Report

Acoustics – State Significant Development Application

Sydney Olympic Park new high school
NSW School Infrastructure

CONFIDENTIAL

Revision: 4.0 – Response to Review
Issued: 16 September 2021

Norman Disney & Young
A TETRA TECH COMPANY

Table of Contents

1 INTRODUCTION

NDY has been engaged by NSW Schools Infrastructure to undertake a Noise Impact Assessment as part of the development approval for the proposed Sydney Olympic Park new high school project. This report was prepared to assess the noise and vibration impacts of the proposed development and to determine feasible and reasonable treatment options.

This study has addressed key noise and vibration impacts during both construction and operation.

1.1 Information Sources

- NSW EPA (2017) Noise Policy for Industry;
- NSW EPA (2014) Road Noise Policy;
- Australian Standards 2107-2016 *'Acoustics - Recommended design sound levels and reverberation times for building interiors'*
- NSW EPA Interim Construction Noise Guide (2009);
- NSW EPA (2006) *Assessing Vibration: a technical guideline;*
- AS2436-2010 *Guide to Noise and Vibration Control on Construction Sites*;
- DIN 4150-3 (1999) Vibration in Buildings - Part 3: Effects on Structures;
- Group GSA Architectural Drawings dated 05 April 2021.

1.2 Authority

Authority to undertake this report was provided by Shane Lee of School Infrastructure.

1.3 Information Sources

This report was written with reference to the following documents:

- Client Brief received 26 June 2020.
- Woods Bagot Architectural drawings date 16 August 2021

1.4 Revision History

Revision	Date Issued	Comment
1.0	12 May 2021	DA Report
2.0	23 June 2021	DA Report
3.0	30 August 2021	Minor Update
4.0	16 September 2021	Response to Review

2 PROJECT DESCRIPTION

The proposed development is for the construction of a school whereby the project is known as Sydney Olympic Park new high school. The school is to be developed in two stages. The SSD application will seek consent for both Stage One and Stage Two. While Stage Two is submitted as part of this proposal, construction is subject to approval of additional funding.

Stage One will provide for a Stream 5 high school, catering for up to 850 students. Stage Two will bring the school up to a stream 9 school capability catering up to 1,530 students.

The design features a six storey building. To the north of the site, a hall building (for sports and performance) is proposed.

The play space required to meet the need of students for Stage One can be generally accommodated onsite, within the 9,511sqm available. Additional play space may be required to accommodate the increased student numbers anticipated during Stage 2. The proposed adjoining play space comprises an area of around 8,800sqm, and will be subject to a Joint Use Arrangement and available for public use outside of school hours. The future Wentworth Point Peninsula Park will result in an open space area of approximately 4 ha.

The remainder of the peninsula (TfNSW land) is under review and will be subject to a separate approval process. Redevelopment of this land will include the new access road proposed off Burroway Road along the eastern boundary of the subject site and is proposed to include car parking, drop-off zones and delivery zones.

2.1 Site Description

The proposed development is located within the peninsula of Wentworth Point at 7-11 Burroway Road, Wentworth Park across parts of three lots; Lot 202 DP1216628, Lot 203 DP1216628 and Lot 204 DP1216628. The site forms part of the Wentworth Point Planned Precinct, which was rezoned in 2014 for the purposes of high density residential, public recreation, school and business purposes.

The site is approximately 9,511sqm in area, with a frontage of approximately 91m to Burroway Road. It currently contains vacant land, which is cleared of all past development, and almost entirely cleared of native vegetation.

The surrounding area is generally characterised by high rise residential and mixed-use developments. The site is directly adjacent to the Wentworth Point Peninsula Park and immediately east of Wentworth Point Public School.

Figure 2-1 - Site Aerial Map (Source: Mecone)

2.2 Noise Sensitive Receivers

The proposed development is located adjacent to, and has been assessed to, the following:

1. Wentworth Point Primary School (to the west)
2. 17 Wentworth Place, an existing residential apartment complex (to the south)
3. Block H, a proposed residential development (to the south)
4. A proposed mixed-use development (to the east).
5. Future peninsula park (to the north)

