6.2. This information should also be included as part of the CNVMSP.

Table 26 Recommended indicative safe working distances for vibration intensive plant.

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Vibratory roller[1]	< 50 kN (Typically 1 – 2 tonnes)	5[1]	15 – 20[1]
	< 100 kN (Typically 2 – 4 tonnes)	6[1]	20[1]
	< 200 kN (Typically 4 – 6 tonnes)	12[1]	40[1]
	< 300 kN (Typically 7 – 13 tonnes)	15[1]	100[1]
	> 300 kN (Typically more than 13 tonnes)	20[1]	100[1]
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Vibratory pile driver	Sheet piles	2 – 20	20
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements

6.8 Construction Noise Monitoring

Noise monitoring, if required, will be performed by an acoustical consultant directly engaged by the contractor in accordance with the Conditions of Consent.

Noise monitoring is recommended to be undertaken by attended noise measurements including the following periods:

1. at the start of any new phase of works (i.e. demolition, excavation or construction etc.).

2. In response to ongoing complaints from the neighbouring receivers.

The statistical parameters to be measured should include the following noise descriptors: L_{Amin}, L_{A90}, L_{A10}, L_{A01}, L_{Amax} and L_{Aeq}. Unattended noise measurements should be conducted over consecutive 15-minute periods.

This monitoring should also be complemented by undertaking attended noise measurements in order to:

- Differentiate between construction noise sources and other extraneous noise events (such as road traffic and aircraft noise)

- Note and identify any excessive noise emitting machinery or operation.

In addition to the above detailed measurements, should any complaints be received which have not been determined previously, it should be confirmed by conducting additional attended noise measurements.

The survey methodology and any equipment should comply with the requirements discussed in Standard AS 1055.1-1997.

6.8.1 Consrtcution Vibration Monitoring

Vibration monitoring, if required, should be undertaken continuously at the nearest most affected structures in accordance with the conditions of the consent.

The monitoring location would be on a stiff part of the structure (at the foundation) on the side of the structure adjacent to the subject demolition and construction works.

The vibration monitoring system will be configured to record the peak vibration levels and to trigger an alarm when predetermined vibration thresholds are exceeded. The thresholds correspond to an "Operator Warning Level" and an "Operator Halt Level", where the Warning Level is 75% of the Halt Level. The Halt Level should be determined based on the vibration criteria for building contents and structure (refer to Section 6.4).

Exceedance of the "Operator Warning Level" would not require excavation or demolition work to cease, but rather, alerts the site manager to proceed with caution at a reduced force or load.

An exceedance of the "Operator Halt Level" would require the contractor to implement an alternative excavation technique pending further analysis of the vibration frequency content in order to determine any potential exceedance of the criteria.

The vibration monitoring equipment would be downloaded and analysed by the acoustical consultant.

Reports of the measured vibration levels and their likely impacts would be prepared by the acoustical consultant and issued to the contractor.

6.9 Community Engagement

During the proposed construction of the project (including excavation and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

1. Notification of the proposed works to be undertaken on the site and the periods when works will be conducted, including information regarding the programme of works such as demolition and excavation. This should include the expected period when activities such as hydraulic hammering, rock breaking, concrete or rock sawing is required to be undertaken.

2. Details of the relevant site representative where complaints can be registered.

3. Details of the methodology to respond to complaints raised from the surrounding receivers.

4. A register of complaints, to be kept on site including record of time and nature of the complaint as well as the outcomes and comments regarding investigations resulting from the complaint.

7 CONCLUSION

Pulse White Noise Acoustics Pty Ltd (PWNA) has been engaged by UPG Wickham Pty Ltd to undertake an acoustic assessment for the planning proposal for the mixed-use development located at 10 Dangar Street, Wickham. This report includes the noise and vibration impact required for the SSD submission of the project.

As part of this assessment, we have undertaken a review of the building envelope and noise emissions from the use of the site. From this assessment we note the following:

- Minimum acoustic performances and associated indicative constructions for the building envelope have been provided in section 4.1 of this report. The recommended treatments have been provided to ensure compliance with the objectives presented in 3.1.

- To control noise impacts at external receivers, recommended indicative treatments for major engineering services have been provided in section 5. From our review we have formulated the following opinion:

    - At this stage of the project the exact selections/locations of plant items are not known. A preliminary assessment, however, has been carried out using our experience with similar types of developments and the typical plant items installed in each type of plant room.

    - From this review we recommend the selection of high-performance acoustic treatment to ensure that the operation of the plant items comply with the project criteria. Therefore, it is recommended that prior to the issue of a Construction Certificate (CC) a detailed acoustic assessment is undertaken to ensure all cumulative noise from engineering services (including the roof plant room) comply with the requirements as listed in section 5.1.

- An assessment of the impacts associated with number of vehicles on surrounding public roads around the site and the impact is less than 2dBA and therefore is compliant with the NSW EPA RNP.

- An assessment of construction noise and vibration has been undertaken and details, including in Section 6 of this report.

Based on the acoustic assessment of the proposed development to the proposed development includes that which will be acoustically acceptable.

For any additional information please do not hesitate to contact the person below.

Regards

Ben White
Director
PULSE WHITE NOISE ACOUSTICS PTY LTD

APPENDIX A: ACOUSTIC GLOSSARY

The following is a brief description of the acoustic terminology used in this report:

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
LMax	The maximum sound pressure level measured over a given period.
LMin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
dB (A)	'A' Weighted overall sound pressure level
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt

APPENDIX B: UNATTENDED NOISE MONITORING RESULTS

10 Dangar Street, Wickham NSW 2293

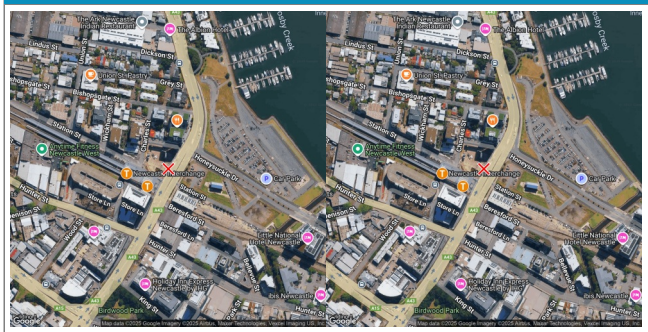
Ambient noise monitoring report

Item	Information
Logger Type	NL-42
Serial number	998081
Address	10 Dangar Street, Wickham NSW 2293
Location	Top of Pedestrians Safety Cover Structure
Facade / free field	Free field
Environment	

