Acoustic DA Report

St. Mary's Preschool Wagga Acoustics

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Contents

1. Introduction

This Acoustic report has been issued in relation to the development application (DA) for the proposed preschool named 'St. Mary's' located on Farrer Road, Boorooma, NSW. Background noise monitoring was conducted for the assessment to determine noise criteria for onsite and offsite activities. The site location is shown in Figure 1.

Figure 1: Site location (Source: City of Wagga Wagga Intramaps, 2018 Aerial Image)

Based on the current architectural drawings by Gray Puksand Architecture, dated 22 April 2024, the proposed preschool will be a single-storey construction with details as follows:

- The proposed pre-school is in close proximity to Charles Sturt University (CSU) and adjacent university buildings.
- Capacity of 90 children aged between 3-5 years, generally divided into 3 classrooms (105-106m^2 each) holding up to 30 children each. Each classroom has connected bathrooms.
- A total of 3,933m^2 outdoor play area, on the western, northern and eastern sides of the proposed building.
- A training room (80m^2) is also located in the southeastern corner of the building, to hold groups of up to 30 children out of class times.
- A courtyard (101m^2) and sensory room (28m^2) located centrally in the building.

- An admin room with reception, staff room, head of school office, storeroom and program office in the southwestern side of the building.
- Chair storeroom, bathrooms and an MFH office located on the eastern side of the building.
- A meeting room, laundry and bathrooms located centrally adjacent to the courtyard.
- A carpark of 23 spaces is located on the southern side of the building.
- Site access is via Farrer Road to the south.
- Operating hours of Monday-Friday, 7am-6pm.

The overall site plan of the development, by Gray Puksand Architecture dated 27 July 2024, is shown in Figure 2. The current floor layout dated 25 June 2024, is shown in Figure 3. The current landscaping plans, which detail the location of outdoor play areas, is shown in Figure 4.

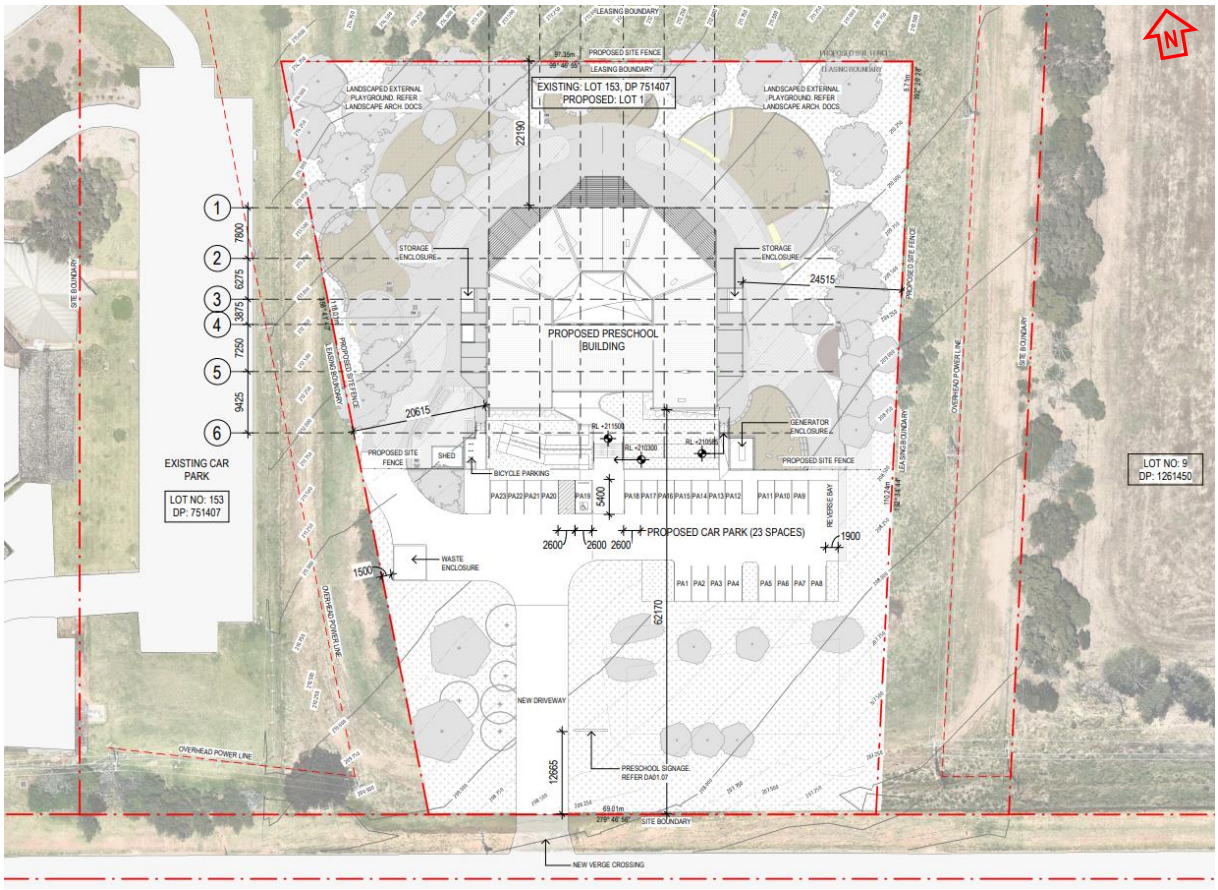

Figure 2: Proposed Site Plan (dated 26 July 2024, by Gray Puksand Architecture)