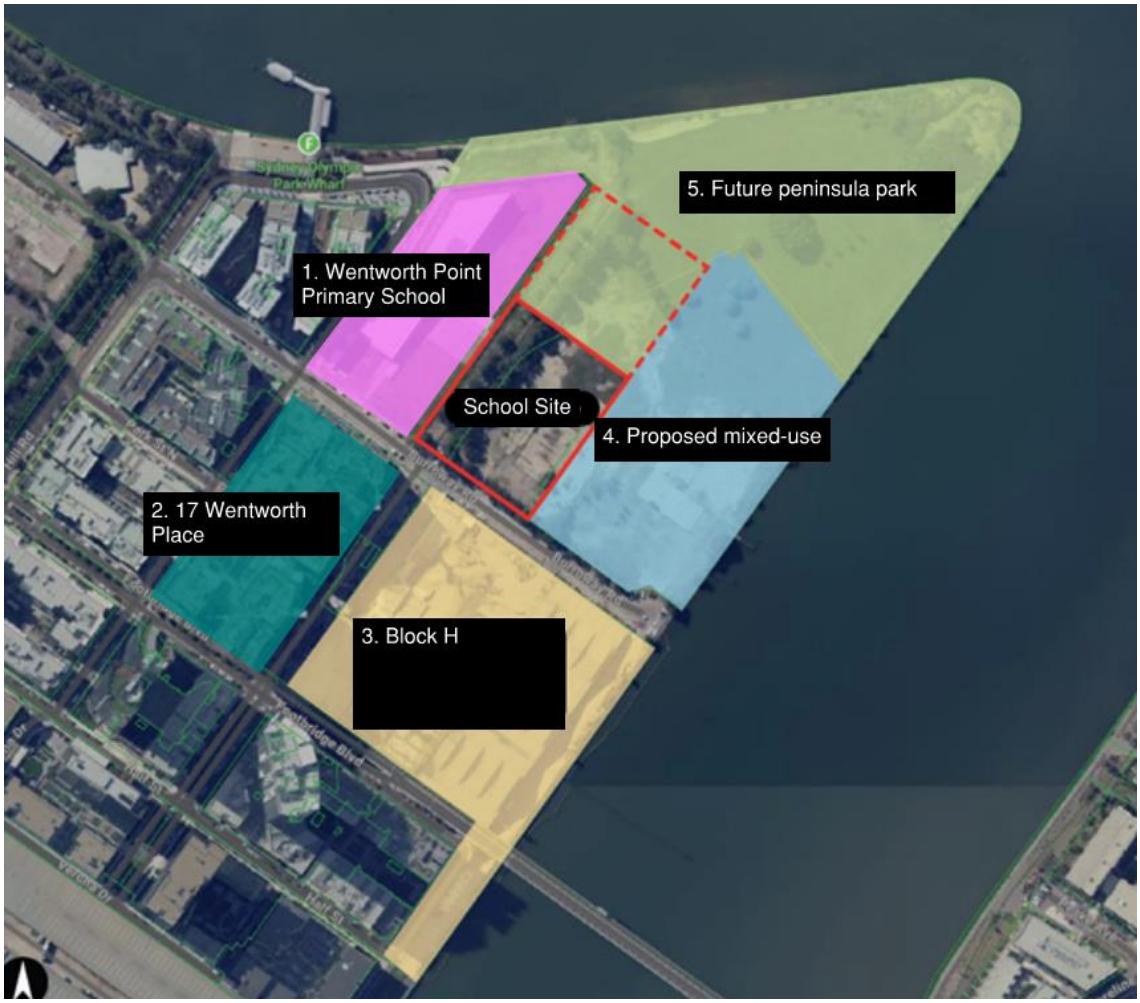

Figure 2-2 - Noise sensitive receivers

3 ACOUSTIC CRITERIA

3.1 Noise Policy for Industry

Unattended noise measurements were carried out on the site between Tuesday 20th April and Monday 3rd May 2021 to establish existing background noise levels. 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 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.

3.1.1 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 (L_{A90}) 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 (L_{Aeq}) 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.

The NPfI recommends Intrusive noise levels are only applied to residential receivers (residences).

3.2 Determination of Project Specific Trigger Levels

To determine the project specific trigger levels, a noise logger was deployed over the period of Tuesday 20th to Tuesday 27th April 2021 to measure the baseline background noise levels. The noise logger was deployed at the boundary of the proposed development site, shown in Figure 3-1 below.

