# ACOUSTIC REPORT

## Noise and Vibration Impact Assessment

### Upgrade to Cammeray Public School
### NSW Department of Education

NDY
A TETRA TECH COMPANY

CONFIDENTIAL

**Revision:** 3.1 – REF Application | **Issued:** 4 March 2025

**Document name**: CPS-NDY-XX-XX-RP-Y-0001

## VERIFICATION

| REVISION | DATE ISSUED | PREPARED BY | VERIFIED BY | AUTHORISED BY | COMMENT |
|---|---|---|---|---|---|
| 1.0 | 31/10/2024 | Jim Wu | Thomas Warren | Jarrad Underwood | Draft planning report |
| 1.1 | 13/12/2024 | Jim Wu | Thomas Warren | Jarrad Underwood | Planning Report |
| 2.0 | 14/01/2024 | Jim Wu | Thomas Warren | Jarrad Underwood | Schematic Design |
| 3.0 | 03/03/2025 | Jim Wu | Thomas Warren | Jarrad Underwood | REF Application |
| 3.1 | 03/03/2025 | Jim Wu | Thomas Warren | Jarrad Underwood | REF Application |

## STAKEHOLDERS

| ROLE | TEAM MEMBER | ORGANISATION |
|---|---|---|
| Client Representative | Ant Courtman | NSW Education |
| Project Manager | Lynne Donohoe | RP Infrastructure |
| Architect | Niloofar Khodabandehloo | Fulton Trotter |
| Planner | Georgia Sedgmen | Gyde Consulting |
| Services Engineer (Mechanical) | Chia Halim | NDY |
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# 1 INTRODUCTION

The purpose of this report is to assess any noise and vibration effects of the upgrade works at the school.

This Noise and Vibration Impact Assessment has been prepared to support a Review of Environmental Factors (REF) for the Department of Education (DoE) for the upgrade of the Cammeray Public School (CPS) (the activity). The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Section 3.37 of the T&I SEPP and in consideration of the stakeholder and community participation plan.

The proposed activity is for upgrades to the existing CPS at 68 Palmer Street, Cammeray NSW 2062 (the site).

The purpose of this report is to assess any noise and vibration effects of the upgrade works at the school.

## 1.1 AUTHORS

This report was prepared by Jim Wu, member of the Australian Acoustical Society (M.A.A.S) and the Acoustic Society of New Zealand (M.A.S.N.Z). Quality assurance was carried out by Thomas Warren, member of the Acoustic Society of New Zealand (M.A.S.N.Z). NDY is a Member of the Australasian Association of Acoustical Consultants (AAAC).

## 1.2 PURPOSE

The purpose of this report is to provide acoustic design input into the following areas:

- Baseline noise survey of the area
- Statement of environmental effect such as noise emissions to the boundary from onsite plant equipment
- Construction Noise and vibration assessment to the boundary

## 1.3 AUTHORITY

Authority to undertake this report was provided by Lynne Donohoe of RP Infrastructure.

## 1.4 INFORMATION SOURCES

The report is written with reference to the following information. Where a standard or guideline is listed, this does not necessarily mean that the standard has been adopted in its entirety, as it may not all apply to this site.

- NSW Noise Policy for Industry (NPfI) 2017
- NSW Interim Construction Noise Guideline (ICNG) 2009
- NSW Road Noise Policy (RNP) 2011
- NSW Government Department of Planning Development Near Rail Corridors and Busy Roads – Interim Guidelines (2008)
- NSW EPA Assessing Vibration: A Technical Guideline 2006
- State Environmental Planning Policy (Transport and Infrastructure) 2021
- AS / NZS 2107:2016 Acoustics, Recommended design sound levels and reverberation times for building interiors
- NSW Department of Environment & Climate Change (DECC), Interim Construction Noise Guideline, 2009
- DEFRA 2005 Data base, including the existing construction noise database on BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration control on construction and open sites Part 1 Noise and Part 2 Vibration
- NSW Interim Construction Noise Guideline 2009
- German DIN 4150: Part 3 – 1999 "Effect of Vibration on Structure" (DIN 1999)
- Australian Standard AS 2670.2 1990 – Evaluation of Human Exposure to Whole Body Vibration – Part 2: Continuous and Shock Induced Vibration in Building (1 Hz to 80 Hz)
- British Standard BS 6472 – 2008 – Evaluation of Human Exposure Vibration in Buildings (1 Hz to 80 Hz)
- NSW EFSG Design Guidelines 2020 (Applies to Education)

- North Sydney Council LEP and DCP
- Architectural drawings for Schematic Design, issued by Fulton Trotter Rev 3, dated 10/01/2025.
- NDY Electrical drawing set, schematic design, Rev 3, 13.12.2024
- NDY Mechanical drawing set, schematic design, Rev 3, 10.01.2025

# 2 PROJECT INFORMATION

The proposed activity involves upgrades to the existing CPS, including the following:

- Construction of 4 new permanent teaching spaces in a two-storey building incorporating 2 general learning spaces and 2 practical activity areas
- New egress lift and stairs for access to all building levels
- External covered walkways connecting the new building to the existing school network
- Landscaping and external works including compensatory planting
- Upgrades to site infrastructure and services to support the new buildings
- Removal of 3 temporary (demountable) classrooms from the eastern side of the school
- 50 bicycle parking spaces

The intent of the activity is to provide 4 permanent teaching spaces (PTS) plus 2 practical activity areas (PAA) across a two-storey addition, adjoining Building E. This will result in CPS retaining the capacity of a 'large' school (553-1,000 students) under EFSG (SINSW Education Facilities Standards and Guidelines).

Figure 1 below shows the scope of works for the proposed activity.

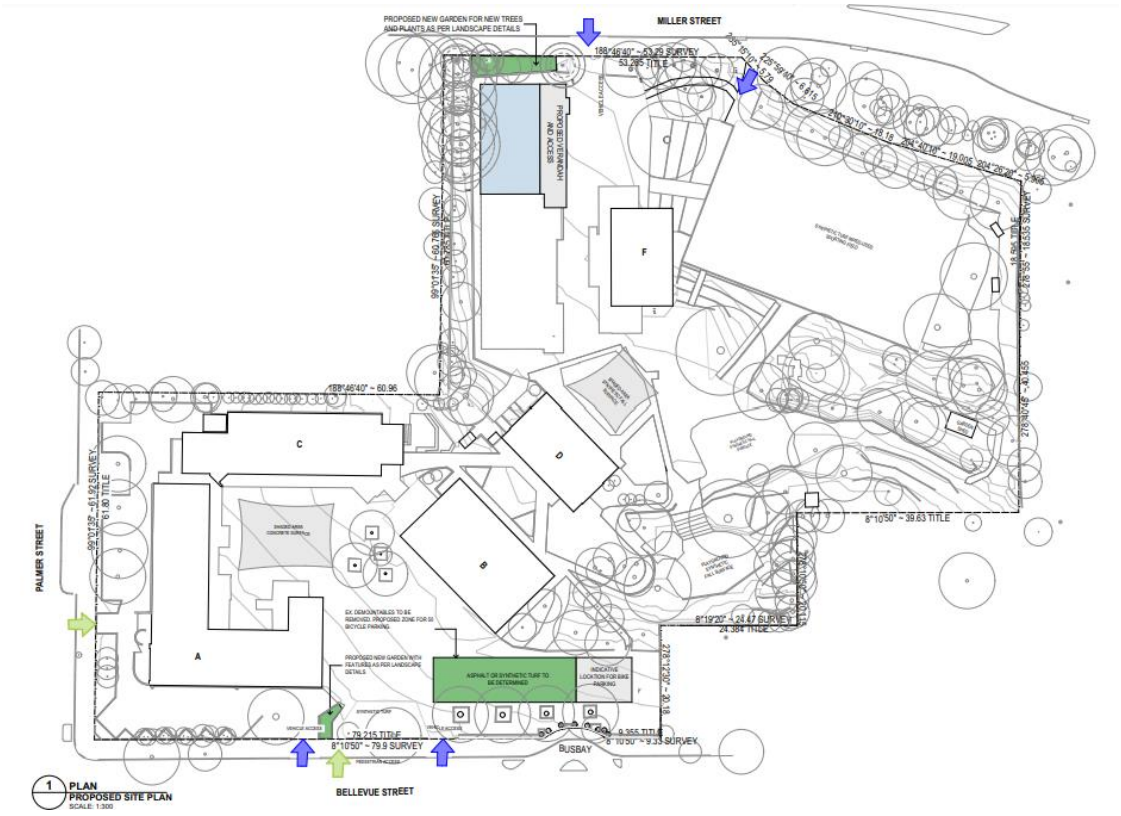


FIGURE 1: PROPOSED SCOPE OF WORKS (SOURCE: FULTON TROTTER ARCHITECTS, PROPOSED SITE PLAN (REV P6))

## 2.1 SITE LOCATION AND DESCRIPTION

CPS is located at 68 Palmer Street, Cammeray on the northern side of Palmer Road, bound by Palmer Street to the south, Bellevue Street to the east and Miller Street to the west. The site has an area of 1.36 ha and comprises 11 allotments, legally described as:

- Lot 11 DP 837836
- Lot 1 DP 316130

- Lot 1 DP 316706
- Lot 1 DP 123406
- Lot 2 DP 174370
- Lot 1 DP 174370
- Lot 4 Sec 35 DP 758790
- Lot 5 Sec 35 DP 758790
- Lot 66 DP 1049613
- Lot 3 DP 571310
- Lot 4 DP 571310

The site currently comprises an existing co-education primary (K-6) public school with 6 permanent buildings, 3 demountable structures, covered walkways linked at multiple levels, play areas, on-grade parking, sports court, covered outdoor learning area (COLA) and vegetation/green spaces with mature trees.

The existing school buildings are clustered towards the southern portion of the site and comprise both single and 2 storey buildings. The northern portion of the site contains the sports court, vegetable garden and play equipment. The north-western portion of the site is heavily vegetated with trees of high landscape significance that are protected with fencing.

