Pymble Ladies' College – 20 Avon Road, Pymble

SSD Acoustic Assessment

Pymble Ladies' College
PO Box 136
North Ryde BC, NSW 1670

Report Reference: 250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R5

Date: 8 October 2025

Revision: R5

Project Number: 250009

PULSE WHITE NOISE ACOUSTICS Suite 601, L6, 32 Walker St, North Sydney NSW 2060
P 1800 4 PULSE (1800 478 573) **E** info@pwna.com.au **pwna.com.au** ABN 95 642 886 306

DOCUMENT CONTROL

Project Name:	Pymble Ladies' College – 20 Avon Road, Pymble
Project Number:	250009
Report Reference:	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R5
Client:	Pymble Ladies' College

Revision	Description	Reference	Date	Prepared	Checked	Authorised
DRAFT	DRAFT – For Review	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R0	25/02/25	NDC	BW	BW
R1	Report finalisation / amendments.	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R1	21/03/25	NDC	BW	BW
R2	Accessibility changes.	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R2	17/04/25	NDC	BW	BW
R3	Minor amendments.	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R3	04/06/25	NDC	BW	BW
R4	Minor amendments.	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R4	05/06/25	NDC	BW	BW
R5	Response to Agency comments	250009 – Pymble Ladies' College – 20 Avon Road, Pymble – SSD Acoustic Assessment – R5	08/10/25	NDC	BW	BW

PREPARED BY:
Pulse White Noise Acoustics Pty Ltd
ABN: 95 642 886 306
Address: Level 6, 32 Walker Street, North Sydney, 2060
Phone: 1800 4 PULSE

CONTENTS

Figures

Tables

1 INTRODUCTION

Pulse White Noise Acoustics has been commissioned by Pymble Ladies' College (the College) to prepare this noise and vibration impact assessment in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs) and in support of the preparation of an Environmental Impact Statement (EIS) and State Significant Development Application (SSD - 79146716) to the Department of Planning, Housing and Infrastructure (DPHI).

This report has been prepared with reference to architectural plans prepared by 3XN and dated May 26, 2025.

1.1 SEARs Satisfaction Table

In addressing the requirements of SEARs item 11, each item is addressed in the following section:

Table 1 SEARs Satisfaction Table Response.

Acoustic Assessment SEARs Satisfaction Table		
SEAR	**Project SEAR Requirements SSD 79146716**	**Section of report**
11	*Provide a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines*	This report
	The assessment must detail construction and operational noise (including and public-address systems, events, and out of hours use of school facilities)	Refer to Section 6 for operational noise. Refer to section 7 for construction noise.
	…. vibration impacts on nearby sensitive receivers and structures	Refer to Section 7 for construction vibration.
	…. considers noise intrusion	Refer to Section 5
	…. and outline the proposed management and mitigation measures that would be implemented	Refer to Section 6 and 7

1.2 Description of the Site and Locality

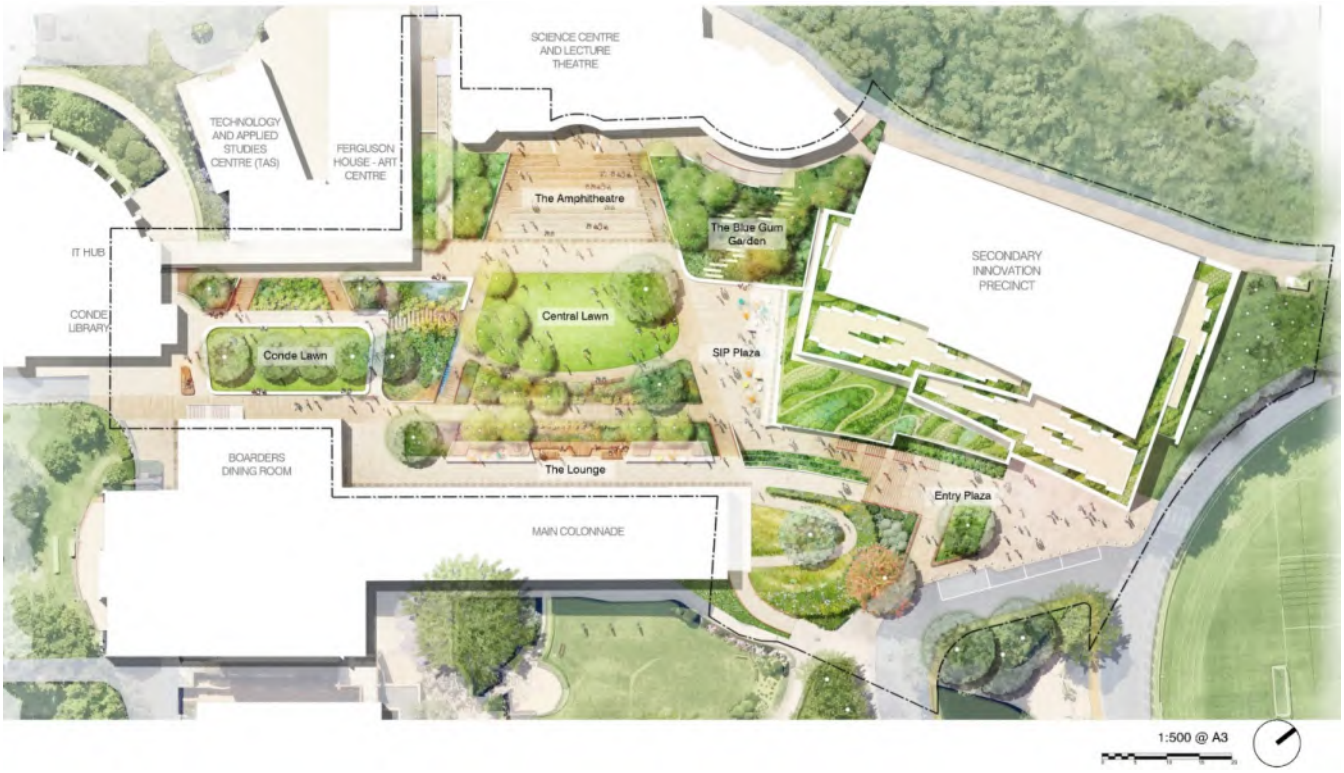
The site is located at 20 Avon Road, Pymble, within the Ku-Ring-Gai Local Government Area (LGA). The site comprises multiple parcels of land and is legally described as:

- Lot 1 Deposited Plan 69541
- Lots 11- 17 Deposited Plan 7131

The site boundary and top view of the proposed works are illustrated in Figure 1 and Figure 2 below respectively.

Figure 1 Project site boundary (source: Urbis).

Figure 2 Concept design plan.



Key features of the site are as follows:

- The site accommodates the existing Pymble Ladies' College which accommodates Kindergarten to Year 12 students.
- Vehicular access to the College is provided via separate ingress and egress driveways on the northern and western sections of Avon Road.
- Pedestrian access is provided through multiple gates along Avon Road.
- The project area that is subject to this SSDA is located at the entrance to the College west of the oval.
- The project area slopes down from south to north with a fall from RL 124.50 at the southern corner to RL 116 at the north west corner.

Key features of the locality:

The development context surrounding the site is a leafy suburban environment, predominantly made up of detached residential properties set within expansive gardens and along avenues lined with mature trees.
Recent developments of moderate-scale residential apartment buildings occur closer to the railway corridor. Two storey commercial establishments are located near to Pymble train station, specifically along the Pacific Highway and on the northern flank of the railway line.

- The site is located approximately 19 km north west of the Sydney Central Business District.
- The College is situated approximately 200 m from Pymble train station, situated on Pacific Highway and Pymble town centre.

The immediately surrounding locality is described as follows:

- **North:** Avon Road and Pacific Highway (approximately 400 m).
- **East:** Residential uses, accommodating a mixture of dwelling houses and residential flat buildings.

- **South:** Avondale Golf Course.
- **West:** Avon Road, beyond which is a residential area characterised by detached dwelling houses.

1.3 Project Description Brief

The project comprises demolition of several existing buildings and the construction of the Secondary Innovation Precinct, associated landscaping and Campus Commons at the Pymble Ladies College. The SIP is a five-storey building that will consolidate STEM based learning opportunities within the College.

1.4 Detailed Description

The proposal seeks development approval for the Secondary Innovation Precinct (SIP) and Campus Commons at Pymble Ladies' College. The development comprises:

- Demolition of the existing Isabel Harrison, Dorothy Knox, John Vicars and Robert Vicars Buildings.

1. Tree removal.
2. Excavation of the basement level.
3. Construction of the new five storey SIP building of RL 145.3 m and including:
    - General Learning Spaces.
    - STEM teaching spaces.
    - Senior student facilities.
    - Function spaces.
    - Food and beverage facilities.
    - Associated amenities.
    - Storage and building services.
4. One (1) loading space within the basement (for service vehicles) accessible from the existing rear vehicle service road.
5. Minor kerb realignment of the existing access road to the east of the SIP.
6. Landscaping on the outdoor terraces and surrounding the building.

The project also includes the Campus Commons, a significant garden lawn and amphitheatre connecting the SIP precinct to the rest of the campus.

2 SURROUNDING RECEIVERS

The nearest sensitive noise receivers to the site are identified below.

Receiver 1: Existing single storey residential receiver located at 49 Avon Road, Pymble. See Figure 3 below.

Receiver 2: Existing two storey residential receiver located at 45 Avon Road, Pymble. See Figure 3 below.

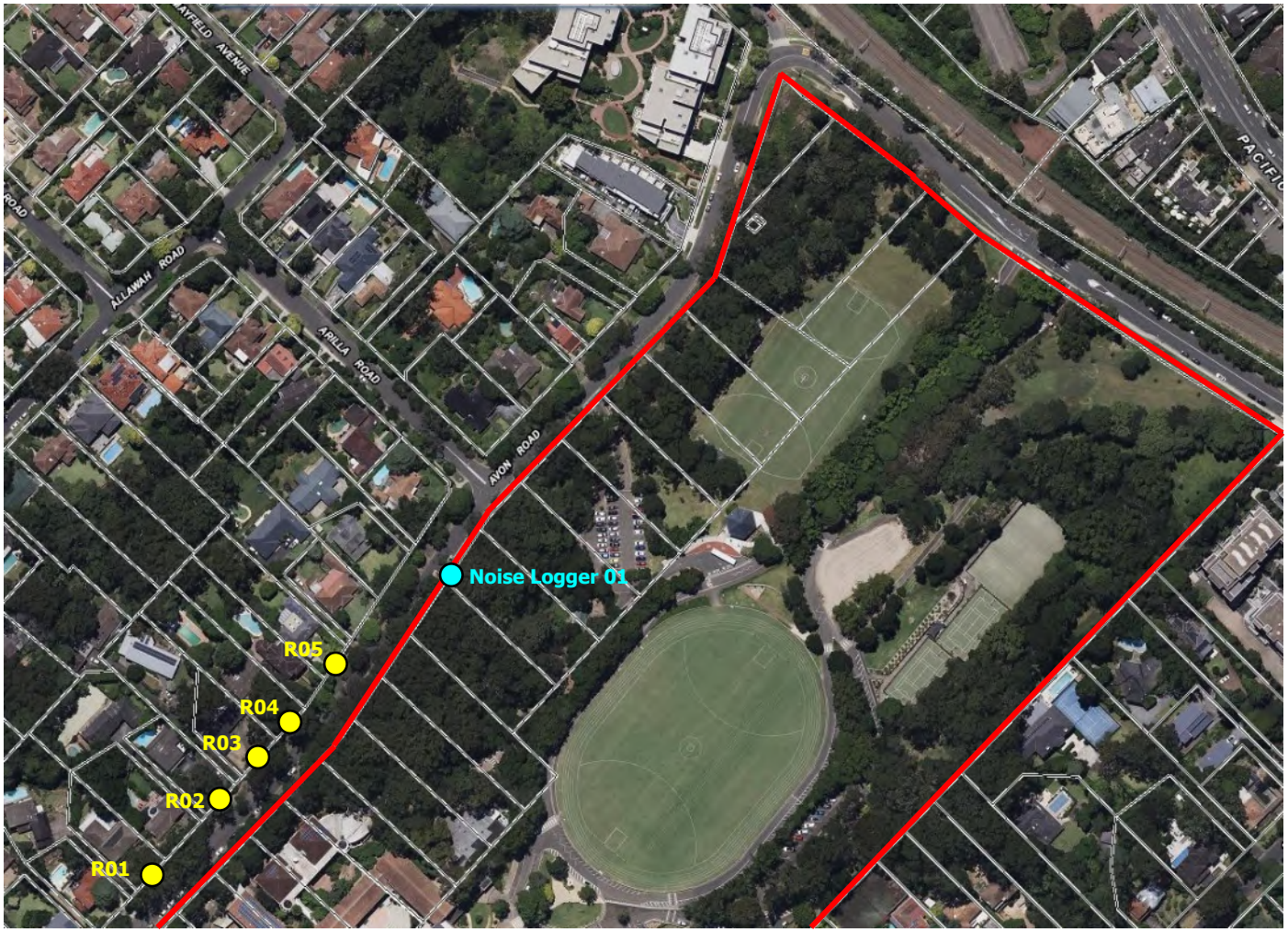
Receiver 3: Existing single storey residential receiver located at 41 Avon Road, Pymble. See Figure 3 below.