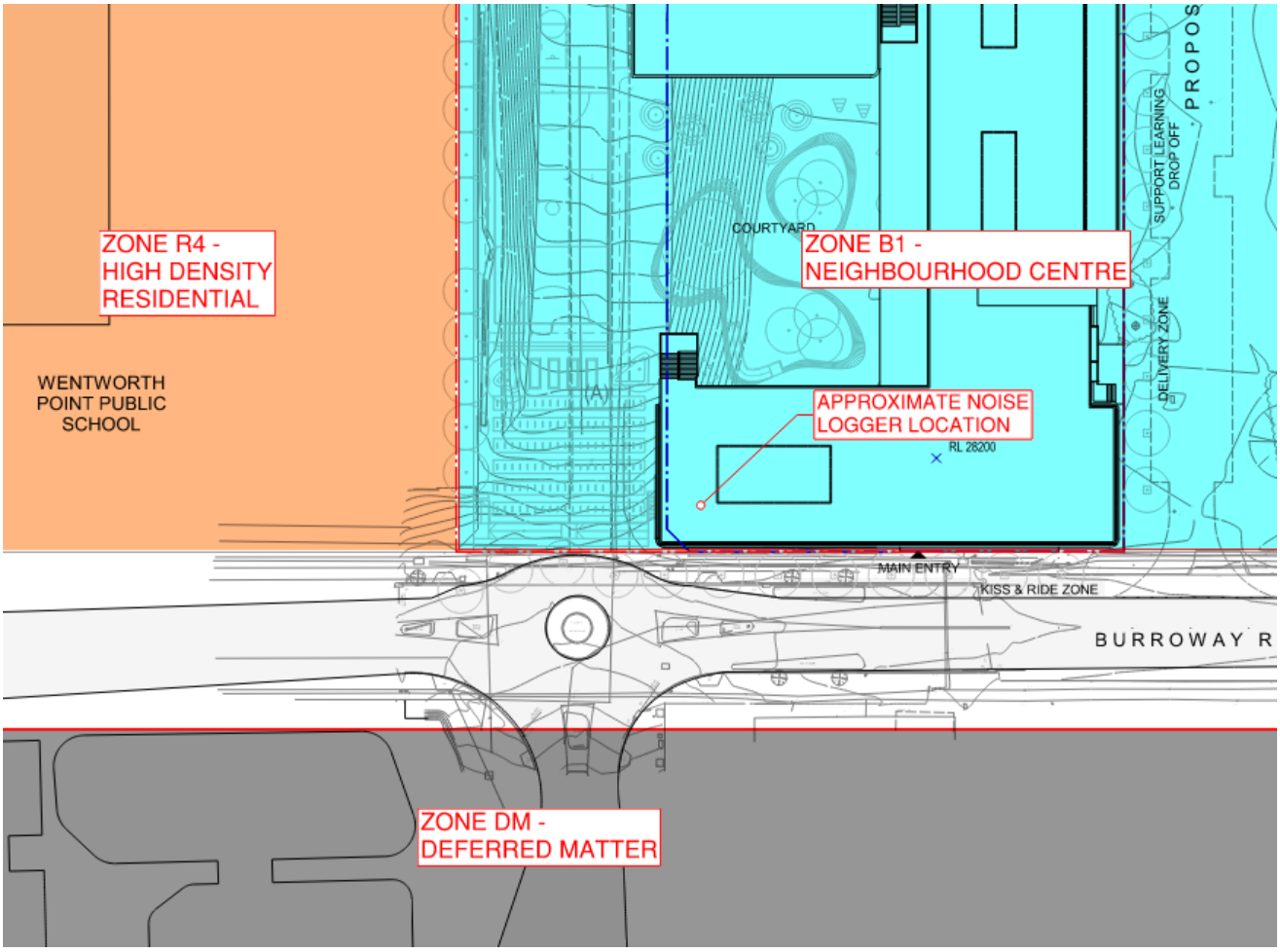

Figure 3-1 Noise Monitoring Location Relative to the Project Site and Zoning

Following the noise monitoring, the following site-specific noise levels were adopted for this study, as shown in Table 3-1 below.

Table 3-1 Baseline Noise Data for the Proposed Development

Location	Average Noise Level - L_{Aeq}			Rated Background Noise Level, RBL		
	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
Logger 1 Burroway Road, on site boundary to the corner of school and residential developments	54	53	47	46	48	40

As the urban land use categories apply, the following project specific criteria would apply. As shown in Table 3-2, the intrusiveness criteria was deemed to be the most conservative criteria for residential receivers, and hence the following project trigger levels were determined.

Table 3-2 NPFI Project Specific Trigger Levels – $L_{eq15min}$, dB(A).

Period	Urban Amenity Criteria*	Intrusiveness Criteria (RBL + 5)	Project Trigger Levels
Day (0700-1800)	58 dB(A)	51 dB(A)	$L_{eq(15min)}$ **51 dB(A)**
Evening (1800-2200)	48 dB(A)	53 dB(A)	$L_{eq(15min)}$ **48 dB(A)**
Night (2200-0700)	43 dB(A)	45 dB(A)	$L_{eq(15min)}$ **43 dB(A)**
*Determined from NSW Noise Policy for Industry 'Table 2.1'			

3.3 Construction Noise and Vibration Criteria

3.3.1 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 development would be more than 3 weeks and therefore a quantitative method has been used for this assessment.