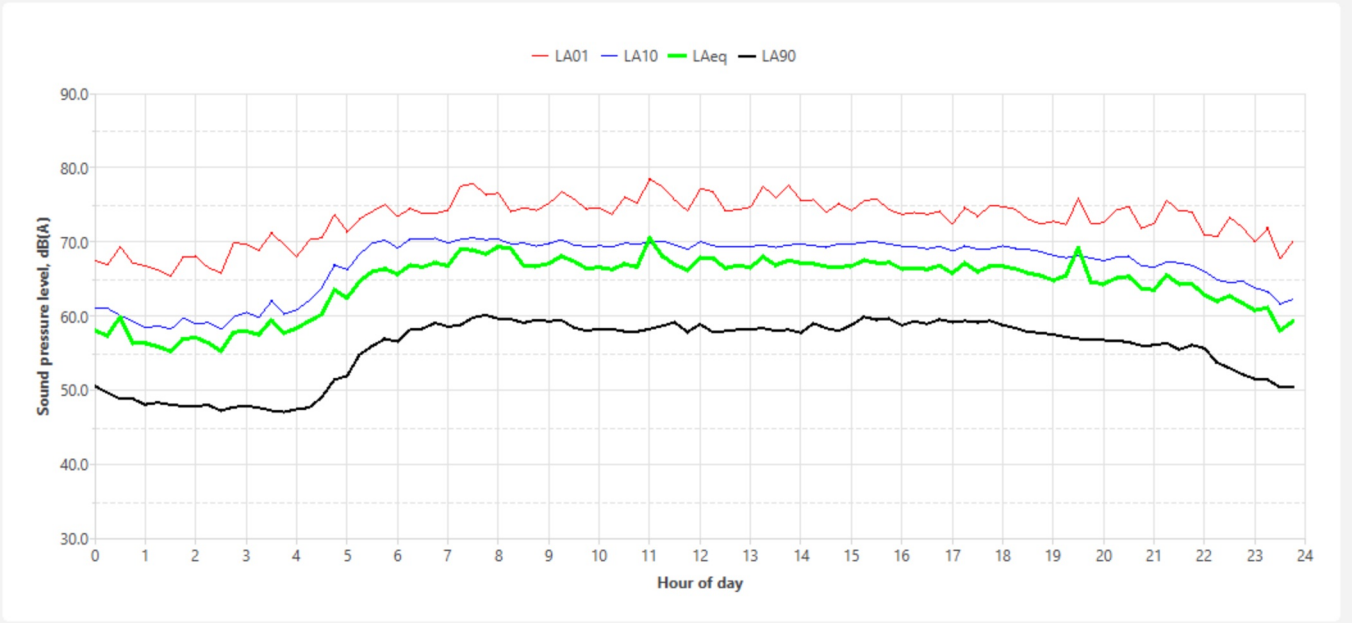
Measured noise levels

Logging date	Rating Background Level			$L_{Aeq,period}$		
	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-7am	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-7am
Thu 23 Oct 2025	-	55	-	-	70	-
Fri 24 Oct 2025	59	55	47	68	66	63
Sat 25 Oct 2025	57	56	46	67	65	64
Sun 26 Oct 2025	55	53	47	65	63	61
Mon 27 Oct 2025	58	55	46	67	66	62
Tue 28 Oct 2025	58	55	46	70	68	62
Wed 29 Oct 2025	59	53	47	69	65	65
Thu 30 Oct 2025	58	55	46	68	66	63
Fri 31 Oct 2025	59	56	47	68	67	63
Sat 01 Nov 2025	58	57	49	69	66	64
Sun 02 Nov 2025	55	54	49	67	65	62
Mon 03 Nov 2025	58	53	48	69	64	63
Tue 04 Nov 2025	58	52	47	67	64	63
Wed 05 Nov 2025	58	54	45	67	65	62
Thu 06 Nov 2025	58	56	48	68	66	64
Fri 07 Nov 2025	59	56	48	68	66	63
Sat 08 Nov 2025	57	55	48	71	65	62
Sun 09 Nov 2025	55	53	48	66	64	61
Mon 10 Nov 2025	58	53	47	68	65	62
Tue 11 Nov 2025	58	56	48	68	69	63
Wed 12 Nov 2025	58	56	45	67	65	61
Thu 13 Nov 2025	-	-	-	68	-	62
Summary	**58**	**55**	**47**	**68**	**66**	**63**

Note: Results with a '-' identify that there were not enough measurements available to correctly calculate the level, in accordance with the Noise Policy for Industry. The data has been excluded either from weather or manual exclusions. See the charts for more information

Logger location	Logger deployment photo
	

Typical Day



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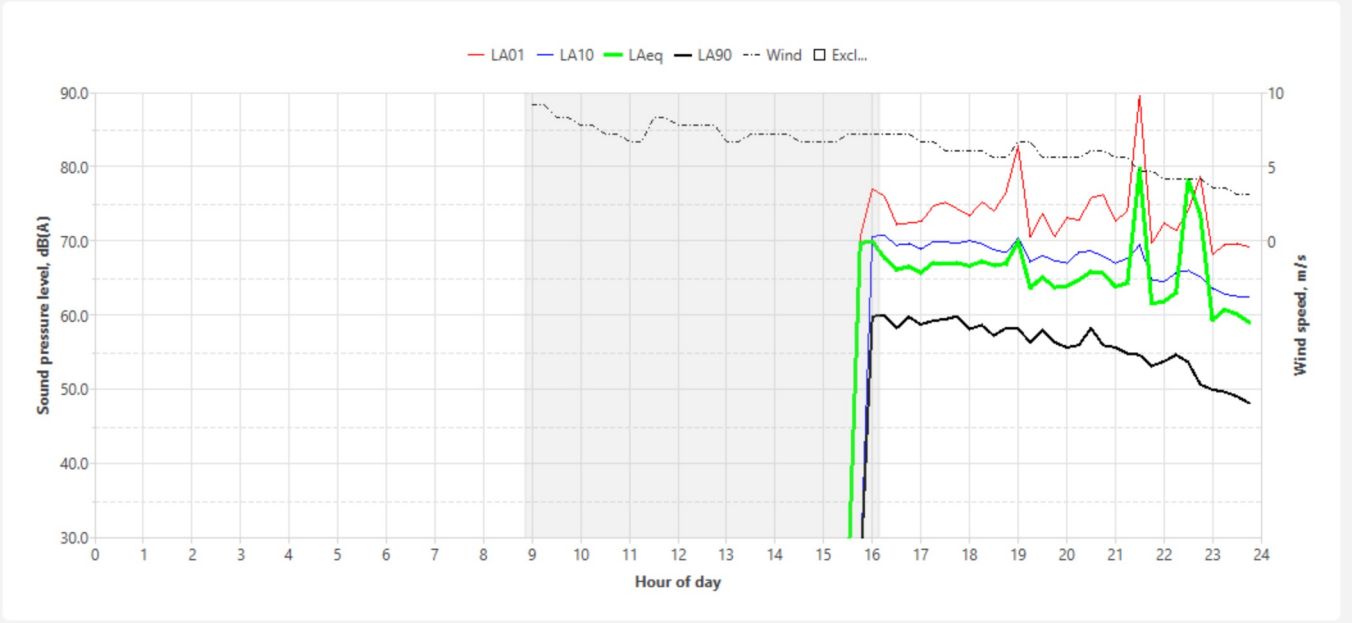
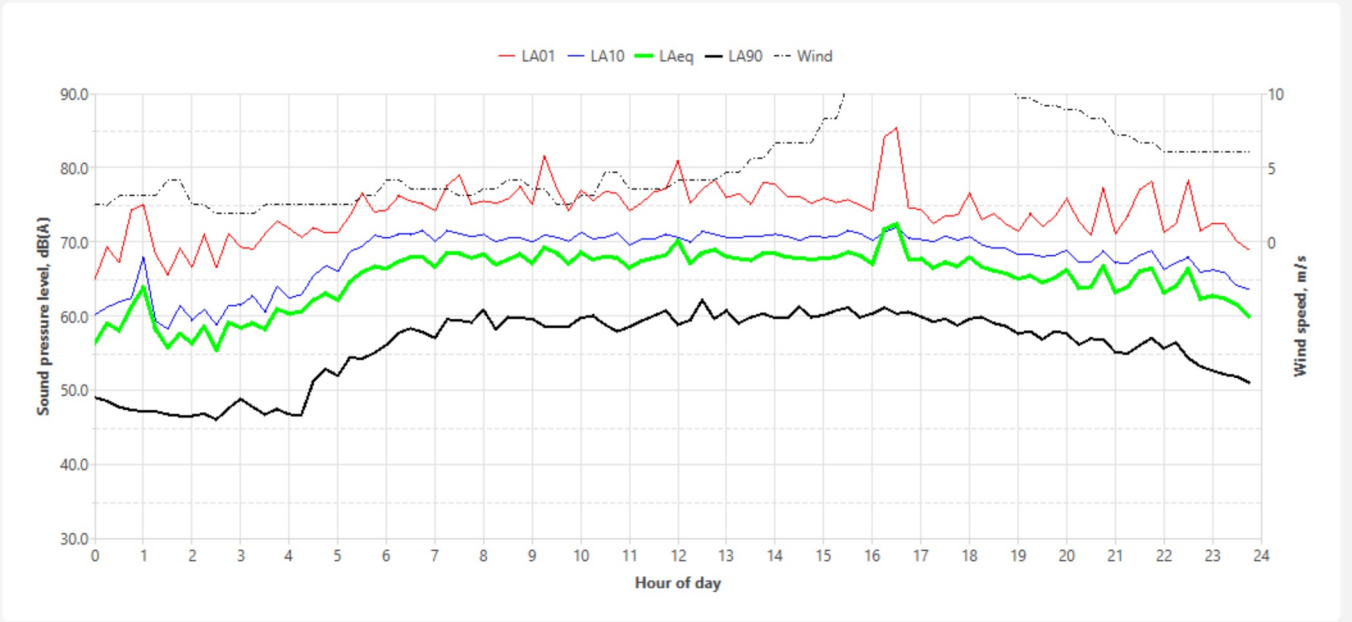
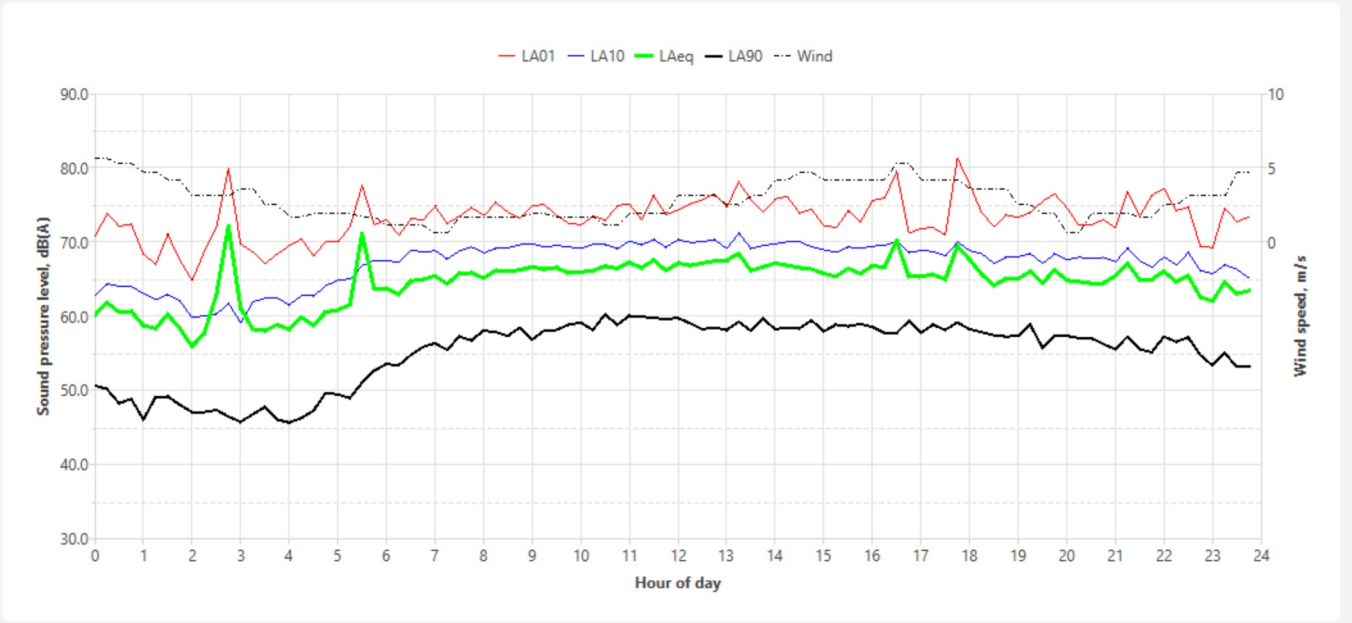