Receiver 4: Existing single storey residential receiver located at 39 Avon Road, Pymble. See Figure 3 below.

Receiver 5: Existing single storey residential receiver located at 35 Avon Road, Pymble. See Figure 3 below.

A map showing the site location as well as nearest receivers is provided in Figure 3 below. This figure also shows the location of onsite unattended measurements which were conducted as part of this assessment.

Figure 3 Nearest receivers and unattended noise logger location.



3 ACOUSTIC NOISE SURVEY

Measured noise levels from the onsite noise survey are outlined below.

3.1 Unattended Noise Monitoring

One unattended noise monitor was deployed to the site to survey existing background noise levels as well as ambient L_{Aeq} noise levels.

The noise logger was located along the western boundary of the project site (along Avon Road), away from external noise sources and has been used for determining existing acoustic environment for the nearby surrounding receivers as shown in Figure 3 above.

Onsite acoustic noise survey was conducted from Friday 31st January 2025 and Wednesday 12th February 2025. All data in the graphs presented in Appendix B have not been corrected (i.e., raw data is presented).

Instrumentation for the survey comprised one (1) Norsonic NOR139 sound level meter (serial number 1393013). Calibration of the monitor 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.

3.1.1 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 2

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 Terry Hills Observation (ID 060801). Levels presented below are processed results with extraneous weather events removed.

Table 2 Measured ambient noise levels corresponding to the NPI's assessment time periods.

Measurement Location [4]	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] (dB(A))	L_{Aeq}[3] (dB(A))	L_{A90}[2] (dB(A))	L_{Aeq}[3] (dB(A))	L_{A90}[2] (dB(A))	L_{Aeq}[3] (dB(A))
Noise Logger 01 – Western Boundary (see Figure 3)	42	57	38	56	30	51

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 LA90 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 LAeq 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.*

3.1.2 Results in accordance with the NSW Department of Planning, Housing and Infrastructure (DPHI) "Road Noise Policy"

In determining the required façade construction for the proposed building in accordance with the internal noise level requirements of Department of Planning, Housing and Infrastructure (DPHI) "Road Noise Policy", measured noise levels are shown based on the time periods defined by the 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 3 Measured ambient noise levels corresponding to the "Road Noise Policy" assessment time periods.

Measurement Location	Daytime [1] 7:00 am to 10:00 pm $L_{Aeq\ (whole\ period)}$ [2] (dB(A))	Night-time [1] 10:00 pm to 7:00 am $L_{Aeq\ (whole\ period)}$ [2] (dB(A))
Noise Logger 01 – Western Boundary (see Figure 3)	57	51

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

Note 2 The LAeq 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.

4 NOISE AND VIBRATION CRITERIA

All relevant noise and vibration criteria for the project is presented below. It has been separated into four main components: external noise emission criteria, building envelope criteria (façade), vibration criteria and construction noise / vibration criteria. Each are discussed in detail below.

4.1 External Noise Emission Criteria

4.1.1 Ku-ring-gai Local Environmental Plan (LEP) 2015 & Development Control Plan (DCP) 2015

Acoustic requirements relevant to noise emitted from the building are not provided in the Ku-ring-gai Council LEP or DCP documents. Therefore, requirements of the NSW Education EFSG, NSW EPA NPI 2017 and RNP 2011 will be adopted. Each is discussed in detail below.

4.1.2 NSW Educational Facilities Services Guidelines (EFSGs)

Section DG11 Acoustics of the EFSGs states the following:

> Noise emission considerations include:
>
> - Noise emission from school activity (e.g.: music performance, sporting activity)
> - Noise emission from a mechanical service (such as air conditioning unit or fan)
>
> The extent to which noise emission will have to be considered and the extent of acoustic treatment required will depend upon:
>
> - Whether noisy activities take place in a room or space
> - Whether the room or space is naturally ventilated and therefore windows and/or doors are expected to be open when noisy activities are taking place
> - Room facade construction and orientation of 'acoustically weak' facades relative to noise-sensitive receivers
> - Distance to noise-sensitive receivers
> - Whether mandatory noise emission criteria are required to be satisfied at nearby boundaries and land uses.

Note: In addressing the above, the following is proposed:

- In the assessment of noise emissions from plant items, the NSW EPA NPI 2017 will be adopted.
- In the assessment of vehicles on the site, guidance from the NSW EPA NPI 2017 will be adopted.
- In the assessment of vehicles on public roads, the NSW RNP 2011 will be adopted.

All are discussed in the below sections.

4.1.3 NSW EPA Noise Policy for Industry (NPI) 2017

(Assessment of Building Services & Onsite Vehicles)

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.

4.1.3.1 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.

4.1.3.2 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 LAeq noise level should not exceed the level appropriate for the 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 LAeq,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*).

4.1.3.3 Residential Receivers – Area Classification

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

- An acoustical environment that:
    - An area that has local traffic with characteristically intermittent traffic flows or with some limited commercial industry.
    - This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.

As shown in Figure 4 below, the nearest noise sensitive receivers are within an area made up of R2 and R3 type developments (Low / Medium Density Residential). Based on classification of R2 and R2, using table 2.3 of the NPI (see below), we believe that the most appropriate classification for the development site is suburban Residential.

Figure 4 – NSW ePlanning Spatial Viewer.

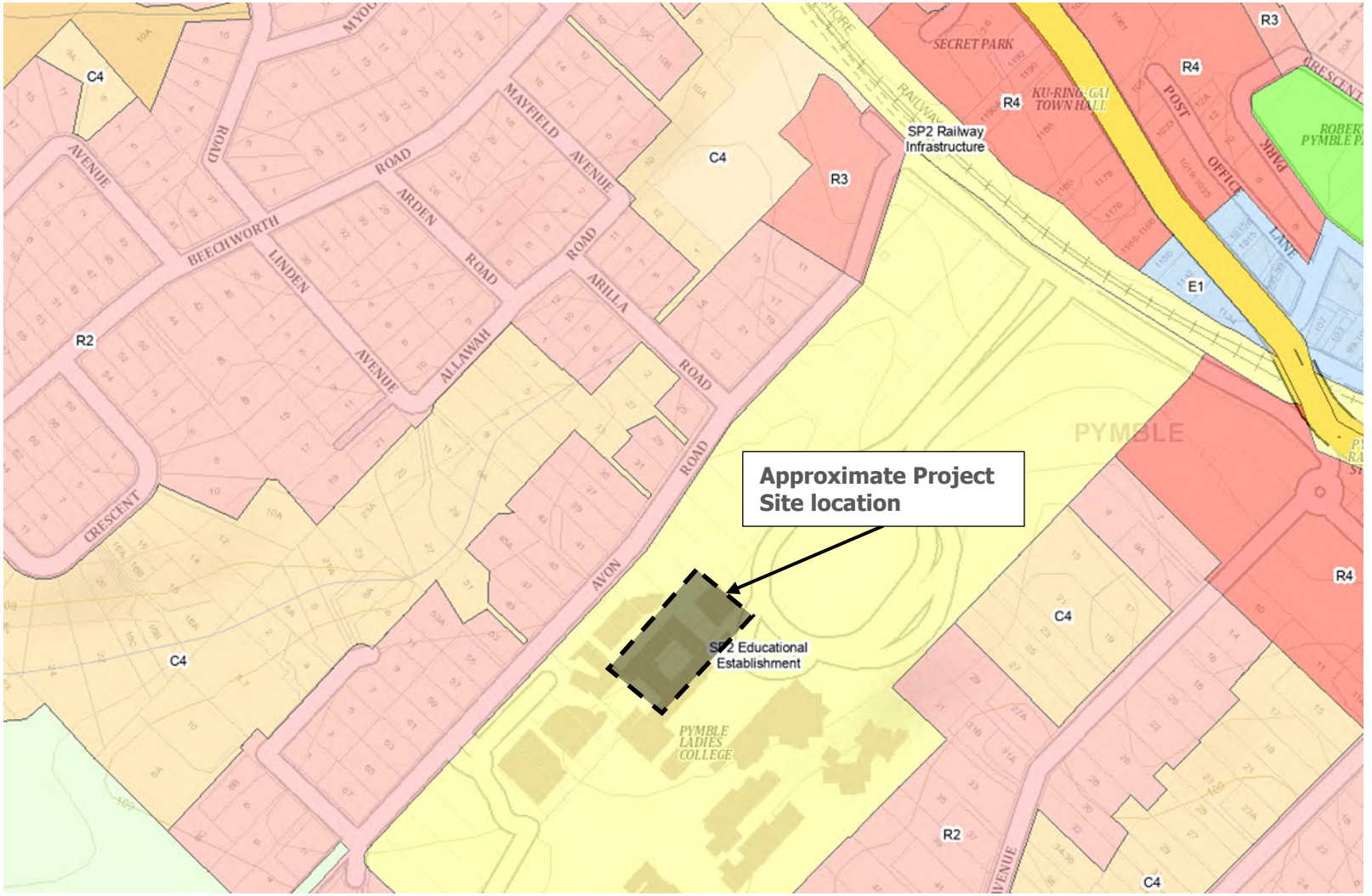


Figure 5 - NPI Extract - Table 2.3 Determining which of the residential receiver categories applies.

Table 2.3: Determining which of the residential receiver categories applies.

Receiver category	Typical planning zoning – standard instrument*	Typical existing background noise levels	Description
Rural residential	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime RBL <40 dB(A) Evening RBL <35 dB(A) Night RBL <30 dB(A)	**Rural** – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented in column 3 due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition R2 – low density residential R3 – medium density residential E2 – environmental conservation E3 – environmental management	Daytime RBL<45 dB(A) Evening RBL<40 dB(A) Night RBL <35dB(A)	**Suburban** – an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.
Urban residential	R1 – general residential R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime RBL> 45 dB(A) Evening RBL> 40 dB(A) Night RBL >35 dB(A)	**Urban** – an area with an acoustical environment that: • is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • has through-traffic with characteristically heavy and continuous traffic flows during peak periods • is near commercial districts or industrial districts • has any combination of the above.

Notes: *As cited in Standard Instrument – Principal Local Environmental Plan, New South Wales Government, Version 15 August 2014. RBL = rating background noise level.

Resultant amenity levels for suburban receivers are shown Table 4 below.