Table 3-3 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 will require community consultation and a Construction Noise & Vibration Management Plan (CNVMP).

Table 3-3: Noise at Residences using Quantitative Assessment

Recommended Hours	Time of Day	External Management Level $L_{eq,15min}$ [dBA]
Recommended Standard Hours	Monday – Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise Affected RBL + 10
		Highly noise affected 75
Note: Noise Levels apply at the boundary that is most exposed to construction noise and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most affected point within 30m of the residence.		

3.3.2 Noise Management Levels

Noise Management Levels (NML) associated with the construction works on the project site are presented in Table 3-4.

Table 3-4: Construction Noise Management Levels, $L_{eq\ 15min}$

Receivers	Recommended Hours	Period	RBL $L_{A90,15mins}$ [dBA]	External Noise Management Level [dBA]
Surrounding Residences & School	All Hours (Standard Construction Hours)	When in use	54 dB(A)	(54+10) = **64 dB(A)** (noise affected) **75 dB(A)** (highly noise affected)

3.3.3 Construction Vibration Criteria

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

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

3.3.3.1 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.

3.3.3.2 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). We have assumed hotels will be assessed as per the criteria for residences.

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.*"

3.3.3.3 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. We have assumed hotels will be assessed as per the criteria for residences.

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

3.3.3.4 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.

3.3.3.5 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 3-5 below refer to the evaluation of the effects of short-term vibration on structures. The criteria are the peak particle velocities (pp.) measured on any foundation or uppermost full storey of any building not related to the site.

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 3-5: 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

3.3.3.6 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 3-6.

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 3-6: 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

4 NOISE AND VIBRATION IMPACT ASSESSMENT

4.1 Noise Emissions

Figure 4-1 below depicts the proposed building layout and the potential noise sources relative to the noise sensitive receivers.