The site is identified as a locally listed heritage item (I0019) under Schedule 5 Environmental Heritage pursuant to the *North Sydney Local Environmental Plan 2013* (NSLEP). The school is also identified in the Plateau Heritage Conservation Area (HCA) (Part 2 Schedule 5 of the NSLEP). The school is listed on the Department of Education (DoE) Section 170 Heritage Conservation Register as 'Cammeray Public School'. The site is approximately 115m from a State heritage item (I0004) being the electricity substation at 143 Bellevue Street and in close proximity to locally heritage listed items.

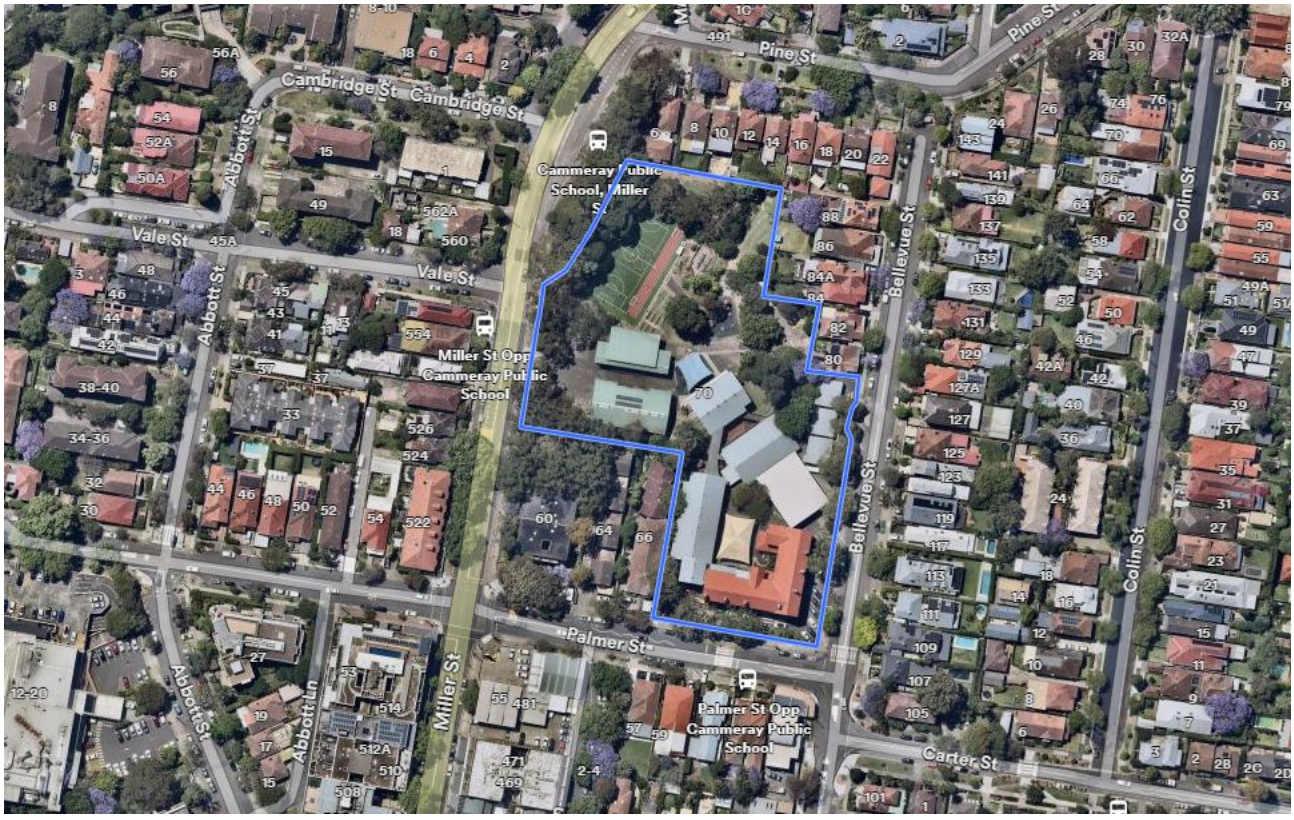


FIGURE 2 AERIAL IMAGE OF THE SITE, OUTLINED IN BLUE (SOURCE: NEARMAP, TAKEN 30 OCTOBER 2024)

The site is surrounded largely by low to high density residential zones as well as a E1 – Local Centre zone and a RE1 – Public Recreation zone. A map showing the zoning of the site and nearby receivers is shown in Figure 3.


FIGURE 3: SITE LOCATION, WITH THE BOUNDARIES OF THE SCHOOL SHOWN AS THE SP2 EDUCATIONAL ESTABLISHMENT ZONE

## 2.2 SCHOOL OPERATION HOURS

We understand that the school operating hours will be as per below:

- Operating hours: 0700 – 1700 hours
- Limited operations for evening periods outside of these hours (including after school care extending to 6pm) and no night time operations

## 2.3 SENSITIVE RECEIVERS

The most sensitive receivers for this project are located as per table below:

TABLE 1: SENSITIVE RECEIVERS / PER STAGE (IF APPLICABLE)

| RECEIVER | DISTANCE (APPROXIMATE) | TYPE OF RECEIVER / ZONE |
|---|---|---|
| **62-64 Palmer Street (62 Palmer St)** | 8m | Residential Properties |
| **524, 548-554 Miller St (550 Miller St)** | 26m | |

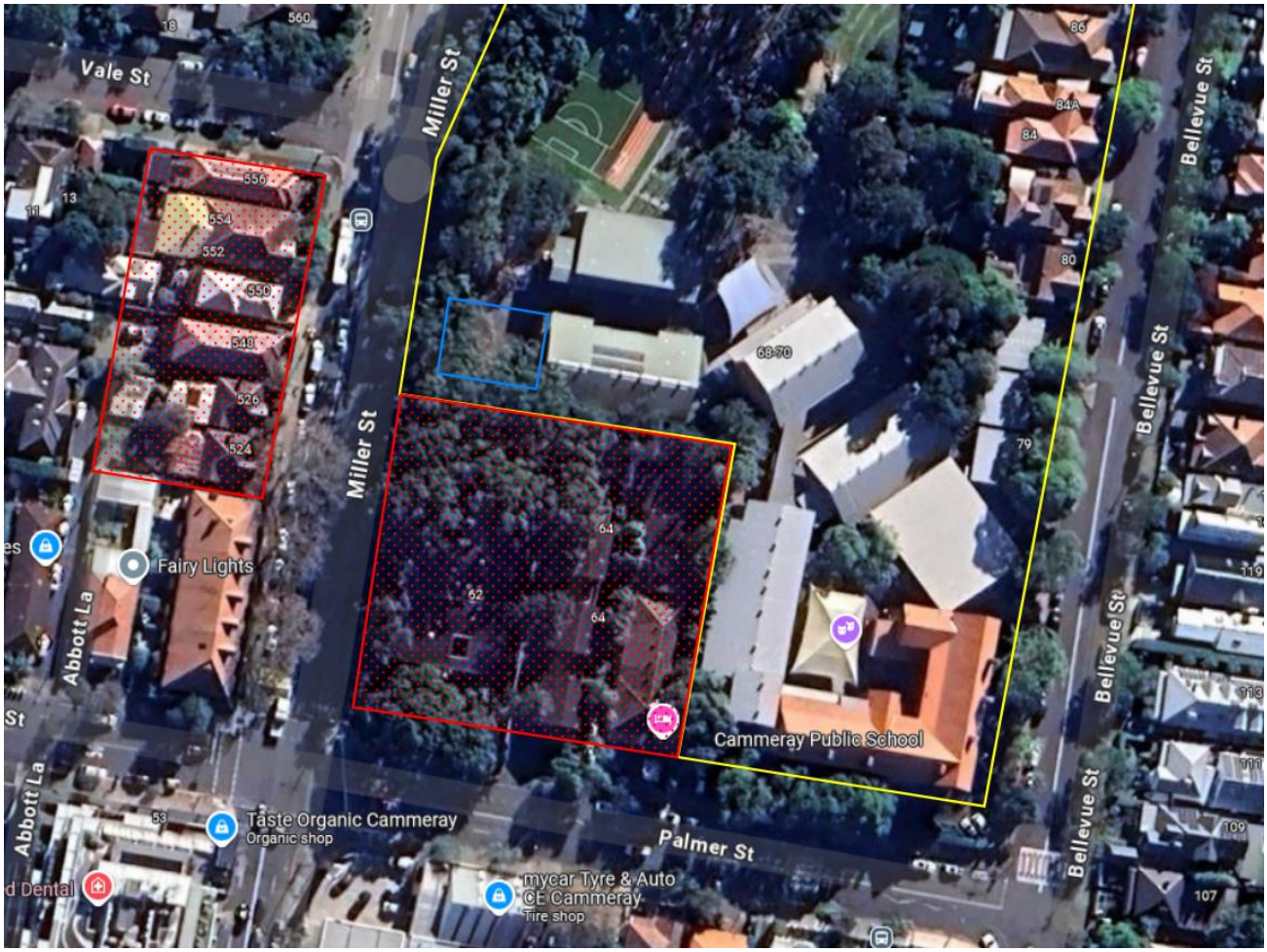


FIGURE 4: SENSITIVE RECEIVERS LOCATIONS. NOTE RECEIVERS SHOWN SHADED IN RED, SCHOOL BOUNDARY SHOWN IN YELLOW, AND EXTENSION APPROXIMATE LOCATION SHOWN IN BLUE

# 3 METHODOLOGY

This report was prepared using the below methodology:

- Review of the NSW standards, NPfI regulations and North Sydney Council requirements for noise and vibration (North Sydney LEP and DCP).
- Review of the site location, zoning and most affected receivers for all stages.
- Review of possible busy roads near the site and location of rail corridors.
- Selection of logger location was based on:
  - Critical receivers
  - Location of the receivers
  - Coordination with the planners discussing the proposed location.
- Assessment of operating noise and vibration sources, by coordinating with mechanical, electrical, and fire protection designers to establish noise sources and operating times. Other consultants involved were included such as traffic and garbage collection.
- To assess the construction noise and vibration sources, coordination was done with the client, project manager to understand the approximate construction programme and phases.
  - Note that for construction noise assessment, the REF Phase includes a preliminary estimation using the information existing at the time. If predicted noise levels exceed 75 dBA, then it is necessary a detailed construction noise and vibration management plan.