Table 4 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

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

4.1.3.4 Maximum Noise Level Event (Sleeping Disturbance)

Section 2.5 of the NPI states the following:

> The potential for sleep disturbance from maximum noise level events from premises during the night-time period needs to be considered. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages.
>
> Where the subject development/premises night-time noise levels at a residential location exceed:
>
> - $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
> - L_{AFmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,
>
> a detailed maximum noise level event assessment should be undertaken.

As outlined in section 3.1 above, the measured rating background noise level during the night hours (10:00 pm to 7:00 am) is 30 dB(A) L_{A90}. Therefore, the resultant RBL + 15 dB is 45 dB(A) which is both below the minimum 52 dB(A) L_{AFmax}. As such the 52 dB(A) will be adopted for this assessment.

4.1.3.5 Project Specific External Noise Emission Criteria

(Assessment of Building Services and onsite vehicle noise)

The intrusive, amenity and maximum noise event criteria for noise emissions, derived from the measured data, are presented in Table 5. These criteria are nominated for the purpose of determining the operational noise limits for building services 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. These are shown in bold text in Table 5.

Table 5 External noise level criteria in accordance with the NSW NPI.

Receiver Type	Time of Day [1]	Project Amenity Noise Level, $L_{Aeq, period}$ [2 4] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [3] (dBA)	Measured $L_{Aeq, period}$ Noise Level [4] (dBA)	Intrusive $L_{Aeq, 15\ min\ Criterion}$ [4] for New Sources (dBA)	Amenity $L_{Aeq, 15\ min\ Criterion}$ [4 5] for New Sources (dBA)
Residential Receivers	Day	50	42	57	**47**	53
	Evening	40	38	56	**43**	**43**
	Night	35	30	51	**35**	38

Note 3 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 – 7:00 am.

Note 4 Project Amenity Noise Levels corresponding to "Suburban" areas, equivalent to the Recommended Amenity Noise Levels minus 5 dBA.

Note 5 LA90 Background Noise or Rating Background Level.

Note 6 The LAeq 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 7 According to Section 2.2 of the NSW NPI, the LAeq, 15 minutes is equal to the LAeq, period + 3 dB.

Note 8 Project Noise Trigger Levels are shown in bold.

In addition, a maximum noise level criterion of 52 dB(A) L_{AFmax} during the night period (10:00 pm to 7:00 am) at residential receivers also applies.

4.1.4 NSW EPA NSW Road Noise Policy (RNP) 2011

(Assessment of Vehicles on Public Roads)

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy 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.

4.1.5 School Activity Noise

Noise associated with school activities (i.e., playgrounds, school halls, outdoor learning spaces etc.) is not well addressed in NSW. Ku-ring-gai Council LEP / DCP and the NSW EPA NPI are not intended for the application of noise associated with these types of areas. School activity noise is also not listed under Schedule 1 of the Protection of the Environmental Operations Act (POEO) of 1997.

In the absence of any applicable acoustic requirements related to the noise associated with the use of the school we believe guidance from the Association of Australasian Acoustical Consultants (AAAC) document Guideline for Child Care Centre Acoustic Assessment should be sought.

The Child Care Centre Guideline was first prepared in 2008 as a guide for AAAC members in conducting assessments of these type of facilities due to the absence of acoustic criteria. In the current revision of the guideline, the AAAC recommends the following criteria be adopted for residential receivers:

External Play Areas

> ***Up to 4 hours (total) per day*** *– If outdoor play is limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed Leq, 15minute noise level emitted from the outdoor play shall not exceed the background noise level by more than 10 dB at the assessment location.*

A typical structure of a public-school day will include use of the outdoor play areas before school (typically 8:00 am to 9:00 am), a short break mid-morning (typically 11:00 am to 11:30 am) and finally an hour in the middle/early afternoon (typically 12:30 pm to 1:30 pm). This would result in approximately 2.5 hours of outdoor play with a buffer of 1.5 hours for additional activities.

For this assessment, it is proposed that the Background + 10 dB(A) $L_{Aeq(15\text{-}minute)}$ level outlined in the AAAC guideline for outdoor play will be adopted as a Noise Management Level (NML) for this assessment.

Indoor Play (i.e. Classroom + Auditorium Noise

> *…. with the exception of noise emission from outdoor play discussed above, shall not exceed the background noise level by more than 5 dB at the assessment location as defined above. This includes the noise emission resulting from:*
>
> - *Indoor play;*
> - *Mechanical plant;*
> - *Drop off and pick up;*
> - *Other activities/operations (not including outdoor play).*

For this assessment, it is proposed that the Background + 5 dB(A) $L_{Aeq(15\text{-}minute)}$ level outlined in the AAAC guideline for indoor activities will be adopted as a Noise Management Level (NML) for this assessment.

In relation to the NML's outlined above, it's important to note that these are intended/proposed as limits (i.e., like those established above for mechanical plant and the like). The NML's are established to provide a framework to enable the management of noise from these areas areas.

In many cases across NSW school playgrounds are located directly adjacent to surrounding residential receivers. During the initial site planning phase, the project team considered several elements before determining the proposed layout being most suitable, including noise emissions, noise intrusion, bulk and scale, security, visual impacts etc. As a result, the current site planning provided the best possible outcome for the community and future school occupants.

As the Pymble community is mostly under construction/development, measured ambient noise levels are currently lower than typical noise levels of large established communities. We believe with the location of the school within a neighbourhood centre and an increase population immanent, ambient noise levels in the future are likely to increase. With this increase in, subjectively the predicted noise levels are likely to have a lower impact on surrounding receivers.

Additionally, we do note that in an NSW Land and Environment Court (LEC) proceeding (Meriden School v Pedavoli) on the 22nd of October 2009 case NSW LEC 183, the court noted "All noise that emanates from the normal activities at a school is not offensive".

4.2 Noise Intrusion Criteria

4.2.1 Ku-ring-gai Council Local Environmental Plan (LEP) 2015 & Development Control Plan (DCP)

Kur-ring-gai Council Local Environmental Plan (LEP) 2015 and Development Control Plan (DCP) does not provide any specific site numerical objectives. Therefore, requirements of the NSW Education EFSG will be adopted.

4.2.2 EFSG Section DG11 – Internal Noise Levels

Section DG11 **Acoustics** of the EFSGs states the following:

> *An internal noise level assessment must be carried out for all new buildings to ensure comfortable acoustic conditions for the spaces occupied.*
>
> *The internal noise levels within the space must meet the limits stipulated in Table 11.06.1 of Section 11.6 Acoustic Performance Guidelines or be within the range stipulated in Table 1 of the AS/NZS 2107:2016 standard. The more stringent of the two should be met.*
>
> *Noise measurements conducted for at least 10% of the spaces will be required to demonstrate compliance with the noise levels criteria. The spaces considered for onsite testing shall be the ones most susceptible to internal and external noise sources as a conservative measure.*
>
> ***Sound Sources Description***

- *Steady-state(consistent) noise intrusion from external sources:*
    - *Road (and in some cases, rail) traffic noise*
    - *Industry*
    - *General environmental noise including external school activity*
- *Intermittent (occasional) noise intrusion from external sources:*

- *Individual rail pass-bys*
- *Aircraft flyovers*
- *Rain noise*

- *Steady-state (consistent) noise contribution of internal sources:*
  - *Mechanical equipment*
  - *Air conditioning*
- *Intermittent (occasional) noise intrusion from internal sources:*
  - *Hydraulic services*
- *The potential impact of the noise and the extent of acoustic treatment will depend upon:*
  - *Required internal noise levels*
  - *The sensitivity of a room or space to a particular intermittent or intrusive noise source*
  - *The proximity of the room or space to external noise sources and the external noise level incident upon the facade (principally the glazing, ventilation openings or lightweight facade or roof construction)*
  - *Whether mechanical ventilation or air conditioning is present*
  - *Rainfall conditions in the region*

Table 11.06.1 from the EFSGs provides the following Acoustic Performance Guidelines; see below.

Table 6 Table 11.06.1 from DG11 – EFSGs.

Type of Occupancy / Activity	Internal Noise Level (dB L_{Aeq})
Art/Craft Studios	40
Assembly halls up to 250 seats	40 [6]
Assembly halls over 250 seats	40 [6]
Audio-Visual areas	40 [6]
Computer rooms – Teaching	40
Computer rooms – Laboratories	45
Conference Room	35
Corridors and lobbies	45
Dance Studios	40
Dining Rooms	45
Drama Studios	40 [6]

Duplicating rooms/stores	50
Engineering workshops	45
Gymnasiums	45 [6]
Interview/counselling rooms	35
Kitchens	50
Laboratories – Teaching	40
Laboratories – Working	45
Lecture Theatres – without speech reinforcement and < 50 seats	35
Lecture Theatres – with speech reinforcement	40 [6]
Libraries – General areas	45 [6]
Libraries – Reading Areas	40
Libraries – Stack Areas	40 [6]
Manual art workshops	40
Medical Rooms (First Aid)	40
Music Practice Rooms	40 [6]
Music Studios	35 [6]
Office Areas	40
Open Plan Teaching Areas	40
Professional and Administrative offices	40 [6]
Staff Common Rooms	45 [6]
Study Rooms	40 [6]
Teaching Spaces – students who are deaf or hard of hearing	30
Teaching Spaces – Primary schools	40 [6]
Teaching Spaces – secondary schools	40 [6]
Toilet/change/showers	50

Notes:

Note 1 All noise levels are to be free of tonal or annoying characteristics.

Note 2 Internal noise levels to include the combined noise from environmental noise intrusion as well as building services operations.

Note 3 Rain noise is to be assessed only for general learning areas, music, drama, movement studios and halls or as otherwise directed. Rain is to be assessed using the one-year annual recurrence, one-hour event for the region as reported by the Bureau of Meteorology.

Note 4 Assuming departure item one (1) as detailed above is approved.

Note 5 Internal noise levels detailed above comply with the requirements of the Green Star Buildings v1 tool.

Note 6 This project has revised project requirements based on the EFSG and these have been reflected above for consistency.

4.2.3 NSW EPA Road Noise Policy (RNP) 2011

External noise impacts also include noise targets for outdoor passive and active areas of a School Playground. Table 4 of the NSW EPA RNP 2011 recommends that a school playground (deemed a passive area) should have traffic noise levels which are below 55 dB(A) $L_{Aeq\ (15hour)}$ when in use.

4.3 Vibration Criteria

4.3.1 Ku-ring-gai Council Local Environmental Plan (LEP) 2015 & Development Control Plan (DCP) 2015

Vibration requirements relevant to vibration levels emitted from the building are not provided in the Ku-ring-gai Council LEP or DCP documents. Therefore, requirements of the NSW EPA AV-TG 2006, British Standard BS 7385: Part 2-1993 AND German DIN 4150: Part 3 – 1999 – Building Damage will be adopted. Each is discussed in detail below.

4.3.2 NSW EPA (formerly, Department of Environment and Climate Change) *Assessing Vibration: a technical guideline 2006* - 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*". (AV-TG). This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources - Table 7.
- Impulsive vibration – up to three instances of sudden impact e.g., dropping heavy items, per monitoring period - Table 8.
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously - Table 9.

Table 7 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

Table 8 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

Table 9 Intermittent vibration impacts criteria (m/s1.75) 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

4.3.3 British Standard BS 7385: Part 2-1993 AND German DIN 4150: Part 3 – 1999 – Building Damage

It is expected that the human comfort criteria discussed in Section 4 will be more stringent than that corresponding to building damage.

Table 10 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.

4.4 Construction Noise and Vibration Criteria

4.4.1 Construction Noise Criteria

Relevant construction noise criteria applicable to this project are outlined below.

4.4.2 Ku-ring-gai Council Local Environmental Plan (LEP) 2015 & Development Control Plan (DCP) 2015

Acoustic requirements relevant to construction noise and vibration levels emitted from the site are not provided in the Ku-ring-gai Council LEP or DCP documents. Therefore, requirements of the NSW EPA ICNG 2009 will be adopted. Each is discussed in detail below.