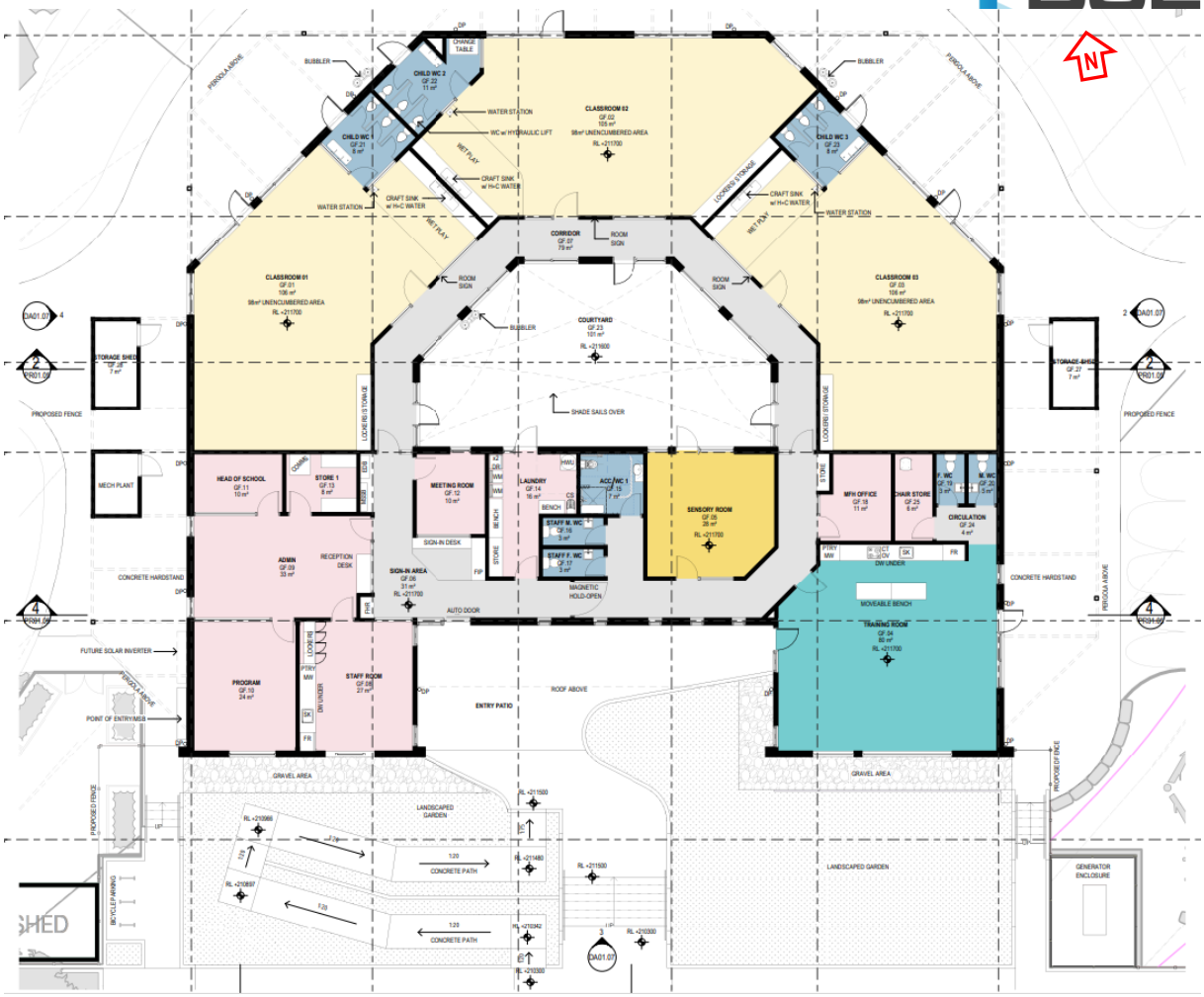

Figure 3: Proposed Floor Layout (dated 25 June 2024, by Gray Puksand Architecture)

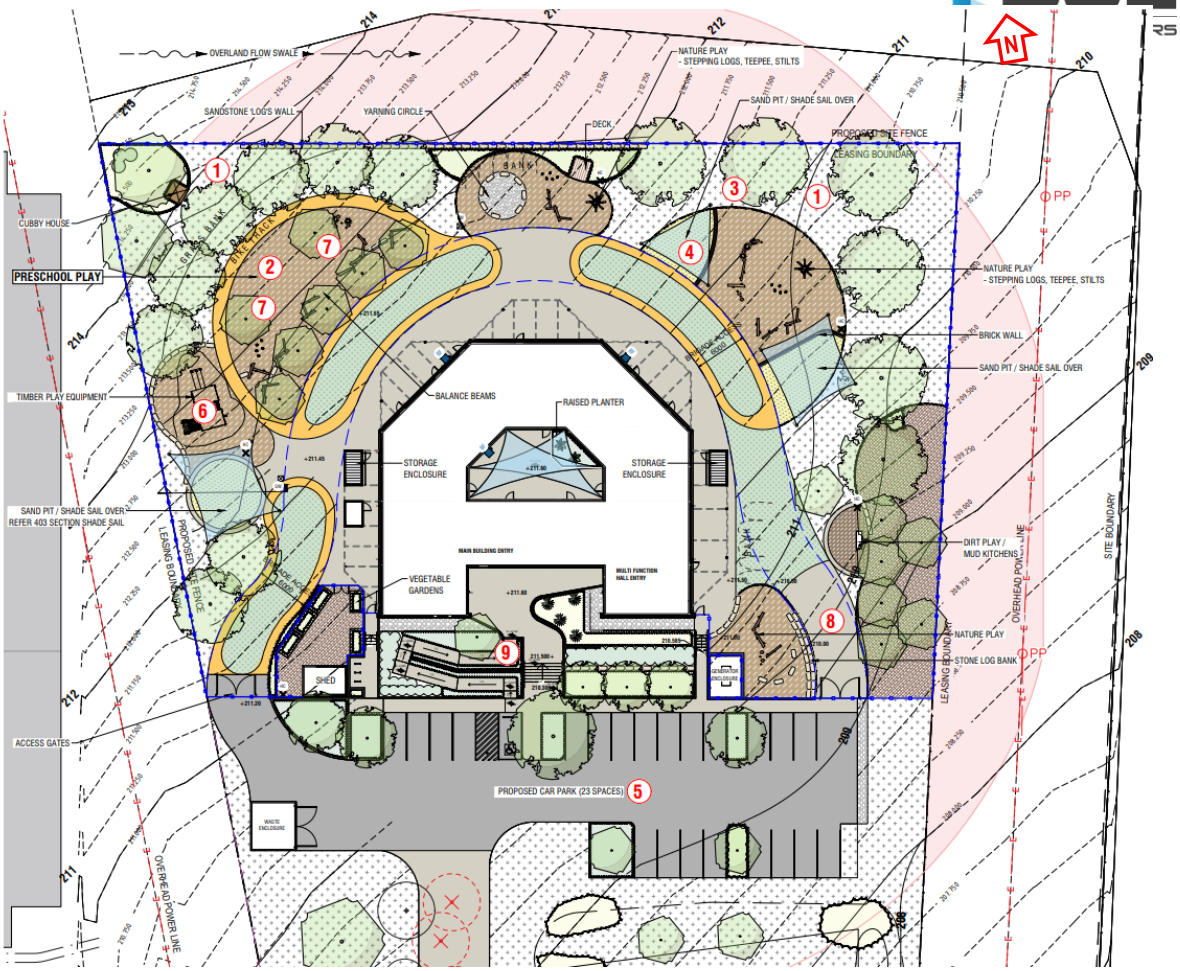

Figure 4: Proposed Outdoor Landscaping Drawing ('General Arrangement Plan' by Harris Hobbs Landscapes)

1.1. Referenced Documents

This assessment is based upon client provided site drawings shown in Table 1.

Table 1: Client Provided Site Drawings

Document	Drawing No.	Revision	Drawing Title	Drawn By	Project Number	Drawn
DA Architectural Plans	DA01.02	9	Site Plan	Gray Puksand	423039	26/07/2024
	DA01.04	6	Floor Plan – Ground Floor			25/06/2024
	DA01.06	6	Reflected Ceiling Plan – Ground Floor			25/06/2024
	DA01.07	6	Elevations + External Finishes Schedule			25/06/2024
	DA01.08	6	Sections			25/06/2024

2. Project information

2.1. Description of Site and Surrounding Area

The proposed site location comprises a section of lot 8 on DP1261450, on Farrer Road, Boorooma. The site location is shown in the map and aerial image of the surrounding area, in Figure 5.The site is located on the northern side of Farrer Road, although currently access to the large rural lot is on Maybal Lane to the north. Access via Farrer Road is proposed as part of the development.

To the west of the site are educational buildings part of Charles Sturt University (CSU). These buildings were previously used for performing arts education but have recently been utilised by Autism Spectrum Australia (Aspect). Aspect operates the site between 7am-5pm for staff, and between 8:30am-3pm for students. The existing number of students is 19. It is currently unknown whether separate approval for educational use has been granted to this site.

To the north and east are largely empty rural lots. Farrer Road borders the site to the south and separates the development from a suburban housing development. The surrounding area is shown in Figure 5.

