ACOUSTIC REPORT

Noise and Vibration Impact Assessment

Kogarah Public School Upgrade
NSW Department of Education

NDY
A TETRA TECH COMPANY

CONFIDENTIAL

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VERIFICATION

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STAKEHOLDERS

ROLE	TEAM MEMBER	ORGANISATION
Client Representative	Frank Princi	SINSW
Architect	Jarrod Phillips	Fulton Trotter
Project Manager	Michael Want/ Matthew Spooner	RPInfrastructure
Planner	Ben Miller	BRS
Hydraulic and fire Engineering	Rhys Edwards	ACOR Consultants
Services Engineer – Mechanical	Jason Zhao	NDY
Services Engineer – Electrical	Shrinivas Sapre	NDY

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1 INTRODUCTION

This Noise and Vibration Impact Assessment report has been prepared to support the Review of Environmental Factors (REF) being prepared on behalf of the NSW Department of Education (DoE) for the proposed Kogarah Public School upgrade (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 (NSW DoE) 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, Clause 3.37 of the T&I SEPP.

This document has been prepared in accordance with the Guidelines for Division 5.1 assessments (the Guidelines) by the Department of Planning, Housing and Infrastructure (DPHI) as well as the Addendum guidelines for schools. The purpose of this report is to assess the noise, and vibration impacts of the proposed activity and to determine feasible and reasonable treatment options.

1.1 PURPOSE

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

- Baseline noise survey of the area
- Review of the zoning, type of area, LEP, DCP plans and assessment to obtain Project trigger noise levels
- Statement of environmental effect such as noise emissions to the boundary from onsite plant equipment
- Construction Noise and vibration assessment to the boundary, including the surrounding properties (residential, other school buildings, church and childcare).

1.2 AUTHORITY

Authority to undertake this report was provided by Paul Nickson of NSW Department of Education.

1.3 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)
- 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)
- Georges River Local Environmental Plan 2021
- Georges River Development Control Plan (GRDCP) 2021
- Kogarah PS - Revised Masterplan Validation Report Rev B, prepared by Fulton Trotter Architects, dated 05.08.2024
- SINSW Kogarah Public School Detailed Due Diligence checklist dated 12.05.2023

- Kogarah Public School Rapid Transport Assessment 'P6177.002P' dated 20.03.2024
- Kogarah Public School Concept Design, KOPS-FTA-00-00-DR-A-1001 Rev 01 by Fulton Trotter dated 31.10.2024
- Kogarah Public School Concept Design Mechanical Drawing Set KOPS-NDY-XX-XX-DR-M-000000 Rev 2 dated 28.10.2024
- SINSW Kogarah Public School Upgrade Electrical Drawing Set Concept Design KOPS-NDY-XX-XX-DR-E-000000 Rev 2 dated 28.10.2024
- Geotechnical Report '32976LTrptRev2KPS, by JK GEOTECHNICS dated 28.02.2020

1.4 INFORMATION REQUIRED

- There is an ongoing coordination with the mechanical project and equipment selections.

2 PROJECT INFORMATION

2.1 SITE LOCATION AND DESCRIPTION

Kogarah Public School is located at 24B Gladstone Street, Kogarah and contains a site area of 1.644ha per Detail Survey. The school is accommodated within the following allotments:

- Lots 1-3 DP 999122;
- Lot 1 DP 179779
- Lot 1 DP 667959
- Lot 2 DP 175247; and
- Lot A DP 391026.

The site is irregular in shape with existing vehicular access and the car park provided from Gladstone Street along the south-western boundary. Pedestrian access is provided from Gladstone Street and Princes Highway. The site accommodates eight (8) permanent buildings and number of modular school buildings with play areas largely confined to the centre and north-eastern portions of the site.

Development surrounding the site includes:

- **North**: Residential flat building at 71 Regent Street, retail tenancies orientated to Princes Highway(39-43 Princes Highway) and a smaller residential flat building at No 41 Princes Highway;
- **East**: Princes Highway and further to a mix of commercial and mid-rise residential development;
- **South**: St Paul's Church complex comprising St Paul's Childcare Centre, St Paul's Anglican Church and a residential flat building located at 24-30 Gladstone Street; and
- **West**: A mix of single dwelling and residential flat building development with Regent Street beyond.

The site is zoned SP2 Educational Establishment in accordance with Georges River Local Environmental Plan 2021 (GRLEP).

An aerial image of the site is provided in Figure 1 below.

FIGURE 1: AERIAL IMAGE OF THE SITE

The proposed Kogarah Public School upgrade works include the following:

- Demolition of existing playground facilities and Covered Outdoor Learning Area (COLA) in addition to footings and services associated with former demountable buildings;
- Tree removal;
- Construction of a new three storey Classroom building and attached amenities facilities;
- Construction of a single storey Hall with attached Covered Outdoor Learning Area;
- New pedestrian pathway connections providing access throughout the site;
- Service upgrades; and
- Site landscaping works.

Any works relating to the existing demountables will be undertaken via a separate planning pathway. An extract of the proposed Site Plan is provided in Figure 2 below.

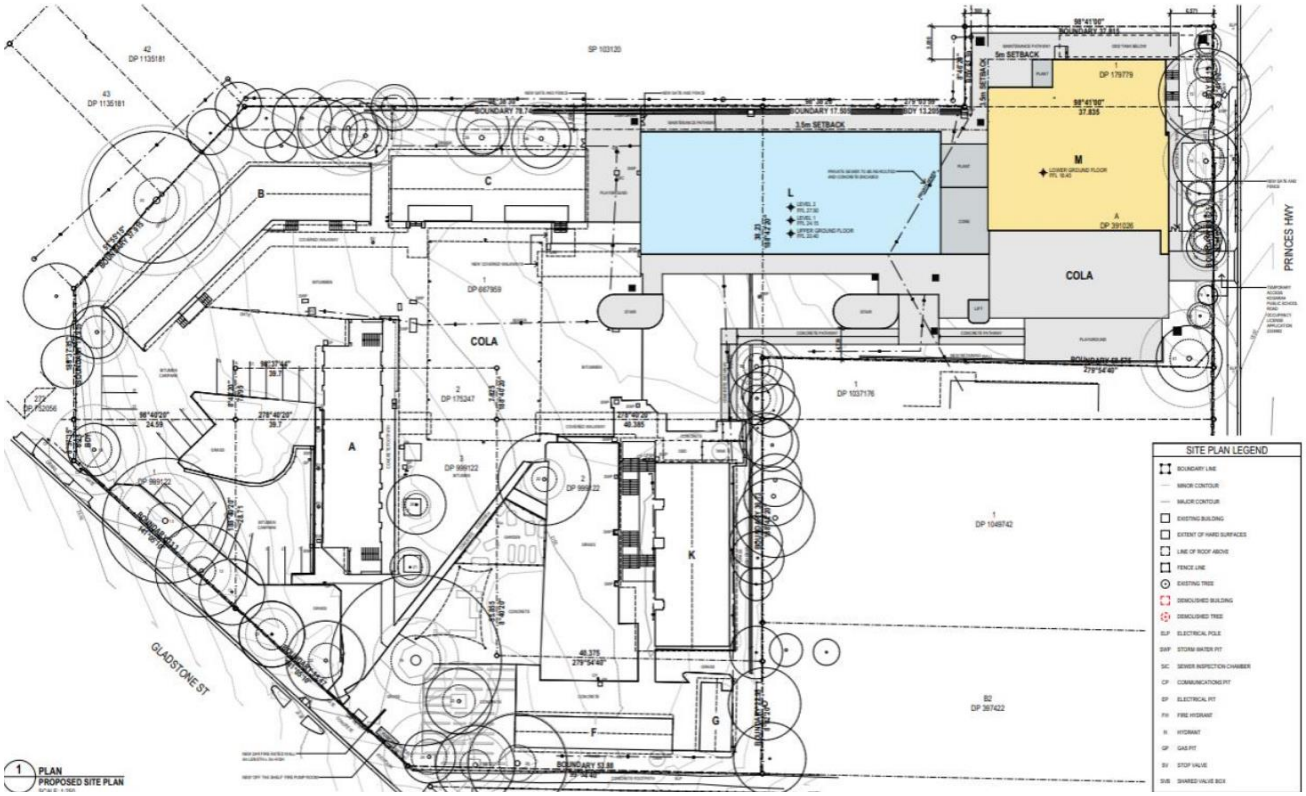

FIGURE 2: EXTRACT OF PROPOSED SITE PLAN

We understand that this proposed activity is expected to increase student population from 480 to 870.