4.4.2.1 NSW EPA Interim Construction Noise Guideline (ICNG) 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 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 11 NMLs for quantitative assessment at residences.

Time of Day	Noise Management Level $L_{Aeq(15minute)}$ [1,2]	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15minute)}$ 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.
	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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.
Outside the recommended standard hours above	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 notify the community.

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 Industrial Noise Policy (EPA 2000).

Based on the measured background noise levels summarised in Section 3.1, and the NMLs outlined above, the construction noise criteria to be used in this assessment are listed in section 4.

Table 12 NMLs as basis for the acoustic assessment.

Receiver Types		NML, dB $L_{Aeq(15minute)}$	
		Standard Hours **Monday to Friday:** **7:00am to 6:00pm** **Saturday:** **8:00am to 1:00pm**	**Outside Standard Hours** **All hours not listed in the adjacent column.**
Residences (Measured externally)	All residential receivers	**NAFL:** **52** (RBL (42) + 10 dB) **HNAL** **75**	RBL + 5dB

Note 1 The LAeq 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.

4.4.3 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.
- Effects on building contents – where vibration can cause damage to fixtures, fittings, and other non-building related objects.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

4.4.3.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from AV-TG. This type of impact can be further categorised and assessed using the appropriate criterion as follows:

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

Table 13 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

Table 14 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

Table 15 Intermittent vibration impacts criteria (m/s1.75) 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

4.4.3.2 Vibration Criteria – Building Contents and Structure

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

- For transient vibration: British Standard BS 7385: Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration" (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 "Effects of Vibration on Structure" (DIN 1999).

4.4.3.2.1 British 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 16 and illustrated in Figure 6.

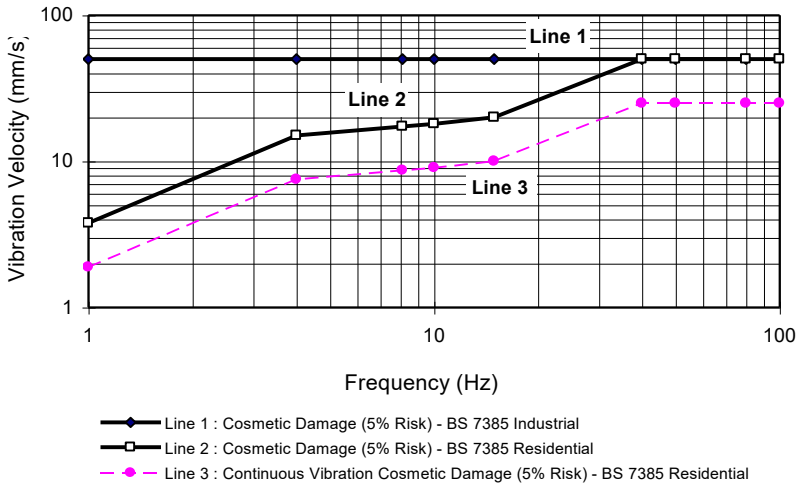
Table 16 Transient vibration criteria as per standard BS 7385 Part 2 – 1993.

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 16 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such that it results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 16 may need to be reduced by up to 50% (refer to Line 3 in Figure 6).

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 , 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 the 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 should not be reduced for fatigue considerations.

4.4.3.2.2 German 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 17. The criteria are frequency dependent and specific to particular categories of structures.

Table 17 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

4.4.4 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.

5 EXTERNAL NOISE INTRUSION ASSESSMENT

5.1 Façade Acoustic Treatments

Preliminary façade acoustic treatments based on the external levels measured above from surrounding roads and other environmental sources as discussed in section 3.1 above are provided below.

5.1.1 Glazing Recommendations

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

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).**

Table 18 Recommended Glazing Construction.

Spaces	Façade	Indicative Construction	Minimum Glazing System Rating Requirements
Auditorium	All orientations	10.38 mm Laminated Glass	Rw (C;Ctr): 35 (-1,-3)
TAS Staff / Kitchens	All orientations	6.38 mm Laminated Glass	Rw (C;Ctr): 31 (-1,-3)
General Learning Spaces and Special Learning Rooms	All orientations	6.38 mm Laminated Glass	Rw (C;Ctr): 31 (-1,-3)
Staff Rooms / Staff Offices	All orientations	6.38 mm Laminated Glass	Rw (C;Ctr): 31 (-1,-3)
Senior School Hub	All orientations	6.38 mm Laminated Glass	Rw (C;Ctr): 31 (-1,-3)

It is recommended prior to the issue of a Crown Certificate (CC) a further detailed review be undertaken to verify if future noise levels have increased resulting in a higher performing façade system.

5.1.2 External Wall Construction

External wall constructions which are constructed from a concrete or masonry construction will be acoustically sufficient and no further acoustic upgrading is required. However, for wall systems constructed from a lightweight cladding system, the following construction is recommended.

Table 19 Recommended light weight external wall construction.

Location	Occupancy Area 1	Minimum External Wall Rating Requirements [1]
Auditorium	All Spaces	Rw (C;Ctr): 45 (-0;-11)
All other Facades		Rw (C;Ctr): 43 (-0;-11)

Note 1 Recommended performances are identical for each level.

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.

It is recommended prior to the finalisation of the detailed design stage, a further detailed review be undertaken (including additional noise measurements) to verify if future noise levels have increased resulting in a higher performing façade system.

5.1.3 External Roof Construction

External wall constructions which are constructed from a concrete or masonry construction will be acoustically sufficient and no further acoustic upgrading is required. External roofs constructed from a lightweight sheet metal cladding will require the following minimum constructions, detailed in Table 20 below.

Table 20 Recommended Light Weight Roof Construction.

Building	Occupancy Area [1]	Minimum External Roof Rating Requirements [1]
Auditorium	All Spaces	Rw (C;Ctr): 47 (-0;-9)
All other Facades		Rw (C;Ctr): 45 (-0;-9)

Note 1 These are preliminary selections will be confirmed in the detailed design stage once the layouts and façade orientations are finalised.
Note 2 Recommended system does not address rain noise criteria. Further detailing is required for compliance with rain noise criteria.

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.

It is recommended prior to the finalisation of the detailed design stage, a further detailed review be undertaken (including additional noise measurements) to verify if future noise levels have increased resulting in a higher performing roof system.

5.2 External Noise Level within Playground

As outlined in section 4.2.3 above, the NSW EPA RNP recommends open passive open spaces to have a 55 dB(A) $L_{Aeq(15\text{-}hour)}$ noise level exposure. Measured onsite noise levels indicate compliance with the 55 dB(A) objective will be achieved without the need for acoustic screens to control noise into the playground.

6 OPERATIONAL NOISE EMISSION ASSESSMENT

Assessment of the potential noise emissions from the operation of the new school impacts on the adjacent land users are outlined below. Noise emissions expected from the operation of the building are mainly from any base building services (mechanical, electrical, hydraulic), vehicle movements around and activity noise.

Each major component is discussed in detail below.

6.1 Noise from Engineering Services

Noise associated with the operation of all engineering services whilst onsite must comply with the requirements listed in section 4.1 above. This includes (however not limited to) all mechanical plant (including ventilation systems and air conditioning plant), hydraulic plant (including hot water systems) and electrical systems.

At this stage of the project, only the location of plant area is known (within two rooftop plant rooms). The final selections of plant and the associated noise levels are not known as such a detailed assessment cannot be undertaken.

Details of the required mechanical services equipment and acoustic treatments to ensure the relevant noise level criteria is achieved will be provided as part of the CC submission of the project.

Experience with similar projects indicates that the acoustic treatment of all services items proposed for the site is both possible and practical such that the relevant noise level criteria at all surrounding receivers is achieved.

Detailed of this are to be confirmed during the CC submission stage of this project.

Additionally, although it is not currently possible to provide quantitative predictions, the new mechanical plant that may be selected for the project (that will replace a significant amount of the existing equipment located on the three buildings that are set to be demolished) will likely feature a lower sound power level due to advancements in technology and the additional benefit of being located within a mechanical plantroom (where additional acoustic mitigation measures will be possible to be applied if required).

6.2 Vehicle Movements

Vehicle movements in and out of the Pymble Ladies College includes those from the existing drive way accessing the school off Avon Road. There will be no proposed staff vehicle access to the proposed Secondary Innovation Precinct building as part of the normal operation of the development.

One (1) loading space is proposed within the basement for deliveries and service vehicles. No additional car spaces are proposed as part of this development. As such, no further assessment of vehicles is required for a development of this nature.

Based on the proposed operation of the project there will not be any resulting noise impact on surrounding receivers resulting from vehicle movements accessing the site.

6.3 Activity Noise

Noise levels associated with the operation of the school are outlined below. It has been separated into three sections: outdoor play areas, internal areas classrooms and auditorium; see below.

6.3.1 Noise from Outdoor Areas

Assessment of the use of the proposed external outdoor play / learning / external terrace areas is detailed below. Outlined below is an assessment of school use between typical daytime school hours.

- One (1) outdoor learning area is located along the eastern side of ground floor. Featuring an area of approximately 45 m^2.
- One (1) outdoor learning area is located along the western side of level 01. Featuring an area of approximately 30 m^2.
- One (1) outdoor learning area is located along the eastern side of level 01. Featuring an area of approximately 46 m^2.
- One (1) outdoor learning area is located along the western side of level 02. Featuring an area of approximately 30 m^2.
- One (1) external terrace is located along the southern side of level 02. Featuring an area of approximately 355 m^2.
- One (1) external terrace is located along the western side of level 03. Featuring an area of approximately 10 m^2.
- One (1) external terrace is located along the southern side of level 03. Featuring an area of approximately 315 m^2.

Noise levels of students playing in outdoor areas which have been adopted in this assessment are provided below. These are determined based on PWNA professional experience and noise measurements undertaken at other school playgrounds during break periods (i.e., recess/lunch) for other School Infrastructure projects.

Table 21 Sound power levels for outdoor play activities

Parameter	Octave Band Centre Frequency, Hz								Overall dBA
	63	125	250	500	1000	2000	4000	8000	
Passive Play (10 Students)	69	79	84	88	91	88	82	80	**94**

Based on the assumptions outlined above, predicted noise levels during outdoor play times are presented below.

Table 22 Predicted Outdoor area noise levels – $L_{Aeq(15\text{-}minute)}$.

Receiver Location (Refer to Figure 3)	Predicted Noise Level dBA $L_{Aeq\ (15\text{-}minute)}$	Noise Management Level (NML) dBA $L_{Aeq\ (15\text{-}minute)}$	Result
Receiver 01	Up to 55	Day: 47	Refer to management controls below.
Receiver 02	Up to 55		
Receiver 03	Up to 55		
Receiver 04	Up to 55		
Receiver 05	Up to 55		

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 The LAeq 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.

In relation to above, we note:

- Predicted noise levels during periods of the day when the entire student faculty is utilising the outdoor play areas (i.e., recess and lunch) are likely to intermittently exceed the formulated NML in a worst-case scenario assessment.
- Noise levels during periods where the outdoor areas are used for structured learning activities to be significantly lower and are more frequent.
- As discussed in section 4.1, in NSW there is no defined acoustic criteria for the operational use of a school. As such we developed a Noise Management Level (NML) based on similar guidelines.
- Notwithstanding the discussion above the following acoustic mitigation measures should be implemented by the school to minimise impacts to surrounding residential receivers:
    - All use of the school playground is to be supervised by school staff to ensure no excessive yelling or screaming occurs.
    - Use of the school playground is limited to the school hours during the daytime period as proposed.
    - Use of the Public Address (PA) system is in accordance with section 6.4 below.
    - All of the listed mitigation measures are to be reflected in the School's Operation Management Plan (OMP).

- Therefore, in our professional opinion we believe the outdoor areas of the school is acoustically acceptable and justified.