# 4 ACOUSTIC ASSESSMENT OF THE EXISTING ENVIRONMENT

## 4.1 METEOROLOGICAL DATA

To verify that the noise data was obtained during suitable meteorological conditions, weather data such as rain and wind speed were obtained from the Weather Underground service (Station ID ISYDNE3637) as a representative site located 100m away from the site.

Noise data is excluded (as per the NSW NPfI methodology) from the results in case of:

- Rain observed during any 15-minute noise measurement period and/or;
- Wind speeds exceeded 5 m/s during any 15-minute noise measuring period.

## 4.2 INSTRUMENTATION

Noise levels were measured using a Svantek SV 977D and SV 977A sound level meter. The details of these SLMs and the calibration details are listed in Table 2.

TABLE 2: NOISE LOGGER AND SOUND LEVEL METER INFORMATION

| NOISE LOGGER/SOUND LEVEL METER | TYPE | SERIAL NUMBER | DATE OF LAST CALIBRATION |
|---|---|---|---|
| **Svan 977D** | Class 1 | 99073 | 22/06/2023 |
| **Svan 977A** | Class 1 | 69795 | 23/04/2024 |

The equipment calibration was checked prior to, and after the noise survey using a 94 dB external calibration tone at 1 kHz.

The noise loggers were configured to record all relevant noise parameters including background noise ($L_{A90}$) and equivalent continuous noise levels $L_{Aeq}$. Samples were recorded at 15-minute A-weighted continuous intervals. The noise monitor responses were set to fast response. The analysers are Class 1 compliant with AS IEC 61672.2-2004.

## 4.3 NOISE LOGGER LOCATION

The noise logger was deployed along Miller Street, on the sidewalk around 550 Miller Street. This location was selected as it was close to the closest sensitive receiver not blocked by a barrier. This was agreed to with the project team and project planner. Logger was deployed between in two rounds – one from 23/09/24 to 27/09/24, and one from 17/10/24 to 28/10/24.

The location of the loggers is shown in Figure 5.

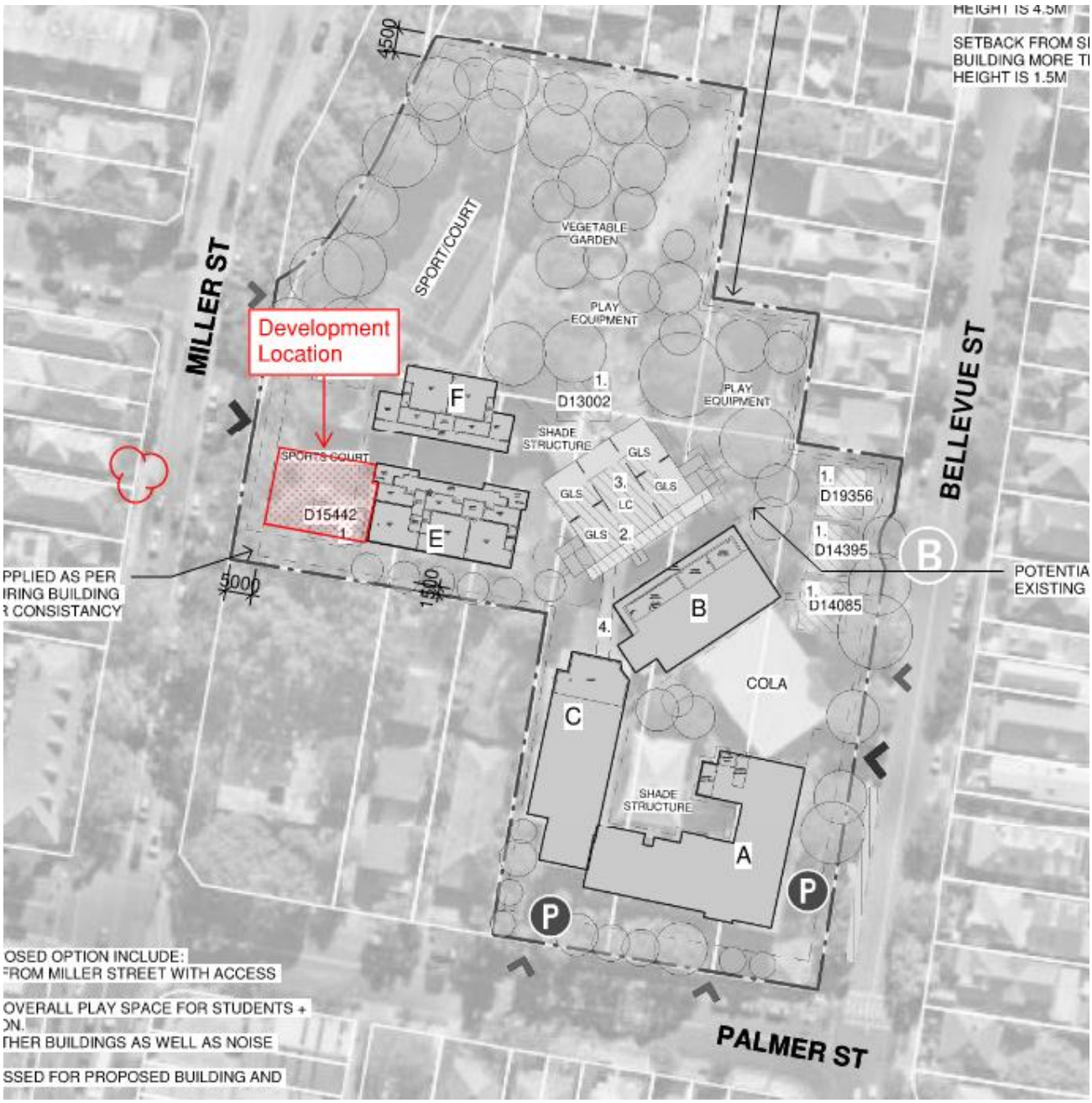


FIGURE 5: LOGGERS DEPLOYMENT AREAS

### 4.3.1 SHORT TERM NOISE MEASUREMENTS

In addition to the long-term noise monitoring, short term measurements were conducted along Miller Street at the location of logger deployment. The results of these are summarised below:

TABLE 3: EXISTING NOISE LEVELS (ATTENDED), DBA

| SHORT TERM MONITORING LOCATION | DATE AND TIME | SHORT TERM ATTENDED MEASUREMENT | |
|---|---|---|---|
| | | LAeq | L90 |
| **Along Miller Street** | 17/10/2024 16:54 | 74 | 64 |

# 5 NOISE AND VIBRATION CRITERIA

## 5.1 LOCAL CITY COUNCIL RULES

Cammeray Public School is located within the jurisdiction of the North Sydney Council. As this application is not a DA, the rules of the North Sydney LEP are not strict criteria but have been included here for completeness:

***1.2 Aims of Plan***

*(1) This Plan aims to make local environmental planning provisions for land in North Sydney in accordance with the relevant standard environmental planning instrument under section 3.20 of the Act.*

*(2) The particular aims of this Plan are as follows—*

- *a. (aa) to protect and promote the use and development of land for arts and cultural activity, including music and other performance arts,*
- *a. to promote development that is appropriate to its context and enhances the amenity of the North Sydney community and environment,*
- *b. in relation to the character of North Sydney's neighbourhoods—*
  - *i. to ensure that new development is compatible with the desired future character of an area in terms of bulk, scale and appearance, and*
  - *ii. to maintain a diversity of activities while protecting residential accommodation and local amenity, and*
  - *iii. to ensure that new development on foreshore land does not adversely affect the visual qualities of that foreshore land when viewed from Sydney Harbour and its tributaries,*
- *c. in relation to residential development—*
  - *iv. to ensure that new development does not adversely affect residential amenity in terms of visual and acoustic privacy, solar access and view sharing, and*
  - *v. to maintain and provide for an increase in dwelling stock, where appropriate,*
- *d. in relation to non-residential development—*
  - *vi. to maintain a diversity of employment, services, cultural and recreational activities, and*
  - *vii. to ensure that non-residential development does not adversely affect the amenity of residential properties and public places, in terms of visual and acoustic privacy, solar access and view sharing, and*
  - *viii. to maintain waterfront activities and ensure that those activities do not adversely affect local amenity and environmental quality,*
- *e. in relation to environmental quality—*
  - *ix. to maintain and protect natural landscapes, topographic features and existing ground levels, and*
  - *x. to minimise stormwater run-off and its adverse effects and improve the quality of local waterways,*
- *f. to identify and protect the natural, archaeological and built heritage of North Sydney and ensure that development does not adversely affect its significance,*
- *g. to provide for the growth of a permanent resident population and encourage the provision of a full range of housing, including affordable housing.*

The North Sydney DCP 2012 outlines acoustic noise and privacy criteria for new developments within the North Sydney Council area. Section 3.2.5 outlines acoustic amenity criteria to nearby residents from non-residential developments in residential zones:

### 3.2.5 Noise

***Objectives***

*O1 To ensure reasonable levels of acoustic amenity to nearby residents.*

***Provisions***

*P1 Noise emission associated with the operation of non-residential premises must not exceed the maximum 1 hour noise levels (LAeq 1 Hour) specified in Table B-3.1.*

| ***TABLE B-3.1: Noise Emission Limits*** | | | | |
|---|---|---|---|---|
| ***Time Period*** | | | ***Max 1 hour noise levels (LAeq 1 Hour)*** | |
| ***Day*** | ***Week*** | ***Time*** | ***Urban Area**** | ***Suburban Area#*** |
| *Weekday* | *Day* | *7am – 6pm* | *60 dBA* | *55 dBA* |
| | *Evening* | *6pm – 10pm* | *50 dBA* | *45 dBA* |
| | *Night* | *10pm – 7am* | *45 dBA* | *40 dBA* |
| *Weekend* | *Day* | *8am – 7pm* | *60 dBA* | *55 dBA* |
| | *Evening* | *7pm – 10pm* | *50 dBA* | *45 dBA* |
| | *Night* | *10pm – 8am* | *45 dBA* | *40 dBA* |

***Notes:*** *Laeq (1hour) readings are to be measured during the noisiest 1 hour period between Day – 7/8am to 6/7pm, Evening – 6/7pm – 10pm and Night – 10pm to 7/8am.*

** Urban Area – applies to any allotment of land zoned SP1 Special Activities or SP2 Infrastructure that is located adjacent to land zoned E1 Local Centre, E2 Commercial Centre or MU1 Mixed Use.*

