



# Cumberland Cluster Schools (CCS)

## Construction Noise and Vibration Management Sub Plan (CNVMSP)

**Roberts Co (NSW) Pty Ltd**  
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Sydney NSW 2000

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# 1 INTRODUCTION

Pulse White Noise Acoustics (PWNA) has been engaged by Roberts Co (NSW) Pty Ltd to prepare a site-specific Construction Noise and Vibration Management Sub-Plan (CNVMSP) for the construction of the Cumberland Education Precinct, which includes upgrades to Carlingford West Public School (CWPS) and Cumberland High School (CHS). The Project Sites are located at 59-73 Felton Road (CWPS) and 183 Pennant Hills Road (CHS), Carlingford with a common boundary between the schools.

This CNVMSP has been prepared to satisfy the requirements of Condition B15 of the consent conditions presented to this office given in the Notice of Determination – Approval issued for Development Application No. SSD-43065987.

Onsite unattended noise levels have previously been determined for the project by Acoustic Studio in the site’s Noise and Vibration Impact Assessment submitted as part of the SSD Application, report reference: 20221027 SVM3451.0002.Rep.docx (dated 27 October 2022). These will be adopted for the purpose of establishing residential Noise Management Levels (NMLs).

A glossary of acoustic terminology used throughout this report is included in Appendix A.

## 1.1 Condition Satisfaction

In addressing the requirements of condition B15.

**Table 1 Condition Satisfaction Table**

CEMP Condition Satisfaction Table		
Condition	Condition Requirements	Document/Sub-Plan Reference
B15	<i>The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to the following,</i>	-
	<i>a) Be prepared by a suitably qualified and experienced noise expert;</i>	Refer to Appendix C.
	<i>b) Describe procedures for achieving the noise management levels in EPA’s Interim Construction Noise Guideline (DECC, 2009);</i>	Refer to section 4.2.
	<i>c) Describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;</i>	Refer to section 5.2.
	<i>d) Include strategies that have been developed with the community for managing high noise generating works;</i>	Refer to section 5.4.
	<i>e) Describe the community consultation undertaken to develop the strategies in condition B15(d);</i>	Refer to section 5.4.
	<i>f) Include a complaints management system that would be implemented for the duration of the construction; and</i>	Refer to section 5.4.
	<i>g) Include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the management measures in accordance with Condition B13(d).</i>	Refer to sections 5.3.2 (Vibration) and 5.2.3 (Noise).

## 1.2 Development Overview

In brief, the proposed redevelopment will entail the following works:

- Carlingford West Public School (CWPS):
  - The upgrades to CWPS will cater for a total student population of 1,610 and include the construction of four new buildings in the north-west portion of the site known as Buildings W, X, Y and Z. These buildings range from one to three storeys and contain a variety of uses including general learning spaces, library, amenities, staff rooms and combined canteen, OSCH, gym and hall. The construction of a new kiss and ride off Felton Road West and a waste loading area, On-Site Detention (OSD) tank and staff carpark.
- Cumberland High School (CHS):
  - The works proposed at CHS will cater for a total student population of 2,040 and include the construction of three new buildings in the south-east portion of the site known as Buildings X, Y and Z. These buildings range from one to five storeys and contain a variety of uses including a general and specialists learning spaces, library, administration, staff and student amenities, and combined lecture theatre, canteen, OSCH and gym/hall. The works also propose the construction of a new bus link road and waste loading area from Dunmore Avenue to Pennant Hills Road.

**Figure 1 Carlingford West Public School (CWPS) and Cumberland High School (CHS) Upgrades Scope of Project and Proposed Masterplan (Source: Woods Bagot)**





## 1.3 Project Construction

The development upgrades to CWPS and CHS is to be constructed in two stages. The works proposed for Stage 1 exclude CHS Building X as illustrated in Figure 1. For further details on scope and timing of staging refer to architectural documentation.

## 1.4 Site Layout

The Project Sites are located at 59-73 Felton Road (CWPS) and 183 Pennant Hills Road (CHS), Carlingford with a common boundary between the schools. The site is located within the City of Parramatta Council local government area.

The site is bordered by residential receivers along the northern, southern, eastern and western portion of the site. Residential receivers which are located along the northern, southern, eastern and western boundaries are a combination of single and two storey dwellings with windows overlooking the school site.

Surrounding the proposed project site are several sensitive receivers, these are summarised below for the project site.

- Receiver 1:** Single and two storey residential dwellings located to the in the south-west corner of the site along Sandringham Drive. Receivers are located along the eastern side of Sandringham Drive (No. 43-51). Receiver one will be known as *Sandringham Drive Receivers (North)* in this report.
- Receiver 2:** Two storey residential dwellings located along the western boundary of the site adjacent to the Felton Road (West) entry. Receivers are located along the southern side of Felton Road (No. 86 & 88). Receiver two will be known as *Felton Road West (South)* in this report.
- Receiver 3:** Two storey residential dwellings located along the western boundary of the site adjacent to the Felton Road (West) entry. Receivers are located along the northern side of Felton Road (No. 86 & 88) and eastern side of Edinburgh Avenue (32). Receiver three will be known as *Felton Road West (North)* in this report.
- Receiver 4:** Single and two storey residential dwellings located along Adrian Court, adjacent to the northern portion of the western boundary of the site. Receivers are located along the eastern side of Adrian Court (No. 5-21). Receiver four will be known as *Adrian Court Receivers* in this report.
- Receiver 5:** Single and two storey residential dwellings located along Adrian Court and Hilar Avenue, adjacent to the northern boundary of the site. Receivers are located along the eastern side of Adrian Court (No. 23) and southern side of Hilar Avenue (No. 5-21). Receiver five will be known as *Hilar Avenue Receivers* in this report.
- Receiver 6:** Single and two storey residential dwellings located along Billyard Place, adjacent to the eastern boundary of the site. Receivers are located along the western side of Billyard Place (No. 9-13). Receiver six will be known as *Billyard Place Receivers* in this report.
- Receiver 7:** Single and Two storey residential dwellings located along the eastern boundary of the site adjacent to the Felton Road (East) entry. Receivers are located along the northern side of Felton Road (No. 55 & 57). Receiver seven will be known as *Felton Road East (North)* in this report.