2.2 SCHOOL OPERATING HOURS

We understand that the school facilities will operate during daytime (7:00 am – 6:00pm) with limited/no activities during evening time (6:00 pm to 10:00pm) and no activities during the nighttime. The school hall will be used infrequently in the evening period for events such as school balls etc.

2.3 SENSITIVE RECEIVERS

The most sensitive receivers for this project have been identified, depicted in Figure 3 and listed in Table 1 below:

TABLE 1: SENSITIVE RECEIVERS FOR STAGE 1 (EXTERNAL RECEIVERS)

RECEIVER	RECEIVER	RECEIVER DISTANCE, (APPROXIMATE) M	TYPE OF RECEIVER
R1	Kogarah Central Apartments 71-97 Regent St, Kogarah NSW 2217	10 – 14	Residential
R2	Future Development 41-47 Princes Hwy, Kogarah NSW 2217	10 – 14	
R3	St Paul's Children Centre, 57 Princes Hwy, Kogarah NSW 2217	25 – 37	Childcare
R4	St Paul's Anglican Church 57 Princes Hwy, Kogarah NSW 2217	37 – 51	Place of Worship

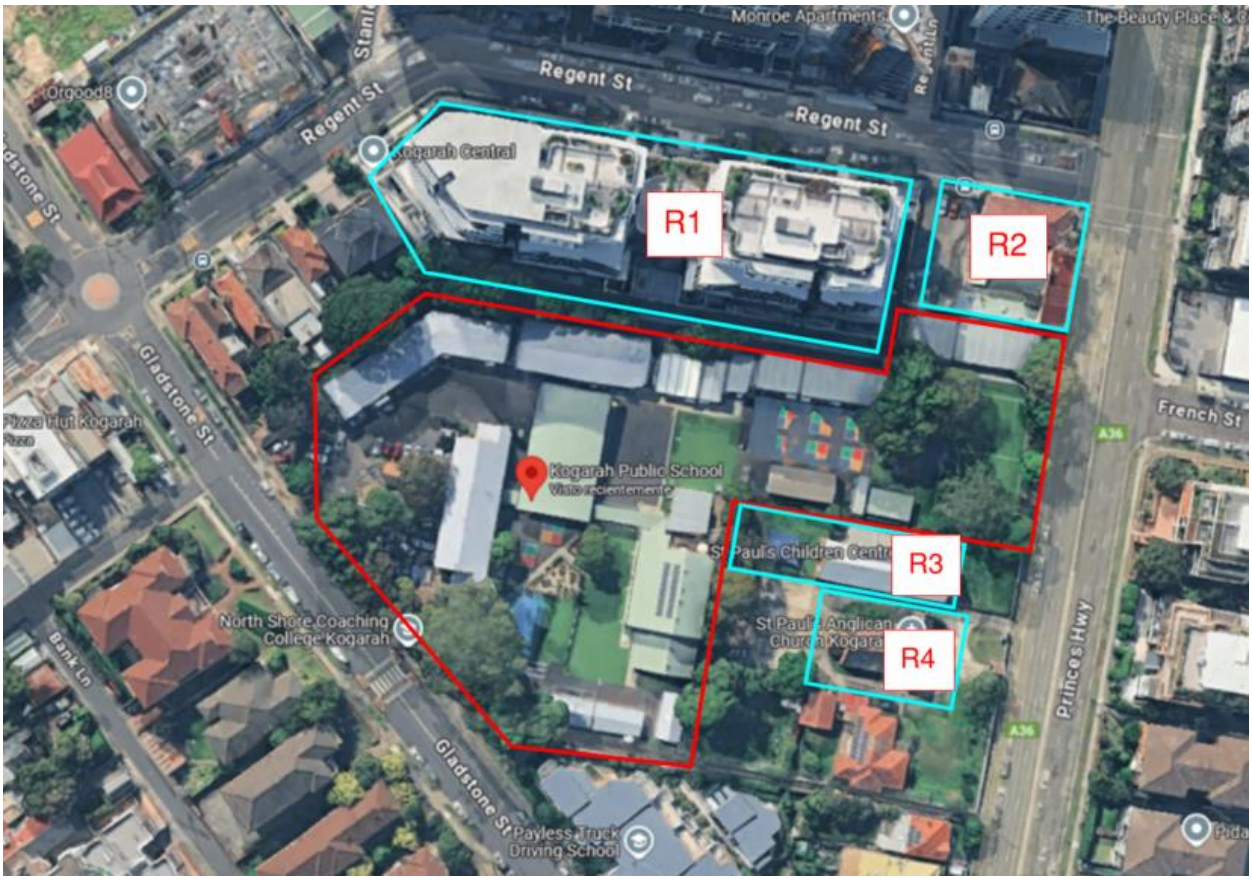

FIGURE 3: LOCATION OF SENSITIVE RECEIVERS. OUTSIDE SCHOOL.

Inside the existing school, the most sensitive receivers would be building C and Building K, at 9 m and 30 m from the future building L.