*# Suburban Area – Applies to any allotment of land not classified as an urban area.*

*P2 In terms of determining the maximum noise levels as required by P1 above, the measurement is to be taken at the property boundary of the nearest residential premises.*

*P3 Despite P1 above, the noise emission associated with the operation of non-residential premises must not exceed 5 dBA above the background maximum 1 hour noise level (LAeq 1 Hour) during the day and evening and not exceeding the background level at night when measured at the boundary of the property.*

*P4 Council may require the submission of an Acoustic Report to ensure compliance with P1 above.*

*P5 Plant and machinery should incorporate noise reduction measures to minimise their impacts.*

*P6 Developments should be designed and / or incorporate features that reduce noise transmission.*

*P7 Where practical, development should incorporate adequate measures for tonal, low frequency, impulsive, or intermittent noise.*

*P8 Developments must comply with EPA Noise Policy for Industry 2017, in particular the modification required for acceptable noise level (ANL).*

Additionally, Section 3.2.10 states the following for acoustic privacy for non-residential development in residential zones:

### 3.2.10 Acoustic privacy

***Objectives***

*O1 To ensure all residents are provided with a reasonable level of acoustic privacy.*

***Provisions***

P1 *Materials with low noise penetration properties should be used where practical.*

P2 *Mechanical equipment, such as pumps, lifts or air conditioners should not be located adjacent to bedrooms or living rooms of dwellings on adjoining properties. P3 Where buildings are located on busy roads incorporate the following into the design of the development to reduce traffic noise within the building:*

a. *cavity brick walls;*
b. *double glazing;*
c. *solid core doors;*
d. *concrete floors; and*
e. *recessed* balconies.

P4 *Development comprising places of public worship, hospitals, educational facilities or child care centres on land which is on or is within 100m of a railway corridor, a road corridor for a freeway, a tollway, a transit way or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the Transport for NSW) must consider the requirements of the DoP's Development Near Rail Corridors and Busy Roads – Interim Guideline (19 December 2008) in accordance with cl.s 2.100(2) and 2.120(2) of SEPP (Transport and Infrastructure) 2021. An acoustic report may be required to be prepared to demonstrate compliance with this Guideline and the acoustic requirements within cl.s 2.100(3) and 2.120(3) of the SEPP (Transport and Infrastructure) 2021.*

## 5.2 NSW DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS

These guidelines support specific rail and road provisions of the State Environmental Planning Policy (Transport and Infrastructure) 2021 Clauses 2.100 and 2.120 for rail and busy roads. As there are no rail lines close to the school, only the busy roads legislation apply. These are presented below:

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

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

*(a) residential accommodation,*

*(b) a place of public worship,*

*(c) a hospital,*

*(d) an educational establishment or centre-based child care facility.*

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

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

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

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

*(3A) Subsection (3) does not apply to a building to which State Environmental Planning Policy (Housing) 2021, Chapter 3, Part 7 applies.*

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

As the development does not feature any residential accommodation or similar spaces, the noise criteria within the SEPP do not apply.

Through the NSW Traffic volume viewer, we confirmed that Station Id: 21032, Strathallen Avenue (same Miller Street further North) has a reported maximum traffic of 15,000 (all vehicles) in 2006 and 9,900 (all vehicles) in 2021, we assume that Miller street is not going to report more than 20,000 vehicles. This means that this policy would not apply for this school.

## 5.3 NSW NOISE POLICY FOR INDUSTRY (NPFI) 2017

For the purpose of the assessment, the measured noise data was processed into the following time periods:

- Daytime: 0700 to 1800 hrs.
- Evening: 1800 to 2200 hrs.
- Night-time: 2200 to 0700 hrs.

The measured background ($L_{A90}$) and equivalent continuous ($L_{Aeq}$) noise levels during these defined time periods. The $L_{A90}$ noise levels presented are *Rating Background Levels* (RBLs), being the median of the background $L_{A90}$ (i.e. of the lowest 10$^{th}$ percentile of samples) in each daytime, evening and night-time measurement period, for each 24-hour period during the noise survey.

The $L_{Aeq}$ noise levels presented are the logarithmic average of all the $L_{Aeq}$ samples taken in each of the daytime, evening and night-time periods.

TABLE 4: AMENITY NOISE LEVELS FOR NOISE LOGGERS, DBA

| LOCATION | NOISE INDEX | NOISE LEVEL, DB RE 20 µPA | | |
|---|---|---|---|---|
| | | Daytime 0700 to 1800 | Evening 1800 to 2200 | Night - time 2200 to 0700 |
| **Along Miller Street** | $L_{A90}$ (RBL) | 58 | 48 | 33 |
| | $L_{Aeq,period}$ | 73 | 72 | 65 |

### 5.3.1 AMENITY AND INTRUSIVENESS 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:

- Controlling intrusive noise impacts for residential receivers. Assessing intrusiveness generally 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 the equivalent continuous noise level (LAeq) of the source(s) under consideration should be controlled to not exceed background noise levels by more than 5 dB(A).
- 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 to industrial-type 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 is equalled to recommended amenity noise level minus 5dB(A).
- A +3dB(A) 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 more below 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.

TABLE 5: PROJECT SPECIFIC NSW NPFI AMENITY CRITERIA / TAKEN FROM TABLE 2.2 NPFI

| TYPE OF RECEIVER | INDICATIVE NOISE AMENITY AREA | PERIOD OF TIME | $L_{AEQ}$ DB(A) | AMENITY CRITERIA LAEQ DB(A) – 5 DB + 3 DB |
|---|---|---|---|---|
| **Residence** | Urban | Day 7:00 to 18:00 | 60 | 58 |
| | | Evening 18:00 to 22:00 | 50 | 48 |
| | | Night 22:00 to 7:00 | 45 | 43 |

The NSW NPfI characterise the above areas as per the below description:

| Receiver category | Typical planning zoning – standard instrument* | Typical existing background noise levels | Description |
|---|---|---|---|
| Rural residential | RU1 – primary production<br>RU2 – rural landscape<br>RU4 – primary production small lots<br>R5 – large lot residential<br>E4 – environmental living | Daytime RBL <40 dB(A)<br>Evening RBL <35 dB(A)<br>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.<br>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<br>RU6 – transition | Daytime RBL<45 dB(A)<br>Evening RBL<40 dB(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 |
| | R2 – low density residential<br>R3 – medium density residential<br>E2 – environmental conservation<br>E3 – environmental management | Night RBL <35dB(A) | following characteristic: evening ambient noise levels defined by the natural environment and human activity. |
| Urban residential | R1 – general residential<br>R4 – high density residential<br>B1 – neighbourhood centre (boarding houses and shop-top housing)<br>B2 – local centre (boarding houses)<br>B4 – mixed use | Daytime RBL> 45 dB(A)<br>Evening RBL> 40 dB(A)<br>Night RBL >35 dB(A) | **Urban** – an area with an acoustical environment that:<br>• 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<br>• has through-traffic with characteristically heavy and continuous traffic flows during peak periods<br>• is near commercial districts or industrial districts<br>• has any combination of the above. |

FIGURE 6: NPFI EXTRACT – TABLE 2.3 DETERMINING WHICH OF THE RESIDENTIAL RECEIVER CATEGORIES APPLIES

We believe the Urban area description above is the one more suitable for our project location based on the measured ambient noise levels.

The NPfI recommends "Intrusive noise levels are only applied to residential receivers (residences)". For other receiver types identified in Table 2.2 (Table 5 of this report), only the amenity levels apply. The project amenity and intrusive noise levels are be listed below.

TABLE 6: PROJECT INTRUSIVENESS AND AMENITY NOISE CRITERIA

| LOCATION | NOISE LEVEL, $L_{EQ,15MINS}$ [DBA] | | |
|---|---|---|---|
| | Daytime 0700 to 1800 | Evening 1800 to 2200 | Night - time 2200 to 0700 |
| Along Miller Street | **Project Amenity Assessment, $L_{Aeq, 15min}$** | | |
| | 63 | 62 | 55 |
| | **Project Intrusiveness Assessment, $L_{Aeq, 15min}$** | | |
| | 63 | 53 | 38 |

### 5.3.2 DETERMINATION OF PROJECT SPECIFIC NOISE TRIGGER LEVEL (PNTL)

The project Noise trigger noise levels (PNTL) are the most stringent noise levels of the NSW NPfI project intrusiveness and project amenity noise levels for day, evening and night-time periods and are project specific, as shown below:

TABLE 7: EXTERNAL PROJECT NOISE TRIGGER LEVEL (PNTL) FOR OPERATION NOISE

| LOCATION / AFFECTED | TIME | DESCRIPTOR | EXTERNAL PNTL [DBA] |
|---|---|---|---|
| Along Miller Street | 0700 to 1800 | $L_{Aeq, Day}$ | 63 |
| | 1800 to 2200 | $L_{Aeq, Evening}$ | 53 |
| | 2200 to 0700 | $L_{Aeq, Night}$ | 38 |

## 5.4 SUMMARY OF OPERATIONAL NOISE CRITERIA

TABLE 8: SUMMARY OF NOISE CRITERIA

| REGULATION | CRITERIA |
|---|---|
| **Council LEP / DCP** | • LAeq (1 hour) Day: 60 dBA / Evening: 50 dBA / Night: 45 dBA<br>• 5 dBA above the background maximum 1 hour noise level (LAeq 1 Hour) during the day and evening and not exceeding the background level at night when measured at the boundary of the property. |
| **PTNL (NPfI 2017)** | • PTNL Day: 63 dBA / Evening: 52 dBA / Night: 37 dBA |

## 5.5 CONSTRUCTION NOISE AND VIBRATION CRITERIA

### 5.5.1 Interim Construction Noise Guideline

The NSW Interim Construction Noise Guideline was developed by the NSW-Department of Climate Change, Energy, the Environment and Water (DCCEEW) which incorporates the EPA. The Guideline contains detailed procedures for the assessment and management of construction noise impacts.

The guideline presents two ways of assessing construction noise impacts – the quantitative method, which is generally suited to longer term construction works and the qualitative method, which is generally suited to short term works (usually not more than 3 weeks) such as infrastructure maintenance.