6.3.2 Noise from Internal Areas (Classrooms and Library)

In the assessment of noise from the general learning spaces and specialist classrooms and associated support areas has been conducted on the assumption of a highly noise activity being undertaken with a sound pressure level within the classroom of 70 dB(A) sound pressure level and windows open for natural ventilation purposes which would be considered a worst-case scenario. Predicted noise levels at surrounding receivers is provided below.

Table 23 Predicted internal GLS noise levels – $L_{Aeq(15\text{-}minute)}$.

Receiver Location (Refer to Figure 3)	Predicted Noise Level dB(A) $L_{Aeq\ (15\text{-}minute)}$		Noise Management Level (NML) dBA $L_{Aeq\ (15\text{-}minute)}$	Result
	Windows Open	Windows Closed		
Receiver 01	Up to 44	<20	Day: 47	Refer to management controls below.
Receiver 02	Up to 44	<20		
Receiver 03	Up to 46	<20		
Receiver 04	Up to 46	<20		
Receiver 05	Up to 44	<20		

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 The LAeq 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.

To ensure compliance, the following operational parameters must be incorporated into the School Noise Management Plan (NMP):

- The classrooms within the Secondary Innovation Precinct are not to operate during the nighttime period (10:00 pm – 7:00 am).
- It is recommended that all operable windows be closed during periods of high intensity.

6.3.3 Noise from School Auditorium

The school auditorium is proposed to be used for regular school activities during typical school hours. As such an assessment of the hall is undertaken during the daytime period, representing between 7:00 am and 6:00 pm. This assessment assumes all students are within the hall (limited to seating capacity) and the installed PS system is in operation. The assumed Sound Pressure Level within the auditorium is 85 dB(A) $L_{Aeq\ (15\text{-}minute)}$.

Table 24 Predicted auditorium noise levels – $L_{Aeq(15\text{-}minute)}$.

Receiver Location	Predicted Noise Level dB(A) $L_{Aeq\ (15\text{-}minute)}$ Windows Closed	Noise Management Level (NML) dBA $L_{Aeq\ (15\text{-}minute)}$	Result
Receiver 01	<35	Day: 47	Refer to management controls below.
Receiver 02	<35		
Receiver 03	<35		
Receiver 04	<35		
Receiver 05	<35		

Note 1 *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 – 7:00 am.*

Note 2 *Note 2: The LAeq 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.*

Predicted noise levels indicate the operation of the school auditorium will not exceed the noise management levels when the entry doors are open and the noise level within the auditorium does not exceed 85 dB(A) $L_{Aeq\ (15\text{-}minute)}$ during the daytime period.

To ensure compliance, the following operational parameters must be incorporated into the School Noise Management Plan (NMP):

- Auditorium entry doors are permitted to be open during 7:00 am to 6:00 pm.
- If, on occasions the auditorium is being used outside of the daytime period (7:00 am – 6:00 pm), all entry doors must be closed, unless the auditorium is being used for low intensity 'passive use' which much not use any form of amplified music / noise. It is then permissible to leave the auditorium doors open within the evening period (6:00 pm – 10:00 pm).
- It is recommended that the auditorium is not used during the nighttime period (10:00 pm – 7:00 am).
- Noise levels within the auditorium must not exceed 85 dB(A) $L_{Aeq\ (15\text{-}minute)}$. (sound pressure level) unless the doors are closed.
- It's recommended the auditorium audio system be limited to 85 dB(A) L_{Aeq} (sound pressure level).

6.4 Public Address Systems

The location and design of the Public Address / Bell system has not been undertaken at this stage, however, will be required from an operation perspective. As such we provide the following acoustic design advice which must be incorporated during the design phase:

Noise levels at surrounding residents should not exceed the RBL + 5 dB(A) criteria established above.

A detailed review should be undertaken during the detailed design phase to ensure compliance with the RBL + 5 dB(A) criteria.

7 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

A preliminary acoustic assessment of the noise and vibrations impact during the construction of the Secondary Innovation Precinct and Campus Commons has been undertaken below.

The current construction program is proposed to comprise a single stage, over 24 months from December 2026 – December 2028.

All construction operations are proposed to occur within standard construction hours.

7.1 Construction Activities Sound Power Levels (Lw)

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 the listed tasks are provided in the table below.

Table 25 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	119
	Hand held jack hammer [1]	111	
	Dump truck [1]	104	
	Concrete saw [1]	114	
	Skid steer	110	
	Power hand tools	109	
Structure	Hand held jack hammer [1]	106	117
	Concrete saw [1]	114	
	Power hand tools	109	
	Welder	101	
	Concrete pump truck	110	
	Concrete agitator truck	108	
Internal Works	Power hand tools	109	109
Common and External Works	Concrete agitator truck	108	117
	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.

7.2 Predicted Construction Noise Levels

Predicted construction noise levels are presented below for each of the surrounding receivers in accordance with the NSW EPA ICNG.

Table 26 Receiver 1 – 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 dB(A) $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	57 to 63	60 to 66	**During Approved working hours** Noise management level: 42 + 10 = **52** **Highly Noise Affected Level** Approved construction Hours **75 dB(A) $L_{Aeq\ 15\ min}$**	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver, but below the highly noise affected level.
	Power hand tools		56 to 62			
	Semi Rigid Vehicle		48 to 53			
Ground Works	Excavator	119	59 to 65	64 to 70		
	Handheld jack hammer		65 to 71			
	Dump truck		57 to 63			
	Concrete saw		54 to 59			
	Skid steer		47 to 52			
	Power hand tools		57 to 62			
Structure	Handheld jack hammer	117	57 to 63	63 to 68		
	Concrete saw		56 to 62			
	Power hand tools		49 to 54			
	Welder		57 to 62			
	Concrete pump truck		56 to 62			
	Concrete agitator truck		48 to 54			
Internal Works	Power hand tools	109	57 to 63	51 to 57		
Common and External Works	Concrete agitator truck	117	55 to 61	61 to 67		
	Saw cutter		51 to 57			
	Dump truck		55 to 61			
	Concrete saw		47 to 52			
	Power hand tools		47 to 52			

Table 27 Receiver 2 – 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	59 to 64	62 to 67	**During Approved working hours** Noise management level: 42 + 10 = **52** **Highly Noise Affected Level** Approved construction Hours **75 dB(A) $L_{Aeq\ 15\ min}$**	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver, but below the highly noise affected level.
	Power hand tools		58 to 63			
	Semi Rigid Vehicle		49 to 55			
Ground Works	Excavator	119	61 to 66	66 to 71		
	Handheld jack hammer		67 to 72			
	Dump truck		59 to 64			
	Concrete saw		55 to 61			
	Skid steer		48 to 54			
	Power hand tools		58 to 64			
Structure	Handheld jack hammer	117	59 to 64	66 to 70		
	Concrete saw		58 to 63			
	Power hand tools		50 to 56			
	Welder		58 to 64			
	Concrete pump truck		58 to 63			
	Concrete agitator truck		50 to 55			
Internal Works	Power hand tools	109	59 to 64	53 to 58		
Common and External Works	Concrete agitator truck	117	57 to 62	63 to 68		
	Saw cutter		53 to 58			
	Dump truck		57 to 62			
	Concrete saw		48 to 54			
	Power hand tools		48 to 54			

Table 28 Receiver 3 – 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	62 to 68	65 to 71	**During Approved working hours** Noise management level: 42 + 10 = **52** **Highly Noise Affected Level** Approved construction Hours **75 dB(A) $L_{Aeq\ 15\ min}$**	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver, but below the highly noise affected level.
	Power hand tools		61 to 67			
	Semi Rigid Vehicle		52 to 58			
Ground Works	Excavator	119	64 to 70	69 to 75		
	Handheld jack hammer		70 to 76			
	Dump truck		62 to 68			
	Concrete saw		58 to 64			
	Skid steer		51 to 57			
	Power hand tools		61 to 67			
Structure	Handheld jack hammer	117	62 to 68	67 to 73		
	Concrete saw		61 to 67			
	Power hand tools		53 to 59			
	Welder		61 to 67			
	Concrete pump truck		61 to 67			
	Concrete agitator truck		53 to 59			
Internal Works	Power hand tools	109	62 to 68	56 to 62		
Common and External Works	Concrete agitator truck	117	60 to 66	66 to 72		
	Saw cutter		56 to 62			
	Dump truck		60 to 66			
	Concrete saw		51 to 57			
	Power hand tools		51 to 57			

Table 29 Receiver 4 – 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	62 to 67	65 to 70	**During Approved working hours** Noise management level: 42 + 10 = **52** **Highly Noise Affected Level** Approved construction Hours **75 dB(A) $L_{Aeq\ 15\ min}$**	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver, but below the highly noise affected level.
	Power hand tools		61 to 66			
	Semi Rigid Vehicle		52 to 57			
Ground Works and Demolition	Excavator	119	64 to 69	69 to 74		
	Handheld jack hammer		70 to 75			
	Dump truck		62 to 67			
	Concrete saw		58 to 63			
	Skid steer		51 to 56			
	Power hand tools		61 to 66			
Structure	Handheld jack hammer	117	62 to 67	67 to 73		
	Concrete saw		61 to 66			
	Power hand tools		53 to 58			
	Welder		61 to 66			
	Concrete pump truck		61 to 66			
	Concrete agitator truck		53 to 58			
Internal Works	Power hand tools	109	62 to 67	56 to 61		
Common and External Works	Concrete agitator truck	117	60 to 65	66 to 71		
	Saw cutter		56 to 61			
	Dump truck		60 to 65			
	Concrete saw		51 to 56			
	Power hand tools		51 to 56			

Table 30 Receiver 5 – 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	61 to 68	64 to 71	**During Approved working hours** Noise management level: 42 + 10 = **52** **Highly Noise Affected Level** Approved construction Hours **75 dB(A) $L_{Aeq\ 15\ min}$**	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver, but below the highly noise affected level.
	Power hand tools		60 to 67			
	Semi Rigid Vehicle		51 to 58			
Ground Works and Demolition	Excavator	119	63 to 70	68 to 75		
	Handheld jack hammer		69 to 76			
	Dump truck		61 to 68			
	Concrete saw		57 to 64			
	Skid steer		50 to 57			
	Power hand tools		60 to 67			
Structure	Handheld jack hammer	117	61 to 68	67 to 73		
	Concrete saw		60 to 67			
	Power hand tools		52 to 59			
	Welder		60 to 67			
	Concrete pump truck		60 to 67			
	Concrete agitator truck		52 to 59			
Internal Works	Power hand tools	109	61 to 68	55 to 62		
Common and External Works	Concrete agitator truck	117	59 to 66	65 to 72		
	Saw cutter		55 to 62			
	Dump truck		59 to 66			
	Concrete saw		50 to 57			
	Power hand tools		50 to 57			

7.3 Construction Traffic Noise Assessment

From the criteria, 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.

Construction traffic required to access the site as part of the works to be undertaken on the site will be management in accordance with a *Construction Management Plan* which will be developed once a building contractor has been appointed.

7.4 Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in Section 4.4, it is recommended that the indicative safe distances listed in Table 31 should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking measurements of vibration levels generated by construction and demolition equipment to be used on site.

Since 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 onto this sensitive equipment.

Additionally, any vibration levels should be assessed in accordance with the criteria discussed in Section 4.4.3. This information should also be included as part of a Construction Noise Vibration Management Plan (CNVMP).

Table 31 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	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20
	< 100 kN (Typically 2 – 4 tonnes)	6	20
	< 200 kN (Typically 4 – 6 tonnes)	12	40
	< 300 kN (Typically 7 – 13 tonnes)	15	100
	> 300 kN (Typically more than 13 tonnes)	20	100
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

7.5 Acoustic Management Procedures

7.5.1 Summary of Management Procedures

Table 32 below summarises the management procedures recommended for airborne noise and vibration impact. These procedures are also further discussed in the report.

Table 32 Summary of mitigation procedures.