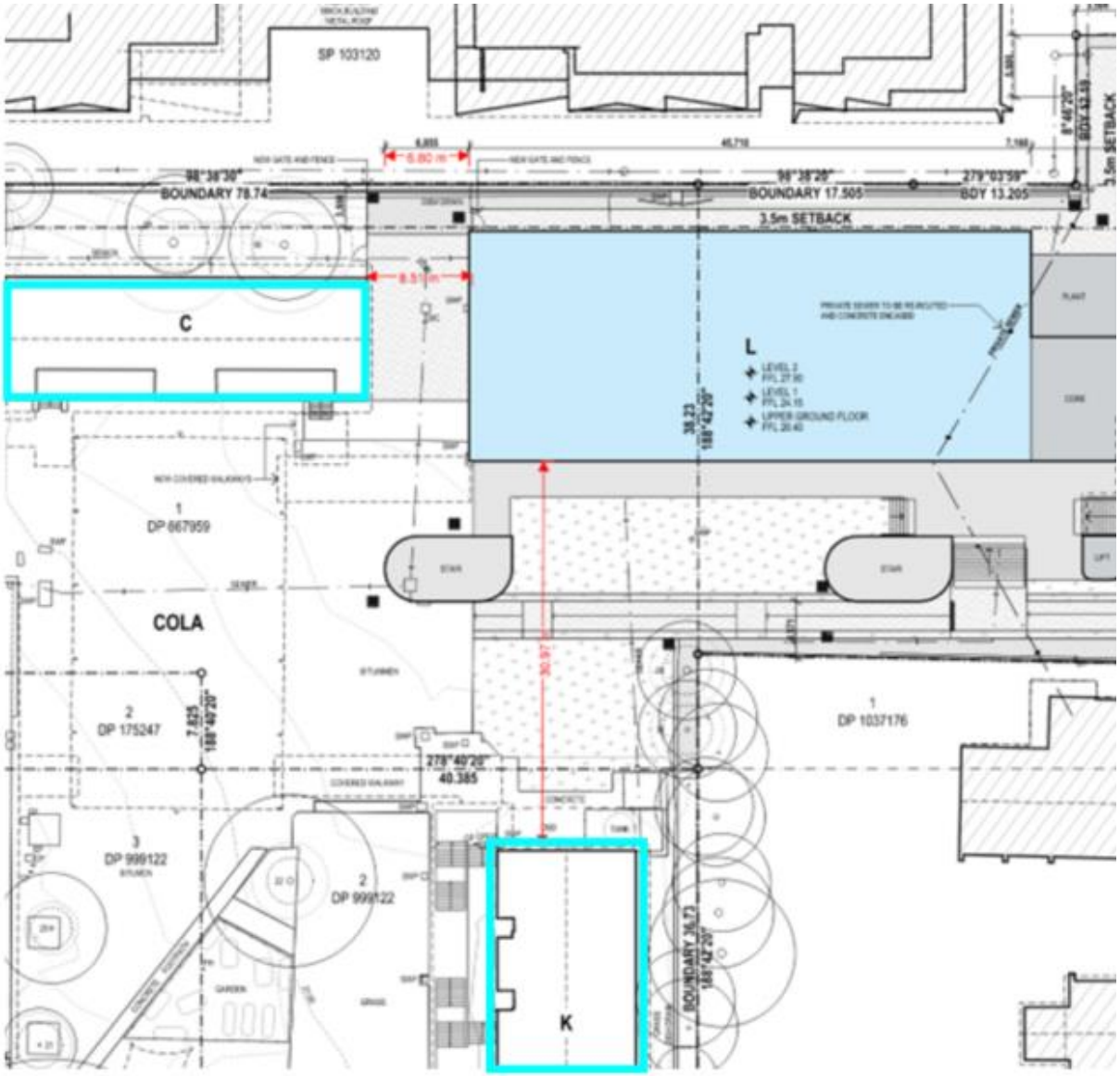

FIGURE 4: LOCATION OF SENSITIVE RECEIVERS. INSIDE SCHOOL.

3 METHODOLOGY

This report was prepared using the below methodology:

- Review of the NSW standards, NPfI regulations and local requirements for noise and vibration (local council DCP / LEP).
- 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's location was based on:
  - Critical receivers
  - Location of the receivers
  - A prelim. meeting with 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 a construction noise assessment, the REF Phase includes a preliminary estimation, using the information existing at the time, and if predicted noise levels exceed 75 dBA, then a detailed construction noise and vibration management plan will be required.

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 station 'Rockdale Post Office' (Latitude / Longitude:33.953° S, 151.14° E)**,** Station ID **ISYDNE3786** as a representative site located approximately 2km 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 noise loggers. Table 2 provides information relating to each noise loggers/sound level meter.

TABLE 2: NOISE LOGGER AND SOUND LEVEL METER INFORMATION

NOISE LOGGER/SOUND LEVEL METER	TYPE	SERIAL NUMBER
SVAN 977A	Class 1	SN 92622
SVAN 977A	Class 1	SN 69790

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 and Class 2 compliant with AS IEC 61672.2-2004.

4.3 NOISE LOGGERS' LOCATIONS

The noise logger locations that were agreed with the project team and project planner are as follows, which were selected to represent the most affected sensitive receivers:

- **Logger 1**: SN 92622 near to sensitive receivers R1 and R2
- **Logger 2**: SN 69790 near to sensitive receivers R1 and R2 as well as capturing noise data from Princes Hwy

Noting that the noise environment around R3 is expected to be similar to R2, therefore we believe that the noise levels captured via Logger 2 are suitable to determine the noise criteria for R3.

Below Figure 5 depicts the noise loggers installed at site and their measurement locations, which based on our assessment is appropriate in representing noise levels of sensitive receivers surrounding the site.

FIGURE 5: LOGGER DEPLOYMENT LOCATIONS

To confirm the above approach, during a site visit on 13.09.24, our team conducted a hand-held noise measurement at the school boundary next to Prices Hwy as shown in Figure 6 and the results are depicted in Table 3 below:

TABLE 3: HAND-HELD NOISE MEASUREMENTS IN OCTAVE BANDS

LOCATION	SOUND PRESSURE LEVEL (DB) PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
Princes Highway (3.50PM, 13/08/2024)	73	70	69	69	71	65	57	48	**73**

FIGURE 6: SHORT TERM NOISE MEASUREMENTS LOCATIONS

5 NOISE AND VIBRATION CRITERIA

5.1 LOCAL CITY COUNCIL RULES

The Georges River Local Environmental Plan 2021 and) Georges River Development Control Plan (GRDCP) 2021 have been reviewed and have no particular requirements for noise.

5.2 NSW DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS – INTERIM GUIDELINE

These guidelines support specific provisions of the State Environmental Planning Policy (Transport and Infrastructure) 2021 – Section 2.120 for busy roads:

***Section 2.120**: 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 :*

- *residential accommodation*
- *a place of public worship,*
- *a hospital,*
- *an educational establishment or centre-based child care facility.*

Section 3.6.1 of the guideline provides noise criteria for the various types of developments adjacent to busy roads; the applicable criteria has been highlighted in Figure 7 below.

Table 3.1: Noise criteria

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

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

FIGURE 7 - NSW BUSY ROADS NOISE CRITERIA

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 noise indexes are the 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 10th 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: MEASURED NOISE LEVELS FOR NOISE LOGGERS, DBA

LOCATION	NOISE INDEX	SOUND PRESSURE LEVEL DB		
		DAYTIME 0700 TO 1800	EVENING 1800 TO 2200	NIGHT TIME 2200 TO 0700
Logger 1 (71 - 97 Regent St)	L_{A90} (RBL)	43	41	35
	$L_{Aeq,period}$	67	49	49
Logger 2 (91 Regent St and 41 – 47 Princes Hwy)	L_{A90} (RBL)	50	48	35
	$L_{Aeq,period}$	62	62	56

Note: As explained in sections above, the loggers locations and their results show the most representative noise levels of the area for the critical receivers.

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 equaled 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.

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

	R2 – low density residential R3 – medium density residential E2 – environmental conservation 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 R4 – high density residential B1 – neighbourhood centre (boarding houses and shop-top housing) B2 – local centre (boarding houses) B4 – mixed use	Daytime RBL> 45 dB(A) Evening RBL> 40 dB(A) Night RBL >35 dB(A)	**Urban** – an area with an acoustical environment that: • is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources • has through-traffic with characteristically heavy and continuous traffic flows during peak periods • is near commercial districts or industrial districts • has any combination of the above.

Receiver category	**Typical planning zoning – standard instrument***	**Typical existing background noise levels**	**Description**
Rural residential	RU1 – primary production RU2 – rural landscape RU4 – primary production small lots R5 – large lot residential E4 – environmental living	Daytime RBL <40 dB(A) Evening RBL <35 dB(A) Night RBL <30 dB(A)	**Rural** – an area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse. Note: Where background noise levels are higher than those presented in column 3 due to existing industry or intensive agricultural activities, the selection of a higher noise amenity area should be considered.
Suburban residential	RU5 – village RU6 – transition	Daytime RBL<45 dB(A) 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

FIGURE 8: NPFI EXTRACT - TABLE 2.3 DETERMINING WHICH OF THE RESIDENTIAL RECEIVER CATEGORIES APPLIES

As the majority of the neighbourhood comprises of high-density residential zoning and the obtained RBLs and spot measurements are that of an urban neighbourhood, we believe the Urban area description above is the one more suitable for our project. In addition, the Detailed Due Diligence report categories the area as an 'existing built-up urban suburb of Sydney.'

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 Area	Day 7:00 to 18:00	60	58
		Evening 18:00 to 22:00	50	48
		Night 22:00 to 7:00	45	43
School Classroom	-	Noisiest 1-hr period when in use	40* (internal noise)	-

TYPE OF RECEIVER	INDICATIVE NOISE AMENITY AREA	PERIOD OF TIME	L_{Aeq} DB(A)	AMENITY CRITERIA LAEQ DB(A) – 5 DB+ 3 DB
Active Recreation (playground)	-	When in use	55	53

*Note: Increased from 35 dBA, due to classroom already affected by existing traffic noise.