- Receiver 8:** Single storey residential dwellings located along the eastern boundary of the site adjacent to the Felton Road (East) entry. Receivers are located along the southern side of Felton Road (No. 60 & 62). Receiver eight will be known as Felton Road East (South) in this report.
- Receiver 9:** Single and two storey residential dwellings located along the eastern boundary of the site adjacent to Blenheim Road. Receivers are located along the northern and southern side of Blenheim Road (No. 23-26). Receiver nine will be known as Blenheim Road Receivers in this report.
- Receiver 10:** Single and two storey residential dwellings located along the eastern boundary of the site to the north of Dunmore Avenue. Receivers are located along the northern side of Dunmore Avenue (No. 9 & 11). Receiver ten will be known as Dunmore Avenue (North) in this report.
- Receiver 11:** Single and two storey residential dwellings located along the eastern boundary of the site to the south of Dunmore Avenue. Receivers are located along the southern side of Dunmore Avenue (No. 16 & 18). Receiver eleven will be known as Dunmore Avenue (South) in this report.
- Receiver 12:** Single and two storey residential dwellings located across Pennant Hills Road to the south of the site. Receivers are located along the southern side of Pennant Hills Road (No. 240-248). Receiver twelve will be known as Pennant Hills Road (South) in this report.
- Receiver 13:** Single and two storey residential dwellings located along the southern boundary of the site to the north of Pennant Hills Road. Receivers are located along the northern side of Pennant Hills Road (No. 177-181). Receiver thirteen will be known as Pennant Hills Road (North/East) in this report.
- Receiver 14:** Single and two storey residential dwellings located along the southern boundary of the site to the north of Pennant Hills Road. Receivers are located along the northern side of Pennant Hills Road (No. 173-175). Receiver fourteen will be known as Pennant Hills Road (North/West) in this report.
- Receiver 15:** Single and two storey residential dwellings located along the western boundary of the site along Sandringham Drive. Receivers are located along the eastern side of Sandringham Drive (No. 31-41). Receiver fifteen will be known as Sandringham Drive Receivers (South) in this report.

Maps showing the site location, receiver locations and all measurement locations is provided in the figures below.

Figure 2 – Site Map, Measurement Locations and Surrounding Receivers Carlingford West Public School (CWPS) – Sourced from SixMaps



**Figure 3 Site Map, Measurement Locations and Surrounding Receivers Cumberland High School (CHS) – Sourced from SixMaps**





## 2 EXISTING ACOUSTIC ENVIRONMENT

Measurements of the existing background noise levels have previously been conducted by Acoustic Studio as part of their Noise and Vibration Impact Assessment submitted for as part of the SSD Application, report reference: *20221027 SVM3451.0002.Rep.docx* (dated 27 October 2022). Information regarding the monitoring conducted by Acoustic Studio is provided below:

**Figure 4 - Extract from Acoustic Studio Noise and Vibration Impact Assessment**

### 3 Existing Noise Environment

#### 3.1 General Survey Information

A survey of the existing noise environment at and around the site was conducted through unattended noise monitoring to continuously record the noise levels at the site and surrounds.

Monitoring was carried by Acoustic Studio in collaboration with monitoring carried out by Pulse White Noise Acoustics (PWNA). The PWNA monitoring is particularly useful for the SSDA noise impact assessment since it was undertaken prior to construction works which have since commenced at CWPS.

Isaac Bradbury and Anthony Cano of Acoustic Studio Pty Ltd carried out the surveys for CHS at the school site. Mathew Furlong from PWNA carried out the unattended noise surveys for CWPS and the residential receiver locations at CHS.

#### 3.1.1 CHS

Unattended long-term noise monitoring was carried out for the following periods at CHS:

- Period 1 – 14<sup>th</sup> April to 25<sup>th</sup> April 2022 (during school holidays)
- Period 2 – 26<sup>th</sup> April to 6<sup>th</sup> May 2022 (during school term)

The unattended long-term noise monitoring was carried out with the following noise loggers:

- School Site (Acoustic Studio)
  - Logger CHS-S1 (Svan 971, S/N 60787)
  - Logger CHS-S2 (Svan 971, S/N 74364)
  - Logger CHS-S3 (Svan 957, S/N 27552)
- Residential Receivers (PWNA)
  - Logger CHS-R1 (Rion NL-42 S/N 00396931)
  - Logger CHS-R2 (Rion NL-42 S/N 001173759)
  - Logger CHS-R3 (Rion NL-42 S/N 01000231)

The noise loggers recorded  $L_{A1}$ ,  $L_{A10}$ ,  $L_{A90}$ , and  $L_{Aeq}$  noise parameters at 15-minute intervals continuously for the measurement period. The calibration of the loggers was checked before and after use and no variations were noted.

Operator attended, short-term monitoring was also carried out on the following dates:

- Thursday 14<sup>th</sup> April 2022
- Friday 6<sup>th</sup> May 2022

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**Figure 5 - Extract from Acoustic Studio Noise and Vibration Impact Assessment (Cont.)**

### 3.1.2 CWPS

Unattended long-term noise monitoring was previously carried out (in 2021) by PWNA for a previously withdrawn assessment for the CWPS. This data has been considered in this assessment. The PWNA monitoring is particularly useful for the SSDA noise impact assessment since it was undertaken prior to construction works which have since commenced at CWPS.

Monitoring was previously carried out by PWNA for the following periods at CWPS:

- Period 1 – 14<sup>th</sup> April to 21<sup>st</sup> April 2021 (during school holidays)
- Period 2 – 26<sup>th</sup> April to 5<sup>th</sup> May 2021 (during school term)

The unattended long-term noise monitoring was carried out with the following noise loggers:

- School Site (PWNA)
  - Logger CWPS-S1 (Rion NL-42 S/N 01000233)
  - Logger CWPS S2 (Rion NL-42 S/N 00396931)
  - Logger CWPS-S3 (Rion NL-42 S/N 00396932)
- Residential Receivers (PWNA)
  - Logger CWPS-R1 (Rion NL-42 S/N 01000233)
  - Logger CWPS-R2 (Rion NL-42 S/N 00396931)
  - Logger CWPS-R3 (Rion NL-42 S/N 00396932)



**Figure 6 - Extract from Acoustic Studio Noise and Vibration Impact Assessment (Cont.)**

### 3.1.3 Short Term Monitoring

Short-term noise monitoring was conducted in order to supplement the long-term monitoring data across the site and at key surrounding receivers, plus to obtain spectral noise data for traffic noise at the proposed site.

These short-term measurements included measurements at the property boundaries of the closest residential properties, which were used to confirm that the long-term monitoring at each location (on the opposite side of the street) is representative of the background and ambient noise levels at the nearest noise sensitive receivers.

***NOTE: Short term noise monitoring was used to augment unattended monitoring and further confirm that selected locations were representative of reasonably most affected noise sensitive receivers. However, background noise levels were established in accordance with the NPI and only using the data captured from the unattended long term noise monitoring.***

Attended short-term measurements were made with two Brüel & Kjær Hand-held Analysers Type 2250 (Serial Numbers 2832406 and 3010373). The calibrations of the analysers were checked before and after the surveys and no variation in levels occurred.