Procedure	Abbreviation	Description
General Management Measures	GMM	Introduce best-practice general mitigation measures in the workplace which are aimed at reducing the acoustic impact onto the nearest affected receivers.
Project Notification	PN	Issue project updates to stakeholders, discussing overviews of current and upcoming works. Advanced warning of potential disruptions can be included. Content and length to be determined on a project-by-project basis.
Verification Monitoring	V	Monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers. If the measured levels are higher than those predicted, then the measures will need to be reviewed and the management plan will need to be amended.
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders
Specific Notification	SN	Individual letters or phone calls to notify stakeholders that noise levels are likely to exceed noise objectives. Alternatively, contractor could visit stakeholders individually in order to brief them in regard to the noise impact and the mitigation measures that will be implemented.
Respite Offer	RO	Offer provided to stakeholders subjected to an ongoing impact.
Alternative Construction Methodology	AC	Contractor to consider alternative construction options that achieve compliance with relevant criteria. Alternative option to be determined on a case-by-case basis. It is recommended that the selection of the alternative option should also be determined by considering the assessment of on-site measurements (refer to Verification Monitoring above).

The application of these procedures is in relation to the exceedances over the relevant criteria. For airborne noise, the criteria are based on NMLs. The allocation of these procedures is discussed in Section 7.5.2.

For vibration, the criteria either correspond to human comfort, building damage or scientific and medical equipment. The application of these procedures is discussed in Section 7.5.3.

7.5.2 Allocation of Noise Management Procedures

For residences, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs (refer to 7.2 for list of NMLs used in the acoustic assessment). The allocation of these procedures is summarised in Table 33 below.

Table 33 Allocation of noise management procedures – Residential Receivers.

Construction Hours	Exceedance over NML (dB)	Management Procedures (see definition above)
Standard Hours Mon – Fri: 7:00 am to 6:00 pm Sat: 8:00 am – 1:00 pm	0 - 3	GMM, CMS, AC
	4 - 10	GMM, CMS, AC, V [1]
	11 - 20	GMM, CMS, PN, AC, V [1]
	≥ 21	GMM, CMS, PN, AC, SN, V [1]
	≥ 75 dB(A)	GMM, CMS, PN, AC, SN, RO, V [1]
Outside Standard Hours (If applicable)	Specific NMP will be undertaken should this be required.	

Note 1 Verification monitoring to be undertaken upon complaints received from affected receivers.

7.5.3 Allocation of Vibration Management Procedures

Table 34 below summarises the vibration management procedures to be adopted based on exceedance scenarios (i.e., whether the exceedance occurs over human comfort criteria, building damage criteria, or criteria for scientific and medical equipment). Please note these management procedures apply for any type of affected receiver (i.e., for residences as well as non-residential receivers).

Table 34 Allocation of vibration management procedures.

Construction Hours	Exceedance Scenario	Management Procedures
Standard Hours Mon – Fri: 7:00 am to 6:00 pm Sat: 8:00 am – 1:00 pm	Over human comfort criteria (refer to Section 4.4.3)	GMM, CMS, AC, SN, V [1]
	Over building damage criteria (refer to Section 4.4.3)	GMM, CMS, AC, SN, VM, RO, V [1]
Outside Standard Hours (If applicable)	Specific VMP will be undertaken should this be required.	

Note 1 Verification monitoring to be undertaken upon complaints received from affected receivers.

7.6 Site Specific Noise Mitigation Measures

7.6.1 General Comments

The contractor will, where reasonable and feasible, apply best practice noise mitigation measures. These measures shall include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same site area.
- Orienting equipment away from noise sensitive areas.

- Carrying out loading and unloading away from noise sensitive areas.

In order to minimise noise impacts during the works, the contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal.

7.6.2 Noise Monitoring

Noise monitoring, if required, will be performed by an acoustical consultant directly engaged by the contractor.

Noise monitoring for the excavation, compaction and construction works should be undertaken using statistical noise loggers. The statistical parameters to be measured should include the following noise descriptors: LA90, LA10 and LAeq. Noise measurements should be conducted over consecutive 15-minute periods.

This monitoring should also be complemented by undertaking attended noise measurements 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 the event of any complaints, the noise impact at the affected location should be confirmed by conducting attended noise measurements.

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

7.6.3 Alternate Equipment or Process

Exceedance of the site's NMLs should result in an investigation as to whether alternate equipment could be used, or a difference process could be undertaken.

In some cases, the investigation may conclude that no possible other equipment can be used, however, a different process could be undertaken.

7.6.4 Acoustic Enclosures/Screening

Typically, on a construction site there are three different types of plant that will be used: mobile plant (i.e., excavators, skid steers, etc.), semi mobile plant (i.e., hand tools generally) or static plant (i.e., diesel generators).

For plant items which are static it is recommended that, in the event exceedances are being measured due to operation of the plant item, an acoustic enclosure/screen is constructed to reduce impacts. These systems can be constructed from Fibre Cement (FC) sheeting or, if airflow is required, acoustic attenuators or louvres.

For semi mobile plant, relocation of plant should be investigated to either be operated in an enclosed space or at locations away from a receiver.

With mobile plant it is generally not possible to treat these sources. However, investigations into the machine itself may result in a reduction of noise (i.e., mufflers/attenuators etc).

7.7 Vibration Mitigation Measures

7.7.1 General Comments

As part of the CNVMP, the following vibration mitigation measures could be implemented as part of the delivery of the project. The building contractor (once appointed) is to undertake a feasibility of possible mitigations, such as the following:

- Any vibration generating plant and equipment is to be in areas within the site in order to lower the vibration impacts.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of construction plant and equipment; that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Schedule a minimum respite period of at least 30 minutes before activities commence which are to be undertaken for a continuous 4-hour period.
- Conduct attended measurements of vibration generating plant at commencement of works to validate the indicative safe working distances advised in Table 31 and, consequently, to establish safe working distances suitable to the project. Measurements should be conducted at the nearest affected property boundary. These safe working distances should be defined by considering the vibration criteria discussed in Section 4.4.3 (i.e., criteria for structural damage and human comfort).

7.7.2 Vibration Monitoring

Vibration monitoring, if required, should be undertaken continuously at the nearest most affected structures.

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 audible/visual 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.

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.

7.8 Community Consultation

Active community consultation and the maintenance of positive relations with local residents and businesses would assist in alleviating concerns and thereby minimising complaint. It is common for construction projects to provide community consultation if an exceedance of noise goals has been predicted. This communication is commonly conducted in the form of a letter box drop or more active engagement with more highly impacted receivers.

This form of notification should provide specific notification of the duration and timing of the construction activities so that residents are informed about the proposed works ahead of time. The letter should also provide the community with a hotline number for a community liaison officer available to adequately respond to all project related enquiries.

Ideally the hotline number should provide concerned locals an opportunity to raise any concerns with the project proponent and provide an opportunity to determine the best method to satisfy all requirements.
Prior to the works onsite being undertaken, it is recommended that community consultation with the neighbouring affected parties be undertaken.

The communication however should not be limited to the beginning of the onsite works but throughout providing the community with constant updates to the progress and upcoming works. In our experience these could include:

- Site noticeboard.
- Email notifications; and
- Letterbox drops.

7.9 Complaints Management System

The Contractor is to establish a communication register for recording incoming complaints. The registration of a particular item will remain open until the complaint has been appropriately dealt with.

All complaints should be investigated by the Contractor in accordance with the procedures outlined in Australia Standard 2436-2010. In addition, the following procedures are an example of the procedures that are to be specifically adopted for complaints relating to noise.

Upon receipt of a complaint the Contractor is to:

- Try to ascertain from the complaint which appliance is causing the problem i.e., inside or outside the site and in what position.
- Establish from the monitoring equipment if the allowable noise levels have been complied with.
- Establish if the appliance positioning has previously been highlighted as a problem area. If not and the noise levels are above the allowable limit, then the equipment and its position shall be noted.
- Move machinery if the allowable levels have been exceeded or take other acoustic remedial action.
- The Site Supervisor is to ensure that a report of any incident is provided to the Project Manager.
- The Project Manager is to provide a report on the incident to the relevant stakeholders.
- The Contractor is to provide a 24-hour telephone contact number and this number is to be prominently displayed on the site.

7.10 Complaints Management System

Should complaints arise they must be delt with in a responsible and uniform manner, therefore a management system to deal with complaints is detailed above.

7.11 Contingency Plans

Contingency plans are required to address noise or vibration problems if excessive levels are measured at surrounding sensitive receivers and / or if justified complaints occur. Such plans could include:

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most construction noise and vibration at the sensitive receivers; and
- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.

7.12 General Mitigation Measures (Australia Standard 2436-2010)

As well as the above project specific noise mitigation controls, AS 2436-2010 *"Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites"* sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

7.12.1 Adoption of Universal Work Practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevated work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

7.12.2 Plant and Equipment

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.

- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

7.12.3 On Site Noise Mitigation

- Maximising the distance between noise activities and noise sensitive land uses.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

7.12.4 Work Scheduling

- Providing respite periods which could include restricting very noisy activities to time periods that least affect the nearby noise sensitive locations, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.

7.12.5 Source Noise Control Strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site.
- Siting of equipment: locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective equipment maintenance.

8 CONCLUSION

Pulse White Noise Acoustics Pty Ltd (PWNA) has undertaken a detailed acoustic assessment for the proposed Secondary Innovation Precinct and Campus Commons development to be located at within the existing Pymble Ladies' College, located at 20 Avon Road, Pymble.

This noise and vibration impact assessment has been prepared in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs) and in support of the preparation of an Environmental Impact Statement (EIS) and State Significant Development Application (SSD - 79146716) to the Department of Planning, Housing and Infrastructure (DPHI).

A review of existing onsite noise at the site have been assessed and recommended acoustic treatments to the future buildings facades to ensure internal noise levels are within permissible limits. These recommendations also assist with the control of noise emissions from high noise spaces such as the community and dance studios will comply with relevant guidelines at nearby receivers.

Analysis of noise from internal areas such of the proposed development as well as noise associated with external play areas and the use of the public address system have been assessed and suitable acoustic building constructions and operational controls to mitigate noise emissions resulting from the development are detailed in this report.

Noise emissions from the use of the school play areas during periods where maximum capacities are achieved (i.e. recess and lunch) is likely to exceed the formulated criteria outlined above. However as cited above, "All noise that emanates from the normal activities at a school is not offensive" and therefore is deemed acceptable.

Construction noise emissions from a range of construction scenarios has been considered for the nearest noise sensitive receivers. The assessment identified that there were no noise sensitive receivers which would be highly noise affected. However, there were receivers that had noise predictions significantly above the project NMLs. Appropriate construction noise management and mitigation measures have been recommended to reduce the potential for impacts on the surrounding community.

Regards,

Nikolaj Drydale-Cech
Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD

APPENDIX A. APPENDIX TERMINOLOGY

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0 dB(A) Threshold of human hearing 30 dB(A) A quiet country park 40 dB(A) Whisper in a library 50 dB(A) Open office space 70 dB(A) Inside a car on a freeway 80 dB(A) Outboard motor 90 dB(A) Heavy truck pass-by 100 dB(A) Jackhammer/Subway train 110 dB(A) Rock Concert 115 dB(A) Limit of sound permitted in industry 120 dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Ambient sound	The all-encompassing sound at a point composed of sound from all sources near and far.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Reverberation	The persistence of sound in a space after the source of that sound has been stopped (the reverberation time is the time taken for a reverberant sound field to decrease by 60 dB)
Air-borne sound	The sound emitted directly from a source into the surrounding air, such as speech, television or music
Air-borne sound isolation	The reduction of airborne sound between two rooms.
Sound Reduction Index [R] *(Sound Transmission Loss)*	The ratio the sound incident on a partition to the sound transmitted by the partition.
Weighted sound reduction index [R_w]	A single figure representation of the air-borne sound insulation of a partition based upon the R values for each frequency measured in a laboratory environment.
C_{tr}	A value added to an R_w or $D_{nT,w}$ value to account for variations in the spectrum.
Energy Equivalent Sound Pressure Level [$L_{A,eq,T}$]	'A' weighted, energy averaged sound pressure level over the measurement period T.
Percentile Sound Pressure Level [$L_{Ax,T}$]	'A' weighted, sound pressure that is exceeded for percentile x of the measurement period T.
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
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
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
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.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the LA90 value
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.
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.
L01	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 L90 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.