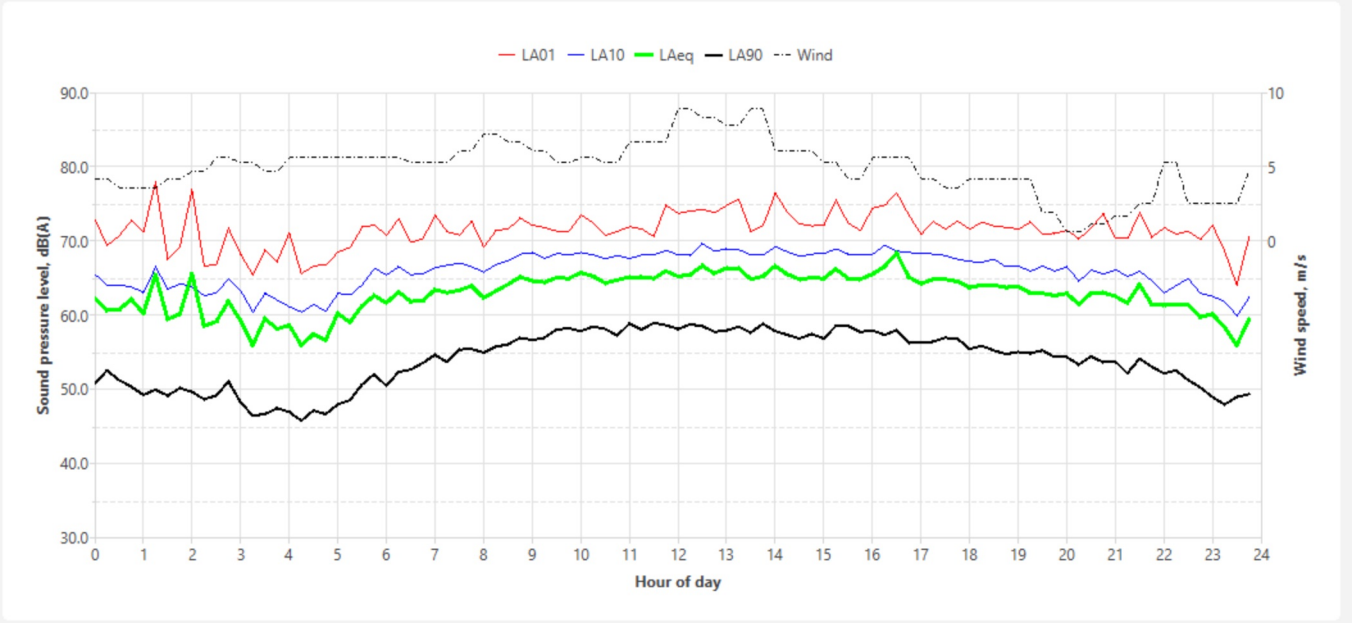
Friday, 24 October 2025



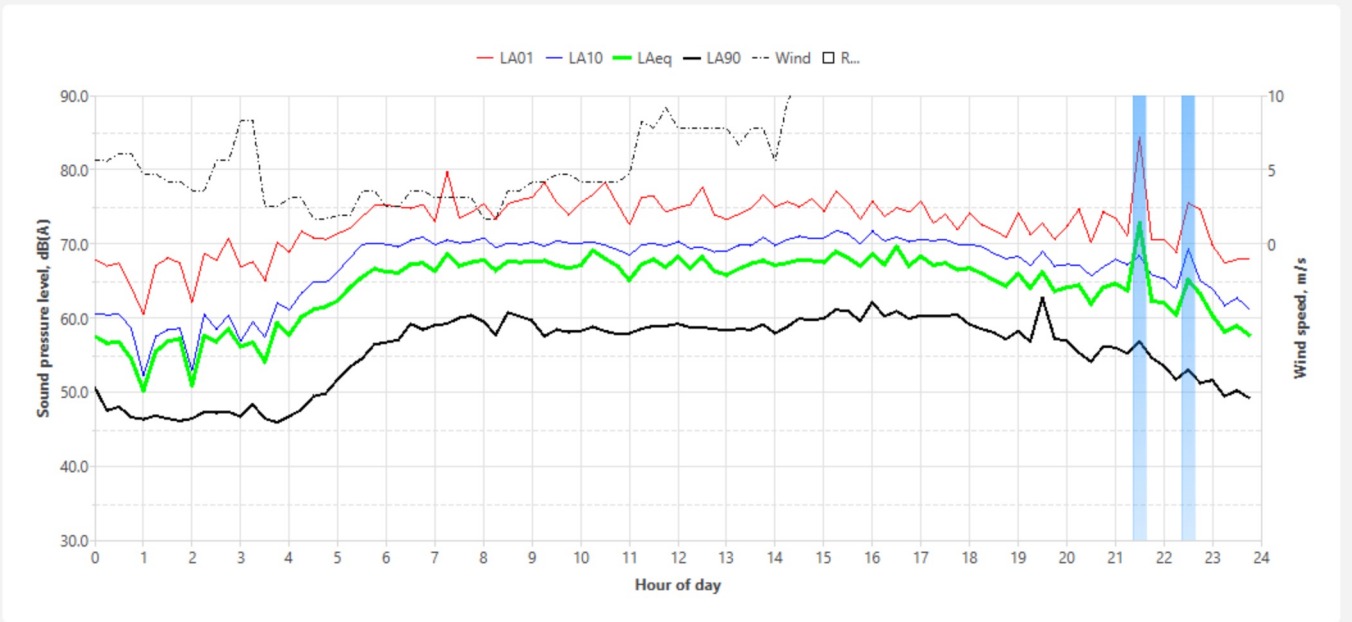
Saturday, 25 October 2025



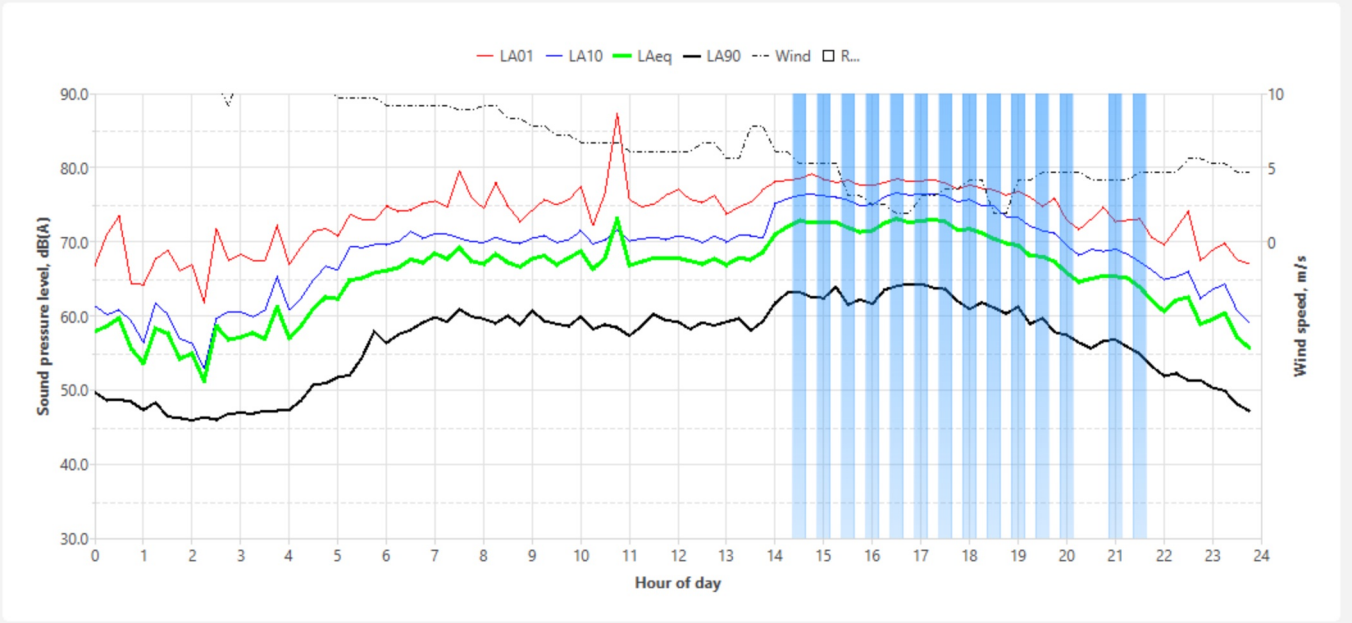
Sunday, 26 October 2025