Windshields were used to protect the microphones of all the loggers and analysers. Weather conditions were generally calm and dry during the attended noise surveys, and therefore the data captured was not affected by weather.

Isaac Bradbury and Anthony Cano of Acoustic Studio Pty Ltd carried out the attended surveys.

### 3.1.4 Monitoring Data

The detailed results of the unattended long-term noise monitoring at the Twelve logger locations are shown in Appendix A.

**Figure 7 - Extract from Acoustic Studio Noise and Vibration Impact Assessment (Cont.)**

### 3.2 Noise Monitoring Locations

#### 3.2.1 CHS

The loggers were located at the proposed site at the following locations:

- School Site
  - Logger CHS-S1 - East of the site at the existing play courts and car park
  - Logger CHS-S2 - South east boundary of the school site
  - Logger CHS-S3 - In the existing south west car park behind block E
- Residential Receivers
  - Logger CHS-R1 - 26 Blenheim Road
  - Logger CHS-R2 - 18 Dunmore Avenue
  - Logger CHS- R3 - 16 / 173-175 Pennant Hills Road



Figure 5: CHS in relation to noise sensitive receivers and noise monitoring locations

**Figure 8 - Extract from Acoustic Studio Noise and Vibration Impact Assessment (Cont.)**

**3.2.2 CWPS**

The loggers were located at the proposed site at the following locations:

- School Site
  - Logger CWPS-S1 – Western school boundary, near Felton Rd (west).
  - Logger CWPS-S2 – Site northern boundary.
  - Logger CWPS-S3 – Eastern school boundary, near Felton Rd (east).
- Residential Receivers
  - Logger CWPS-R1 – 75 Felton Rd.
  - Logger CWPS-R2 – 5 Hilar Avenue.
  - Logger CWPS-R3 – 62 Felton Rd.



Figure 6: CWPS in relation to noise sensitive receivers and noise monitoring locations





**Figure 9 - Extract from Acoustic Studio Noise and Vibration Impact Assessment (Cont.)**

**3.2.3 Review of Locations and timing of Monitoring**

These locations were chosen as they;

- were secure places to leave the noise loggers unattended,
- are judged to provide representative of background and ambient noise levels at the nearest noise sensitive receivers,
- provide ambient noise levels at both school side and residential side of shared boundaries, plus
- for residential receivers, noise loggers were installed at locations considered representative of the nearest, reasonably (or potentially) most affected residences as detailed in the NPI.

It is noted that noise monitoring data for CWPS has based on data obtained by PWNA in 2021 from a previously withdrawn assessment for CWPS. This data is considered suitable based on the following:

- It is particularly useful for the SSDA noise impact assessment since it was undertaken prior to construction works which have since commenced at CWPS.
- The 2021 CWPS noise monitoring data was also compared with the 2022 CHS noise logger data and showed very similar background noise levels (L90).
- The measured background noise levels used to establish the corresponding criteria established are already very close to the minimum NPI background noise level (generally within 3 dB during Daytime hours and worst case night time period). Current noise levels are expected to be similar and unlikely to be any lower based on the latest monitoring that has been carried out plus based on observations at and around the sites.
- NSW TfNSW Infrastructure and Services Construction Noise and Vibration Strategy (April 2018) implies that noise survey data under five years old is considered to be valid, with this note on page 18: "If considered necessary (i.e. noise measurements are more than 5 years old), RBL measurements may be confirmed through the implementation of this [construction noise and vibration assessment] procedure."

**3.3 Unattended Long-term Monitoring Results**

**3.3.1 Background and Ambient Noise**

The logged data shows the background and ambient noise levels representative of the area. The recorded background noise levels have been used to establish noise targets for noise emitted from the construction and operation of the new buildings.

The background sound level is defined as the sound level exceeded 90% of the time, and is designated as the L90. The Rating Background Noise Level (RBL) provides a single figure that represents the background noise level over the entire monitoring period for assessment purposes. The ambient noise level impacting on the buildings is referred to as the



**Figure 10 - Extract from Acoustic Studio Noise and Vibration Impact Assessment (Cont.)**

equivalent continuous sound level ( $L_{eq}$ ). This parameter is commonly used to describe a time varying noise such as traffic noise.

The background sound levels have been established in general accordance with the methodology described in the NSW Noise Policy for Industry (NPI), i.e. the 10<sup>th</sup> percentile background sound level for each period for each day of the ambient noise survey. The median of these levels is then presented as the background sound level for each assessment period.

These background noise levels are shown in Table 1 and 2 below, together with the  $L_{Aeq}$  ambient noise levels measured for each period.

These represent the lowest of the collected long-term survey data, being the data collected during the school holidays and, therefore, excluding contributions from the existing schools.

**CHS**

Location	Background Noise Levels (RBL), dB(A)			Leq Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Logger CHS-S1	38	42	36	57	50	47
Logger CHS-S2	40	41	31	54	50	46
Logger CHS-S3	35	42	32	51	51	44
Logger CHS-R1	35	39	33	56	51	47
Logger CHS- R2	40	41	32	56	50	46
Logger CHS- R3	35	39	30	50	50	42

Table 1: CHS - Long-term background and ambient noise levels (2022)

Based on our observations during the site inspections, both ambient and background noise levels around the Project Site are generally dominated by traffic noise and general suburban hum around the site at all locations.

**CWPS**

Location	Background Noise Levels (RBL), dB(A)			Leq Ambient Noise Levels, dB(A)		
	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Logger CWPS-S1	39	37	34	58	47	45
Logger CWPS-S2	38	36	34	52	48	49
Logger CWPS-S3	36	39	32	56	52	47
Logger CWPS-R1	36	35	31	53	46	43
Logger CWPS-R2	-	-	-	-	-	-
Logger CWPS-R3	36	38	30	53	46	44

Table 2: CHS - Long-term background and ambient noise levels (2021)

NOTE: Due to a technical issue with the noise logger at position CWPS-R2, data was not collected at this location.

PWNA Adopted  
Noise Levels

PWNA Adopted  
Noise Levels

In the assessment of Construction Noise in NSW “Background + 10dBA” (or known as a Noise Affected Level) objective is applied. As such, to determine what the noise affected level is for each of the surrounding residential receivers, rating background noise levels presented in the table below have been adopted.



**Note:** As mentioned in the sections above, Acoustic Studio have previously identified surrounding receivers and recorded background noise levels. For this assessment, PWNA have adopted these noise level selections and applied them to our additional receivers.