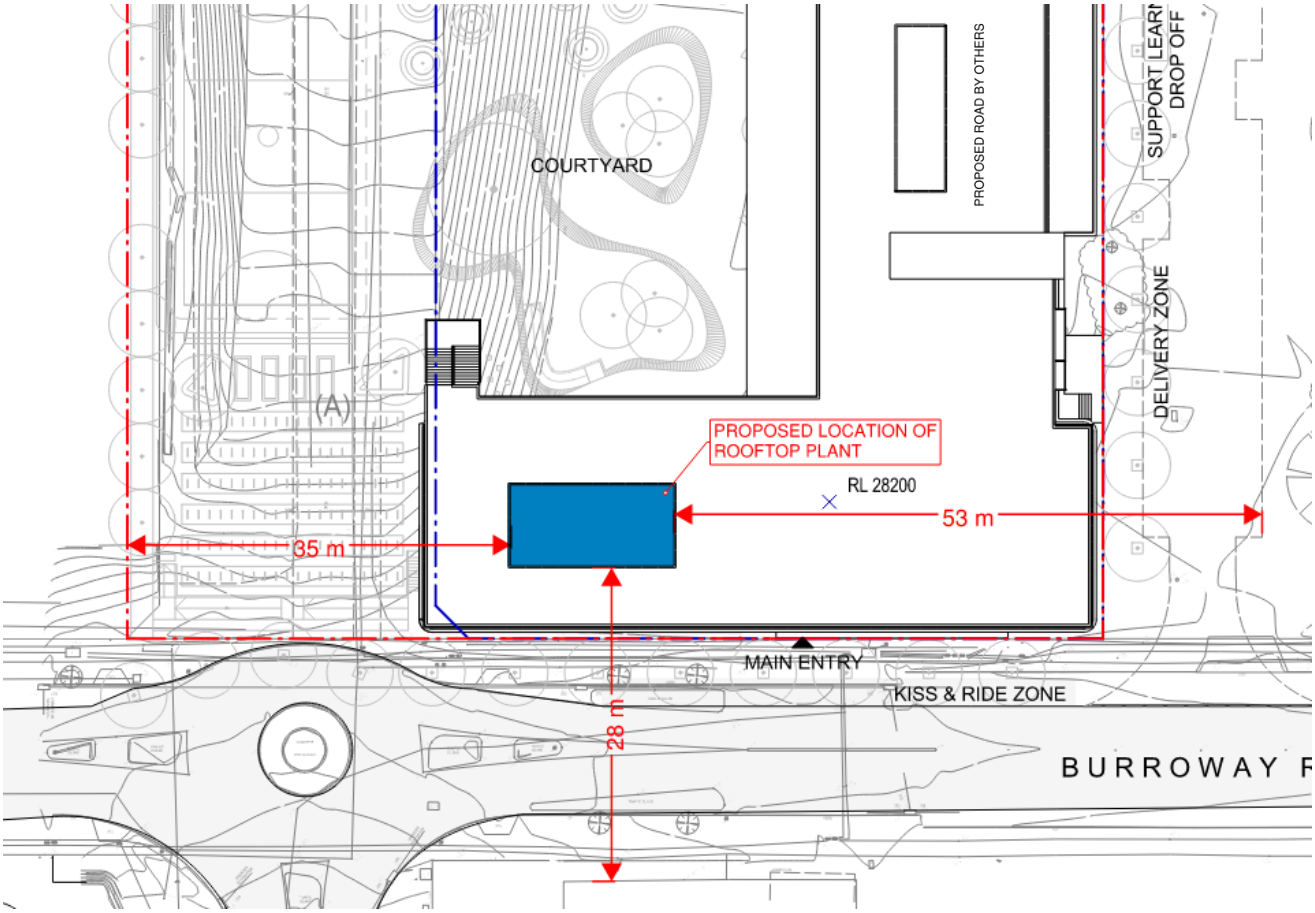

Figure 4-1 Distances between Noise Receivers

4.1.1 Plantroom Noise Emissions

Based upon the current building design and layout, it is proposed that major plant such as chillers, cooling towers etc are to be located on the rooftop of the development. Figure 4-1 above depicts the proposed plant locations and the relative distances to the nearest noise receivers.

For preliminary purposes, as equipment selections are not currently available (as the project is still in the early stages of design), we have modelled noise levels to the nearest affected boundaries derived upon previous projects of similar size. The following assumptions have been made:

- Two chillers with a sound power level of Lw89 dBA (100% load);
- Acoustic treatment to chillers (such as acoustic louvres surrounding the plant deck, acoustic lining to ductwork or fan silencers)
- Major plant is expected to be running on reduced load/turned off during the night period.

Typical worst-case noise emissions at the nearest affected receivers are presented below in Table 4-1. As shown predicted noise levels for typical worst-case scenario were compliant with the noise criteria at the

receiver boundaries, given the sound attenuation by distance between the outdoor plant and the receivers. However, these noise levels at receivers can be further reduced by selection of lower noise units and additional acoustic treatment such as noise barriers and acoustic louvres.

Table 4-1 Predicted Chiller Noise Levels at Receivers, $L_{eq15mins.}$

Location	Predicted Noise Levels	Project Trigger Levels (Evening, 6pm – 10pm)	Complies Yes/No
Residences to East (Proposed Residential Development)	47 dB(A)	48 dB(A)	Yes
Residences to South/Wentworth Point Primary School	45 dB(A)	48 dB(A)	Yes

4.1.2 Noise from PA and School Bell

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.
- The PA system use to be limited to school hours only

Both the PA system and the school bell should be installed and adjusted such that the project trigger levels during school hours, i.e. $L_{eq(15\ min)}$ 51 dBA, are met at the noise sensitive receivers.

4.1.3 Dust Extractor

A dust extractor is located on Level 3. Although the dust extractor is some distance from nearby receivers dust extraction systems have the potential to cause nuisance due to the particular acoustic characteristics of the system (e.g. vibratory cleaning and high velocity air flows).

As such we recommend the following treatment be considered:

- An acoustic enclosure is allowed for surrounding the extraction system. The enclosure is to be lined with acoustic absorption within to reduce reverberant build-up.
- Attenuator/s on the fan outlet

Detailed design and selection of materials/products will occur when the dust extraction system has been selected.

4.1.4 Outdoor Workshop

An outdoor workshop is located on Level 3 outside the wood and metal workshops. At this stage no information is available on what equipment or activities may be occurring in the outdoor workshops. Given the proximity to the wood and metal workshops however it is reasonable to assume that there is the

potential for noise producing activities to occur. As an example, a circular saw producing 78 dBA at 10m would exceed the project trigger levels at the existing Wentworth Point Primary School.

In such cases, acoustic mitigation measures should be considered including, but not necessarily limited to, the following:

- Acoustic shielding
- Absorptive finishes on exterior walls in close proximity to the outdoor workshop
- Time management
- Restriction of use to quiet activities

Using the same example of a circular saw, implementing acoustic shielding around the outdoor workshop would reduce noise levels to be compliant with project trigger levels with no time management required.