Figure 5: Preschool site location, potentially affected receivers, and monitoring location

3. Existing Acoustic Environment

The site is located in a suburban/rural interface and the acoustic environment consists predominantly of road traffic, fauna noise, and other suburban activity. The location of nearby sensitive receivers, and details of the unattended noise monitoring conducted by BSE are detailed in this section.

3.1. Potentially Affected Receivers

The sensitive receivers potentially most affected from noise from the source under consideration are listed in Table 2 and shown in the aerial image of the surrounding area in Figure 5.

A Colorbond fence is situated along the northern boundary of the residential properties on Farrer Road (receiver 2). Fences of this construction generally provide only minimal acoustic screening due to their low surface density – as a conservative assessment we have assumed there is no attenuation in noise levels through this barrier.

Table 2: Table of potential affected receivers

Receiver ID	Receiver Type	Address	Description
R01	Commercial*	250 Boorooma Street, Charles Sturt University	Charles Sturt University educational buildings – Performing Arts
R02	Residential	75-81 Strickland Drive & 131 Farrer Road, Boorooma	Single-storey residential dwellings
*Note that receiver 1 CSU buildings have recently been utilised by Aspect as an institution for children. However, the exact approval for the site in this capacity is not currently known. Therefore, the existing buildings may be a standard commercial receiver or assessed under school classrooms. This report takes both into consideration and council should determine which is applicable.			

The area immediately to the west of the site was previously used for performing arts studios but are now in use by Autism Spectrum (Aspect) Australia. The exact approval is not known, and these buildings may be of school classroom or general commercial use. Recommendations in this report are provided for both scenarios, and final implemented treatments would depend on the use of the buildings.

3.2. Sound Monitoring Equipment

BSE have undertaken unattended sound measurements in preparing this assessment using a Class 1 instrument, compliant with *IEC61672-1:2013 Electroacoustics – Sound level meters – Part 1: Specifications*, and within current NATA calibration at the time of the monitoring.

The sound logger was set to the "A-weighted" frequency weighting, the "Fast" time response, and was calibrated before and after use, using a NTi CAL200 S/N:17897 94 dB, 1 kHz tone, with no significant drift occurring. The sound logger serial number and calibration information are presented in Table 3.

Table 3 Noise Logger Calibration Information

Instrument model	Serial number	NATA Calibration certificate: issue date	Pre-Calibration [dB]	Post-Calibration [dB]
Rion NL-52EX	00710353	Nov 2023	94.0	94.0
NTi CAL200	17897	Feb 2024	-	-

Meteorological data for the project was sourced from the Bureau of Meteorology's weather station at Wagga Wagga Airport (IDN 072150). As required by the NSW Environmental Protection Authority's (EPA), all weather affected measurements with wind speeds > 5 m/s and rainfall events were deleted from the data set.

3.3. Unattended Sound Measurement Location

To determine the required appropriate site-specific sound levels of the project, one unattended sound logger was installed onsite between 21 and 28 February 2024. A photo of the noise monitor at this location is shown in Figure 6. The intent of this location was to determine the ambient noise levels – consisting predominantly of fauna, local road traffic, and general suburban noise – and to determine site specific Rating Background Noise Levels (RBLs).

Figure 6 – In-situ logger location – onsite, looking west to Charles Sturt University buildings.

3.4. Measured Ambient Noise Levels

3.4.1. Unattended Background Levels

Following analysis, the overall L_{eq} ambient levels and Rating Background Levels (RBL) measured for day, evening, and night periods are shown in Table 4.

Table 4 Overall L_{eq} ambient levels and Rating Background Levels (RBL)

	Day	Evening	Night
RBL [$L_{90, period}$ dB(A)]	37	38*	35
Leq [$L_{eq, period}$ dB(A)]	41	42	37

*NSW Noise Policy for Industry 2017 states that the evening background level should not be higher than the daytime levels. When calculating the intrusive criteria, an evening level of 37dBA has been applied.

Background noise levels were observed to consist predominantly of natural noises such as birds during setup and pickup of the monitor in the late afternoon. These noises would likely have occurred during the evening and early morning (in the night-time period) and therefore RBLS for each period are very similar. Low level insects were possibly active late in the night (midnight-5am). Distant traffic to the east was also consistently audible.

Note that the proposed St. Mary's Preschool will be open during the daytime hours only and therefore only the daytime criteria are applied in this assessment.

A graphical depiction of the measured ambient noise levels throughout the week is shown in Figure 7.

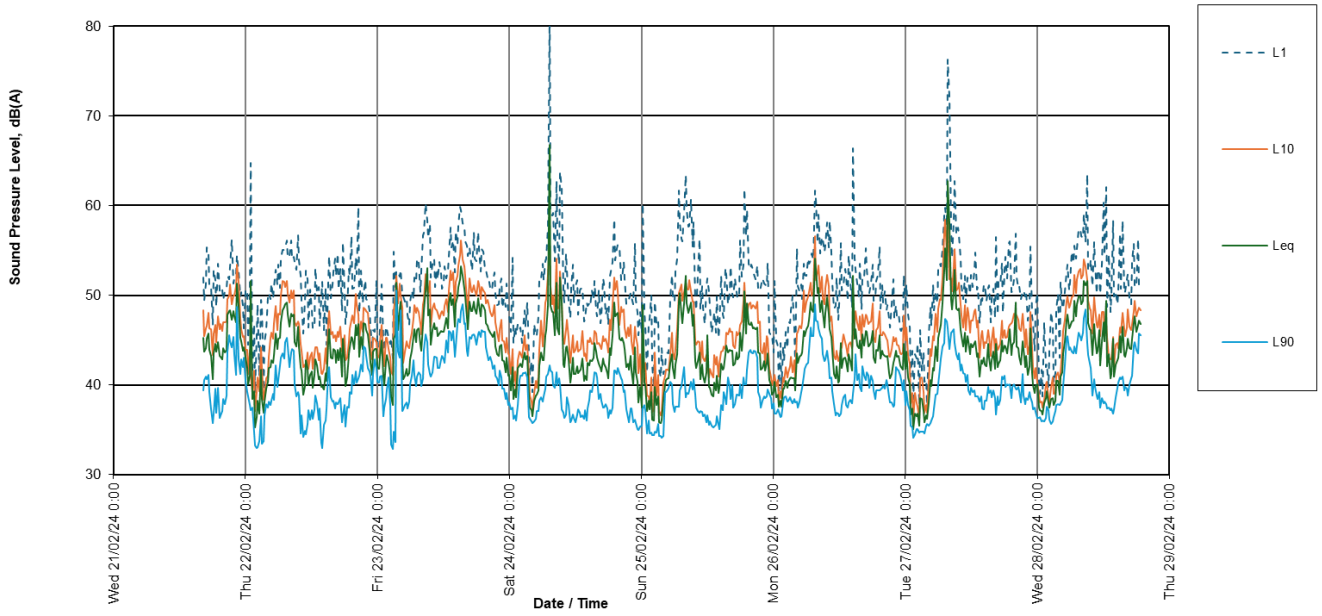

Figure 7: Ambient Noise Level Graph

Based on the measured noise levels, project specific criteria have been determined in the following section.