**Table 2 Assumed ambient noise levels at residential receivers.**

Receiver Number	Receiver Location	Adopted Measured Rating Background Level at Receiver Location dBA L <sub>A90</sub> <sup>2</sup>	
		Monday to Friday	Saturday
		7:00am to 6:00pm	8:00am to 1:00pm
Receiver 1	Receivers are located along the eastern side of Sandringham Drive (No. 43-51).	36	36
Receiver 2	Receivers are located along the southern side of Felton Road (No. 86 & 88)	36	36
Receiver 3	Receivers are located along the northern side of Felton Road (No. 86 & 88) and eastern side of Edinburgh Avenue (32).	36	36
Receiver 4	Receivers are located along the eastern side of Adrian Court (No. 5-21).	38	38
Receiver 5	Receivers are located along the eastern side of Adrian Court (No. 23) and southern side of Hilar Avenue (No. 5-21).	38	38
Receiver 6	Receivers are located along the western side of Billyard Place (No. 9-13).	38	38
Receiver 7	Receivers are located along the northern side of Felton Road (No. 55 & 57).	36	36
Receiver 8	Receivers are located along the southern side of Felton Road (No. 60 & 62).	36	36
Receiver 9	Receivers are located along the northern and southern side of Blenheim Road (No. 23-26)	35	35
Receiver 10	Receivers are located along the northern side of Dunmore Avenue (No. 9 & 11).	38	38
Receiver 11	Receivers are located along the southern side of Dunmore Avenue (No. 16 & 18).	40	40
Receiver 12	Receivers are located along the southern side of Pennant Hills Road (No. 240-248).	40	40
Receiver 13	Receivers are located along the northern side of Pennant Hills Road (No. 177-181).	35	35
Receiver 14	Receivers are located along the northern side of Pennant Hills Road (No. 173-175).	35	35
Receiver 15	Receivers are located along the eastern side of Sandringham Drive (No. 31-41).	35	35

*Note 1 For Monday to Saturday, Daytime 7:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 7:00 am. On Sundays and Public Holidays, Daytime 8:00 am – 6:00 pm; Evening 6:00 pm – 10:00 pm; Night-time 10:00 pm – 8:00 am*

*Note 2 The LA90 noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.*



### 3 NOISE AND VIBRATION CRITERIA

Relevant noise and vibration criteria for construction activities are detailed below.

#### 3.1 SSD Approval (SSD-43065987) Planning Conditions

Relevant conditions of the consent require the following in relation to construction noise and vibration impacts from the site.

##### **Condition B15 – Construction Environmental Management Plan**

*The Construction Noise and Vibration Management Plan must address, but not be limited to, the following:*

- a) Be prepared by a suitably qualified and experienced noise expert;*
- b) Describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009);*
- c) Describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;*
- d) Include strategies that have been developed with the community for managing high noise generating works*
- e) Describe the community consultation undertaken to develop the strategies in condition B15(d);*
- f) Include a complaints management system that would be implemented for the duration of the construction; and*
- g) Include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the management measures in accordance with Condition B13(d).*

##### **Condition C4, C5, C6, C7 & C8– Construction Hours**

*C4. Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:*

- a) between 7am and 6pm, Mondays to Fridays inclusive; and*
- b) between 8am and 1pm, Saturdays.*

*No work may be carried out on Sundays or public holidays.*

##### **Condition C5– Construction Hours**

*C5. Notwithstanding condition C4, provided noise levels do not exceed the existing background noise level plus 5dB, works may also be undertaken during the following hours:*

- a) between 6pm and 7pm, Mondays to Fridays inclusive; and*
- b) between 1pm and 4pm, Saturdays.*



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**Condition C6 – Construction Hours**

- C6. Construction activities may be undertaken outside of the hours in condition C4 and C5 if required:
- a) by the Police or a public authority for the delivery of vehicles, plant or materials; or
  - b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or
  - c) where the works are inaudible at the nearest sensitive receivers; or
  - d) for the delivery, set-up and removal of construction cranes, where notice of the crane-related works is provided to the Planning Secretary and affected residents at least seven days prior to the works; or
  - e) where a variation is approved in advance in writing by the Planning Secretary if appropriate justification is provided for the works.

**Condition C7 – Construction Hours**

- C7. Notification of such construction activities as referenced in condition C6 must be given to affected residents before undertaking the activities or as soon as is practical afterwards.

**Condition C8 – Construction Hours**

- C8. Rock breaking, rock hammering, sheet piling, pile driving, and similar activities may only be carried out between the following hours:
- a) 9am to 12pm, Monday to Friday;
  - b) 2pm to 5pm Monday to Friday; and
  - c) 9am to 12pm, Saturday.

**Condition C13 – Construction Noise Limits**

- C13. The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures identified in the approved Construction Noise and Vibration Management Plan.

**Condition C14 – Construction Noise Limits**

- C14. The Applicant must ensure construction vehicles (including concrete agitator trucks but excluding site personnel vehicles) do not arrive at the site or surrounding residential precincts outside of the construction hours of work outlined under condition C4 and C5.

**Condition C15 – Construction Noise Limits**

- C15. The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, the use of 'quackers' to ensure noise impacts on surrounding noise sensitive receivers are minimised.



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### **Condition C16 – Construction Vibration Limits**

*C16. Vibration caused by construction at any residence or structure outside the site must be limited to:*

- a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and*
- b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).*

### **Condition C17 – Construction Vibration Limits**

*C17. Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition C16.*

### **Condition C18 – Construction Vibration Limits**

*C18. The limits in conditions C16 and C17 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition B15 of this consent.*

## **3.2 Construction Noise Criteria**

### **3.2.1 NSW EPA Interim Construction Noise Guideline (ICNG) – DECC 2009**

Noise criteria for construction and demolition activities are discussed in the Interim Construction Noise Guideline (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all “feasible” and “reasonable” work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for residential receivers have been reproduced from the guideline and are listed in the table below.



**Table 3 NMLs for quantitative assessment at residences**

Time of Day	Noise Management Level $L_{Aeq(15minute)}^{1,2}$	How to Apply
<b>Recommended standard hours:</b> <b>Monday to Friday</b> <b>7 am to 6 pm</b> <b>Saturday 8 am to 1 pm</b> <b>No work on Sundays or public holidays</b>	"Noise Affected Level" RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> <li>Where the predicted or measured <math>L_{Aeq(15minute)}</math> is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>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.</li> </ul>
	"Highly Noise Affected Level" 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> <li>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:                             <ol style="list-style-type: none"> <li>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).</li> <li>If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ol> </li> </ul>
<b>Outside recommended standard hours</b>	Noise affected. RBL + 5 dB	<ul style="list-style-type: none"> <li>A strong justification would typically be required for works outside the recommended standard hours.</li> <li>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.</li> </ul>

*Note 1 Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

*Note 2 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Noise Policy for Industry (EPA 2017).*

*Note 3 Requirements listed in the table above are in accordance with the Construction Hours listed in Condition C4.*

Construction noise levels at other noise receivers are outlined below:

- Construction noise levels within classrooms at schools and other educational institutions is not to exceed 45dB  $L_{Aeq,15minute}$ , when measured internally.
- Construction noise levels within places of worship is not to exceed 45dB  $L_{Aeq,15minute}$ , when measured internally.