The NPfI recommends "Intrusive noise levels are only applied to residential receivers (residences)". For other receiver types identified in Table 2.2, 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
R1 (71 - 97 Regent St) Logger 2*	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	58	48	43
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	48	46	40
R2 (41 – 47 Princes Hwy) Logger 2	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	58	52	46
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	55	53	40
R3 / R4 (57 Princes Hwy) -	**Project Amenity Assessment, $L_{Aeq, 15min}$**		
	53 (playground, when in use) / 40 (classroom, internal)		
	Project Intrusiveness Assessment, $L_{Aeq, 15min}$		
	N/A	N/A	N/A
***Note: Noise data from Logger 2 is used to determine the noise criteria for R1 as it better represents the existing noise environment. Logger 1 noise levels were observed to be very low due to acoustic shielding from the built environment and therefore would yield artificially low noise criteria.**			

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	TIME	DESCRIPTOR	EXTERNAL PNTL [DBA]
R1 (71 - 97 Regent St)	0700 to 1800	$L_{Aeq, Day}$	55
	1800 to 2200	$L_{Aeq, Evening}$	52
	2200 to 0700	$L_{Aeq, Night}$	40
R2 (41 – 47 Princes Hwy)	0700 to 1800	$L_{Aeq, Day}$	55
	1800 to 2200	$L_{Aeq, Evening}$	52
	2200 to 0700	$L_{Aeq, Night}$	40
	When in use (Playground)	L_{Aeq}	53

LOCATION	TIME	DESCRIPTOR	EXTERNAL PNTL [DBA]
R3 (57 Princes Hwy) -	Worst 1-hr (Classroom)	L_{Aeq}	50* external
R4 (57 Princes Hwy) -	When in use (Place of worship)	L_{Aeq}	50* external
***10 dBA reduction assumed from the building façade (open window), i.e. 50 dBA – 10 dBA = 40 dBA internally**			

5.4 CONSTRUCTION NOISE AND VIBRATION CRITERIA

5.4.1 Interim Construction Noise Guideline

The NSW Interim Construction Noise Guideline was developed by the NSW-Department of Environment & Climate Change DECC, NSW 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 proposed activity would be more than 3 weeks and therefore a quantitative method has been used for this assessment.

TABLE 8 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.

If affected properties receive construction noise above 75 dBA, there might be required community consultation and a Construction Noise & Vibration Management Plan (CNVMP).

Based on the **RBL of 50 dBA** in the daytime, the recommended noise management levels during all aspects of the construction program are summarised in TABLE 8 below.

TABLE 8: NOISE AT AFFECTED USING QUANTITATIVE ASSESSMENT

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) LAEQ,15MIN [DBA]	HOW TO APPLY
Recommended standard hours Monday – Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise Affected 50 + 10 = **60 dB(A)**	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq (15 minutes) noise level is greater than the affected level, the proponent should apply all feasible and reasonable[1)] work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details
	Highly noise affected **75 dB(A)**	The highly noise affected level represents the point above which there may be strong community reaction to noise.

RECOMMENDED HOURS	EXTERNAL NOISE MANAGEMENT LEVEL (NML) LAEQ,15MIN [DBA]	HOW TO APPLY
		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: – Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences). – If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside Recommended standard hours[2)]	**40 dBA** (35 + 5) RBL from nighttime	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.22

1) 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*".
2) Construction works outside of the recommended standard hours are recommended to be addressed in a construction noise and vibration management plan.

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 Figure 9 and TABLE 9 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.

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)

FIGURE 9: EPA CONSTRUCTION NOISE AND VIBRATION GUIDELINE, 2016 / EXTRACT NOISE AT SENSITIVE USERS

5.4.2 NOISE MANAGEMENT LEVELS

Noise Management Levels (NML) associated with the construction works on the project site are presented in TABLE 9.

TABLE 9: CONSTRUCTION NOISE MANAGEMENT LEVELS, LEQ 15MIN

RECEIVERS	RECOMMENDED HOURS	PERIOD	RBL $LA90_{,15mins}$ [dBA]	EXTERNAL NOISE MANAGEMENT LEVEL [dBA]
All Sensitive Receivers	Day time (standard construction hours)	When in use	50 dBA	(50 + 10) = **60 dB(A)** (Noise affected) **75 dB(A)** (highly noise affected)
School receivers / Childcare receivers / church receivers	Day time (standard construction hours)	When in use	-	45 dBA (internal) / ~55 dBA at façade, externally

5.4.3 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.

5.4.3.1 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 the Department of Environment and Conservation NSW 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. 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.

5.4.3.2 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.*"

5.4.3.3 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

5.4.3.4 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).

5.4.3.5 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 10 and illustrated in FIGURE 10.

TABLE 10: 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 10 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 10 may need to be reduced by up to 50% (refer to Line 3 in FIGURE 10).

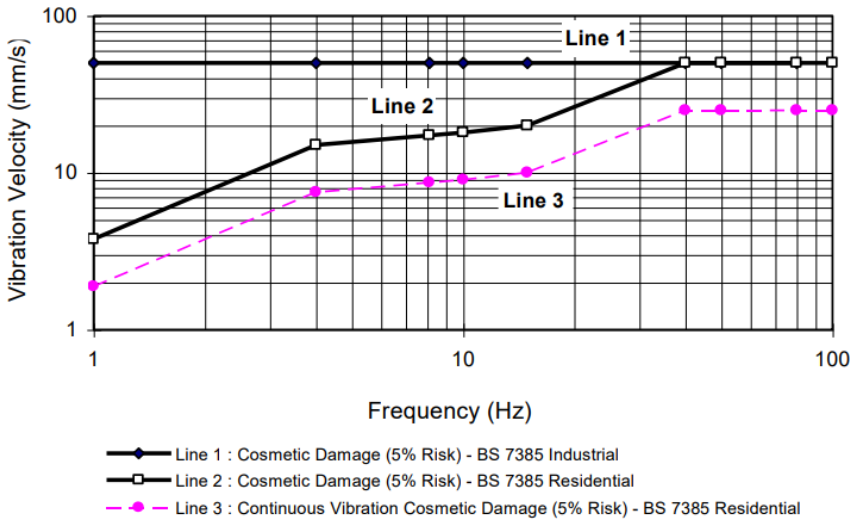

FIGURE 10 – BS 7385 PART 2 – 1993, GRAPH OF TRANSIENT VIBRATION VALUES FOR COSMETIC DAMAGES

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 10, 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 10 should not be reduced for fatigue considerations.

5.4.3.6 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.

5.4.3.7 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 11 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 11: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – SHORT TERM

TYPES 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

5.4.3.8 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 12.

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 12: DIN 4150-3 CONSTRUCTION VIBRATION LIMITS – LONG TERM

TYPES OF STRUCTURES	GUIDELINE VALUES FOR VIBRATION VELOCITY (MM/S) OF VIBRATION IN HORIZONTAL PLANE OF FIRST 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

5.4.4 SUMMARY OF CONSTRUCTION NOISE AND VIBRATION CRITERIA

Construction noise criteria for the areas surrounding the project are NML levels (between 55 dBA and max. 75 dBA) for standard construction hours for the below sensitive receivers:

- **Receiver R1**: 71 - 97 Regent St (~10 - 14m from construction)
- **Receiver R2**: 41 – 47 Princes Hwy (~10 - 14m from construction)
- **Receiver R3**: St Paul's Childcare (~25 – 37 m from construction)
- **Receiver R4**: St Paul's Church (~37 – 51 m from construction)
- **Existing Schools Buildings:** Buildings C and K (~10m to 30m from construction)

Vibration criteria will be as per DIN 4150 – 3:1999 construction vibration limits – long term:

- Residential receivers in the area / existing school buildings will have a peak particle velocity criterion of 5 mm/s.
- St Paul's Anglican Childcare and Church are heritage buildings, will have a peak particle velocity criterion of 2.5 mm/s.
- Commercial buildings of 10 mm/s peak particle velocity criteria.