4. Acoustic Criteria

4.1. NSW Noise Policy for Industry (NPfI) 2017

4.1.1. Intrusive/Amenity Criteria

The NSW NPfI provides assessment methodologies, criteria and detailed information on the assessment of environmental noise emissions in NSW. The NSW NPfI criteria for noise sources consider two (2) components, amenity and intrusive noise. Assessment of the components are summarised as follows:

- Maintaining noise amenity for various categories of land use (including residential receivers and other sensitive receivers). The amenity criterion is based on the sensitivity of a particular land use affected by industrial noise. The recommended amenity noise levels detailed in Table 2.2 of NSW NPfI represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location. This is to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area. The project amenity criteria for each new source of industrial noise are equal to the recommended amenity noise level minus 5dBA.
- A +3dBA conversion is to be added to project amenity noise level for conversion from a period level to a 15-minutes level. Where the resultant project amenity noise level is 10dB or lower than the existing industrial noise level, the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
- Controlling intrusive noise impacts for residential receivers. Assessing intrusiveness usually requires noise measurements to quantify background (LA90) noise levels at a location considered representative of the most potentially affected residential receiver(s). The intrusiveness criterion essentially means that for a given receiver the equivalent continuous noise level (Leq) of the source(s) under consideration should be controlled to 5 dB above the background noise level.

Note that according to the Policy, intrusive noise levels are only applied to residential receivers.

4.1.2. Sleep Disturbance Criteria

Sleep disturbance criteria are nominated in the policy for industry, as follows:

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

Sleep disturbance criteria are applicable in relation to residential receivers during the night-time (10pm-7am Mon-Sat, 10pm-8am Sun/Public Holidays only). As the proposed hours of operation for this preschool are 7am-6pm on weekdays, sleep disturbance criteria do not apply in this assessment.

4.2. Construction Noise

Construction noise is a major environmental noise issue in NSW, and it is well accepted that this activity can adversely affect, sleep, concentration and learning performance and mental and physical health. While construction noise is temporary in nature, its impacts need to be controlled.

The NSW Interim Guideline for Construction Noise (2009) (IGCN) is specifically aimed at managing noise from construction works. From a regulatory perspective, the local Council is the appropriate regulatory authority for non-scheduled construction activities. The following application of the policy is summarised below in Table 5.

Table 5: GCN noise criteria at residences, using quantitative assessment, L_{eq}.

Time of Day	Management Level, $L_{Aeq\ (15min)}$	How to apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL+10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration as well as contact details.
	Highly noise affected 75dB(A)	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, regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, considering: Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) If the community is prepared to accept longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dB	A strong justification would typically be required for work outside the recommended standard hours The proponent should apply all feasible and reasonable work practices to meet the noise affected level Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community For guidance on negotiating agreements see Section 7.2.2 (NSW Interim Construction Noise Guideline)

Table 6: GCN noise criteria at commercial receivers, using quantitative assessment, L_{eq}.

Land Use	Management Level, $L_{Aeq\ (15min)}$ (applies when properties are being used)	How to apply
Classrooms at schools and other education institutions	Internal noise level 45dB(A)	The proponent should consult with noise sensitive land use occupants likely to be affected by noise from the works to schedule the project's work hours to achieve a reasonable noise outcome.

A 10dB(A) reduction is assumed between external and internal noise impacts at the classroom receivers, based on open windows. Therefore, a level of 55dB(A) externally is used as the relevant management level.

4.3. Construction Vibration Limits

Construction vibration levels depend on several factors. These include the activity, the machine, the geology of the ground and the distance between the building and the source. In Australia there is no current specific standard for construction vibration.

The NSW EPA Assessing Vibration: a technical guideline (2006) provides some guidance in relation to human comfort but does not directly relate to damage levels to buildings. This methodology is equivalent to the guidelines issued in current international standards and described in *'AS2670 Vibration and shock - Guide to the evaluation of human exposure to whole body vibration'*, as shown below in Table 7.

Table 7: Multiplying Factors to obtain limit vibration levels (mm/s)

Place	Multiplying Factors		
	Time	Continuous Vibration	Intermittent or Impulsive
Residential	Day 0700-2200	2	60
	Night 2200-0700	1.4	20
Office	Day 0700-2200	4	128
	Night 2200-0700	4	128
Workshops	Day 0700-2200	8	128
	Night 2200-0700	**8**	**128**

With regards to structural damage, the German DIN4150 and NSW OEH/British Standard BS6472 provide guidelines relevant to this assessment. These criteria are summarised below in Table 8.

Table 8: Typical Vibration Limit Criteria (mm/s).

Criterion	Typical Vibration Velocity	Standard
Disturbance to Persons (Day) 0700-2200	0.3 – 0.6 peak	BS6472
Disturbance to Persons (Night) 2200-0700	0.2 peak	BS6472
Damage to Dwellings	5 – 15 rms	DIN 4150
Damage to Heritage Buildings	**3 – 8 rms**	**DIN 4150**

Management of noise and vibration impacts during construction is best mitigated through the implementation of a site noise and vibration management plan by the prospective lead building contractor.

4.4. Project Specific Criteria

4.4.1. Intrusive/Amenity Noise Criteria

The selection of the project specific criterion is detailed in Table 9. Based on the development of the surrounding area, which has intermittent traffic flows, and limited commerce, and the measured background noise levels, the suburban residential amenity noise category has been selected for all residential receivers.

Table 9: NSW Noise Policy for Industry Project Criteria, dB(A).

Receivers	Time Period	Measured L_{90} RBL	Intrusiveness Criteria (RBL + 5dBA)	Nominated Noise Amenity Area	Designated Amenity Noise Level	Project Amenity Criteria (Amenity Level -5dBA + 3dBA)	Overall Criteria (Lower of Intrusiveness/ Amenity)
1 (commercial west of site)	When in Use	N/A	N/A	Commercial	65	63	**63**
1 (classroom west of site, if applicable)	Noisiest 1-hour period when in use	N/A	N/A	School Classroom	45*	43	**43***
2 (residential south of site)	Day	37	42	Suburban Residential	55	53	**42**
	Evening	37	42		45	43	**42**
	Night	35	40		40	38	**38**
Onsite – Active Recreation Area	When in Use	N/A	N/A	Commercial	55	53	**53**

*The EPA Noise Policy for Industry (2017) nominates an internal amenity noise level of 35dB(A) for school classrooms. This table shows external noise criteria, which as per the NPI 2017 is 10dB(A) higher than the internal criteria.

As stated previously, the CSU buildings within receiver 1 are generally commercial in nature, although school classrooms may apply depending on the approved uses of the site. Noise criteria for school classrooms are nominated for the noisiest 1-hour period when in use. The intrusive levels for receiver 2 are nominated as a 15-minute period in the NPfI. For this assessment, a 15-minute interval is used. In reality, the $L_{Aeq,1hr}$ impacts from the site are expected to be lower than the $L_{Aeq,15min}$ as carpark and outdoor play activities will be less intense on average over a longer period. For this assessment, the $L_{Aeq,15min}$ impacts are used for all receivers, which results in a conservative assessment.

Sleep disturbance criteria do not apply to the development, as it is proposed to operate during the daytime period (Mon-Sat 7am-6pm & Sun 8am-6pm) only.

4.4.2. Construction Noise

Following the determination of daytime RBL values, during Recommended Standard Hours, the following Noise Affected and Highly Noise Affected Construction Noise Management Levels are summarised below in Table 10. Predicted construction noise impacts have been determined in Section 4.3 of this report.

Table 10: Construction Noise Management Levels $L_{eq,15min}$ dBA – Recommended Standard Hours.