4.1.5 Waste Collection

A waste storage area (WSA) is located in the north eastern corner of the site (Figure 4-2) with entry via the proposed future road to the east of the site. To control noise emission to the proposed mixed-use development to the east we recommend that waste removal loading activities occur within schools hours and located within the WSA.

If waste loading activities are not able to occur within the WSA the following options will be considered:

Acoustic shielding between the loading area and the proposed mixed-use development (for example at the entry doors)

Implement management procedures for the waste collection contractors. Management procedures may include:

- Switching off engine during loading activities
- Use of low noise vehicles

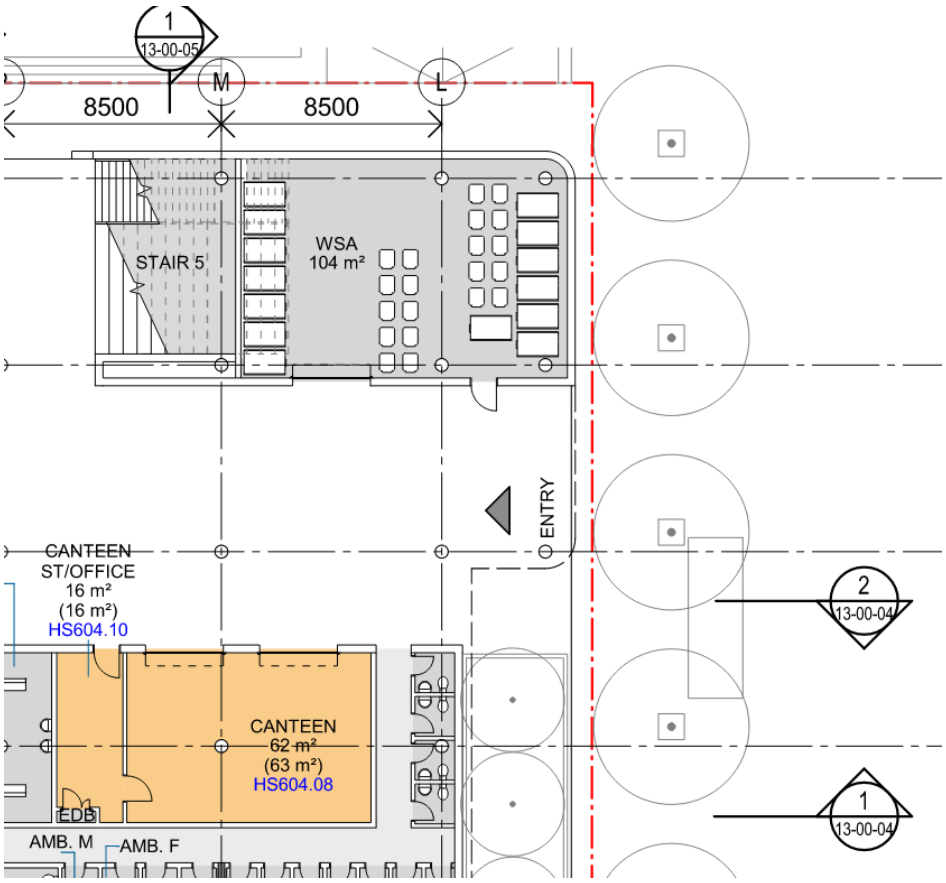

Figure 4-2 Waste storage area (WSA)

4.1.6 Car Park and Delivery Zone

A new access road is proposed off Burroway Road along the eastern boundary of the subject site and is proposed to include car parking, drop-off zones and delivery zones. The access road (including car park, drop-off zones and delivery zones) will be subject to a separate approval process and is therefore not considered in this assessment.

4.1.7 After-hours Use

We understand there is no planned after hours use of the school at this stage. As such no acoustic assessment has been carried out for afterhours activities within this submission.

4.2 Construction Noise

4.2.1 Construction Plant Noise Levels

At the time of writing, the proposed construction plant 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: 1) Excavation 2) Structural Works and 3) Fit out phases of the project. These plant items are summarised below in Table 4-2. Estimated operating distances to the receivers was in the order of 30m to 70m distance from Wentworth Point Primary School and the residential apartments across the road (to the south), with predicted construction noise emissions presented in Section 4.2.2 below.