Construction Vibration criteria consider the most onerous construction activities prone to generate vibration such as: piling, jackhammering, resintatement works. Trucks vibration will be lower than piling vibration.

For the REF process, the construction noise assessment will utilise the information provided by the team at this stage and conduct a preliminary construction noise and vibration assessment. This report will predict if a detailed construction noise and vibration management plan is needed or not.

6 PRELIMINARY ARCHITECTURAL CONSIDERATIONS

6.1 BUILDING ENVELOPE

This section addresses the following noise sources that have the potential to impact on the school.

6.1.1 AIRCRAFT NOISE INTRUSION

The closest airport to the project site is Sydney International Airport. The school is located well outside of the ANEF 20 contour for the airport. Aircraft noise is therefore not expected to be of concern for this project.

6.1.2 RAIL NOISE INTRUSION

Rail noise is not applicable to Kogarah Public School on the basis that the existing Eastern Suburbs & Illawarra Line railway line is over 200m from site.

Given the distance involved and the acoustic shielding provided by the intervening buildings, rail noise intrusion is not expected to be of concern for this project.

6.1.3 ROAD TRAFFIC NOSE INTRUSION

Road traffic noise mainly emanates from Princes Highway. A preliminary traffic noise assessment has been carried out to inform initial allowances for the external building envelope design.

The traffic noise levels for the calculations were obtained at the approximate measurement location shown below.

FIGURE 11 - TRAFFIC NOISE MEASUREMENT LOCATION

The measured traffic noise levels are listed in Table 13 below. Noise levels at the facades/roof have been predicted based on the measured levels.

TABLE 13: MEASURED EXTERNAL TRAFFIC NOISE LEVELS

LOCATION	SOUND PRESSURE LEVEL (DB) PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
Princes Highway (3.50PM, 13/08/2024)	73	70	69	69	71	65	57	48	**73**

6.1.4 REQUIRED FAÇADE CONSTRUCTION

We have made the following assumptions in our assessment:

- Internal noise levels in teaching spaces designed to 40 dBA as per AS/NZS 2107:2016 and NSW DoP Development Near Rail Corridors and Busy Roads– Interim Guideline
- Assembly Hall with acoustically rated roller doors and a reverberation time of ~1.1 seconds.
- Lightweight façade with glazing elements

PRELIMINARY GLAZING RECOMMENDATIONS FOR SCHOOL BUILDING

Glazing installed need to meet the performance requirements outlined in Table 14 in order to meet the internal noise criteria. Various glazing configurations are capable of meeting these performance requirements, provided that laboratory test results are submitted for review by NDY for the complete glazing and framing system being installed on the project. Some suggested glazing configurations are provided below; however, final acceptance of the project's glazing will depend on the adequacy of the laboratory test results.

TABLE 14: GLAZING REQUIREMENTS – SCHOOL BUILDING

GLAZING TYPE ID	MINIMUM FACADE SYSTEM TRANSMISSION LOSS (dB) PER FREQUENCY (Hz)							SUGGESTED GLAZING CONSTRUCTIONS
	63	125	250	500	1k	2k	4k	
G1	25	26	27	35	44	48	48	8.38mm laminate/ 12mm air/ 8mm float (Nominally Rw ~40)

All framing housing glazing will need to be constructed to such a standard that the sound insulation performance of the glazing is not significantly degraded by the framing.

NON-GLAZED FACADE CONSTRUCTION FOR SCHOOL BUILDING

Non-glazed facade systems requirements are outlined in the table below.

TABLE 15: NON-GLAZED FACADE CONSTRUCTIONS – SCHOOL BUILDING

FACADE TYPE ID	CONSTRUCTION DESCRIPTION
Assembly Hall	Precast or lightweight facade system achieving Rw ~52 or greater

For the Assembly Hall exterior doors, door systems need to achieve a sound insulation rating Rw 30 or greater are used.

Figure 12 and Figure 13 below depict the required minimum acoustic ratings of the façade for the Assembly Hall adjacent to Princes highway.

FIGURE 12 - ACOUSTIC REQUIREMENTS FOR ASSEMBLY HALL FACADE FACING PRINCES HIGHWAY

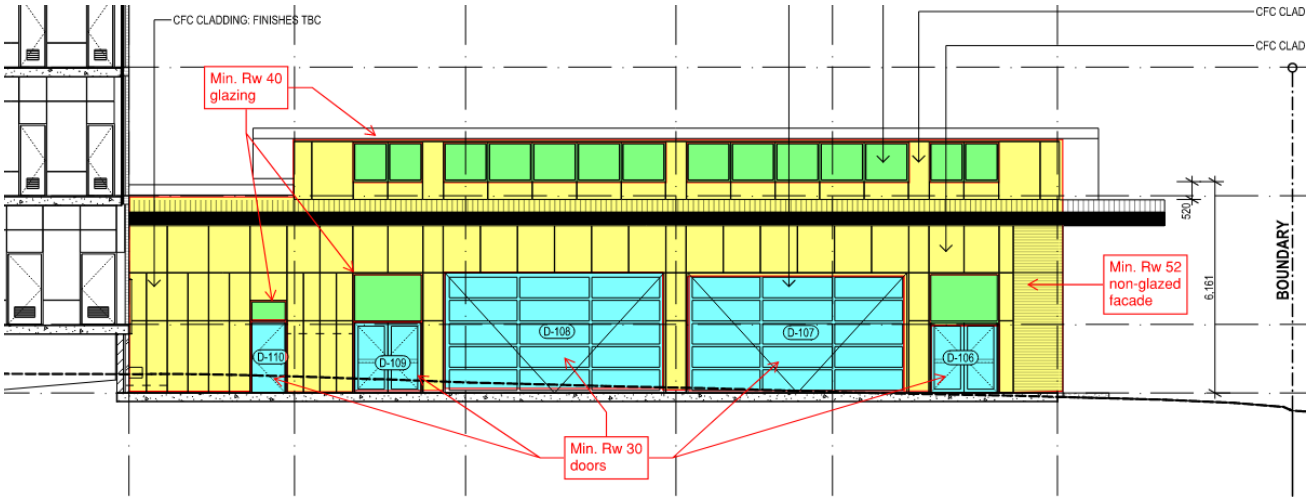

FIGURE 13 - ACOUSTIC REQUIREMENTS FOR ASSEMBLY HALL FACADE PERPENDICULAR TO PRINCES HIGHWAY

FAÇADE OPENINGS / PENETRATIONS

Due to the high noise environment surrounding the proposed activity site, all façade penetrations and openings will need to be acoustically treated. This will need to be reviewed and detailed as the project progresses. Specific treatment and mitigation measures will need to be addressed in an acoustic design report, when more finalized architecture plans and schedules are developed.

7 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.

7.1 NOISE EMISSION FROM PA SYSTEMS AND SCHOOL BELLS

A public address (PA) system will be installed on the site. Appropriate design and commissioning controls will be implemented to minimise noise spill from the PA to receiving locations outside the school. These will be addressed with the design team during the detailed design stage but may include:

- The PA system will be for voice announcements only (no music)
- Speakers to be located away from the school boundary and oriented away from sensitive receivers.
- The PA system use to be limited to school hours only

Both the PA system and the school bell need to be installed and adjusted such that the project trigger levels during school hours are met at the noise sensitive receivers. Sound power level noise limiting devices are required to adjust the speakers.

7.2 NOISE FROM CLASSROOMS

Noise from classrooms is not expected to cause noise emissions exceedances as the building façade of the classrooms is predicted to sufficiently insulate noise from the nearest sensitive receivers.