Monday, 27 October 2025



Tuesday, 28 October 2025



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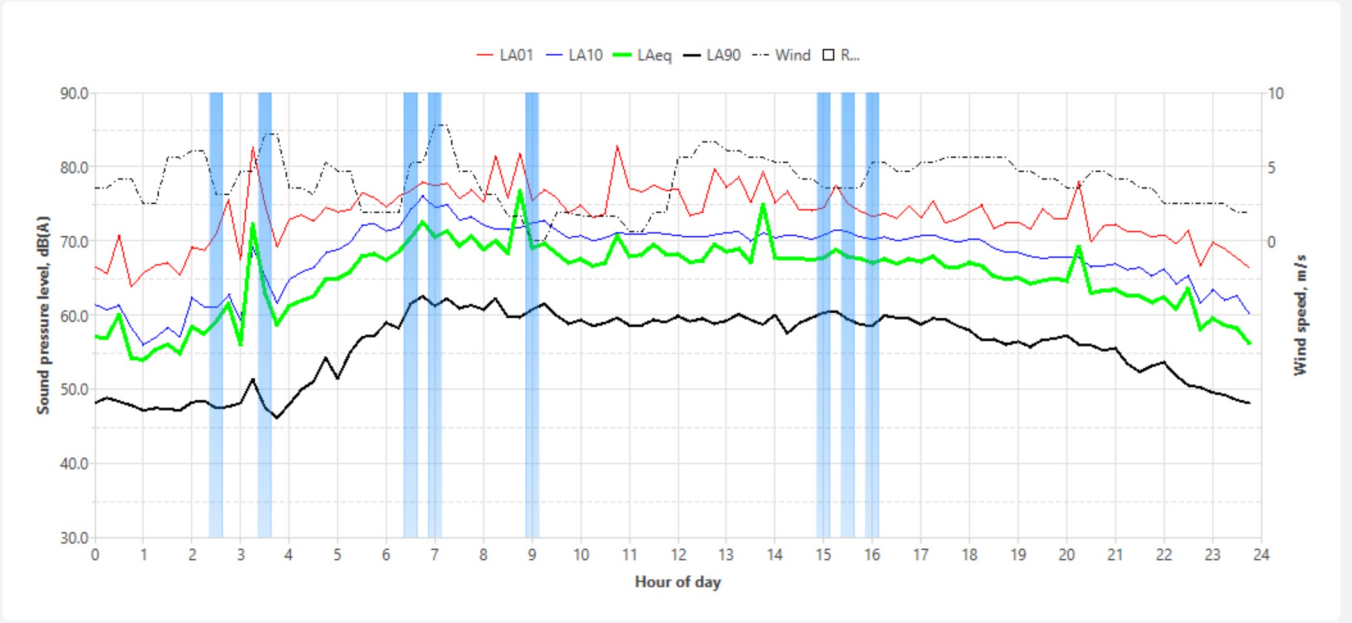
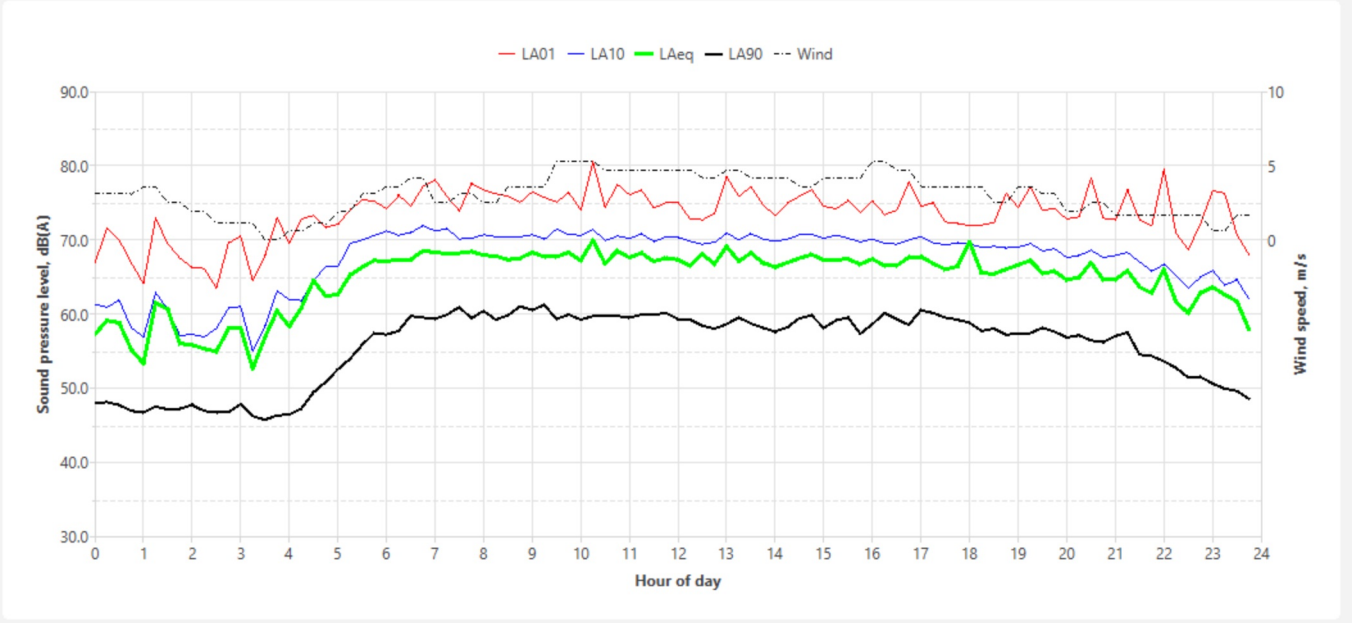