It is expected that the length of the construction works associated with the development would be more than 3 weeks and therefore a quantitative method has been used for this assessment.

**Table 9** set out the management levels for noise at residence and sensitive land uses, respectively. Restrictions to the hours of construction may apply to activities that generate noise at residences above the 'highly noise affected management level' which is >75dBA.

Affected properties above 75 dBA might require community consultation and a Construction Noise & Vibration Management Plan (CNVMP). Based on the RBL of 38 – 39 dBA in the daytime, the recommended noise management level during all aspects of the construction program are summarised in Table 10 below.

TABLE 9: NOISE AT AFFECTED USING QUANTITATIVE ASSESSMENT

| RECOMMENDED HOURS | EXTERNAL NOISE MANAGEMENT LEVEL (NML) $L_{EQ,15MIN}$ [dBA] | HOW TO APPLY |
|---|---|---|
| **Recommended standard hours**<br><br>**Monday – Friday**<br>**7am to 6pm**<br>**Saturday 8am to 1pm**<br>**No work on Sundays or Public Holidays** | Noise Affected<br>68 dB(A)<br>(58 + 10) | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq\ (15\ minutes)}$ noise level is greater than the affected level, the proponent should apply all feasible and reasonable* work practices to meet the noise affected level.<br>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<br>75 dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite period by restricting hours that the very noisy activities can occur, taking into account:<br>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);<br>2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times. |
| **Outside Recommended standard hours** | 38 dBA<br>(33 + 5) | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.<br>For guidance on negotiating agreements see section 7.22 |

*Section 6, 'work practices' of the *Interim Construction Noise Guideline*, states: "*there are no prescribed noise controls for construction works. Instead, all feasible and reasonable work practices should be implemented to minimise noise impacts. This approach gives construction site managers and construction workers the greatest flexibility to manage noise*".

Definitions of the terms feasible and reasonable are given in Section 1.4 of the Guideline.

The Interim Construction Noise Guideline recommends the following noise levels for land uses other than residential, as shown in Table 10 below. The external noise levels should be assessed at the most affected occupied point on the premises. A conservative estimate of 10 dB is generally applied as the difference between the external and internal level for noise sensitive uses that require internal noise measurement.

### 5.5.2 NOISE MANAGEMENT LEVELS

Noise Management Levels (NML) associated with the construction works on the project site are presented in Table 10.

TABLE 10: CONSTRUCTION NOISE MANAGEMENT LEVELS, $L_{EQ\ 15MIN}$

| RECEIVERS | RECOMMENDED HOURS | PERIOD | RBL $L_{A90,15MINS}$ [dBA] | EXTERNAL NOISE MANAGEMENT LEVEL [dBA] |
|---|---|---|---|---|
| **Residential** | Day time (standard construction hours) | When in use | 60 | (60 + 10) = 70 dB(A) (Noise affected)<br>75 dB(A)<br>(highly noise affected) |

For other sensitive land users different from residential, the below table applies:

**Table 3:** Noise at sensitive land uses (other than residences) using quantitative assessment

| Land use | Management level, $L_{Aeq\ (15\ min)}$ (applies when properties are being used) |
|---|---|
| Classrooms at schools and other educational institutions | Internal noise level 45 dB(A) |
| Hospital wards and operating theatres | Internal noise level 45 dB(A) |
| Places of worship | Internal noise level 45 dB(A) |
| Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion) | External noise level 65 dB(A) |
| Passive recreation areas (characterised by contemplative activities that generate little noise and where benfefits are compromised by external noise intrusion, for example, reading, meditation) | External noise level 60 dB(A) |
| Community centres | Depends on the intended use of the centre.<br>Refer to the recommended 'maximum' internal levels in AS2107 for specific uses. |

FIGURE 7: EPA CONSTRUCTION NOISE AND VIBRATION GUIDELINE, 2016 / EXTRACT NOISE AT SENSITIVE USERS

### 5.5.3 CONSTRUCTION VIBRATION CRITERIA

The effects of construction vibration upon buildings can be separated into three main categories:

Perceptibility of the occupants to the vibration and the possibility of them being disturbed or annoyed.
Vulnerability of the building structures to vibration induced damaged.
Vulnerability of the contents of the building that includes types of equipment, activities and processes.

#### 5.5.3.1 Human Response to Vibration

Humans are very sensitive to vibration, and they can be disturbed, annoyed and have their work activities interfered with if the levels are too high. The Interim Construction Noise Guideline references "*Assessing Vibration: a technical guideline*" (Vibration Guideline) issued by DCCEEW for measurement and assessment of vibration. The Vibration Guideline provides vibration criteria for continuous, impulsive and intermittent vibration

| Continuous vibration | Impulsive vibration | Intermittent vibration |
|---|---|---|
| Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery). | Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.<br>Blasting is assessed using ANZECC (1990). | Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria. |

The criteria are discussed in more detail in the following sections.

#### 5.5.3.2 Continuous and impulsive vibration (1-80 Hz)

According to the Vibration Guideline for continuous and impulsive vibration, assessment of impact should be considered on the basis of weighted root-mean-square acceleration values and results are to be compared against the following preferred and maximum values given for each orthogonal axis. The frequency weightings as per BS6841:1987 (reproduced in Appendix B3 of the guideline) are to be applied to the RMS measurement values (1-80Hz).

The criteria in the Vibration Guideline are derived from the limiting values of the assessment curves and multiplying factors from BS 6472:1992 (the curves are no longer referenced in the superseded version of the standard BS 6472:2008).

**Table 2.2 Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration (m/s$^2$) 1–80 Hz**

| Location | Assessment period[1] | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z-axis | x- and y-axes | z-axis | x- and y-axes |
| **Continuous vibration** | | | | | |
| Critical areas[2] | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.010 | 0.0071 | 0.020 | 0.014 |
| | Night-time | 0.007 | 0.005 | 0.014 | 0.010 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.020 | 0.014 | 0.040 | 0.028 |
| Workshops | Day- or night-time | 0.04 | 0.029 | 0.080 | 0.058 |
| **Impulsive vibration** | | | | | |
| Critical areas[2] | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.30 | 0.21 | 0.60 | 0.42 |
| | Night-time | 0.10 | 0.071 | 0.20 | 0.14 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| Workshops | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472–1992

The Vibration Guideline notes "*Activities should be designed to meet the preferred values where an area is not already exposed to vibration. Where all feasible and reasonable measures have been applied, values up to the maximum value may be used if they can be justified. For values beyond the maximum value, the*

*operator should negotiate directly with the affected community. Situations exist where vibration above the preferred values can be acceptable, particularly for temporary disturbances and infrequent events of short-term duration. An example is a construction or excavation project."*

#### 5.5.3.3 Intermittent vibration (1-80 Hz)

According to the Vibration Guideline for intermittent vibration, assessment of impact should be considered on the basis of vibration dose values (VDV). Acceptable values of vibration dose are given as follows.

**Table 2.4 Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)**

| Location | Daytime[1] | | Night-time[1] | |
|---|---|---|---|---|
| | Preferred value | Maximum value | Preferred value | Maximum value |
| Critical areas[2] | 0.10 | 0.20 | 0.10 | 0.20 |
| Residences | 0.20 | 0.40 | 0.13 | 0.26 |
| Offices, schools, educational institutions and places of worship | 0.40 | 0.80 | 0.40 | 0.80 |
| Workshops | 0.80 | 1.60 | 0.80 | 1.60 |

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.
Source: BS 6472–1992

#### 5.5.3.4 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed 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).

#### 5.5.3.5 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 11 and illustrated in Figure 8.

TABLE 11: TRANSIENT VIBRATION CRITERIA AS PER STANDARD BS 7385 PART 2 – 1993

| Line in | 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 value in **Table 11** relate to transient vibration which does not cause resonant response 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 11** may need to be reduced by up to 50% (refer to Line 3 in Figure 8).

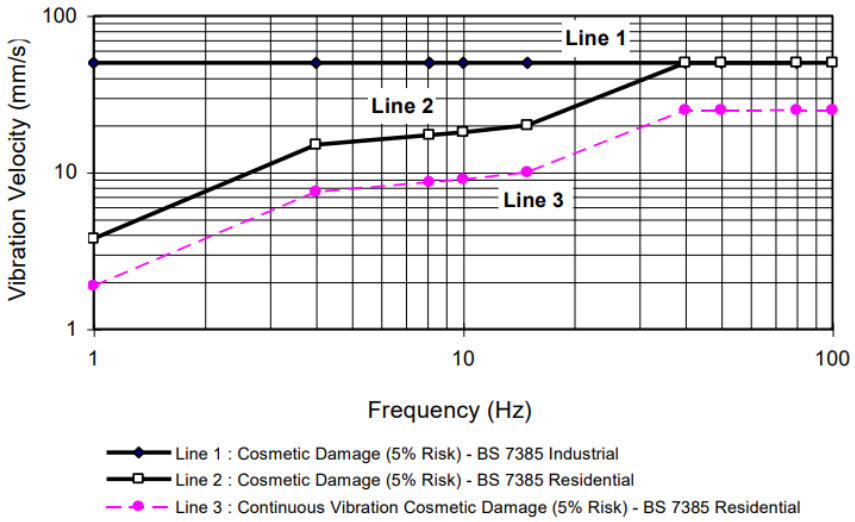


FIGURE 8 – BS 7385 PART 2 – 1993, GRAPH OF TRANSIENT VIBRATION VALUES FOR COSMETIC DAMAGES

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

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in **Table 11**, and major damage to a building structure may occur at values greater than four times the tabulate values.

Fatigue considerations are also addressed in the standard and it is concluded that unless the calculation indicated that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in **Table 11** should not be reduced for fatigue considerations.

#### 5.5.3.6 Structural Response to Vibration - German Standard DIN 4150-3:1999

The German Standard DIN 4150-3 Structural Vibration Part 3: Effects on building and structures is commonly used in Australia to evaluate the effects of vibration on structures primarily used for static loading.

The response of a building to vibration is affected by several factors that include its type of foundation, the underlying ground conditions, its construction and the state of the building. Please note the construction vibration limits are designed to ensure the structural integrity of nearby buildings and are not for human comfort. the limits are well above perceptibility.