APPENDIX B. UNATTENDED NOSIE MONITORING

20 Avon Road, Pymble

Ambient noise monitoring report

Item	Information
Logger Type	NORSONIC 139
Serial number	1393013
Address	20 Avon Road, Pymble
Location	20 Avon Road, Pymble
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
Fri 31 Jan 2025	-	-	-	58	56	47
Sat 01 Feb 2025	45	-	28	59	55	50
Sun 02 Feb 2025	41	-	27	57	53	48
Mon 03 Feb 2025	43	-	28	56	56	52
Tue 04 Feb 2025	40	-	30	55	55	52
Wed 05 Feb 2025	41	35	32	56	56	53
Thu 06 Feb 2025	42	-	29	56	56	52
Fri 07 Feb 2025	43	46	31	57	56	52
Sat 08 Feb 2025	43	-	-	57	54	50
Sun 09 Feb 2025	38	-	30	58	58	48
Mon 10 Feb 2025	46	38	31	61	58	52
Tue 11 Feb 2025	41	-	33	57	57	53
Wed 12 Feb 2025	41	-	32	56	57	52
Thu 13 Feb 2025	-	-	-	56	-	53
Summary	**42**	**38**	**30**	**57**	**56**	**51**

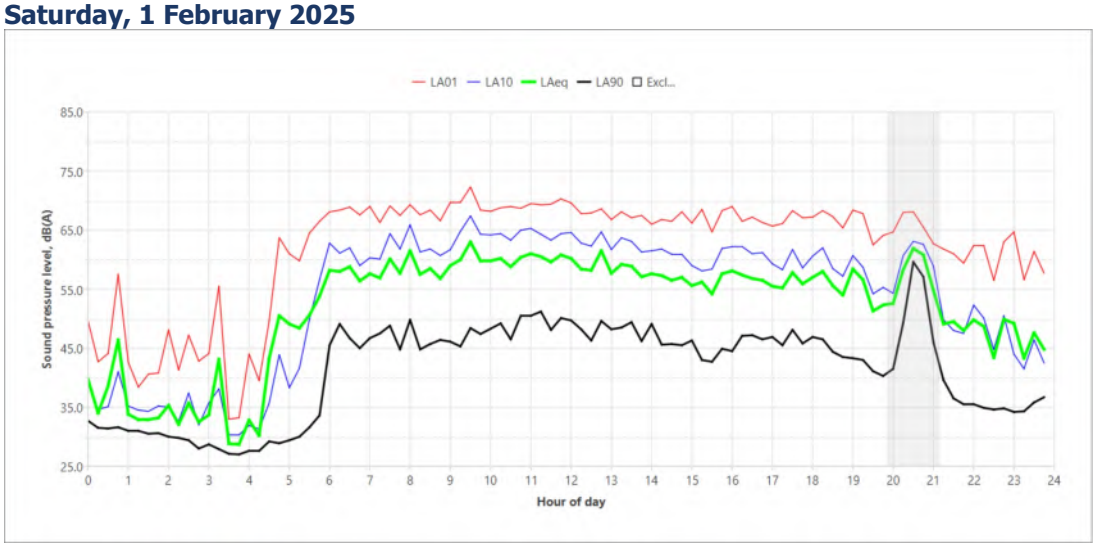
Note: Results with a '-' identify that there were not enough measurements available to correctly calculate the level, in accordance with the Noise Policy for Industry. The data has been excluded either from weather or manual exclusions. See the charts for more information