Thursday, 30 October 2025



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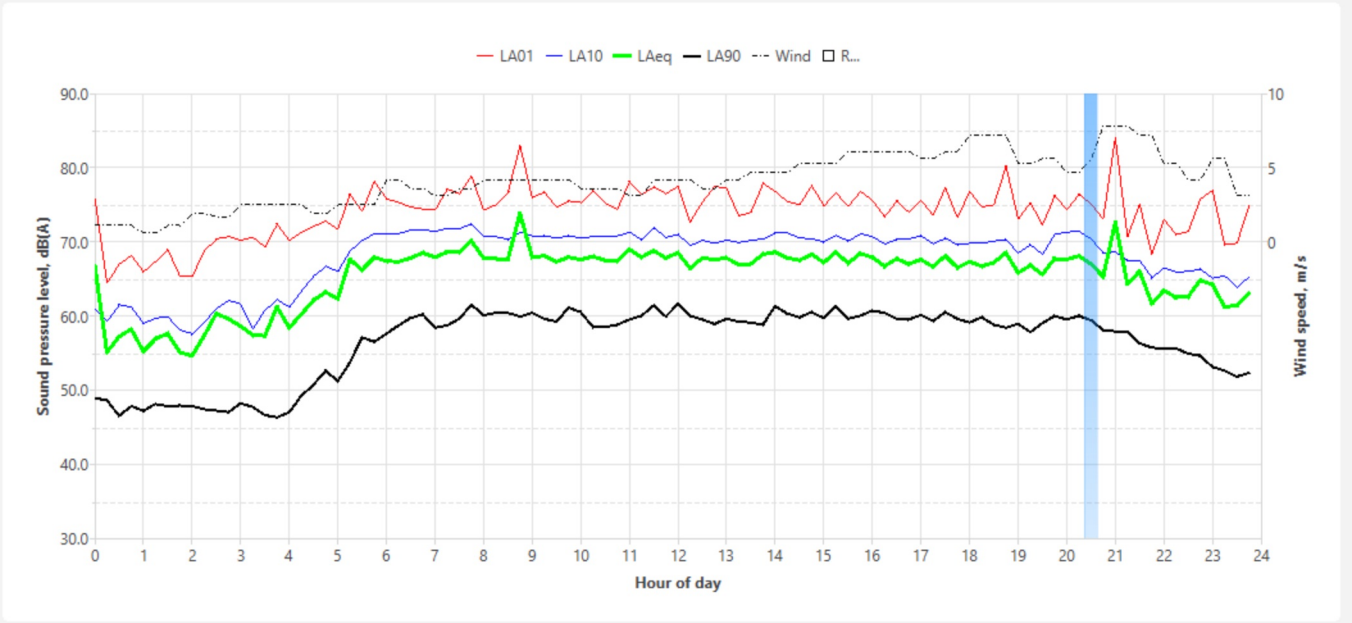
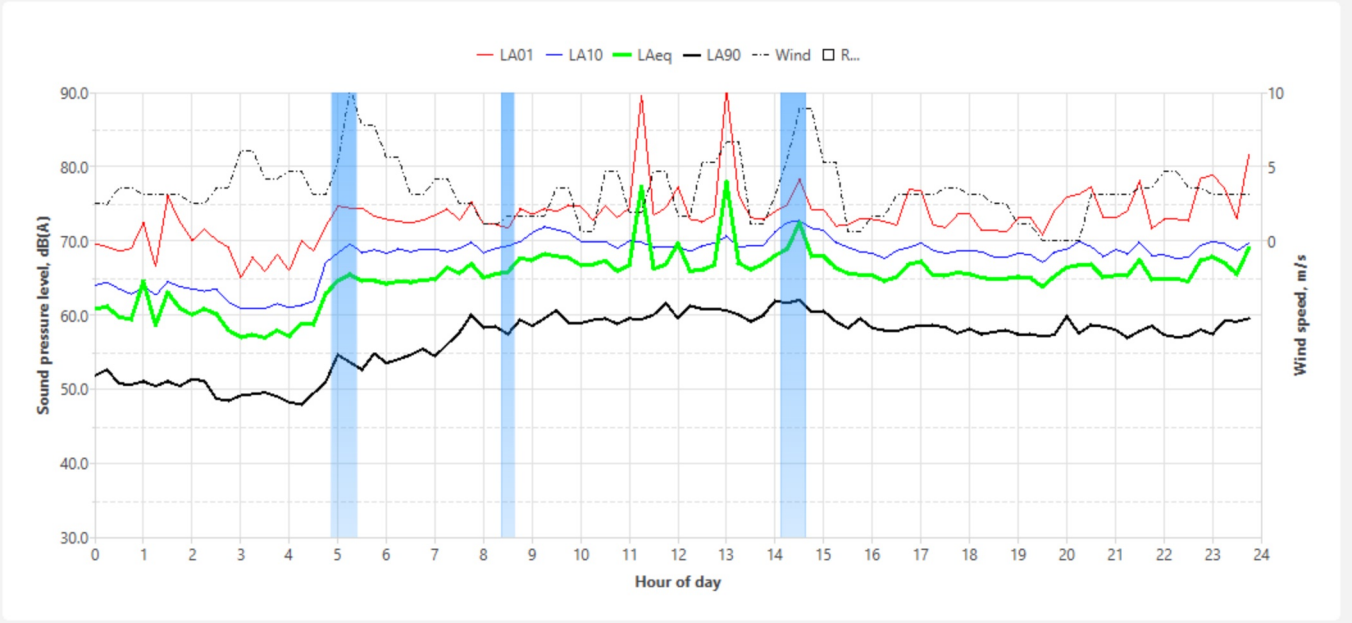


Saturday, 1 November 2025



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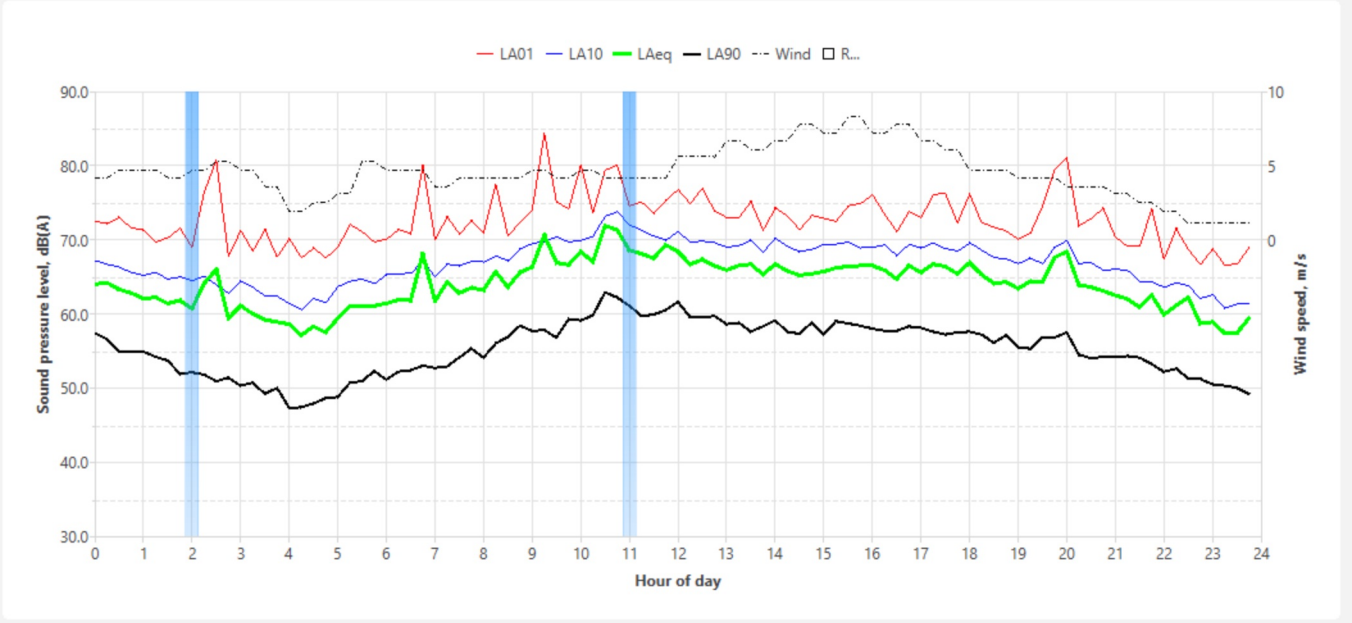

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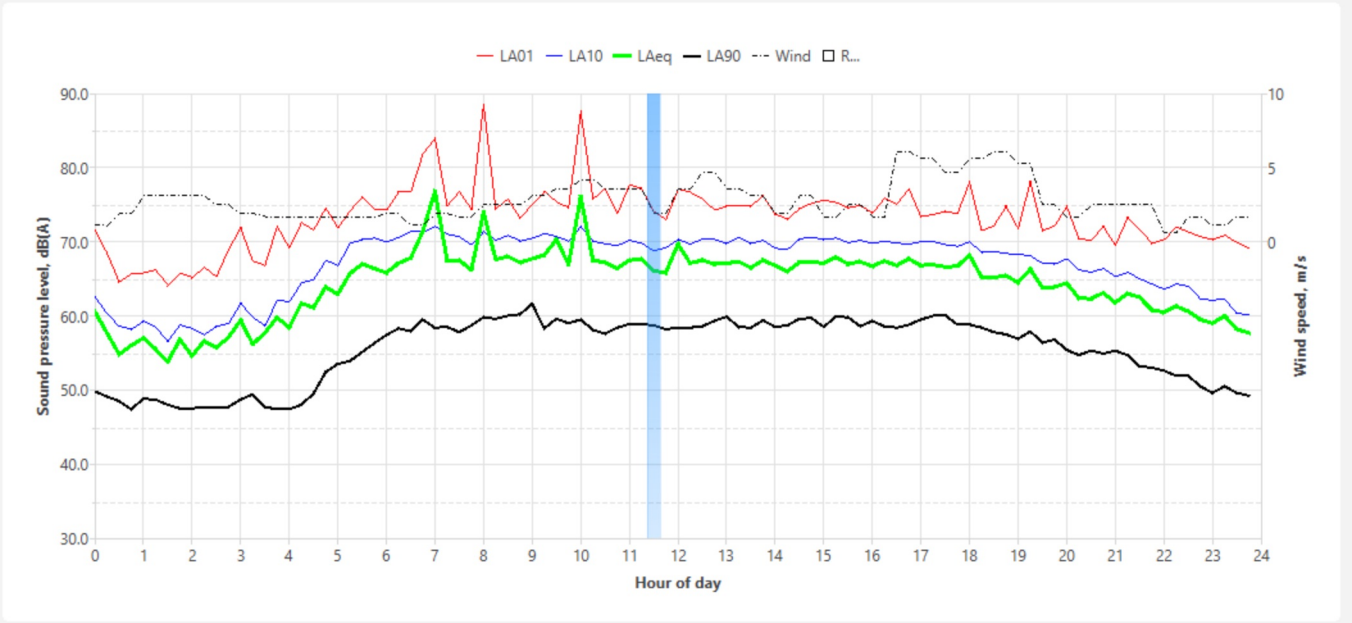