Table 4-2: Typical External Noise Levels of Demolition and Construction Machinery/Activity

Item #	Activity /Machinery	Source	Leq Sound Pressure Level at 10m (dBA)
Excavation and Demolition			
1	Tracked excavator, breaking up brick foundation (121kW, 15t)	DEFRA	90
2	Jack hammers	AS2436	93
3	Hand-held hydraulic breaker 20kg / 69bar	DEFRA	93
4	Backhoe mounted hydraulic breaker, breaking road surface (67kW)	DEFRA	88
5	Tracked excavator, loading dump truck	DEFRA	85
6	Tracked Excavator, Ground Excavation Works (25t, 125kW)	DEFRA	77
7	Crane mounted Screw Piler	DEFRA	79
Structural Works			
8	Tracked Crane	DEFRA	93
9	Bobcat, 5t	DEFRA	104
10	Truck Delivery	DEFRA	93
11	Concrete Pump, 25kW	DEFRA	103
Fit out Works			
12	Angle Grinder	DEFRA	109
13	Hammer	DEFRA	97

4.2.2 Predicted Construction Noise

Based upon the above plant sound power levels, predicted construction noise levels for the various works phases are presented below in Table 4-3. As shown construction noise levels during both excavation and structural works phases were predicted to exceed 75 dB(A). Under the ICNG, this would support the requirements for construction noise to be managed as part of a construction noise and vibration management plan.

However, during fit out works it is anticipated that noise levels will have less noise impact. Recommended construction noise management measures have been provided in Section 6.2 of this report.

Table 4-3: Predicted construction noise $L_{eq,15min}$

Receivers	Recommended Hours	Period	Predicted Construction Noise Level	External Noise Management Level.
Excavation Phase				
Wentworth Point Primary School & Residences	Monday - Friday 7am to 6pm, Saturday 8am to 1pm, No work on Sundays or Public Holidays	Day	~69-80 dB(A)	64 dB(A)(noise affected) 75dB(A) (highly noise affected)
Structural Works Phase				
Wentworth Point Primary School & Residences	Monday - Friday 7am to 6pm, Saturday 8am to 1pm, No work on Sundays or Public Holidays	Day	~64-75 dB(A)	64 dB(A)(noise affected) 75dB(A) (highly noise affected)
Fit out Phase				
Wentworth Point Primary School & Residences	Monday - Friday 7am to 6pm, Saturday 8am to 1pm, No work on Sundays or Public Holidays	Day	~43-55 dB(A)	64 dB(A)(noise affected) 75dB(A) (highly noise affected)
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.				

4.3 Preliminary Vibration Assessment

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

Compliance with vibration limits 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 4-4. As shown 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 4-4: 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
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Jackhammer	Hand held	1 m (nominal)	2 m

5 NOISE INTRUSION

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

- Aircraft noise
- Rail noise
- Road traffic noise

5.1 Aircraft Noise Intrusion

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

5.2 Rail Noise Intrusion

The Main Northern Railway line runs past the school approximately 600m to the east, across Paramatta River. 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.

5.3 Road Traffic Nose Intrusion

Road traffic noise mainly emanates from Burroway Rd. A preliminary traffic noise assessment has been carried out to inform initial allowances for façade glazing.

We have made the following assumptions in our assessment:

- Internal noise levels in teaching spaces designed to 35 dBA as per AS/NZS 2107:2016
- Sample teaching space of 5mx5m with carpet floor and mineral fibre tile ceiling
- Entire façade area is glazed
- A +3dB factor has been applied to the traffic noise source spectrum account for future traffic growth

The 95th percentile $L_{eq(15min)}$ traffic noise levels during daytime hours was calculated base on the measurement data captured between 20th April and 3rd May 2021.

5.3.1 Recommended Façade Glazing

Based on the above, we recommend implementing the following façade glazing for the school:

- DGU rated at Rw 37: 6.38mm laminate/12mm air gap/6mm float glass or similar

6 RECOMMENDATIONS

Based upon the findings in this report, the following recommendations to mitigate noise impacts during operation and during construction are provided below.

6.1 Mechanical Plant Noise

It is understood that the development will include mechanical plant and HVAC equipment which will be located on the rooftop and plantroom of the development. At this stage, the detailed design and selection of mechanical plant is still to be finalised.

It is anticipated that rooftop HVAC equipment, these can be treated using a combination of any of the following options:

- Selection of low noise units;
- Strategic location of equipment away from most sensitive receivers;
- Building shielding;
- Distance attenuation;
- Duct internal acoustic lining (where appropriate);
- Acoustic louvres
- Acoustic barriers (if exceed the above recommendations).