According to DIN 4150 short term vibration refers to vibration which does not occur often enough to cause structural fatigue, and which does not produce resonance in the structure being evaluated. Long-term vibration refers to all types of vibration not covered by the definition of 'short-term vibration'. The criteria for short-term and long-term vibration are listed in the following.

#### 5.5.3.7 Guideline Values for evaluation of short-term vibration - DIN 4150-3:1999

The vibration limits of table 1 in DIN 4150-3:1999 (replicated in **Table 12** below) refer to the evaluation of the effects of short-term vibration on structures.

It should however be noted that compliance with the vibration limits to avoid structural damage of buildings, cannot provide certainty. If damage occurs despite compliance with the standard, it is to be assumed that other causes are responsible, however, further investigations are necessary. And on the other hand, exceeding the limits does not necessarily lead to damage.

TABLE 12: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – SHORT TERM

| TYPE OF STRUCTURES | GUIDELINE VALUES FOR VIBRATION VELOCITY (MM/S) | | | |
|---|---|---|---|---|
| | Vibration at the foundation at a frequency of | | | Vibration at horizontal plane of highest floor at all frequencies |
| | 1Hz to 10Hz | 10 to 50 Hz | 50 to 100Hz (and above) | |
| **Buildings for commercial purposes, Industrial building and building of similar design** | 20 | 20 to 40 | 40 to 50 | 40 |
| **Dwellings and buildings of similar design and/or occupancy** | 5 | 5 to 15 | 15 to 20 | 15 |
| **Structures that because of their particular sensitivity to vibration, cannot be classified as above and are of great intrinsic value (e.g. listed buildings under preservation order)** | 3 | 3 to 8 | 8 to 10 | 8 |

#### 5.5.3.8 Guideline Values for evaluation of long-term vibration - DIN 4150-3:1999

The vibration limits of Table 3 in DIN 4150-3:1999 refer to the evaluation of the effects of long-term vibration on structures.

The criteria are the peak particle velocities measured on the uppermost full storey of any building not related to the site and are listed in **Table 13**.

According to the standard, *exceeding the values listed below does not necessarily lead to damage*.

If a building is subject to harmonic vibration, then maximum values can occur in floors other than the top floor, or in the foundation. The values given also apply in these cases.

TABLE 13: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – LONG TERM

| TYPE OF STRUCTURES | GUIDELINE VALUES FOR VELOCITY, VI, IN MM/S OF VIBRATION IN HORIZONTAL PLANE OF HIGHEST FLOOR, AT ALL FREQUENCIES |
|---|---|
| **Buildings for commercial purposes, Industrial building and building of similar design** | 10 |
| **Dwellings and buildings of similar design and/or occupancy** | 5 |
| **Structures that because of their particular sensitivity to vibration, cannot be classified as above and are of great intrinsic value (e.g. listed buildings under preservation order)** | 2.5 |

### 5.5.4 SUMMARY OF CONSTRUCTION NOISE AND VIBRATION CRITERIA

Construction noise criteria for the areas surrounding the project are NML levels (between RBL + 10 dBA and max. 75 dBA) for standard construction hours. As per below:

- Logger 1 receivers:
  - Recommended standard hours: Noise affected – 70 dBA / Highly noise affected – 75 dBA
- School building receivers: closest blocks E and F 45 dBA (internal) / 55 dBA (external)

We consider that for this project the vibration criteria will be as per DIN 4150 – 3:1999 construction vibration limits – long term. Residential receivers in the area will have a peak particle velocity criterion of 5 mm/s and commercial buildings of 10 mm/s peak particle velocity criteria.

The REF construction noise assessment will utilize the information provided by the team at this stage and conduct a preliminary construction noise and vibration assessment. If the predicted construction noise and vibration levels are not exceeding the limits, there is no need for a future Construction Noise and Vibration Management Plan.

# 6 OPERATIONAL NOISE & VIBRATION IMPACT ASSESSMENT

The following sections present our assessment of noise emission impacts from operational noise sources from the project. Predicted noise levels and associated mitigation measures are also provided according to the noise assessment and criteria.

## 6.1 NOISE EMISSION FROM PA SYSTEMS AND SCHOOL BELLS

The school PA or bells are a part of the existing noise emissions from the school. With these redevelopment works, it is understood that any PA or bell systems will be extended to the existing in order to cover the new building as required. These may be located on the new building and should be oriented to direct sound away from the neighbours where possible.

## 6.2 NOISE EMISSIONS FROM SERVICES

### 6.2.1 MECHANICAL SERVICES

The new building will require additional outdoor HVAC condenser units. These will be located under the building, with 6 units facing out to Miller St. It is understood that these units are expected to operate during the school operating hours (i.e. only during daytime hours).

The location of the units is shown in Figure 9.

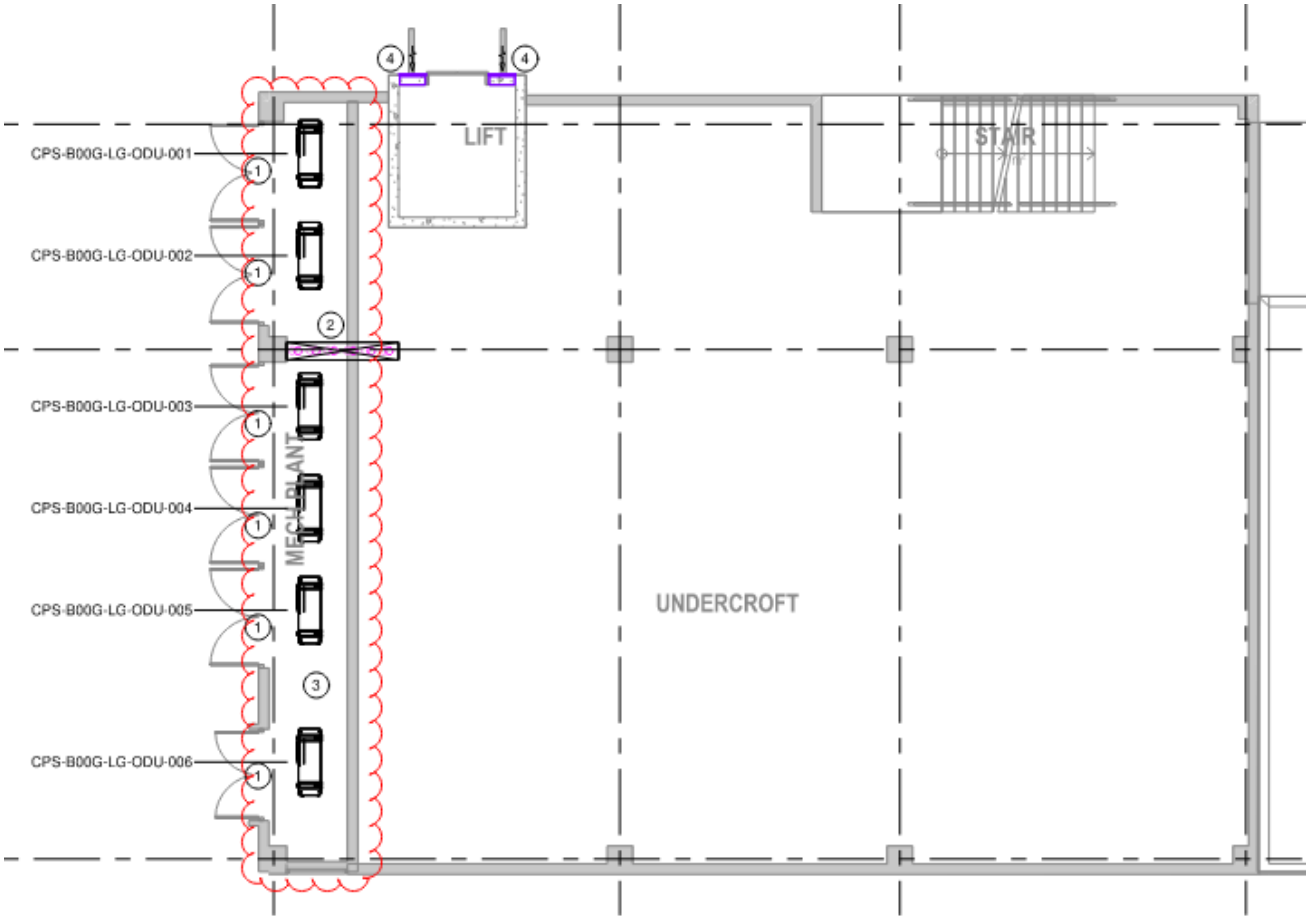


FIGURE 9: LOCATION OF NEW PLANT, SHOWN HERE CLOUDED. NOTE NEW PROPOSED BUILDING TO THE RIGHT.

In addition to this, there are several extract fans expected which will be detailed at a later stage. Locations of these are generally at the highest occupied level.

We understand that final equipment selections are not available at this stage, however a preliminary mechanical equipment assessment was conducted with equipment noise data used for similar projects. Along with the sensitive residential receivers, the NPfI categorises classrooms as sensitive spaces and requires a maximum internal noise limit of 45dBA to be met by the project. In order to ensure that the mechanical plant does not impact the existing classrooms and comply with the NPfI limit of internal noise 45dBA, the assessment was also done for noise propagated from the plant to the closest existing Block F which is estimated to be approximately 18m away from the mechanical plant (based on current layout of new building location).

Mechanical noise sources propagated to critical receivers is shown in table below:

TABLE 14 - MAXIMUM IN-DUCT SOUND POWER LEVELS FOR MECHANICAL EQUIPMENT

| EQUIPMENT | SWL SOUND POWER LEVEL (dB) PER FREQUENCY BAND (HZ) | | | | | | | | DBA |
|---|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | |
| **Outdoor Unit** | 76 | 74 | 74 | 71 | 66 | 63 | 60 | 52 | **73** |
| **Extract Fan** | 71 | 68 | 69 | 68 | 70 | 71 | 66 | 57 | **76** |
| **Total noise for 2x ODUs and 2x fans (SPL at 1m)** | 72 | 70 | 70 | 68 | 66 | 67 | 62 | 53 | **72** |

It is assumed that the closest receivers are exposed to the following:

- 550 Miller St: 6x ODUs and 2x extract fans are located at 26m
- 62 Palmer St: 1x ODU and 2x extract fans are located at 8m
- Block F: 1x ODU and 2x extract fans are located at 18m

These are expected to be very conservative as the fan locations are expected to vary and not be concentrated at the closest location to both receivers. Based on these the following noise levels are predicted:

TABLE 15: MECHANICAL SERVICES NOISE PROPAGATED INTO CRITICAL RECEIVERS

| RECEIVER | NOISE LIMIT | ESTIMATED NOISE LEVEL (OUTSIDE) / (SPL) |
|---|---|---|
| **550 Miller St (26m)** | 63 dB(A)<br>(PTNL for Day) | 46 dB(A) |
| **62 Palmer St (8m)** | 63 dB(A)<br>(PTNL for Day) | 50 dB(A) |
| **Existing Block F (18m)** | 45 dB(A) Internally<br>55 dB(A) Externally[1] | 45 dB(A) |

Daytime PNTLs are the noise limits selected here as the new building is only expected to be running during daytime hours.