Time of Day	Receiver	Measured RBL (dBA)	Management Level, $L_{Aeq\ (15min)}$	Highly Affected Management Level, $L_{Aeq\ (15min)}$
During operating hours of the neighbouring commercial/classroom	1 (West) Commercial	N/A	70	N/A
	2 (West) Classroom, if applicable	N/A	55	N/A
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	3 (South) Residential	3	Noise affected (37 +10) = 47	75

4.5. AS2107:2016 Internal Criteria

Australian Standards AS/NZS 2107:2016 recommends the background noise levels for various spaces based on the type of occupancies and activities undertaken inside the space. These limits are used for onsite rooms in relation to external noise sources, as detailed in Section 6.

Table 11 summarises the recommended background noise levels applicable to the project. Only rooms with external facades are listed in this table.

Table 11: Recommended internal noise levels, L_{eq} dB(A), and reverberation time (s)

Type of Occupancy/Activity	Design Sound Level Range, L_{eq}, dB(A)
Classrooms	35 to 45
Playgroup Multi-function	35 to 45
Admin Room/Offices/Program	35 to 40
Staff Room	40 to 45
Meeting Room	40 to 45
Toilets	<55

5. Noise Impacts to Offsite Receivers

Noise impacts from the proposed development to nearby sensitive receivers are assessed in relation to nominated EPA criteria. The noise methodology and predicted noise impacts are detailed in this section. Relevant recommendations are detailed in Section 8.

5.1. Noise Methodology

BSE have modelled as the following a worst-case 15-min period based on the following information:

- Vehicle entry from Farrer Road and parking within the proposed preschool carpark at the following rate:
  - 15 vehicle passes per 15mins in the daytime period (7am-6pm)
- Each vehicle pass is assessed as a sound power level of:
  - $L_{eq,15sec}$ 79dB(A)
  - L_{Max} 84dB(A)
- A total of 90 children are assessed outside as playing outside simultaneously. To form a worst-case scenario, they are split up as follows:
  - 30 students on the western side of the building
  - 30 students on the northern side of the building
  - 30 students on the eastern side of the building
- Noise levels from children playing are based on those stated in the AAAC Guideline for Child Care Centre Acoustic Assessment, V3.0 dated September 2020, using levels or 3-5 year olds.
- Sound power level is approximated as 8dB(A) higher than the sound pressure level at 1m.

Assessed noise levels are provided in Table 12.

Table 12: Proposed onsite noise source levels octave band centre frequency sound power levels Lw [dB].

Area	Noise Source	Octave Band Centre Frequency, Leq dB								
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
Carpark	Vehicle Parking (per vehicle pass)	80	78	75	72	74	74	69	61	79
Outdoor Areas	30 Children (West)	69	75	80	86	88	85	81	77	92
	30 Children (North)	69	75	80	86	88	85	81	77	92
	30 Children (South)	69	75	80	86	88	85	81	77	92

Noise calculations assumed relevant screening from buildings, as well as distance attenuation to each nominated receiver. Based on this information, predicted noise impacts in comparison to nominated criteria are detailed in Section 5.2.

5.2. Predicted Noise Impacts

Following calculations to the nearest affected sensitive receivers the following predicted noise levels are presented in Table 13 below. The calculations take into account the recommended acoustic barrier as shown in Section 8.

Table 13: Predicted noise impacts to receivers, dB

Scenario	Receiver	Predicted Noise Level dB(A) $L_{eq,15min}$	Daytime Criteria dB(A) $L_{eq,15min}$	Complies Yes/No
Without Recommended Acoustic Barrier	1 (West) Commercial	47	63	Yes
	1 (West) Classroom, if applicable	47	43	No
	2 (South)	45	42	No
With Recommended Acoustic Barrier	1 (West) Office	43	63	Yes
	1 (West) Classroom	43	43	Yes
	2 (South)	41	42	Yes

Compliance is predicted for all nominated receivers during operational hours, provided the recommendations in Section 8 are implemented.

6. Noise Impacts to Onsite Receivers

Predicted noise impacts from the offsite Aspect school, as well as the onsite carpark, have been calculated to the onsite rooms to determine whether internal noise limits stated in Section 4.5 are achieved. Operations for Aspect School occur during the daytime period (7am-6pm) only, according to CSU. The noise methodology and predicted noise impacts are detailed in this section. Relevant recommendations are detailed in Section 8.

6.1. Noise Methodology

BSE have modelled as the following a worst-case 15-min period based on the following information:

- Vehicle movement and parking at the following rate:
  - In the proposed preschool carpark, at 15 vehicle passes per 15mins in the daytime period (7am-6pm)
  - In the existing CSU carpark, related to Aspect School activity, at 15 vehicle passes per 15 minutes in the daytime period (7am-6pm).
- Each vehicle pass is assessed as a sound power level of:
  - $L_{eq,15sec}$ 79dB(A)
  - L_{Max} 84dB(A)
- A total of 19 children are assessed within the Aspect grounds, being in the central courtyard during outdoor play (recess/lunch times). The CSU buildings on the eastern side of the courtyard partly screen the courtyard with the proposed St. Mary's site, although there are some gaps and therefore screening would be minimal. The assessed locations are shown in Figure 8.
- The age of the children in Aspect School are unknown. To provide a conservative assessment, noise levels from children playing are based on those stated in the AAAC Guideline for Child Care Centre Acoustic Assessment, V3.0 dated September 2020, using levels or 3-5 year olds.
- Sound power level is approximated as 8dB(A) higher than the sound pressure level at 1m.

Figure 8: Aspect School Areas and Site

Assessed noise levels are provided in Table 12.

Table 14: Proposed noise source levels octave band centre frequency sound power levels Lw [dB].

Area	Noise Source	Octave Band Centre Frequency, Leq dB								
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB(A)
Aspect School Carpark	Vehicle Parking (per vehicle pass)	80	78	75	72	74	74	69	61	**79**
Onsite (St. Mary's) Carpark	Vehicle Parking (per vehicle pass)	80	78	75	72	74	74	69	61	**79**
Aspect School Outdoor Area	19 Children	67	73	78	84	86	83	79	75	**90**

Noise calculations assumed relevant screening from buildings and the recommended acoustic barriers, as well as distance attenuation to each nominated receiver. Based on this information, predicted noise impacts the proposed onsite building are detailed in Section 6.2.

6.2. Predicted Noise Impacts

Following calculations to the nearest affected sensitive receivers the following predicted noise levels are presented in Table 13 below. The calculations take into account the recommended acoustic barrier as shown in Section 8.

Table 15: Predicted noise impacts to receivers, dB

Scenario	Onsite Receiver	Predicted External Noise Level dB(A) $L_{eq,15min}$	AS2107 Internal Criteria*	NPfI External Criteria	Complies Yes/No
Without Recommended Acoustic Barriers	Western Façade of Proposed Preschool	40	35-40	63	**Yes**
	Southern Façade of Proposed Preschool	42	35-40	63	**Yes**
	External Playground Areas (Active Recreation)	46	N/A	53	**Yes**
With Recommended Acoustic Barriers	Western Façade of Proposed Preschool	38	35-40	63	**Yes**
	Southern Façade of Proposed Preschool	41	35-40	63	**Yes**
	External Playground Areas (Active Recreation)	44	N/A	53	**Yes**
*Note that a 10dBA reduction is assumed from external to internal locations, assuming open windows, in accordance with NSW NPfI 2017					

Noise impacts to the proposed internal areas are predicted to comply with relevant AS2107:2016 criteria. In addition, compliance is predicted at outdoor active recreation areas. Therefore, no additional façade treatments are required for onsite rooms in relation to noise impacts from the surrounding carparks and Aspect School.