7.3 NOISE FROM OUTDOOR PLAY AREA

It is understood that there will be an increase in student numbers from 480 to 870 pupils. Noting that the existing school layout already has an outdoor play area that is directly adjacent to the early childcare centre, increasing the student count from 480 to 870 pupils is expected to only increase potential noise emission levels by under 3 decibels. A less-than 3 dB change in noise levels is expected to be very minor / negligible and only just noticeable.

We also understand that the proposed activity will reduce the overall existing outdoor play space area.

7.4 NOISE EMISSIONS FROM CARPARK

The current scope of works does not discuss the provision of introducing additional car parks and hence it is assumed no new carparks are being introduced as part of this project that would trigger new noise impacts.

7.5 NOISE EMISSIONS FROM HALL BUILDING

It is understood that the school hall building may infrequently hold school events (such as balls and discos etc) in the evening time period (6pm – 10pm). To control noise emissions to the nearest sensitive receivers, 71-97 Regent St and 41 – 47 Princes Hwy, the external building envelope of the Hall building is to be acoustically assessed to minimise noise breakout. We predict that the majority of the noise breakout will be from the roof of the hall building to the adjacent apartments that overlook the school from a higher elevation.

As a preliminary assessment, we have assumed a reverberant internal noise level of 85 dBA from music and speech. Our calculations predict that the event noise emissions criteria can be met with a roof construction that achieves a minimum sound insulation rating of Rw ~40.

Operational controls are also implemented to ensure hall noise levels do not exceed the limits, such as:

- Music noise limiter
- Restrictions on amplified music nearer to the night-period etc.
- No operations after 10:00 pm.
- Community liason

7.6 NOISE EMISSIONS FROM SERVICES

7.6.1 MECHANICAL SERVICES

As per NDY mechanical concept sketches designs, there is an intention of locating a plant room as per below:

- **Plant A to serve the classrooms** and located on ground level, 48 sqm for ODU units. The plant would be on the side of the proposed building facing residential buildings on Regent St.
- **Plant B to serve the hall** and located on ground level of proposed Block M. The plant would be on the side of the proposed building facing residential buildings on Regent St.
- In addition, it was observed the current learning spaces within existing block K have not been provided with A/C and A/C to all learning spaces here have been proposed.

The current locations being considered for the mechanical plant can be seen in Figure 14. The plant needs to be operational during the assumed school operation hours which is during daytime (7:00 am – 6:00pm) with limited activities during evening time (6:00 pm to 10:00pm) and no activities during the nighttime. For the assessment, we understand the mechanical plant consists of the following:

- Plant A consists of max. 12 Outdoor units (ODU) and max. 2 rooftop fans RF1
- Plant B consists of max. 2 Outdoor units (ODU) and max. 2 rooftop fans of Type RF1 (smaller plant compared to plant A)
- Proposed A/C for existing buildings are to have sound data similar to that of 1 packaged unit.

Maximum sound power levels for each plant area is listed in Table 16.

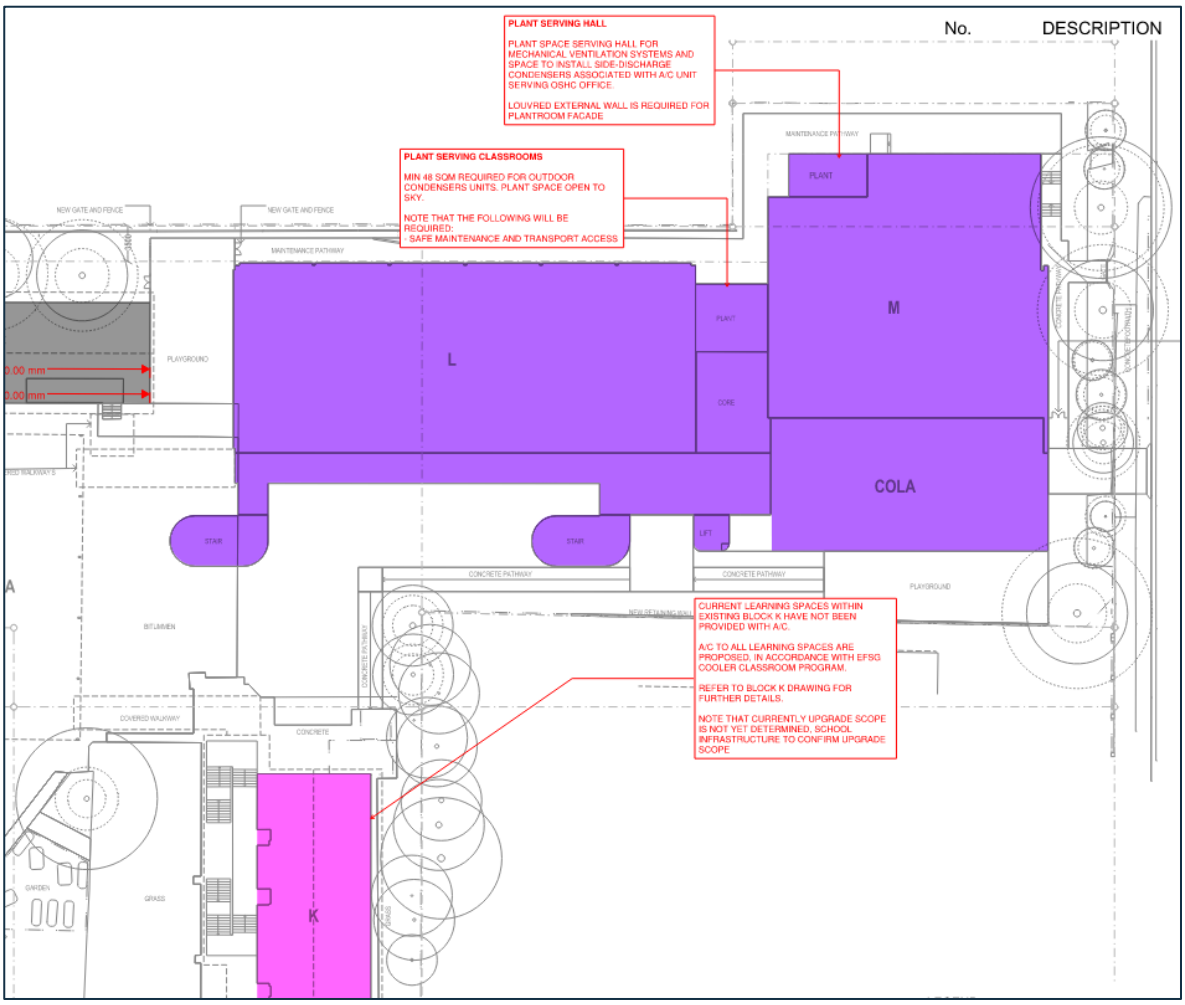

FIGURE 14: CONCEPT LOCATION FOR MECHANICAL PLANT IN NEW BUILDING

TABLE 16: SOUND POWER LEVELS FOR ASSUMED MECHANICAL UNITS

EQUIPMENT	SWL SOUND POWER LEVEL (dB) PER FREQUENCY BAND (HZ)								
	63	125	250	500	1000	2000	4000	8000	dBA
Max. Cumulative noise of Plant A for 12 ODUs and 2 fans (RF1)	87	86	83	82	77	70	68	64	**83**
Max. Cumulative noise of Plant B for 2 ODUs and 2 fans (RF1)	83	82	79	78	73	66	64	61	**79**

The noise impact assessment was conducted to sensitive receivers. The closest possible receivers were identified and their approximate distances to the proposed plant room were determined. The PTNLs for day and evening periods have been used as the noise limits (as the school will not be operational during nighttime). The closest possible sensitive receivers identified are:

- **Receiver R1:** 71 - 97 Regent St at ~9m distance from both Plant A and B
- **Receiver R2:** 41 – 47 Princes Hwy at ~9m distance from both Plant B.