The above levels are propagated outside to the closest receiver's façade. The noise from the HVAC plant will meet the relevant targets in the NPfI without any additiona mitigation.

During mechanical equipment selection, it is recommended to use the utilize the assumed equipment sound data as a guideline and to ensure that the combined sound pressure levels at 1m for the plant do not exceed

[1] A nominal 10 dB reduction has been applied for the façade of the building, so the external target is 55 dB(A)

88 dBA. If they exceed, further acoustic treatment will be required to ensure noise limits as per the NPfI are met. This could mean reselecting attenuators or fans.

### 6.2.2 OTHER SERVICES

As the development is small in scale, no major other services are expected to be required.

## 6.3 OPERATIONAL VIBRATION

For controlling vibration emissions on mechanical plant (VRF, condensers and similar), it would be recommended that all condensers are installed on Embelton Supershearflex, Mason Industries Super W Waffle pads or equal. This would ensure compliance with the NSW EPA document Assessing Vibration: A technical guideline. However, as ODU units are small and far away from any nearby sensitive receivers, we do not consider this will be a noticeable impact on school grounds or residential areas.

# 7 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

The construction methodology details are not fully confirmed, however the following are understood:

- Construction will involve earthworks, concrete pad footing works, and construction and fitout works.
- Confirmation was obtained from the structural team that piling works are not required. Concrete pad footings will be used for the foundations of the structure.

Construction hours are not confirmed, however it is recommended that the following hours are adopted to avoid times where construction noise criteria are more stringent:

- Weekdays 0700 to 1800
- Saturdays 0800 to 1300
- Sundays and public holidays: no work

## 7.1 CONSTRUCTION PLANT NOISE LEVELS

Minimum construction equipment for the estimated construction phases is described below:

TABLE 16 TYPICAL EXTERNAL NOISE LEVELS OF DEMOLITION AND CONSTRUCTION MACHINERY/ACTIVITY

| ITEM # | ACTIVITY/MACHINERY | SOURCE AND REFERENCE NUMBER (BS 5228 – 1:2009) | $L_{eq}$ SOUND PRESSURE LEVEL AT 10m (dBA) |
|---|---|---|---|
| **Excavation and Demolition** | | | |
| **1** | Tracked excavator 14t / 66kW | Table C2 Ref 25 | 69 |
| **2** | Vibratory Roller passby, 3t / 20kW | Table C5 / Ref 27 | 73 |
| **3** | Dumper truck 9T / 75 kW | Table C4 / Ref 4 | 76 |
| **Construction & Fitout Works** | | | |
| **4** | Handheld circular saw 3 Kw | Table C4 / Ref 72 | 79 |
| **5** | Handheld cordless nail gun | Table C4 / Ref 95 | 73 |
| **6** | Diesel generator | Table C4 / Ref 76 | 61 |
| **Pad Footing Works** | | | |
| **7** | Tracked excavator 14t / 66kW | Table C2 Ref 25 | 69 |
| **8** | Concrete pump + cement mixer truck (discharging) 8 T / 350 bar | Table C4 / Ref 24 | 68 |

**Notes:**

- The above equipment shows every equipment noise level as per BS 5228 – 1:2009, the equipment inclusion in each phase is the general equipment that is used in this type of construction. A more detailed assessment will only be done if the preliminary assessment exceeds 75 dBA, if not, the above assessment is adequate for this type of report.
- NSW DECC 2009 Construction noise Guideline quotes on Appendix B Equipment Noise levels, the DEFRA 2005 database, which includes the above referenced BS 5228 – 1:2009 noise levels.

## 7.2 PREDICTED CONSTRUCTION NOISE

### 7.2.1 RESIDENTIAL RECEIVERS

Based upon the above plant sound power levels, predicted construction noise levels for the various works phases are presented below:

TABLE 17 PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$ TO THE RESIDENTIAL RECEIVERS

| RECEIVERS | RECOMMENDED HOURS | PERIOD | PREDICTED CONSTRUCTION NOISE LEVEL | EXTERNAL NOISE MANAGEMENT LEVEL |
|---|---|---|---|---|
| **Excavation and Demolition Phase** | | | | |
| 550 Miller Street | Monday Friday 7am to 6pm<br>Saturday 8am to 1pm<br>No work on Sundays or Public Holidays | Day | 70 dB(A) | 68 dB(A)(noise affected)<br>75dB(A) (highly noise affected) |
| 62 Palmer Street | | | 70 dB(A) | |
| **Construction & Fitout Works Phase** | | | | |
| 550 Miller Street | Monday Friday 7am to 6pm<br>Saturday 8am to 1pm<br>No work on Sundays or Public Holidays | Day | 69 dB(A) | 68 dB(A)(noise affected)<br>75dB(A) (highly noise affected) |
| 62 Palmer Street | | | 67 dB(A) | |
| **Pad Footing Works Phase** | | | | |
| 550 Miller Street | Monday Friday 7am to 6pm<br>Saturday 8am to 1pm<br>No work on Sundays or Public Holidays | Day | 65 dB(A) | 68 dB(A)(noise affected)<br>75dB(A) (highly noise affected) |
| 62 Palmer Street | | | 65 dB(A) | |

NB: 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.

Notes:

- All equipment during the excavation and demolition phase are assumed to have a 50% on-time.
- All equipment during the construction and fitout works are assumed to have a 50% on-time, except any circular saws which are assumed to have a 25% on-time.
- A 2m barrier to 62 Palmer Street has been assumed for the predictions above. An existing fence is located between the school and 62 Palmer Street, this is generally expected to provide this reduction however if required a construction barrier should be installed at this location for the duration of the construction works.
- Construction hours will only be during day-time.
- Construction site is considerably big and not all machinery is expected to be located at the same distance when assessing on a particular boundary.
- Not all machinery are to be working simultaneously.

- The above estimations are the critical scenario for construction noise and assume a worst-case scenario where the equipment is generally located at the closest location to the receivers.

As shown construction noise levels during all stages phases were predicted below 75 dB(A). Under the ICNG, there is no requirements for construction noise to be managed as part of a construction noise and vibration management plan.

### 7.2.2 SCHOOL RECEIVERS

The construction is expected to affect receivers on school grounds located close to the site of construction. This primarily impacts Blocks E and F which are located next to at 13m away from the construction location respectively.

Based upon the above plant sound power levels, predicted construction noise levels for the various works phases are presented below:

TABLE 18 PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$ TO BLOCK E

| EQUIPMENT | DISTANCE [M] | ON-TIME | PREDICTED CONSTRUCTION NOISE LEVEL | EXTERNAL NOISE MANAGEMENT LEVEL (EXTERNAL)[2] | MITIGATION MEASURES |
|---|---|---|---|---|---|
| **Excavation and Demolition Phase** | | | | | |
| Tracked Excavator | 15 | 50% | 52 dB(A) | 45 dBA (internal) / 55 dBA (external) | 2m Noise barrier between plant and Block E |
| Vibratory Roller | 15 | 50% | 54 dB(A) | | 2m Noise barrier between plant and Block E |
| Dump Truck | 25 | 25% | 55 dB(A) | | 2m Noise barrier between plant and Block E |
| **Total** | | | 59 dB(A) | 45 dBA (internal) / 55 dBA (external) | |
| **Construction & Fitout Works Phase** | | | | | |
| Circular Saw | 20 | 25% | 55 dB(A) | 45 dBA (internal) / 55 dBA (external) | 2m Noise barrier between plant and Block E<br>Minimum 20m setback distance |
| **Nail Gun** | 15 | 50% | 55 dB(A) | | 2m Noise barrier between plant and Block E |
| Diesel Generator | 20 | 50% | 48 dB(A) | | 2m Noise barrier between plant and Block E |
| **Total** | | | 58 dB(A) | 45 dBA (internal) / 55 dBA (external) | |

[2] The internal noise levels for classrooms are EPA Construction Noise and Vibration Guidelines set internal noise limits within classrooms to be 45 dBA internally. A 10 dB reduction has been assumed for the façade, giving an external noise limit of 55 dBA.

| EQUIPMENT | DISTANCE [M] | ON-TIME | PREDICTED CONSTRUCTION NOISE LEVEL | EXTERNAL NOISE MANAGEMENT LEVEL (EXTERNAL)[2] | MITIGATION MEASURES |
|---|---|---|---|---|---|
| **Pad Footing Works Phase** | | | | | |
| Tracked Excavator | 15 | 50% | 53 dB(A) | 45 dBA (internal) / 55 dBA (external) | 2m Noise barrier between plant and Block E |
| **Concrete Pump** | 15 | 50% | 52 dB(A) | | 2m Noise barrier between plant and Block E |
| **Total** | | | 56 dB(A) | 45 dBA (internal) / 55 dBA (external) | |

It is understood that Block E will be partly vacated through the course of construction. We expect that the rooms border the façade with the construction site will not be used for the duration of the construction works, the distances and noise predictions above take this into account and predict noise levels to the façade of the classrooms expected to be in use.