7. Construction Noise Impacts

This assessment of construction noise and vibration is preliminary only and is included to provided general information on the expected impacts from standard equipment to nearby sensitive receivers, in order to provide information regarding general management levels likely to be implemented.

A detailed noise and vibration management plan should be conducted before the start of construction works, once the equipment selection, scheduling, etc. have been finalised.

7.1. Construction Noise

To predict the impact of noise associated with construction, estimated plant and sound power levels were split across the main construction stages. At this stage the proposed construction methodology has not been finalised. For preliminary purposes, we have assumed the following construction plant and equipment will be used at each stage of the project. It was assumed that fit out related activity will be largely enclosed. For the purposes of this assessment, we have conservatively assumed a 10 dB(A) shielding loss applies.

Typical plant and converted sound power levels are presented below in Table 16. Predicted construction noise impacts are presented subsequently in Table 17.

Table 16. Typical construction equipment and sound power levels (DEFRA).

Excavation Works									
Typical Equipment	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**dB(A)**
Bobcat 5t	99	99	94	87	87	86	82	76	**93**
Truck Delivery/Spoil	114	110	105	102	98	94	90	83	**104**
Structural Works									
Bobcat 5t	99	99	94	87	87	86	82	76	**93**
Truck Delivery	114	110	105	102	98	94	90	83	**104**
Concrete Pump	112	104	98	99	101	101	94	86	**106**
Concrete Saws	110	110	100	99	97	96	90	92	**103**
Mobile Crane	113	101	95	99	100	97	91	84	**104**
Angle Grinder	85	79	80	88	98	105	101	101	**110**
Hammer	94	94	96	96	91	85	83	79	**97**
Fit out Works									
Angle Grinder	85	79	80	88	98	105	101	101	**110**
Hammer	94	94	96	96	91	85	83	79	**97**

Table 17: Predicted Construction Noise Levels $L_{Aeq15min}$.

Receiver	Phase	Predicted Noise Levels, $L_{Aeq15min}$	Noise Affected Management Level	Highly Noise Affected Management Level
1 (West) Office	Excavation Works	52	70	N/A
	Structural Works	65	70	N/A
	Fit out Works	51	70	N/A
2 (West) Classroom	Excavation Works	50	55	N/A
	Structural Works	63	55	N/A
	Fit out Works	49	55	N/A
3 (South)	Excavation Works	54	47	75
	Structural Works	62	47	75
	Fit out Works	47	47	75

Noise levels are predicted to exceed management level guidelines at receiver 2 during structural works, and receiver 2 during excavation and structural works. Therefore, as stated in the NSW Interim Construction Noise Guideline 2009, all feasible and reasonable work practices to minimise noise should be applied.

When the details of construction equipment, scheduling, etc. are available, the determine noise impacts, and work practices and mitigation measures to minimise noise should be documented, as stated in the ICNG (2009). A construction noise and vibration management plan may be required to fulfil this recommendation.

It is recommended that best practice measures outlined in AS2436-2010 *'Guide to noise and vibration control on construction, demolition and maintenance sites'* and recommended best practice procedures in the NSW EPA Interim Guide are used.

In addition, engineering measures such as boundary hoardings and individual plant enclosure may also be used to minimise impacts at surrounding receivers. As specified by the ICNG (2009) these mitigation measures must be feasible and reasonable options for use. As a guide, AS2436-2010 provides a summary of measures and their effectiveness in reducing noise impacts, as shown below in Table 18.

Table 18: AS2436 typical best practice construction noise mitigation measures.

Control by	Nominal noise reduction, in total A-Weighted sound pressure level, dB(A)
Distance Attenuation	6 dB(A) reduction per doubling of distance
Screening	Normally 5 to 10 dB(A), maximum 15 dB(A)
Enclosure	Normally 10 to 15 dB(A), maximum 50 dB(A)
Silencing/Mufflers	Normally 5 to 10 dB(A), maximum 20 dB(A)

A more detailed assessment of management controls and/or acoustic treatments to minimise noise impacts may be completed in a later noise and vibration management plan for construction.

7.2. Construction Vibration

The NSW Roads and Maritime Services *Construction Noise and Vibration Guideline* (2016) provides suitable working distances for the operation of plant and equipment near sensitive receivers, as shown in Table 19. At this stage, the preferred construction methodology is currently not finalised. Further assessment should be conducted when this information becomes available.

Table 19: Recommended safe working distances for construction plant, metres (m).

Plant Item	Rating Description	Cosmetic Damage	Human Response (OHSE Vibration Guideline - AVATG
Vibratory Roller	<50 kN (Typically 1-2 tonnes)	5m	15-20m
	<100 kN (Typically 2-4 tonnes)	6m	20m
	<200 kN (Typically 4-6 tonnes)	12m	40m
	<300 kN (Typically 7-13 tonnes)	15m	100m
	>300 kN (Typically 13-18 tonnes)	20m	100m
	>300 kN (> 18 tonnes)	25m	100m
Small hydraulic hammer	(300kg – 5 to 12t excavator)	2m	7m
Medium hydraulic hammer	(900kg – 12 to 18t excavator)	7m	23m
Large hydraulic hammer	(1600kg –18 to 34t excavator)	22m	73m
Vibratory Pile Driver	Sheet Piles	2-20m	20m
Pile Boring	< 800mm	2m	4m
Jack hammer	Hand-held	1m	2m

These numbers are designed as a guide only. At this stage, the preferred construction equipment, location and scheduling is not known. However, given the lack of piling and the relatively large distances to receivers, vibration impacts are unlikely to be a cause of concern.

Further assessment should be conducted when this information becomes available. A construction vibration plan should be conducted where vibration limits could potentially cause cosmetic damage or exceed the limits stated in DIN4150-3 (2016) (Vibration in Buildings – Effects on Structures).

8. Recommendations

The development is predicted to comply with noise criteria stated in the NSW Noise Policy for Industry (2017) on condition the following recommendations are implemented:

8.1. Acoustic Barriers

Acoustic barriers are recommended to minimise noise impacts from proposed outdoor play areas to surrounding sensitive receivers. The barrier on the southern boundary is recommended to minimise noise impacts to the nearby residential across Farrer Road. The barrier along the western boundary is required to minimise noise impacts to any school classrooms within receiver 1 (CSU), if applicable. As it is currently unknown whether approval on this lot includes educational facilities, and the exact use of these buildings is also unknown, either the school classroom or commercial noise criteria may be applicable. The following subsections detail the required barrier in both cases.

8.1.1. CSU Commercial Uses Only

If the CSU buildings nominated as receiver 1 incorporate commercial zoning/use only, then the acoustic barrier shown in Figure 9 is recommended to be installed. This barrier is required to minimise noise impacts to the nearest residential receivers to the south of the site. The nominated top and bottom RL of the barrier is shown. The bottom RL of 211.0m is equivalent to the finished ground on the southern side. The barrier must be free of gaps and holes, with a minimum transmission loss of Rw25. Suitable materials include double-lapped timber (16mm thick palings with 60% overlap), 6.38mm thick glass, or 10mm thick Perspex. Other materials may be used provided they achieve the minimum Rw25 rating.