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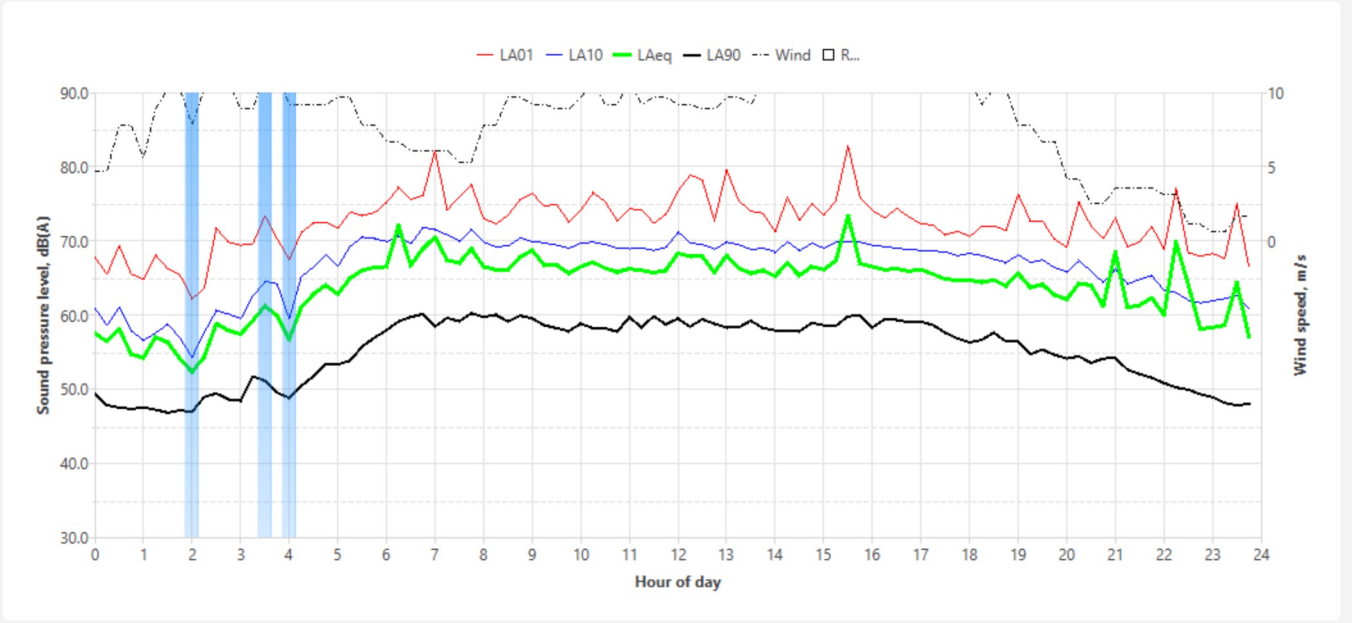
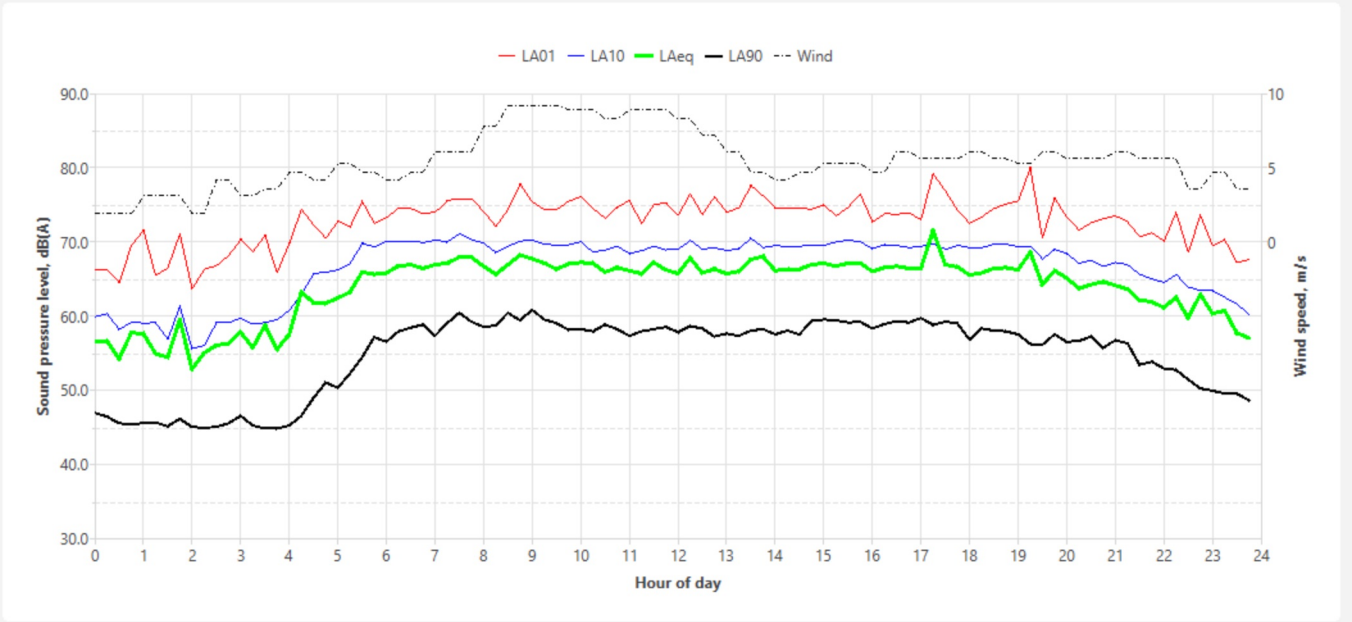
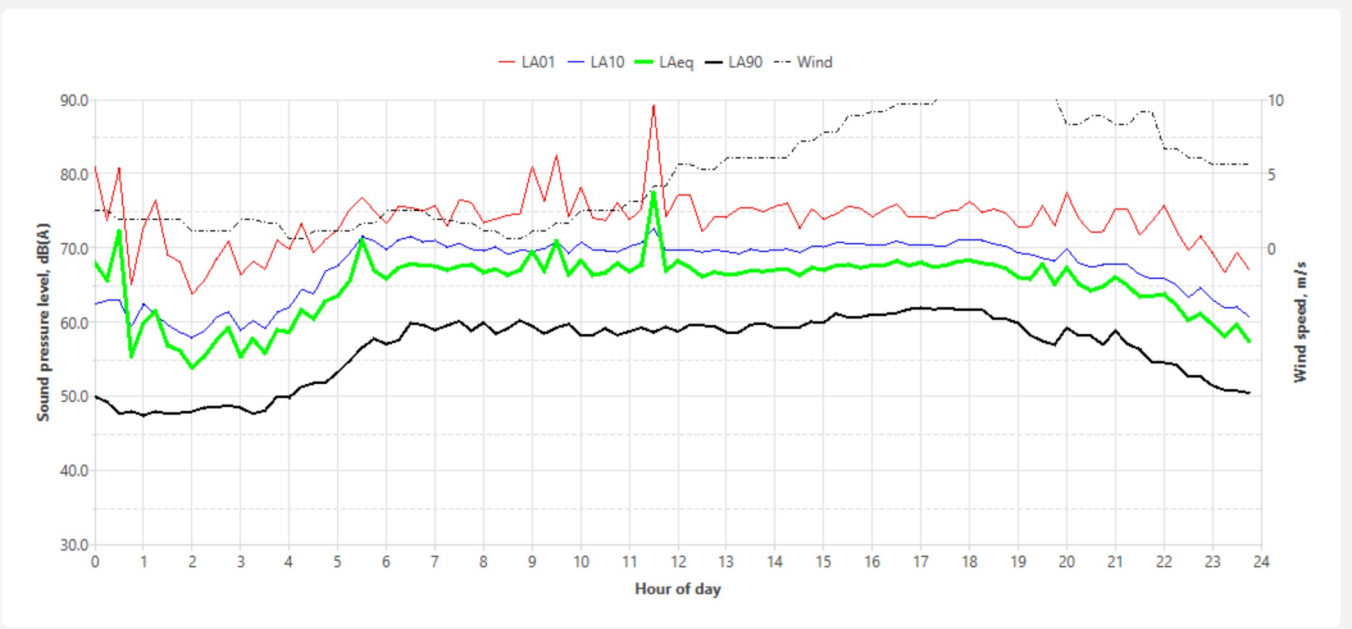