Based on the measured background noise levels summarised in section 2, and the NMLs outlined above the construction noise criteria to be used in this assessment are listed above.



**Table 4 NMLs as basis for the acoustic assessment**

Receiver Types		NML, dB LAeq(15minute)
		Standard Hours Monday to Friday: 7:00am to 6:00pm Saturday: 8:00am to 1:00pm
Residences (Measured externally)	Receiver 1	NAFL: <b>46</b> + HNAL: <b>75</b>
	Receiver 2	NAFL: <b>46</b> + HNAL: <b>75</b>
	Receiver 3	NAFL: <b>46</b> + HNAL: <b>75</b>
	Receiver 4	NAFL: <b>48</b> + HNAL: <b>75</b>
	Receiver 5	NAFL: <b>48</b> + HNAL: <b>75</b>
	Receiver 6	NAFL: <b>48</b> + HNAL: <b>75</b>
	Receiver 7	NAFL: <b>46</b> + HNAL: <b>75</b>
	Receiver 8	NAFL: <b>46</b> + HNAL: <b>75</b>
	Receiver 9	NAFL: <b>45</b> + HNAL: <b>75</b>
	Receiver 10	NAFL: <b>48</b> + HNAL: <b>75</b>
	Receiver 11	NAFL: <b>50</b> + HNAL: <b>75</b>
	Receiver 12	NAFL: <b>50</b> + HNAL: <b>75</b>
	Receiver 13	NAFL: <b>45</b> + HNAL: <b>75</b>
	Receiver 14	NAFL: <b>45</b> + HNAL: <b>75</b>
	Receiver 15	NAFL: <b>45</b> + HNAL: <b>75</b>

**Note: All noise impacts associated with the redevelopment of CHS and CWPS and their impacts within the existing school will be managed directly between Roberts Co (NSW) Pty Ltd and each School/SINSW. This will be managed outside this CNVMSP.**

### 3.2.2 Construction Traffic Noise Criteria

For existing residences and other sensitive land uses affected by additional traffic on existing roads, the NSW Road Noise Policy (RNP) states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB during both day and night-time periods. An increase of 2 dB represents a minor impact that is considered barely perceptible to the average person.





### 3.3 Vibration Criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 3.3.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 3.3.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 3.3.2.

#### 3.3.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled “Assessing Vibration – A Technical Guideline”. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (refer to Table 5).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 6).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 7)

**Table 5 Continuous vibration acceleration criteria (m/s<sup>2</sup>) 1 Hz-80 Hz**

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058

**Table 6 Impulsive vibration acceleration criteria (m/s<sup>2</sup>) 1 Hz-80 Hz**

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92



**Table 7 Intermittent vibration impacts criteria (m/s<sup>1.75</sup>) 1 Hz-80 Hz**

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80

**3.3.2 Vibration Criteria – Building Contents and Structure**

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

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

**3.3.2.1 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 8 and illustrated in Figure 11.

**Table 8 Transient vibration criteria as per standard BS 7385 Part 2 - 1993**

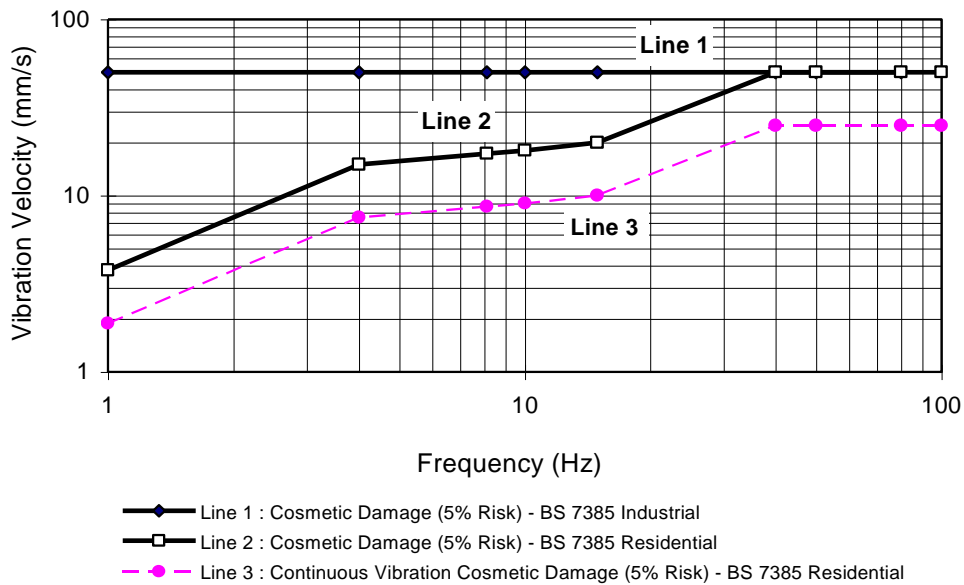
Line in Figure 11	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
<b>1</b>	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
<b>2</b>	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 8 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 8 may need to be reduced by up to 50% (refer to Line 3 in Figure 11).



**Figure 11 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage**



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

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 8, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 8 should not be reduced for fatigue considerations.

**3.3.2.2 Standard DIN 4150 Part 3 - 1999**

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 9. The criteria are frequency dependent and specific to particular categories of structures.

**Table 9 Structural damage criteria as per standard DIN 4150 Part 3 - 1999**

Type of Structure	Peak Component Particle Velocity, mm/s				Vibration of horizontal plane of highest floor at all frequencies
	Vibration at the foundation at a frequency of				
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz		
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40	



Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
<i>Note 1 For frequencies above 100Hz, at least the values specified in this column shall be applied.</i>				

### 3.4 Ground-Borne Noise Criteria

According to the NSW EPA Interim Construction Noise Guideline (ICNG) 2009, the criteria for ground-borne noise at residences is defined as follows:

- Maximum internal noise levels of 40 dB  $L_{Aeq(15mins)}$  between 6:00pm and 10:00pm.

It is noted that the ground borne criteria will apply for construction works undertaken outside of standard hours.