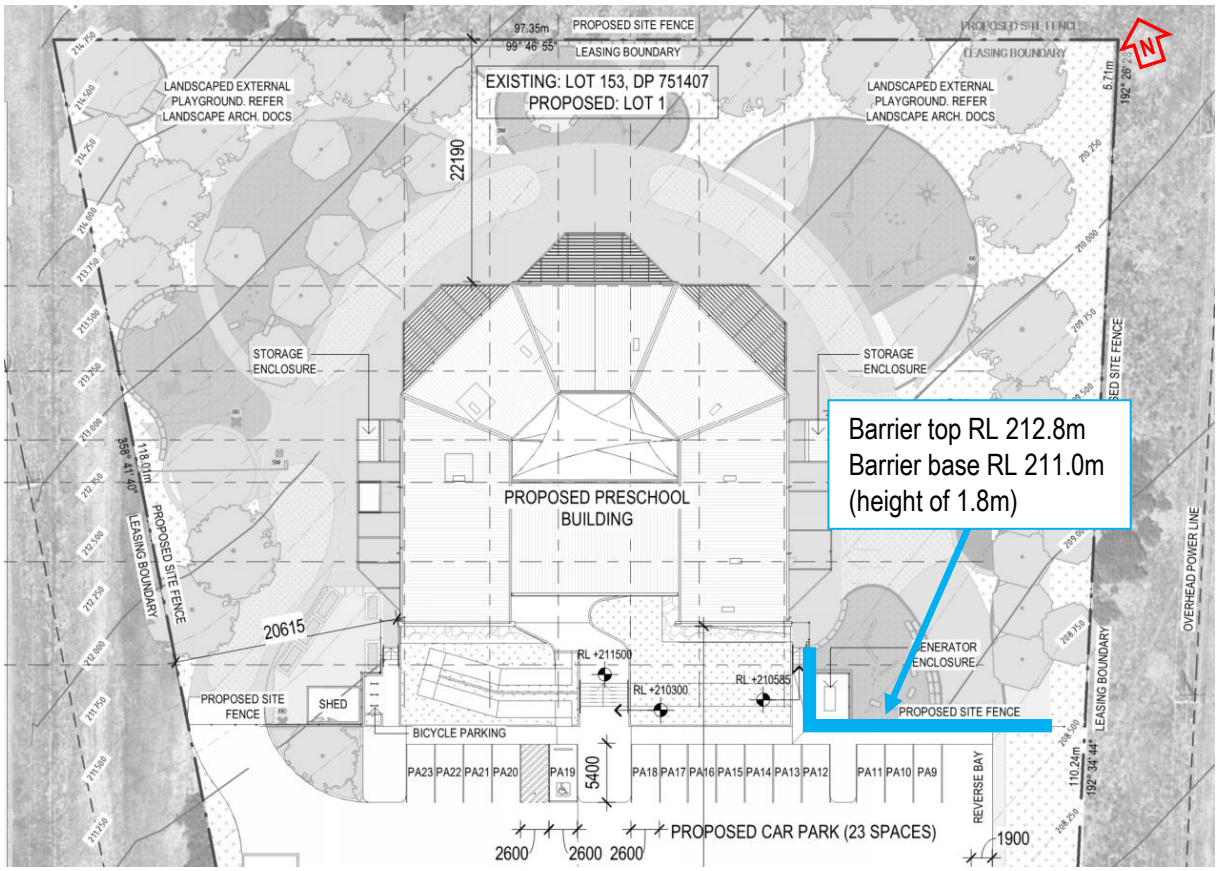

Figure 9: Recommended Acoustic Barriers – CSU Commercial Uses Only

8.1.2. CSU School Classroom Use

If the CSU buildings nominated as receiver 1 incorporate school classroom/s, then the acoustic barriers shown in Figure 9 is recommended to be installed. The nominated top and bottom RLs of the barriers are shown.

For the barrier on the southeastern side of the play area, the bottom RL of 211.0m is equivalent to the finished ground on the southern side. The top RL of the barrier along the western boundary is a consistent height from the outdoor play area, and therefore the height of the barrier relative to natural ground level will change between 0.3m at the northern end, up to 2.05m between the red and blue sections, and 1.8m high at the southern end. If relative heights of playground areas change from the current plans, then the required barrier heights may also change. The barriers must be free of gaps and holes, with a minimum transmission loss of Rw25. Suitable materials include double-lapped timber (16mm thick palings with 60% overlap), 6.38mm thick glass, or 10mm thick Perspex. Other materials may be used provided they achieve the minimum Rw25 rating.

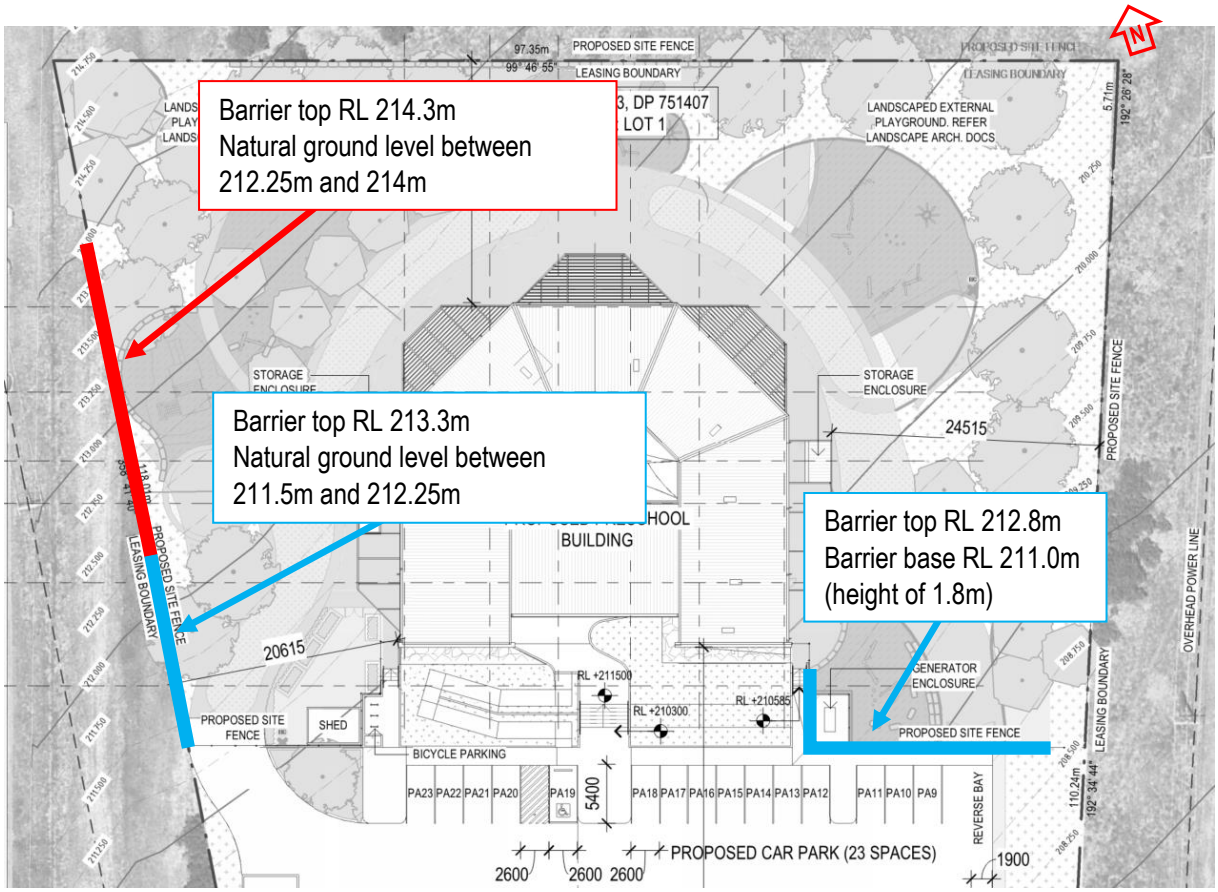

Figure 10: Recommended Acoustic Barriers – CSU Classroom Uses

8.2. Management Controls/General Recommendations

The operational hours of the preschool, including staff activity onsite, is assumed to be during the daytime period (Mon-Sat 7am-6pm & Sun 8am-6pm).