In addition to noise assessments to residential sensitive receivers, the NPfI categorises churches and childcares as sensitive spaces and requires a maximum internal noise limit of 45dBA to be met by the project. This project has such sensitive receivers in its neighbourhood which are St Paul's Anglican Church Kogarah and St Paul's Childcare. Plants A and B will have minimum impact to these receivers as they are on the opposite side of the new building. However, Building K is facing these receivers and since ACs have been proposed for this building, noise impact from the assumed AC to these receivers have been assessed. The church and childcare centre are an approximate distance of 30m from the project.

The Table 17 also provides results to the assessment of noise propagated from the mechanical plant to the critical receivers when such acoustic louvres are utilized.

TABLE 17: MECHANICAL SERVICES NOISE PROPAGATED INTO CRITICAL RECEIVERS

RECEIVER	NOISE LIMIT	ESTIMATED NOISE LEVEL (OUTSIDE) / (SPL)
Receiver R1	55 dB(A) (PTNL for Day)	~55 dB(A)
Receiver R2	52 dB(A) (PTNL for Evening)	~51db(A)
Receiver R3	50 dB(A) (when in use)	~42dB(A)

Due to the close proximity of sensitive receivers R1 and R2, which overlook the proposed plant locations, the noise propagated to receivers R1 and R2 can be compliant with the evening noise limits with the above maximum sound power levels. Hence it is recommended that Plant A (serving the new GLS building) is only operational during daytime (7:00 am – 6:00pm) whereas Plant B (which serves the Hall) can run till 10pm (evening) as the hall may hold events.

The above levels are propagated outside to the closest receiver's façade. With appropriate acoustic treatment measures such as utilizing acoustic louvres / noise barriers on all plant walls as well as fan attenuators and lined ductwork (where required), we predict that the recommended internal noise levels as per AS / NZS 2107 can be achieved.

During detailed mechanical equipment selection, it is recommended to ensure that the combined sound power levels for the plant do not exceed 83 dBA and 79 dBA for Plant A and Plant B respectively.

If final mechanical selections exceed these noise levels, additional acoustic treatment will be required, such as external outdoor insulation for walls and acoustic louvers.

7.6.2 ELECTRICAL SERVICES

As per NDY electrical concept sketches and designs, a new substation is proposed to be located on Gladstone St within the school boundary The closest sensitive receivers identified were the residential properties on Gladstone St and we have used '31 Gladstone St', located around 25m from the proposed location for a noise assessment.

Selections were not available for the substation at the time of this report; however, as a conservative approach we have utilized sound data for a high rated substation, a 750kVA substation used in a previous project of similar nature which had a noise level of 58 dBA (SWL). When propagated to the identified closest receiver, it was observed that the sound levels met all the project PNTL levels.

Should noisier equipment be selected, additional acoustic treatment will be required, such as acoustic louvers.

7.7 OPERATIONAL VIBRATION

For controlling vibration emissions on mechanical plant (VRF, condensers and similar), it would be recommended that all condensers are installed on isolation pads by Mason Industries, Embelton, or equal to ensure compliance with the NSW EPA document Assessing Vibration: A technical guideline. However, as the current assumed plant equipment units are small, we do not consider this will be a noticeable impact on school grounds or residential areas.

Note that acoustic and vibration impact to internal areas is not considered in REF scope.

8 CONSTRUCTION NOISE & VIBRATION IMPACT ASSESSMENT

We understand the critical construction activities proposed in the project involves demolition of structures, construction of a new building and halls as well as refurbishment works to upgrade the existing buildings. The proposed construction plan and equipment for the project is still subject to further development. For preliminary assessment purposes and based on previous experience on similar projects, we have assumed that the following plant and equipment will be used in the following phases:

- Excavation Demolition
- Structural Phase
- Construction works for both new buildings.

We assume the hours of construction will be standard as per below:

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

8.1 CONSTRUCTION PLANT NOISE LEVELS

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

TABLE 18: 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	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
Structural Phase			
3	Tracked excavator 14t / 66kW	Table C2 Ref 25	69
4	Dumper truck 9T / 75 kW	Table C4 / Ref 4	76
5	Mini piling rig (rock bolt) 250mm auger	Table C3 / Ref 18	74
6	Concrete pump + cement mixer truck (discharging) 8 T / 350 bar	Table C4/ Ref24	68
Construction			
7	Handheld circular saw 3 Kw	Table C4 / Ref 72	79
8	Handheld cordless nail gun	Table C4 / Ref 95	73
9	Diesel generator	Table C4 / Ref 76	61

Notes:

- The above equipment and assessment include the expected construction trucks and trucks turntable.
- 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.
- Above equipment also considers construction traffic and trucks.

8.2 PREDICTED CONSTRUCTION NOISE

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

TABLE 19: PREDICTED CONSTRUCTION NOISE $L_{EQ,15MIN}$

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Excavation and Demolition Phase				
Receiver 1- **71 - 97 Regent St (~10 - 14m from construction)**	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	74 dB(A)	53 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2- **41 – 47 Princes Hwy (~10 - 14m from construction)**			73 dB(A)	
Receiver 3- **St Paul's Childcare (~25 - 37m from construction)**			65 dB(A) / 53 dB(A) with hoarding	45 dB(A) internally / ~55 dB(A) externally (conservative)
Receiver 4- **St Paul's Church (~37 - 51m from construction)**			62 dB(A) / 50 dB(A) with hoarding	
Existing School Building C (~10m from construction)			65 dB(A) / 55 dB(A) with hoarding	
Structural Phase				
Receiver 1- **71 - 97 Regent St (~10 - 14m from construction)**	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	74 dB(A)	53 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2- **41 – 47 Princes Hwy (~10 - 14m from construction)**			74 dB(A)	
Receiver 3- **St Paul's Childcare (~25 - 37m from construction)**			66 dB(A) / ~53 dB(A) with hoarding	45 dB(A) internally / ~55 dB(A) externally (conservative)
Receiver 4- **St Paul's Church (~37 - 51m from construction)**			63 dB(A) / ~50 dB(A) with hoarding	

RECEIVERS	RECOMMENDED HOURS	PERIOD	PREDICTED CONSTRUCTION NOISE LEVEL	EXTERNAL NOISE MANAGEMENT LEVEL
Existing School Building C (~10m from construction)			75 dB(A) / **~58** dB(A) with hoarding	
Construction Phase				
Receiver 1- 71 - 97 Regent St (~10 - 14m from construction)	Monday Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Day	74 dB(A)	55 dB(A) (noise affected) 75dB(A) (highly noise affected)
Receiver 2- 41 – 47 Princes Hwy (~10 - 14m from construction)			74 dB(A)	
Receiver 3- St Paul's Childcare (~25 - 37m from construction)			66 dB(A) / 54 dB(A) with hoarding	45 dB(A) internally / ~55 dB(A) externally (conservative)
Receiver 4- St Paul's Church (~37 - 51m from construction)			63 dB(A) / 52 dB(A) with hoarding	
Existing School Building C (~10m from construction)			77 dB(A) / **60** dB(A) with hoarding	
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.				