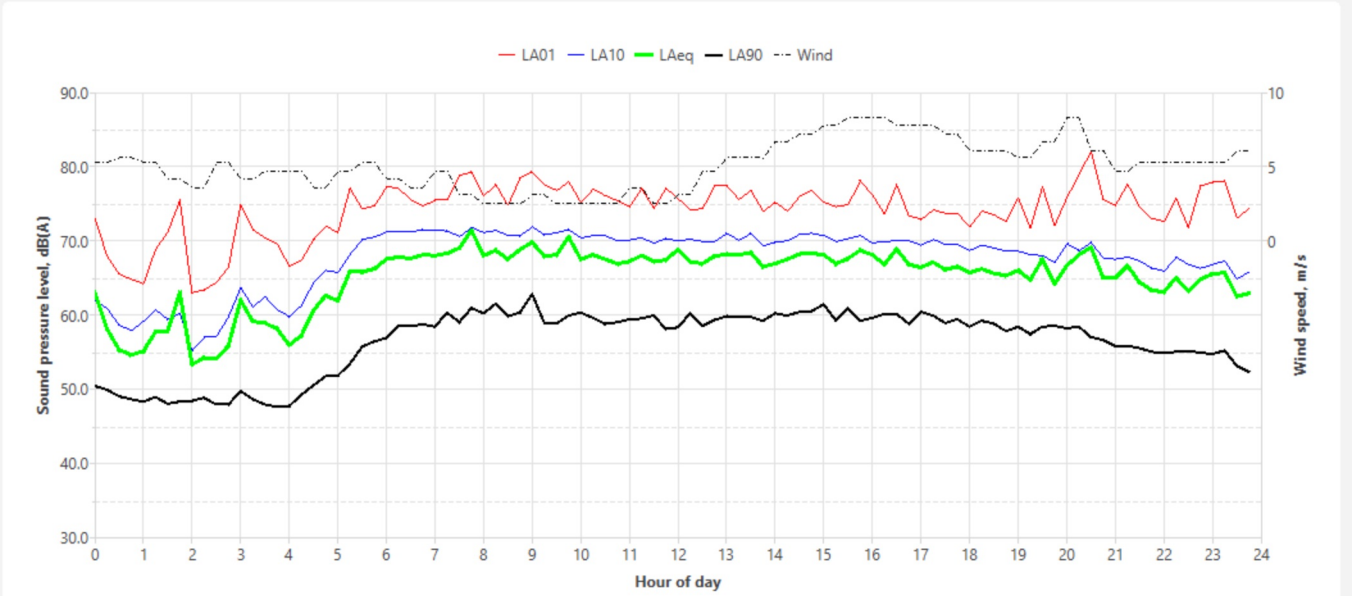
Wednesday, 5 November 2025



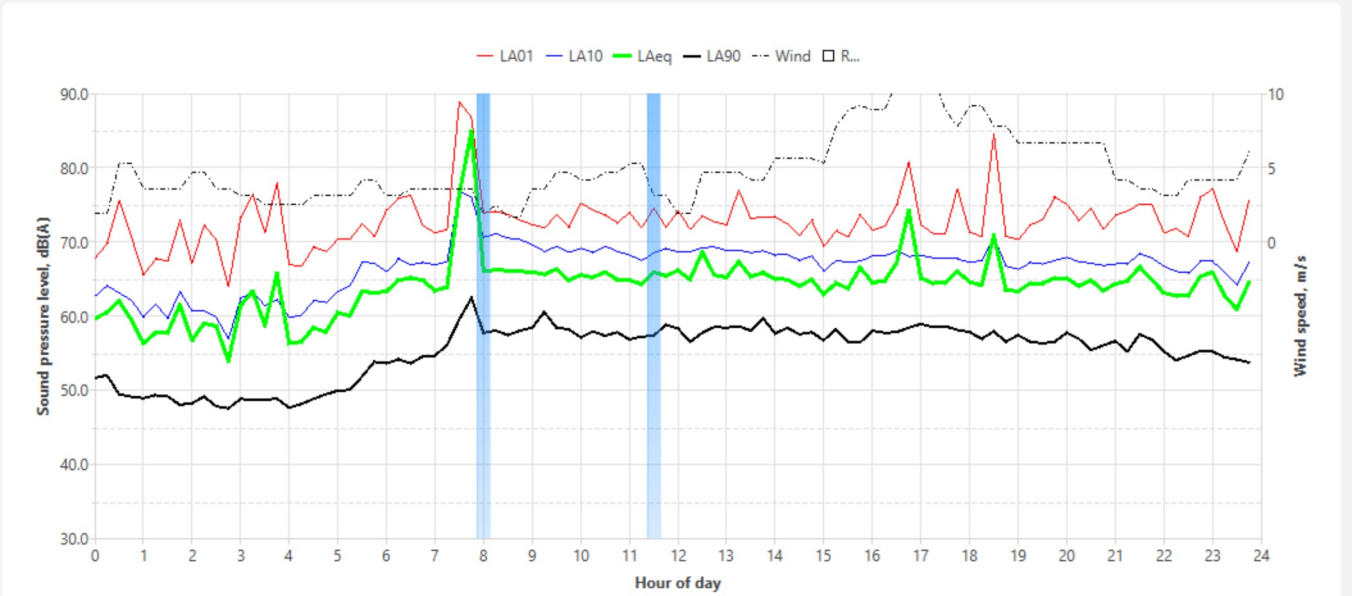
Thursday, 6 November 2025



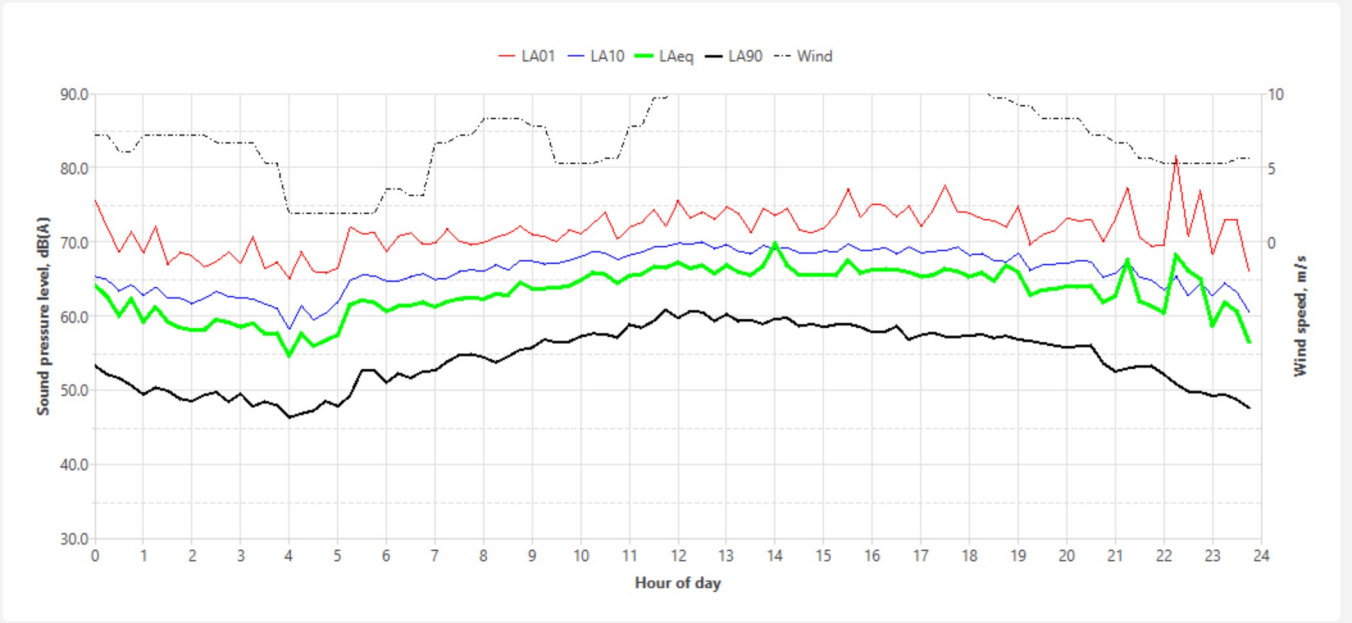
Friday, 7 November 2025



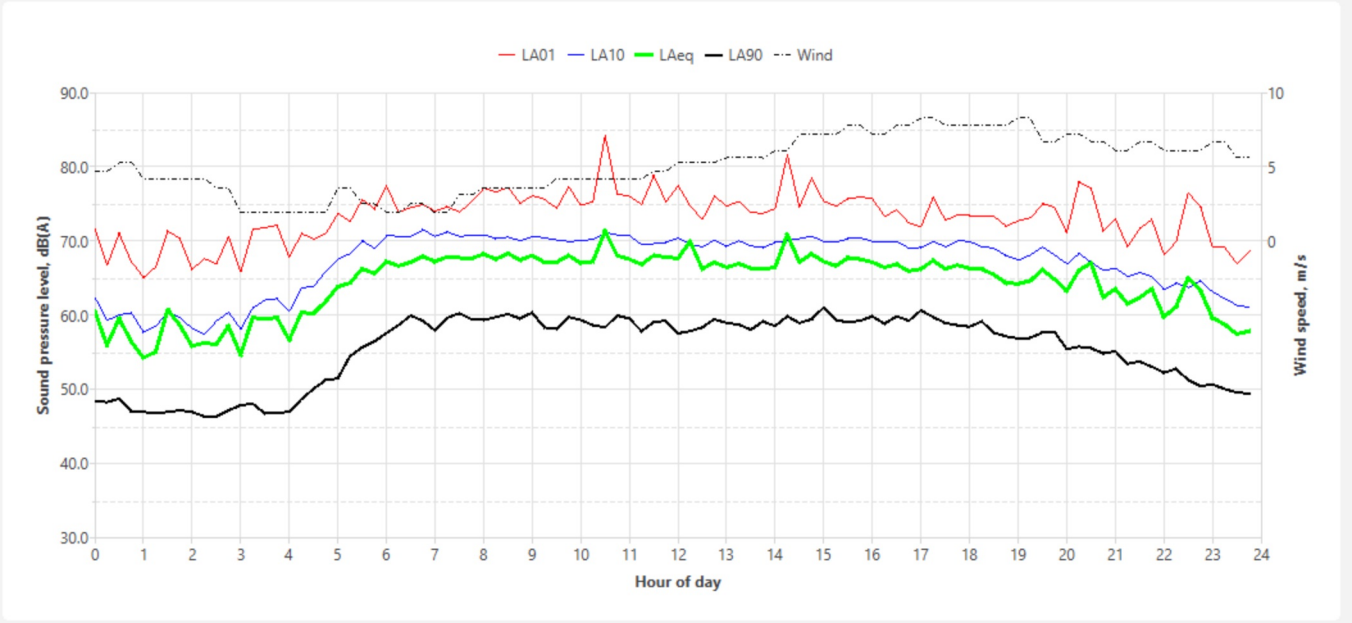