6.2 Construction Noise and Vibration

The findings of this assessment have determined that construction works, which is undertaken during standard hours will exceed the Highly Noise Affected criteria of 75dB(A) or greater during construction works. Hence it is anticipated that a construction noise and vibration management plan will be required for these works. The findings have proposed that construction noise is managed through feasible and reasonable noise mitigation measures, outlined in the NSW Interim Construction Noise Guideline and Australian Standards 2436-2010. Additional site and noise management practices have been provided below for guidance purposes.

6.2.1.1 Construction Noise and Vibration Management Plan

Predicted construction noise levels at the nearest residential properties were determined to be within the 'Highly Noise Affected' noise levels. However, as good practice, it is recommended that a Construction Noise and Vibration Management Plan to be implemented during the construction of the Sydney Olympic Park new high school. 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.

6.2.1.2 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.

6.2.1.3 Construction Activities and Mitigation

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

- Site access for construction vehicles to be set up away from the sensitive boundaries;
- During extended construction 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;
- Where practical, a partial enclosure shall be used to minimise noise levels.

6.2.1.4 Construction Noise Controls

General/ Work Practices:

- 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 daytime 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.

Use and sitting of equipment/activities:

- Where practical fixed plant should be positioned as far as possible from the sensitive receivers.

Enclosures:

- Use temporary site buildings and material stockpile as noise barrier.
- Employ the use of solid barrier plywood hoardings if required.
- Where practical, a partial enclosure shall be used to minimise noise levels.

6.2.1.5 Construction Vibration Controls

Structural Damage:

- Use lower impact or low tonnage equipment – use of small rock breakers.
- Maintain safety distance between construction plant and building, to be determined during detailed design stage.

Human Annoyance:

- Scheduling the use of vibration causing equipment at the least sensitive time of the day.
- Sequencing operations so that high vibration causing activities to do not occur simultaneously.

7 CONCLUSION

A noise impact assessment was undertaken for the proposed Sydney Olympic Park new high shool in Wentworth Point, Sydney, NSW.

The location of mechanical plant and equipment on the rooftop and major plantroom is yet to be finalised. However, it is anticipated that noise emissions to the boundary can be controlled using standard engineering measures outlined in this report. Limiting aggregate sound power levels have been provided to facilitate mechanical plant detailed design.

Construction of the Sydney Olympic Park new high school is predicted to have noticeable noise and vibration impacts, particularly during the excavation and structural works. Based upon the assessment undertaken it is recommended that a noise and vibration management plan is prepared to mitigate and manage these impacts. This report has outlined typical best practice measures that should be considered in the development of a final noise and vibration management plan.

To control traffic noise intrusion we recommend an allowance be made to implement a DGU achieving Rw 37, e.g. 6.38mm laminate/12mm air gap/6mm float glass, on the façade.

NORMAN DISNEY & YOUNG

CONSULTING ENGINEERS

NDY Management Pty Limited trading as Norman Disney & Young
ABN 29 003 234 571
115 Batman Street
West Melbourne Victoria 3003
Telephone: +61 3 9862 6800
Facsimile: +61 3 9862 6900

OFFICES

Australia:	Sydney, Melbourne, Brisbane, Perth, Canberra, Adelaide, Gold Coast
Canada:	Vancouver
Hong Kong SAR:	Hong Kong
New Zealand:	Auckland, Wellington
United Kingdom:	London

CONFIDENTIAL INFORMATION

DISCLAIMER OF LIABILITY

COPYRIGHT

Learn more about NDY
Website: www.ndy.com
LinkedIn: www.linkedin.com/company/norman-disney-&-young
Facebook: www.facebook.com/NDY-Group
Twitter: @ndygroup
YouTube: https://www.youtube.com/ndygroup

NDY QA SYSTEM

Revision No:	4.0
Revision Date:	16 September 2021
Reason Description:	Response to Review
File Location:	\\tt.local\NDY\syd\w\S318xx\S31821\002\J-\24_Reports
Filename:	rp210506s0014
Client Name:	NSW School Infrastructure
Client Contact:	Shane Lee
Project Leader:	Cameron Walbran
Editor:	Cameron Walbran

Authorisation By: Cameron Walbran

Verification By: Kanvin Chen

NDY Offices

AUSTRALIA
Adelaide
Brisbane
Canberra
Gold Coast
Melbourne
Perth
Sydney

CANADA
Vancouver

IRELAND
Dublin

NEW ZEALAND
Auckland
Wellington

UNITED KINGDOM
London

www.ndy.com

Norman Disney & Young
A TETRA TECH COMPANY