8.2.1 CONSTRUCTION MITIGATION MEASURES NOTES

To minimize the NML levels, construction should follow the below:

- Construction hours will only be during day-time (from 7 am – 6 pm).
- Equipment time management per phase is as per below table:

TABLE 20 CONSTRUCTION EQUIPMENT TIME MANAGEMENT PER CONSTRUCTION PHASE

CONSTRUCTION PHASE	REQUIREMENTS FOR TIME MANAGED MACHINERY
Excavation and demolition	– 80% of the construction time for the Tracked excavator 14t / 66kW – 50% of the construction time for the Dumper truck 9T / 75 kW
Structural phase	– 80% of the construction time for the Tracked excavator 14t / 66kW – 30% of the construction time for the Dumper truck 9T / 75 kW – 35% of the construction time for the Mini piling rig (rock bolt) 250mm auger

CONSTRUCTION PHASE	REQUIREMENTS FOR TIME MANAGED MACHINERY
	– 70% of the construction time for the Concrete pump + cement mixer truck (discharging) 8 T / 350 bar
Construction and internal works phase	– 20% of the construction time for the handheld circular saw 3 Kw – 55% of the construction time for the handheld cordless nail gun

Notes:

- Construction traffic will have approx. 3-5 heavy vehicles per day accessing the site. Occurring through the day time (7 am – 6 pm) and outside peak traffic times, outside school zones hours.
- Not all machinery is to be working simultaneously.
- The above estimations are the critical scenario for construction noise.
- Fitout works are expected to be substantially less than shown in the table, assuming noise sources (builders, handheld tools, etc) will be kept inside the new building and shielded from other receivers.
- A construction perimeter hoarding needs to be installed around the new building (min height 2 m, construction min. 12- 15 kg/m2 dense). To protect R1 – R4 receivers.
- The perimeter hoarding will be needed also around the truck turning area (same height and construction) to be able to meet the internal noise levels at the childcare centre and church.
- We understand that the trucks turning areas and trucks traffic, material handling places are still being finalized, so a sketch of the construction hoarding cannot be provided yet.

As shown even with the preliminary mitigation measures, construction noise levels are predicted to be at the limit of 75 dBA and at the limit or exceeding the internal noise criteria in the existing school buildings and childcare. In addition, the area has heritage buildings.

Hence, a construction noise and vibration management plan is required to be developed as soon the construction methodologies, programme and construction traffics management plans are detailed.

8.3 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 proposed activity, activities likely to cause some vibrations are piling, earthworks, reinstatement works for roads pavement construction and earth compaction, etc. We have assumed the soil type to be cohesive for our assessments.

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 21. 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 21 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

PLANT ITEM	RATING/DESCRIPTION	MINIMUM WORKING DISTANCE	
		COSMETIC DAMAGE (BS 7385)	HUMAN RESPONSE (OH&E VIBRATION GUIDELINE)
Jackhammer	Handheld	1 m (nominal)	2 m

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

TABLE 22: PILING AND REINSTATEMENT WORKS ESTIMATED VIBRATION LEVELS AS PER TABLE E.1 OF THE BS 5228-2.2009

EQUIPMENT	VIBRATION LEVEL PPV (mm/s)	SOURCE
<u>New Building</u> **Percussive piling, piles at 10 m depth with cohesive soils.** **distance to closest receiver = 12m**	0.15 mm/s	Table E1. BS 5228-2:2009

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

- Piling at 10 m depth with a W factor of 85Kj for percussive piling
- As per the FTA masterplan, geotechnical section, the soil is mainly consisting of fills, hence it would be a soft soil. This means that the above vibration is a conservative value, calculated for cohesive soils.
- Generated vibration from trucks traffic and turntables are less onerous than piling, trucks traffic sketches, locations and access are still to be finalized.

The above levels meet the construction vibration criteria (sensitive structures to vibration, 2.5 mm/s) as per DIN 4150 – 3. However as stated above, there are close residential, sensitive (childcare and church) and heritage structures around, hence a Construction noise and vibration management plan will need to be developed with a detailed information about the piling techniques, locations, geotechnical information and truck traffic information.

9 NOISE AND VIBRATION MITIGATION MEASURES

TABLE 23: PROPOSED NOISE MITIGATION MEASURES

PROJECT STAGE	MITIGATION MEASURES	REASON FOR MITIGATION MEASURE	SECTION OF REPORT
D	• Façade construction on the assembly hall to meet minimum requirements for glazing (Nominally Rw ~40) and non glazed construction (Rw ~52 or greater) and roof construction (Rw 40). • all façade penetrations and openings acoustically treated.	To meet Internal noise levels in teaching spaces designed to 40 dBA as per AS/NZS 2107:2016 and NSW DoP Development Near Rail Corridors and Busy Roads– Interim Guideline	6.1.4 / 7.5
D & O	• The PA system will be for voice announcements only (no music) • Speakers located away from the school boundary and oriented away from sensitive receivers. • The PA system use to be limited to school hours only 1. Sound power level noise limiting devices are required to adjust the speakers.	To meet project PNTL levels at all receivers.	7.1
O	Hall noise levels need to: • Have a Music noise limiter to max (85 dBA) • Restrictions on amplified music nearer to the night-period etc. • No operations after 10:00 pm. • School needs to have a community liaison person in case of complaints.	To meet project PNTL levels at all receivers from Hall operation.	7.5
D	• Combined sound power levels for the mechanical plant not to exceed 83 dBA and 79 dBA for Plant A and Plant B respectively. • Plant rooms with noisier equipment will require external outdoor insulation for walls and acoustic louvers.	To minimise plant noise emissions to the nearest sensitive receiver. If selections exceed the limits stated, additional mitigation must be assessed and implemented.	7.4.1
O	• Plant A should only be operational during daytime (7:00 am – 6:00pm) whereas Plant B (which serves the Hall) can run till 10pm (evening) if required, as the hall may hold events.	To reduce noise propagated. This is to be validated based on final equipment selections and layouts.	7.4.1
D	• If a noisier electrical substation is installed (more than 58 dBA SWL) acoustic louvers will be required.	To meet project PNTL levels at all receivers from substation operation.	7.6.2

PROJECT STAGE	MITIGATION MEASURES	REASON FOR MITIGATION MEASURE	SECTION OF REPORT
C	• Equipment time management (%) per construction phase as per table 20. • A perimeter hording will be needed around the new building (min 2 m tall and 12 – 15 kg/m2 dense). The perimeter hoarding will be needed also around the truck turning area and heavy trucks routes (same height and construction) to protect the church and childcare centre. • No vibratory piling. • A construction noise and vibration management plan is required when construction methods, programme and construction traffic is defined to ensure compliance with NML levels at all receivers. This is required as sensitive receivers are too close to construction, some buildings are heritage buildings and some of the preliminary calculations are exceeding the criteria for school buildings and childcare. • Construction hours will only be during the recommended standard hours and any works outside of these hours are to be addressed in a construction noise and management plan.	To protect the existing buildings that will have classes / neighbours during construction phases.	8.2.1

Notes:

- D: Design phase
- O: operational phase
- C: Construction phase

10 EVALUATION OF ENVIRONMENTAL IMPACTS

The current noise and vibration impact assessment (NVIA) by NDY, confirms that the activity will not have a significant affect on the environment (refer to section 5.7 of the EP&A Act), provided that the mitigation measures included in this report are incorporated.

CONTACT US

AUSTRALIA

ADELAIDE

T: +61 8 8290 6800
E: adelaide@ndy.com

BRISBANE

T: +61 7 3120 6800
E: brisbane@ndy.com

CANBERRA

T: +61 2 6295 1788
E: canberra@ndy.com

GOLD COAST

T: +61 7 5512 1235
E: goldcoast@ndy.com

MELBOURNE

T: +61 3 9862 6800
E: melbourne@ndy.com

PERTH

T: +61 8 9281 6800
E: perth@ndy.com

SYDNEY

T: +61 2 9928 6800
E: sydney@ndy.com

CANADA

VANCOUVER

T: +1 604 734 9338
E: vancouver@ndy.com

NEW ZEALAND

AUCKLAND

T: +64 9 307 6596
E: auckland@ndy.com

WELLINGTON

T: +64 4 471 0151
E: wellingtonadmin@ndy.com

UNITED KINGDOM

LONDON

T: +44 20 7553 9494
E: london@ndy.com

IRELAND

DUBLIN

T: +353 1 264 6995
E: dublin@ndy.com

To find out more about NDY go to **ndy.com** or follow us on LinkedIn