## 4 NOISE AND VIBRATION ASSESSMENT

### 4.1 Construction Noise Assessment

Sound power levels have been predicted for the construction tasks identified in the project program. The equipment anticipated for use in each task is based on previous project experience. The sound power levels for the equipment likely to be used for each of the listed tasks are provided in Table 10 below.

**Table 10 Summary of predicted sound power levels**

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Power Level per Task (dBA re 1pW)
Site Establishment Works	Mobile crane	110	113
	Power hand tools	109	
	Semi Rigid Vehicle <sup>1</sup>	105	
Ground Works and Demolition	Excavator	112	118
	Handheld jack hammer <sup>1</sup>	111	
	Dump truck <sup>1</sup>	104	
	Concrete saw <sup>1</sup>	114	
	Skid steer	110	
	Power hand tools	109	
Structure	Handheld jack hammer <sup>1</sup>	106	117
	Concrete saw <sup>1</sup>	114	
	Power hand tools	109	
	Welder	101	
	Concrete pump truck	110	
	Concrete agitator truck	108	
Internal Works	Power hand tools	109	109
Common and External Works	Concrete agitator truck	108	117
	Saw cutter <sup>1</sup>	104	
	Dump truck <sup>1</sup>	104	
	Concrete saw <sup>1</sup>	114	
	Power hand tools	109	

*Note 1 An assumed time correction has been applied, this being 5 minutes of operation in any 15-minute interval.*



**Table 11 Receiver 1 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	52 to 78	55 to 82	Monday to Friday: 7:00am to 6:00pm: 46  Saturday: 8:00am to 1:00pm: 46  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		51 to 77			
	Semi Rigid Vehicle		47 to 74			
Ground Works and Demolition	Excavator	118	54 to 80	60 to 87		
	Handheld jack hammer		48 to 75			
	Dump truck		46 to 73			
	Concrete saw		56 to 83			
	Skid steer		52 to 78			
	Power hand tools		51 to 77			
Structure	Handheld jack hammer	117	48 to 75	59 to 86		
	Concrete saw		56 to 83			
	Power hand tools		51 to 77			
	Welder		43 to 69			
	Concrete pump truck		52 to 78			
	Concrete agitator truck		50 to 76			
Internal Works	Power hand tools	109	51 to 77	51 to 77		
Common and External Works	Concrete agitator truck	117	50 to 76	58 to 85		
	Saw cutter		46 to 73			
	Dump truck		46 to 73			
	Concrete saw		56 to 83			
	Power hand tools		51 to 77			



**Table 12 Receiver 2 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	52 to 78	55 to 82	Monday to Friday: 7:00am to 6:00pm: 46  Saturday: 8:00am to 1:00pm: 46  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		51 to 77			
	Semi Rigid Vehicle		47 to 74			
Ground Works and Demolition	Excavator	118	54 to 80	60 to 87		
	Handheld jack hammer		48 to 75			
	Dump truck		46 to 73			
	Concrete saw		56 to 83			
	Skid steer		52 to 78			
	Power hand tools		51 to 77			
Structure	Handheld jack hammer	117	48 to 75	59 to 86		
	Concrete saw		56 to 83			
	Power hand tools		51 to 77			
	Welder		43 to 69			
	Concrete pump truck		52 to 78			
	Concrete agitator truck		50 to 76			
Internal Works	Power hand tools	109	51 to 77	51 to 77		
Common and External Works	Concrete agitator truck	117	50 to 76	58 to 85		
	Saw cutter		46 to 73			
	Dump truck		46 to 73			
	Concrete saw		56 to 83			
	Power hand tools		51 to 77			



**Table 13 Receiver 3 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	52 to 78	55 to 82	Monday to Friday: 7:00am to 6:00pm: 46  Saturday: 8:00am to 1:00pm: 46  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		51 to 77			
	Semi Rigid Vehicle		47 to 74			
Ground Works and Demolition	Excavator	118	54 to 80	60 to 87		
	Handheld jack hammer		48 to 75			
	Dump truck		46 to 73			
	Concrete saw		56 to 83			
	Skid steer		52 to 78			
	Power hand tools		51 to 77			
Structure	Handheld jack hammer	117	48 to 75	59 to 86		
	Concrete saw		56 to 83			
	Power hand tools		51 to 77			
	Welder		43 to 69			
	Concrete pump truck		52 to 78			
	Concrete agitator truck		50 to 76			
Internal Works	Power hand tools	109	51 to 77	51 to 77		
Common and External Works	Concrete agitator truck	117	50 to 76	58 to 85		
	Saw cutter		46 to 73			
	Dump truck		46 to 73			
	Concrete saw		56 to 83			
	Power hand tools		51 to 77			





**Table 14 Receiver 4 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	55 to 78	58 to 82	Monday to Friday: 7:00am to 6:00pm: 48  Saturday: 8:00am to 1:00pm: 48  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		54 to 77			
	Semi Rigid Vehicle		50 to 74			
Ground Works and Demolition	Excavator	118	57 to 80	63 to 87		
	Handheld jack hammer		51 to 75			
	Dump truck		49 to 73			
	Concrete saw		59 to 83			
	Skid steer		55 to 78			
	Power hand tools		54 to 77			
Structure	Handheld jack hammer	117	51 to 75	63 to 86		
	Concrete saw		59 to 83			
	Power hand tools		54 to 77			
	Welder		46 to 69			
	Concrete pump truck		55 to 78			
	Concrete agitator truck		53 to 76			
Internal Works	Power hand tools	109	54 to 77	54 to 77		
Common and External Works	Concrete agitator truck	117	53 to 76	62 to 85		
	Saw cutter		49 to 73			
	Dump truck		49 to 73			
	Concrete saw		59 to 83			
	Power hand tools		54 to 77			



**Table 15 Receiver 5 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	57 to 78	61 to 82	Monday to Friday: 7:00am to 6:00pm: 48  Saturday: 8:00am to 1:00pm: 48  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		56 to 77			
	Semi Rigid Vehicle		53 to 74			
Ground Works and Demolition	Excavator	118	59 to 80	66 to 87		
	Handheld jack hammer		54 to 75			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Skid steer		57 to 78			
	Power hand tools		56 to 77			
Structure	Handheld jack hammer	117	54 to 75	65 to 86		
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			
	Welder		48 to 69			
	Concrete pump truck		57 to 78			
	Concrete agitator truck		55 to 76			
Internal Works	Power hand tools	109	56 to 77	56 to 77		
Common and External Works	Concrete agitator truck	117	55 to 76	64 to 85		
	Saw cutter		52 to 73			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			