TABLE 19 PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$ TO BLOCK F

| EQUIPMENT | DISTANCE [M] | ON-TIME | PREDICTED CONSTRUCTION NOISE LEVEL | EXTERNAL NOISE MANAGEMENT LEVEL (EXTERNAL) [2] | MITIGATION MEASURES |
|---|---|---|---|---|---|
| **Excavation and Demolition Phase** | | | | | |
| Tracked Excavator | 13 | 50% | 53 dB(A) | 45 dBA (internal) / 55 dBA (external) | 2m Noise barrier between plant and Block F |
| Vibratory Roller | 13 | 50% | 54 dB(A) | | 2m Noise barrier between plant and Block F |
| Dump Truck | 25 | 25% | 55 dB(A) | | 2m Noise barrier between plant and Block F |
| **Total** | | | 59 dB(A) | 45 dBA (internal) / 55 dBA (external) | |
| **Construction & Fitout Works Phase** | | | | | |
| Circular Saw | 20 | 25% | 55 dB(A) | 45 dBA (internal) / 55 dBA (external) | 2m Noise barrier between plant and Block F<br>Minimum 20m setback distance |
| Nail Gun | 15 | 50% | 55 dB(A) | | 2m Noise barrier between plant and Block F |
| Diesel Generator | 13 | 50% | 48 dB(A) | | 2m Noise barrier between plant and Block F |
| **Total** | | | 59 dB(A) | 45 dBA (internal) / 55 dBA (external) | |
| **Pad Footing Works Phase** | | | | | |

| EQUIPMENT | DISTANCE [M] | ON-TIME | PREDICTED CONSTRUCTION NOISE LEVEL | EXTERNAL NOISE MANAGEMENT LEVEL (EXTERNAL)[2] | MITIGATION MEASURES |
|---|---|---|---|---|---|
| Tracked Excavator | 15 | 50% | 53 dB(A) | 45 dBA (internal) / 55 dBA (external) | 2m Noise barrier between plant and Block F |
| Concrete Pump | 15 | 50% | 52 dB(A) | | 2m Noise barrier between plant and Block F |
| **Total** | | | 56 dB(A) | 45 dBA (internal) / 55 dBA (external) | |

Due to the closeness of Blocks E and F to the construction site, mitigation is difficult. As these receivers are under the control of Cammeray Public School, some specific mitigation measures can be adopted to ensure that impacts to the users of Blocks E and F are minimised. The following mitigation measures are proposed to ensure that noise levels can be maintained to under 45 dBA internally when in use:

- Although the total noise levels exceed the 55 dBA target, individual noise levels will be under 55 dBA. Scheduling loud works so that they do not occur at the same time when the classrooms are in use should be done where possible.
- Scheduling classrooms in Blocks E and F to be vacant while particularly loud works occur.
- Use of 2m high noise barriers to the buildings and exposed areas
  - Noise barriers can also be installed at the buildings as well as around the construction site. Currently only noise barriers around the site have been accounted for so this would give additional reductions.
- Closing classroom windows while loud works occur. This is expected to happen regardless due to dust and debris which may occur during the course of construction.

## 7.3 PREDICTED CONSTRUCTION VIBRATION

It is important to note that construction vibration levels depend on several factors, such as: activity, type of machine, geology of the ground and the distance between the affected buildings and the source. Surface works are expected to have a lower vibration impact than ground compacting/breaking works.

For the development, earthworks are the only activity likely to cause some vibration, particularly earth compaction works which may require a vibratory roller compactor.

Compliance with vibration limits for building damage is expected based on ensuring ground compacting equipment is selected to adherer to minimum safe working distances. While these magnitudes do not predict cosmetic/structural damage, it is anticipated that human response/comfort would be impacted at these distances.

The current RMS Construction Noise and Vibration Guideline sets safe working distances for vibrating plant and equipment. These are summarised below in Table 20. For this size of works, the use of large hydraulic hammers would not be recommended for these works. Hence it is recommended that the use of smaller rock breakers and handheld jackhammers are used for activity close to the nearest affected residential receivers.

TABLE 20 RMS PLANT VIBRATION SAFE OPERATING DISTANCES - *Construction Noise and Vibration Guideline 2016*

| PLANT ITEM | RATING/DESCRIPTION | MINIMUM WORKING DISTANCE | |
|---|---|---|---|
| | | Cosmetic Damage (BS 7385) | Human Response (OH&E Vibration Guideline) |
| **Small Hydraulic Hammer** | (300 kg - 5 to 12t excavator) | 2 m | 7 m |
| **Jackhammer** | Handheld | 1 m (nominal) | 2 m |

Vibration predictions on Piling and reinstatement works are included below, using Table E.1 Empirical Predictors for groundborne vibration arising from mechanized construction works of the BS 5228 – 2.2009 part II Vibration.

TABLE 21 EARTHWORKS ESTIMATED VIBRATION LEVELS AS PER TABLE E.1 OF THE BS 5228-2.2009

| EQUIPMENT | VIBRATION LEVEL PPV (mm/s) | SOURCE |
|---|---|---|
| Steady state for vibratory compaction, 3m setback distance | 4.5 mm/s | Table E1. BS 5228-2:2009 |

Notes: These levels were calculated (based on the below:

- Critical amplitude of vibration, scaling factor Ks of 143, 33% probability of predicted value being exceeded and 1 m drums width). BS 5228:2009 recommends that for vibrations over 1.0mm/s affected residents should be given prior warning and explanation as to the cause of the vibration.

The above levels meet the construction vibration criteria (residential structures, 5 mm/s) as per DIN 4150 – 3. These values are not likely going to produce complaints on the neighbours and are below all the maximum recommended vibration values as depicted in the criteria section.

## 7.4 GENERAL RECOMMENDATIONS ON CONSTRUCTION NOISE AND VIBRATION MANAGEMENT

Predicted construction noise levels were determined not to exceed the 'Highly Noise Affected' noise levels, which have been specified in the Interim Guide for Construction Noise (ICNG). However, the Interim Guide for Construction Noise (IGCN) list a number of typical best practice measures which can be used to reduce construction related impacts. In addition, Australian Standards 2436-2010 provides best practice measures to mitigate construction noise and vibration.

The following recommendations should be also considered in the development of a construction noise and vibration management plan for the site, when details of the contractor works methodology become finalised.

### 7.4.1 GENERAL/SITE MANAGEMENT ISSUES

- All employees, contractors and subcontractors are to receive an environmental induction and should instruct all persons at the site with regard to all relevant project specific and standard noise mitigation measures, including but not limited to permissible hours or work, limitation of high noise generating activities, location of nearest affected noise receivers, construction employee parking areas, designated loading/unloading areas and procedures, site opening/closing times (including deliveries) and environmental incident procedures.
- A dedicated person will form a point of contact for dissemination of general information regarding site operations. Contact persons will also be defined to receive comment or complaints from the community.

### 7.4.2 CONSTRUCTION ACTIVITIES AND NOISE MITIGATION

The following general construction noise source control measures may be required:

- Extended construction hours are not recommended, for evening hours, less intrusive works will be scheduled to be carried out and/or works will be carried out away from sensitive receivers;
- Activities that approach the highly noise affected criteria for the residential receivers to be carried out during times where receivers are less sensitive to noise;
- Avoid unnecessary revving of engines and turn off plant that is not being used/required;
- Where possible organise the site so that delivery trucks and haulage trucks only drive forward to avoid the use of reversing alarms;
- Where possible, avoid using tonal reverse alarm outside standard construction hours;
- Organise and schedule the equipment operations to limit the noisiest machines operating simultaneously;
- Site set up/ movement of plant / delivery of material/ waste removal to site should generally be restricted to day period;
- Truck drivers are to be informed of site access routes, acceptable delivery hours and must minimise extended periods of engine idling;

- Ensure there is no unnecessary shouting or loud stereo/radios on site. There must be no dropping of metal from heights, throwing of metal items or slamming of doors;
- Use less noise intensive equipment where reasonable and feasible;
- Where practical fixed plant should be positioned as far as possible from the sensitive receivers;
- Use temporary site buildings and material stockpile as noise barrier;
- Employ the use of solid barrier plywood hoardings if required;

# 8 SUMMARY OF NOISE AND VIBRATION MITIGATION STRATEGIES

## 8.1 NOISE MITIGATION STRATEGIES

This section compiles the proposed recommended treatments and strategies mentioned throughout the report to mitigate noise from the development.

### 8.1.1 MECHANICAL

The following mitigation measures are required in the mechanical system design and construction.

| MITIGATION NUMBER/NAME | ASPECT/SECTION | MITIGATION MEASURE | REASON FOR MITIGATION MEASURE |
|---|---|---|---|
| **External plant** | During design and construction | Based on the current mechanical design, external plant are limited to 2x HVAC outdoor units located on the western side of the building and HVAC fans located at the highest occupied level. | To ensure environmental noise limits can be met |
| **Plant equipment selections** | During design and construction | During mechanical equipment selection, the combined sound pressure levels at 1m for the mechanical plant is not to exceed 88 dBA. If it does, additional mitigations must be assessed and implemented. | To ensure environmental noise limits can be met |

### 8.1.2 CONSTRUCTION NOISE

Construction is not expected to exceed 75 dBA to the external residential receivers, however depending on the final layout of the new building a solid perimeter barrier should be installed to protect the existing buildings that will have classes during excavation and structural phases.

Appropriate site management should be applied as described earlier in this report.

| MITIGATION NUMBER/NAME | ASPECT/SECTION | MITIGATION MEASURE | REASON FOR MITIGATION MEASURE |
|---|---|---|---|
| **Construction Noise Barriers** | During the course of the construction period | Installation of a solid noise barrier to the nearby sensitive receivers as outlined in Section 7.2. Note that in some cases there is an existing solid barrier which are expected to provide the required noise reduction | To ensure construction noise levels can meet the noise limit criteria |
| **Construction Noise Equipment On-Time Control** | During the course of the construction period | The on-time allowances as outlined in Section 7.2 are to be followed. | To ensure construction noise levels can meet the noise limit criteria |

# 9 CONCLUSIONS

This REF Acoustic report considers that the proposed development at Cammeray Public School is acceptable from a noise / vibration perspective according to the state and local regulations. The following summarises the findings of our assessment:

- Operational noise and vibration meet the relevant North Sydney LEP/DCP and NPfI criteria with some mitigation in the form of attenuators on the HVAC fans.
- Construction noise will meet the criteria and are all predicted to be less than the highly noise affected criteria of 75 dBA with the mitigation measures listed, including time management of works and noise barriers.
- Construction vibration will meet the DIN4150-3 criteria.

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