Logger location

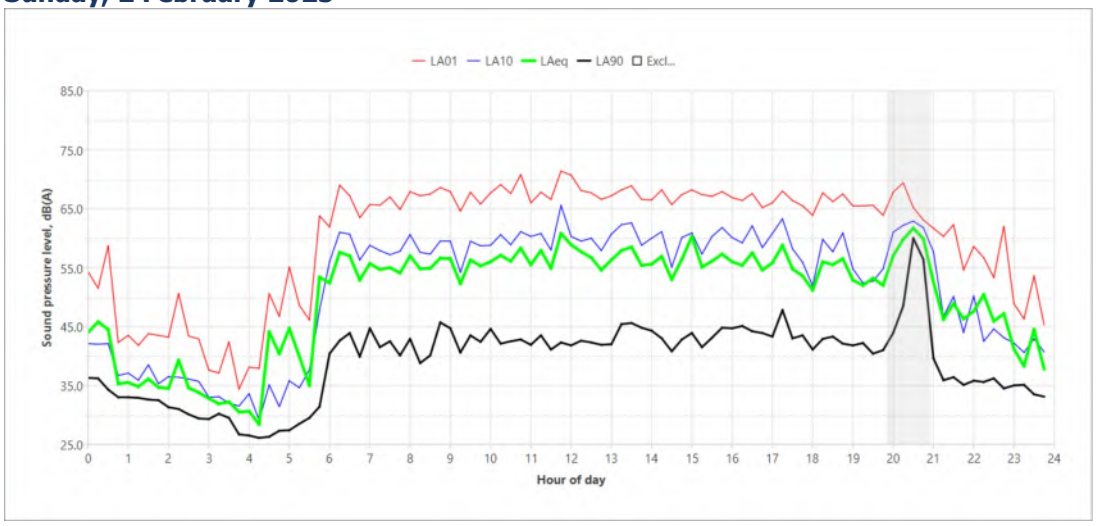
Logger deployment photo

Friday, 31 January 2025

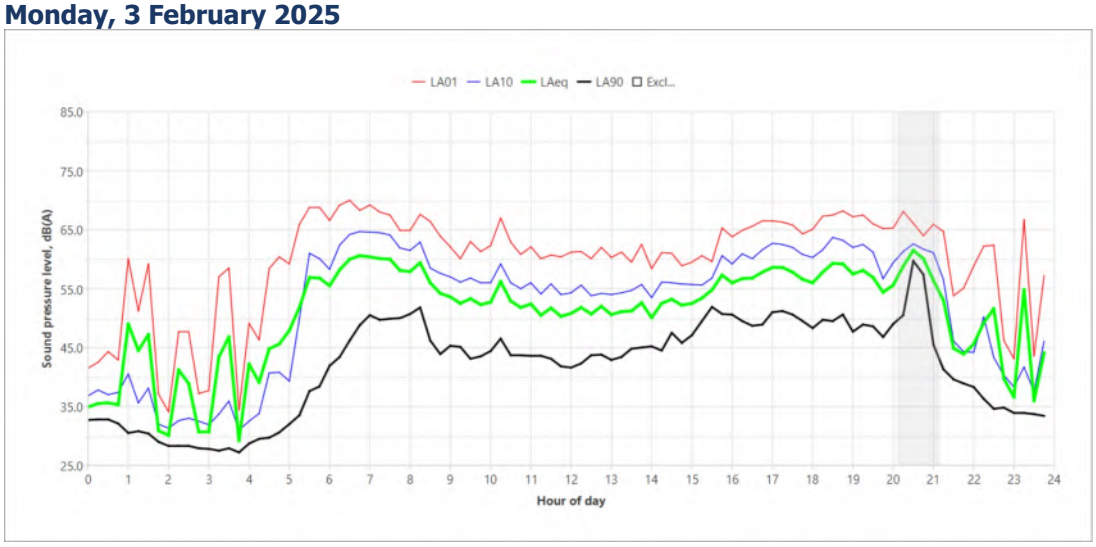
Saturday, 1 February 2025



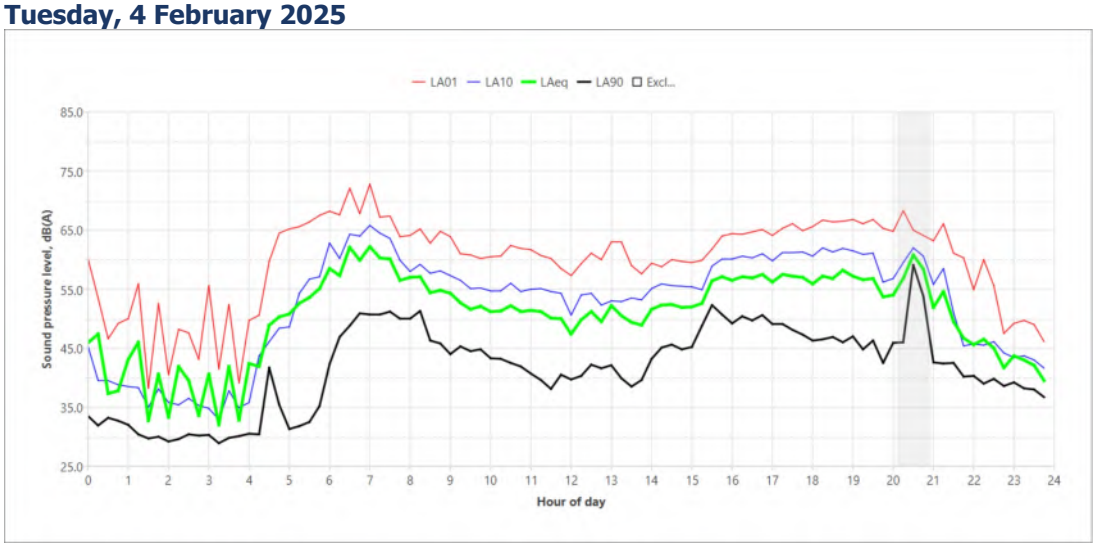
Sunday, 2 February 2025



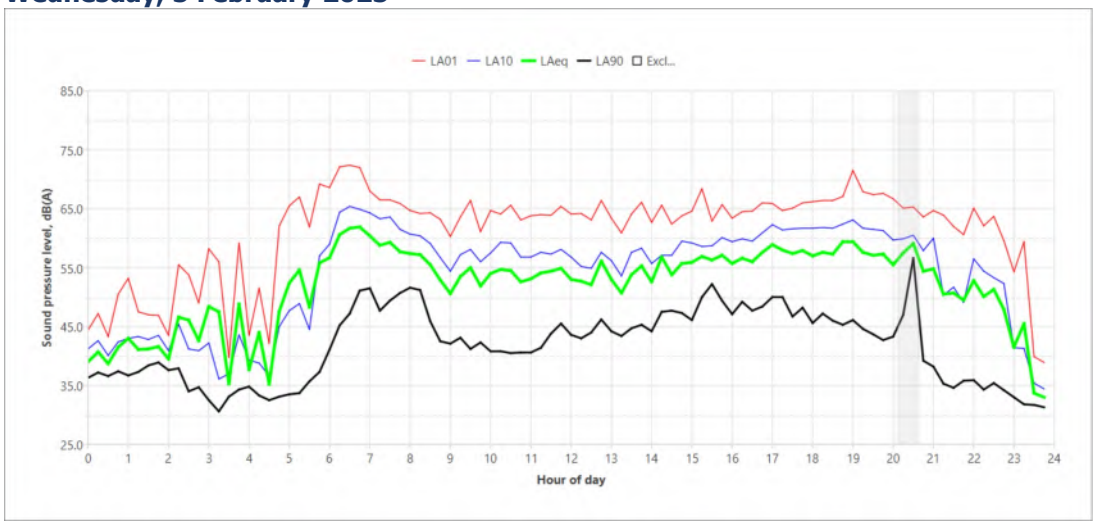
Monday, 3 February 2025



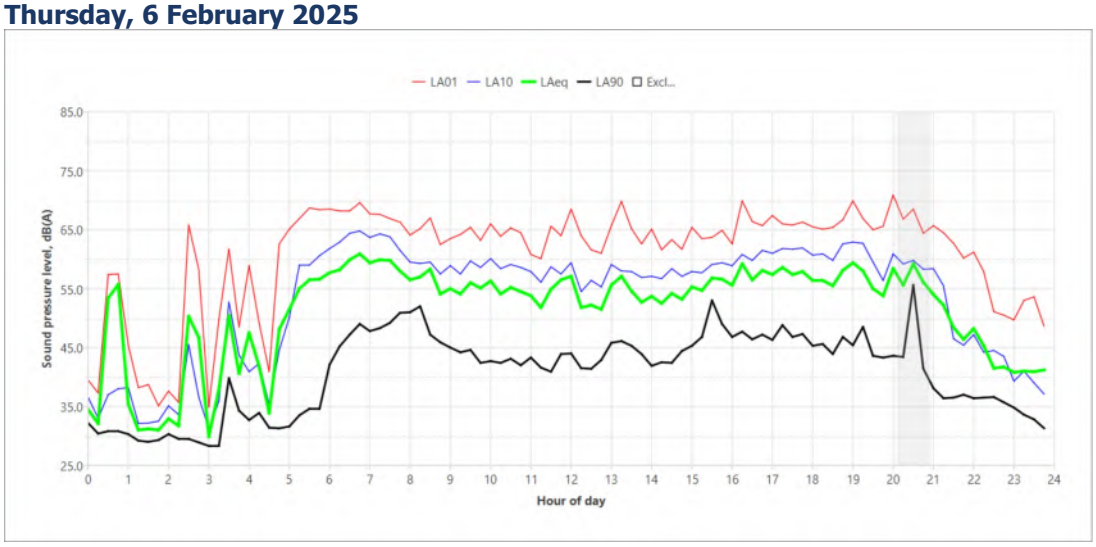
Tuesday, 4 February 2025



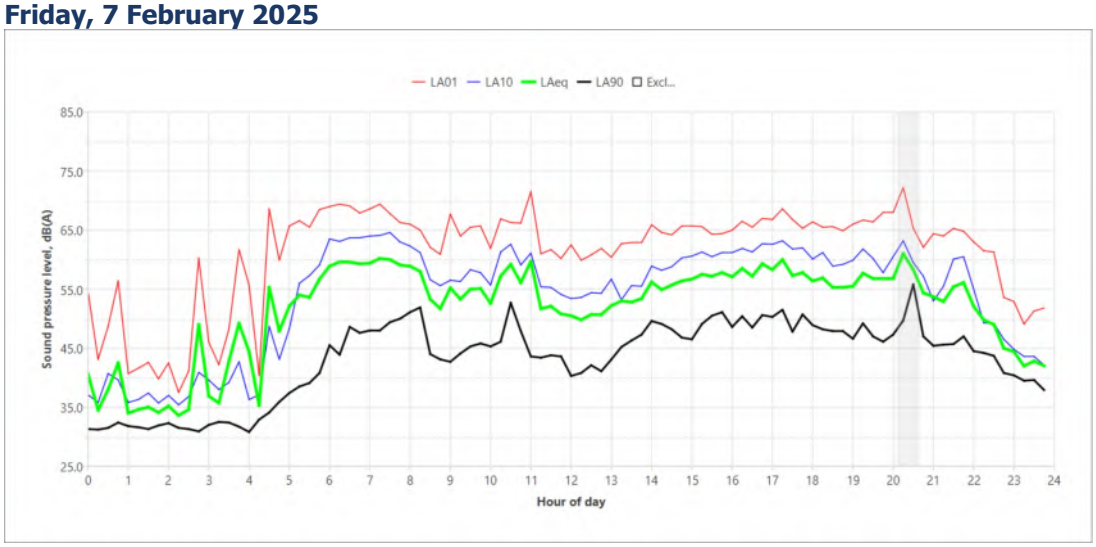
Wednesday, 5 February 2025



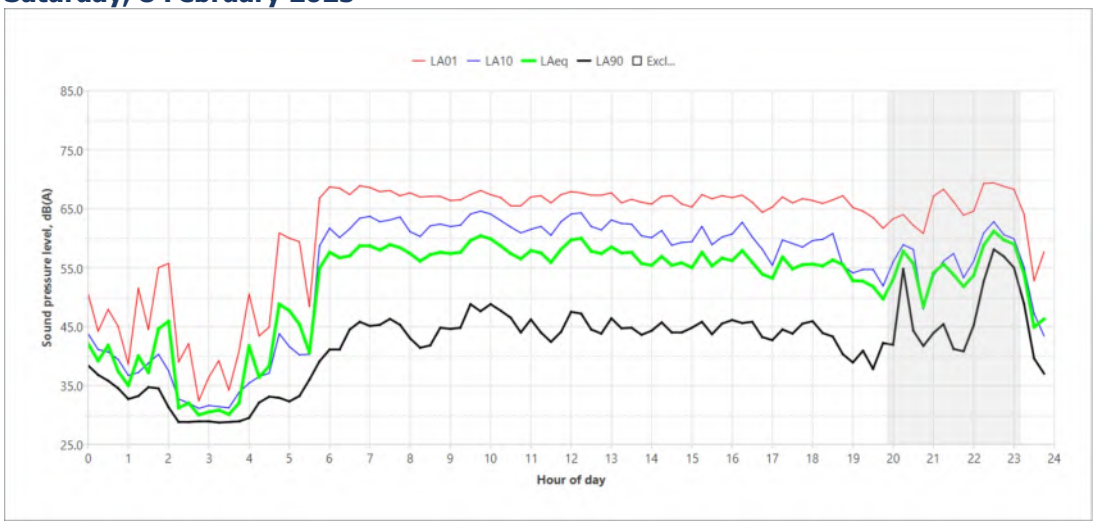
Thursday, 6 February 2025



Friday, 7 February 2025

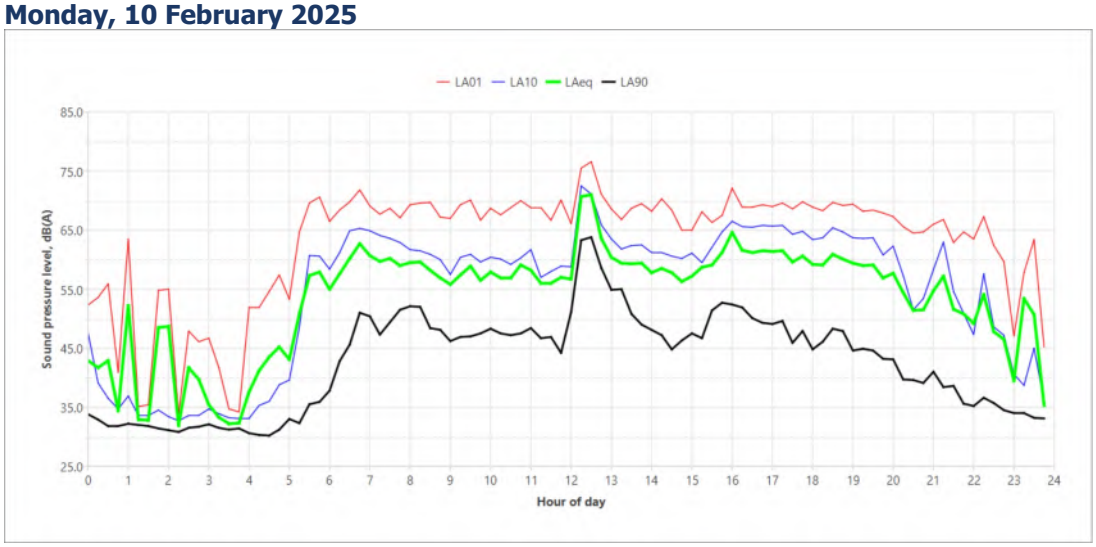


Saturday, 8 February 2025

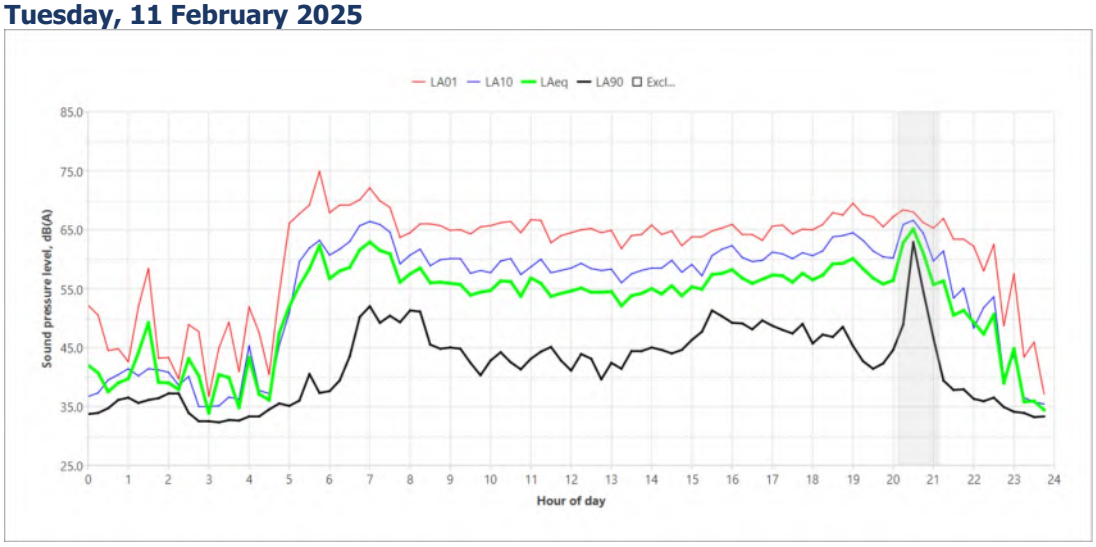


Sunday, 9 February 2025

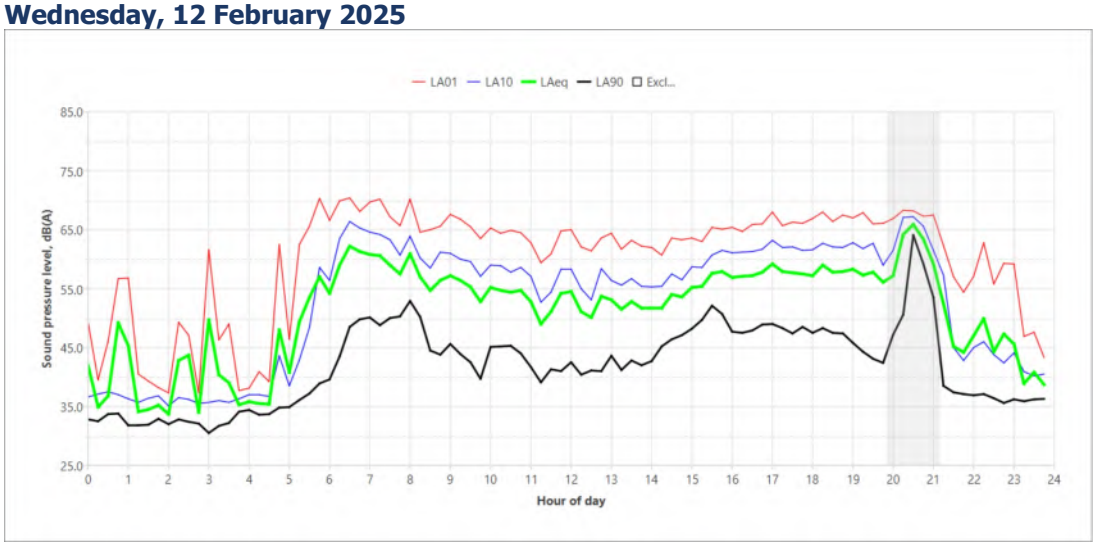
Monday, 10 February 2025



Tuesday, 11 February 2025



Wednesday, 12 February 2025



Thursday, 13 February 2025