**Table 16 Receiver 6 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	55 to 68	58 to 71	Monday to Friday: 7:00am to 6:00pm: 48  Saturday: 8:00am to 1:00pm: 48  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		54 to 67			
	Semi Rigid Vehicle		50 to 63			
Ground Works and Demolition	Excavator	118	57 to 70	63 to 76		
	Handheld jack hammer		51 to 64			
	Dump truck		49 to 62			
	Concrete saw		59 to 72			
	Skid steer		55 to 68			
	Power hand tools		54 to 67			
Structure	Handheld jack hammer	117	51 to 64	63 to 76		
	Concrete saw		59 to 72			
	Power hand tools		54 to 67			
	Welder		46 to 59			
	Concrete pump truck		55 to 68			
	Concrete agitator truck		53 to 66			
Internal Works	Power hand tools	109	54 to 67	54 to 67		
Common and External Works	Concrete agitator truck	117	53 to 66	62 to 75		
	Saw cutter		49 to 62			
	Dump truck		49 to 62			
	Concrete saw		59 to 72			
	Power hand tools		54 to 67			



**Table 17 Receiver 7 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	55 to 72	58 to 76	Monday to Friday: 7:00am to 6:00pm: 46  Saturday: 8:00am to 1:00pm: 46  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		54 to 71			
	Semi Rigid Vehicle		50 to 68			
Ground Works and Demolition	Excavator	118	57 to 74	63 to 81		
	Handheld jack hammer		51 to 69			
	Dump truck		49 to 67			
	Concrete saw		59 to 77			
	Skid steer		55 to 72			
	Power hand tools		54 to 71			
Structure	Handheld jack hammer	117	51 to 69	63 to 80		
	Concrete saw		59 to 77			
	Power hand tools		54 to 71			
	Welder		46 to 63			
	Concrete pump truck		55 to 72			
	Concrete agitator truck		53 to 70			
Internal Works	Power hand tools	109	54 to 71	54 to 71		
Common and External Works	Concrete agitator truck	117	53 to 70	62 to 79		
	Saw cutter		49 to 67			
	Dump truck		49 to 67			
	Concrete saw		59 to 77			
	Power hand tools		54 to 71			



**Table 18 Receiver 8 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	55 to 72	58 to 76	Monday to Friday: 7:00am to 6:00pm: 46  Saturday: 8:00am to 1:00pm: 46  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		54 to 71			
	Semi Rigid Vehicle		50 to 68			
Ground Works and Demolition	Excavator	118	57 to 74	63 to 81		
	Handheld jack hammer		51 to 69			
	Dump truck		49 to 67			
	Concrete saw		59 to 77			
	Skid steer		55 to 72			
	Power hand tools		54 to 71			
Structure	Handheld jack hammer	117	51 to 69	63 to 80		
	Concrete saw		59 to 77			
	Power hand tools		54 to 71			
	Welder		46 to 63			
	Concrete pump truck		55 to 72			
	Concrete agitator truck		53 to 70			
Internal Works	Power hand tools	109	54 to 71	54 to 71		
Common and External Works	Concrete agitator truck	117	53 to 70	62 to 79		
	Saw cutter		49 to 67			
	Dump truck		49 to 67			
	Concrete saw		59 to 77			
	Power hand tools		54 to 71			



**Table 19 Receiver 9 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	55 to 72	58 to 76	Monday to Friday: 7:00am to 6:00pm: 45  Saturday: 8:00am to 1:00pm: 45  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		54 to 71			
	Semi Rigid Vehicle		50 to 68			
Ground Works and Demolition	Excavator	118	57 to 74	63 to 81		
	Handheld jack hammer		51 to 69			
	Dump truck		49 to 67			
	Concrete saw		59 to 77			
	Skid steer		55 to 72			
	Power hand tools		54 to 71			
Structure	Handheld jack hammer	117	51 to 69	63 to 80		
	Concrete saw		59 to 77			
	Power hand tools		54 to 71			
	Welder		46 to 63			
	Concrete pump truck		55 to 72			
	Concrete agitator truck		53 to 70			
Internal Works	Power hand tools	109	54 to 71	54 to 71		
Common and External Works	Concrete agitator truck	117	53 to 70	62 to 79		
	Saw cutter		49 to 67			
	Dump truck		49 to 67			
	Concrete saw		59 to 77			
	Power hand tools		54 to 71			



**Table 20 Receiver 10 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	57 to 78	61 to 82	Monday to Friday: 7:00am to 6:00pm: 48  Saturday: 8:00am to 1:00pm: 48  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		56 to 77			
	Semi Rigid Vehicle		53 to 74			
Ground Works and Demolition	Excavator	118	59 to 80	66 to 87		
	Handheld jack hammer		54 to 75			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Skid steer		57 to 78			
	Power hand tools		56 to 77			
Structure	Handheld jack hammer	117	54 to 75	65 to 86		
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			
	Welder		48 to 69			
	Concrete pump truck		57 to 78			
	Concrete agitator truck		55 to 76			
Internal Works	Power hand tools	109	56 to 77	56 to 77		
Common and External Works	Concrete agitator truck	117	55 to 76	64 to 85		
	Saw cutter		52 to 73			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			



**Table 21 Receiver 11 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	57 to 78	61 to 82	Monday to Friday: 7:00am to 6:00pm: 50  Saturday: 8:00am to 1:00pm: 50  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		56 to 77			
	Semi Rigid Vehicle		53 to 74			
Ground Works and Demolition	Excavator	118	59 to 80	66 to 87		
	Handheld jack hammer		54 to 75			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Skid steer		57 to 78			
	Power hand tools		56 to 77			
Structure	Handheld jack hammer	117	54 to 75	65 to 86		
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			
	Welder		48 to 69			
	Concrete pump truck		57 to 78			
	Concrete agitator truck		55 to 76			
Internal Works	Power hand tools	109	56 to 77	56 to 77		
Common and External Works	Concrete agitator truck	117	55 to 76	64 to 85		
	Saw cutter		52 to 73			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			





**Table 22 Receiver 12 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	52 to 68	56 to 71	Monday to Friday: 7:00am to 6:00pm: 50  Saturday: 8:00am to 1:00pm: 50  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		51 to 67			
	Semi Rigid Vehicle		48 to 63			
Ground Works and Demolition	Excavator	118	54 to 70	61 to 76		
	Handheld jack hammer		49 to 64			
	Dump truck		47 to 62			
	Concrete saw		57 to 72			
	Skid steer		52 to 68			
	Power hand tools		51 to 67			
Structure	Handheld jack hammer	117	49 to 64	60 to 76		
	Concrete saw		57 to 72			
	Power hand tools		51 to 67			
	Welder		43 to 59			
	Concrete pump truck		52 to 68			
	Concrete agitator truck		50 to 66			
Internal Works	Power hand tools	109	51 to 67	51 to 67		
Common and External Works	Concrete agitator truck	117	50 to 66	59 to 75		
	Saw cutter		47 to 62			
	Dump truck		47 to 62			
	Concrete saw		57 to 72			
	Power hand tools		51 to 67			