8.3. Waste Collection

Waste collection should be managed at times that minimise disruption to neighbouring sensitive receivers, i.e. during daytime hours (Mon-Sat 7am-6pm and Sun 8am-6pm), and/or during collection at nearby properties.

8.4. Mechanical Plant

At this stage, architectural drawings include the location external mechanical plant on the western side of the proposed preschool. The selection of equipment has not been finalised and therefore a full assessment cannot be conducted at this stage. The maximum allowable source noise levels for mechanical plant is dependent on the approved use of the CSU buildings to the west of the site. As a preliminary recommendation, the aggregate sound power level of equipment at this location should be limited to:

- If classroom receiver/s are present within the CSU buildings to the west, a maximum aggregate Lw 84dB(A) should be implemented for mechanical plant.
- If the offsite CSU buildings to the west of the site are of general commercial use only, then a maximum aggregate Lw 91dB(A) should be implemented for mechanical plant.

Acoustic treatments may be required if equipment would exceed this level. Other equipment such as rooftop kitchen exhaust may also be relevant although it is not included in this assessment as there is no information currently available.

All mechanical plant should be designed to comply with relevant EPA criteria in Section 4.2. Acoustic design should be undertaken once information regarding the location and equipment models have been selected.

8.5. Construction Noise and Vibration Recommendations

This report has included a preliminary assessment and recommendations for construction noise and vibration, as detailed in Section 7. Further assessment as part of a noise and vibration management plan should be conducted after the equipment, and location/schedule of works is selected.

9. Conclusion

This noise impact assessment has been conducted for the proposed St Mary's Preschool at Farrer Road, Boorooma. Following from calculations of the expected noise sources, the development is predicted to comply with the relevant noise criteria stated in the NSW Noise Policy for Industry (2017). Recommendations to minimise noise impacts to onsite and offsite locations have been detailed in Section 8 of this report. Recommendations for onsite noise impacts to neighbours included an acoustic barrier and management controls.

A. Appendix A – Acoustic Terminology

Absorption

The properties of a material composition to convert sound energy into heat, thereby reducing the amount of energy that can be reflected.

Airborne Noise

A condition when sound waves are being carried by the atmosphere.

Attenuation

The reduction of sound energy as a function of distance travelled.

A-Weighted Sound Level (Noise level)

A measure of sound pressure designed to reflect the response of the human ear, which does not respond equally to all frequencies. The ear is less efficient at low and high frequencies than at medium or speech-range frequencies. To describe sound in a manner representative of the human ear's response, it is necessary to reduce the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. The A-weighted sound level is also called the 'noise level'. Sound level meters have an A-weighting network for measuring A-weighted sound levels. Most levels of occupational, industrial and environmental noise are measured using A-weighting.

Barrier

A material that when placed around a source of noise inhibits the transmission of that noise beyond the barrier. Also, an environment or any physical thing that interferes with communication or listening.

Decibel (dB)

Sound level in Bels as a logarithmic ration. Relative quantity of sound intensity compared to a standard unit used as a reference. The decibel or dB cannot be used by itself. Both the quantity considered (sound power level or sound pressure level) and the standard unit used as a reference must be specified when the decibel is used.

Diffuse Sound Field

A diffuse sound field is one in which the sound field at any given point is made up of sound waves of all angles of incidence.

Direct Field

The sound in a region in which all or most of the sound arrives directly from the source without reflection.

Free Field

Sound waves from an outdoor source where there are no obstructions.

Frequency

The number of oscillations or cycles per unit of time. Acoustical frequency is usually expressed in units of Hertz (Hz) where one Hz is equal to one cycle per second.

Hertz (Hz)

Frequency of sound expressed by cycles per second.

Intensity Level (LI) (IL)

A measure of the acoustic power passing through a unit area expressed on a decibel scale referenced to some standard (usually 10-12) watt per square meter.

Noise Reduction Coefficient (NRC)

The NRC of an acoustical material is the mathematical average, to the nearest multiple of 0.05, of its absorption coefficients at centre frequencies of 250,500,1000, 2000 Hertz Octaves.

Octave Bands

Sounds that contain energy over a wide range of frequencies are divided into sections called bands. A common standard division is in 10 octave bands identified by their centre frequencies 63, 250, 500, 1000, 2000, 4000 and 8000Hz.

Reverberation

Sound after it is ended at the source will continue to reflect off surfaces until the sound wave loses energy by absorption to eventually die out.

Reverberation Time

The time taken for sound to decay 60 dB to 1/1,000,000 of its original sound level after the sound source has stopped. Sound after it has ended will continue to reflect off surfaces until the wave loses enough energy by absorption to eventually die out. Reverberation time is the basic acoustical property of a room, which depends only on its dimensions and the absorptive properties of its surfaces and contents. Reverberation has an important impact on speech intelligibility.

Sound Absorption

The property possessed by materials, objects and air to convert sound energy into heat. Sound waves reflected by a surface create a loss of energy. That energy not reflected is referred to as the absorption coefficient.

Sound Absorption Coefficient

The fraction of energy striking a material or object that is not reflected. For instance, if a material reflects 70% of the sound energy incident upon its surface, then its Sound Absorption Coefficient would be 0.30. SAC=Absorption/Area in sabins per sq. m.

Sound Level

A subjective measure of sound expressed in decibels as a comparison corresponding to familiar sounds experienced in a variety of situations.

Sound Pressure Level (SPL)

An important measure of sound loudness, the level is calculated in decibels by 20 times the logarithm to the base 10 of the ratio of the measured sound pressure level and the reference point.

Sound Level Meter

A device that converts sound pressure variations in air into corresponding electronic signals. The signals are filtered to exclude sound waves outside the desired frequencies.

Sound Transmission Class (STC)

A single-number system used to rate the sound transmission performance of a wall, panel, ceiling, etc. The higher the ranking, the better the ability to obstruct sound transmission.

Structure-Borne Noise

A condition when the sound waves are being carried by a solid material. Sound waves in this state are inaudible to the human ear, since they cannot carry energy to it. Airborne noise can be created from the radiation of structure-borne noise into the air. Structure-borne noise may be propagated by shear waves, tension-compression waves, bending waves, or complicated combinations of waves.

Transmission Loss (TL)

The reduction of airborne sound power that is caused by placing a wall or barrier between the reverberant sound field of a source and the receiver. Transmission loss is a property of the wall or barrier.