Saturday, 8 November 2025



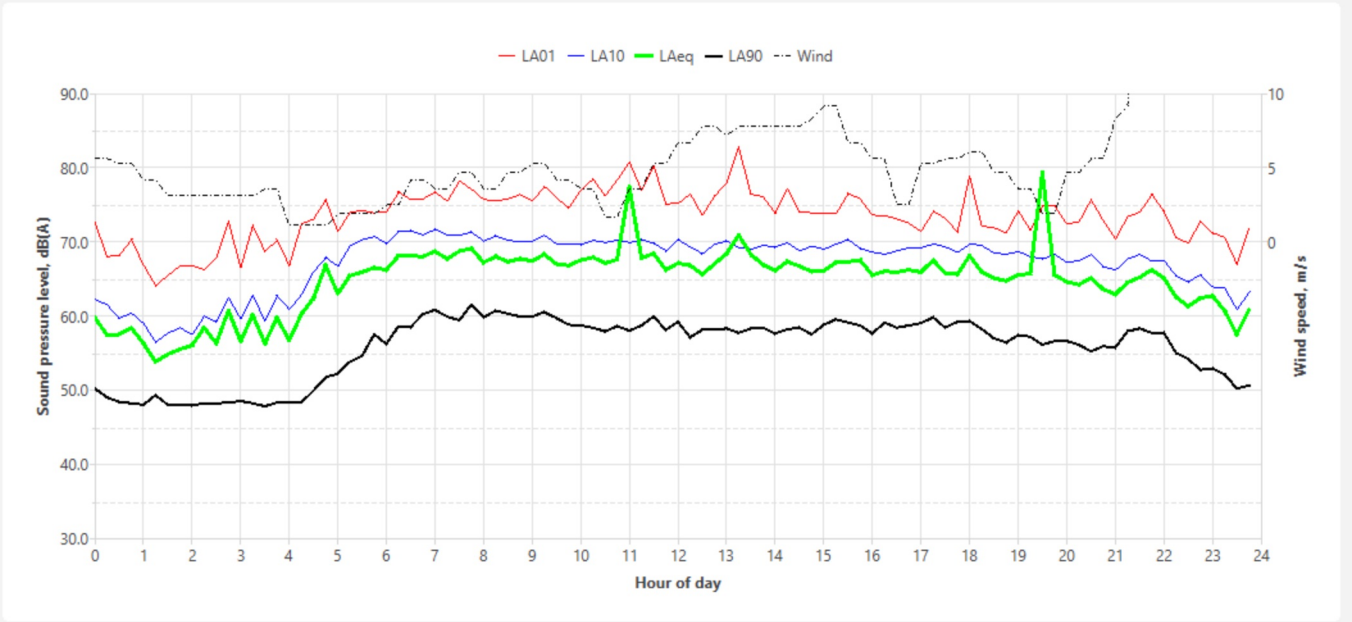
Sunday, 9 November 2025



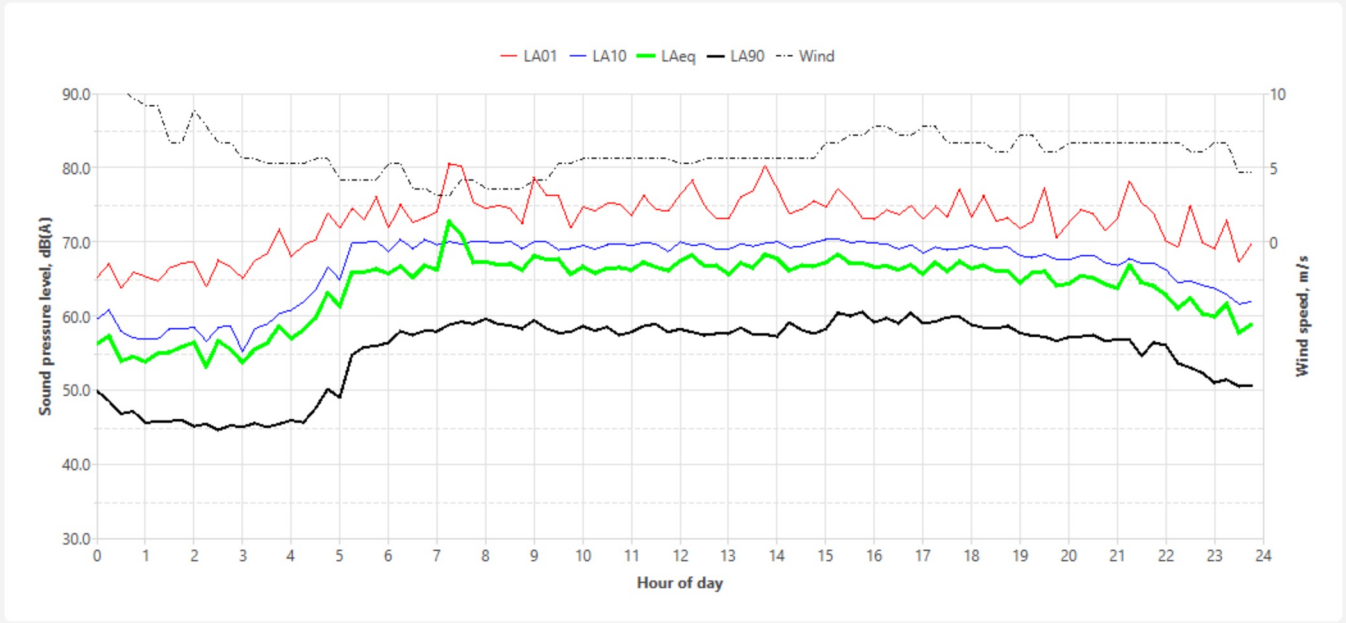
Monday, 10 November 2025



Tuesday, 11 November 2025



Wednesday, 12 November 2025



Thursday, 13 November 2025