**Table 23 Receiver 13 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	57 to 78	61 to 82	Monday to Friday: 7:00am to 6:00pm: 45  Saturday: 8:00am to 1:00pm: 45  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		56 to 77			
	Semi Rigid Vehicle		53 to 74			
Ground Works and Demolition	Excavator	118	59 to 80	66 to 87		
	Handheld jack hammer		54 to 75			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Skid steer		57 to 78			
	Power hand tools		56 to 77			
Structure	Handheld jack hammer	117	54 to 75	65 to 86		
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			
	Welder		48 to 69			
	Concrete pump truck		57 to 78			
	Concrete agitator truck		55 to 76			
Internal Works	Power hand tools	109	56 to 77	56 to 77		
Common and External Works	Concrete agitator truck	117	55 to 76	64 to 85		
	Saw cutter		52 to 73			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			



**Table 24 Receiver 14 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	57 to 78	61 to 82	Monday to Friday: 7:00am to 6:00pm: 45  Saturday: 8:00am to 1:00pm: 45  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		56 to 77			
	Semi Rigid Vehicle		53 to 74			
Ground Works and Demolition	Excavator	118	59 to 80	66 to 87		
	Handheld jack hammer		54 to 75			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Skid steer		57 to 78			
	Power hand tools		56 to 77			
Structure	Handheld jack hammer	117	54 to 75	65 to 86		
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			
	Welder		48 to 69			
	Concrete pump truck		57 to 78			
	Concrete agitator truck		55 to 76			
Internal Works	Power hand tools	109	56 to 77	56 to 77		
Common and External Works	Concrete agitator truck	117	55 to 76	64 to 85		
	Saw cutter		52 to 73			
	Dump truck		52 to 73			
	Concrete saw		62 to 83			
	Power hand tools		56 to 77			



**Table 25 Receiver 15 – Summary of predicted construction noise levels during Standard Hours (BG + 10dBA)**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Predicted Combined Noise Level at Receiver dBA L <sub>Aeq</sub> 15 minutes	Criteria dBA L <sub>Aeq</sub> -15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	55 to 76	58 to 79	Monday to Friday: 7:00am to 6:00pm: 45  Saturday: 8:00am to 1:00pm: 45  Highly Noise Affected Level (Standard Construction Hours): 75	Works undertaken near the site boundary will exceed the BG +10dBA requirement and in some cases the Highly Noise Affected Level of 75dBA for noisy plant items such as hydraulic hammering.  It is recommended that several acoustic mitigation measures are implemented. Refer to Table 27 and following sections below.
	Power hand tools		54 to 75			
	Semi Rigid Vehicle		50 to 71			
Ground Works and Demolition	Excavator	118	57 to 78	63 to 84		
	Handheld jack hammer		51 to 72			
	Dump truck		49 to 70			
	Concrete saw		59 to 80			
	Skid steer		55 to 76			
	Power hand tools		54 to 75			
Structure	Handheld jack hammer	117	51 to 72	63 to 83		
	Concrete saw		59 to 80			
	Power hand tools		54 to 75			
	Welder		46 to 67			
	Concrete pump truck		55 to 76			
	Concrete agitator truck		53 to 74			
Internal Works	Power hand tools	109	54 to 75	54 to 75		
Common and External Works	Concrete agitator truck	117	53 to 74	62 to 83		
	Saw cutter		49 to 70			
	Dump truck		49 to 70			
	Concrete saw		59 to 80			
	Power hand tools		54 to 75			



## 4.2 Construction Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in Section 3.3, it is recommended that the indicative safe distances listed in Table 26 should be maintained. These indicative safe distances should be validated at the start of construction works by undertaking measurements of vibration levels generated by construction and demolition equipment to be used on site.

Additionally, any vibration levels should be assessed in accordance with the criteria discussed in Section 3.3.

**Table 26 Recommended indicative safe working distances for vibration intensive plant**

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20
	< 100 kN (Typically 2 – 4 tonnes)	6	20
	< 200 kN (Typically 4 – 6 tonnes)	12	40
	< 300 kN (Typically 7 – 13 tonnes)	15	100
	> 300 kN (Typically more than 13 tonnes)	20	100
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Vibratory pile driver	Sheet piles	2 – 20	20
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements



## 5 NOISE AND VIBRATION MANAGEMENT PLAN

### 5.1 Acoustic Management Procedures

#### 5.1.1 Summary of Management Procedures

Table 27 below summarises the management procedures recommended for airborne noise and vibration impacts. These procedures are also further discussed in the report. Hence, where applicable, links to further references are provided in Table 27.

**Table 27 Summary of mitigation procedures**

Procedure	Abbreviation	Description	Further Reference
General Management Measures	GMM	Introduce best-practice general mitigation measures in the workplace which are aimed at reducing the acoustic impact onto the nearest affected receivers.	Refer to Section 5.7 For noise impact, also refer to Section 5.2 For vibration impact, also refer to Section 5.3
Project Notification	PN	Issue project updates to stakeholders, discussing overviews of current and upcoming works. Advanced warning of potential disruptions can be included.  Content and length to be determined on a project-by-project basis.	Refer to Section 5.4.
Verification Monitoring	V	Monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers.  If the measured levels are higher than those predicted, then the measures will need to be reviewed and the management plan will need to be amended.	For noise impact, refer to Section 5.2.3 and Section 5.2.4. For vibration impact, refer to Section 5.3.2
Complaints Management System	CMS	Refer to SINSW Complaint Management System	Refer to Section 5.4.
Specific Notification	SN	Refer to SINSW Complaint Management System	Refer to Section 5.4.
Respite Offer	RO	Offer provided to stakeholders subjected to an ongoing impact.	Refer to Section 5.2.1
Alternative Construction Methodology	AC	Contractor to consider alternative construction options that achieve compliance with relevant criteria. Alternative option to be determined on a case-by-case basis. It is recommended that the selection of the alternative option should also be determined by considering the assessment of on-site measurements (refer to Verification Monitoring above).	Refer to Section 5.7.1 and 5.7.2



The application of these procedures is in relation to the exceedances over the relevant criteria. For airborne noise, the criteria are based on NMLs. The allocation of these procedures is discussed in Section 5.1.2

For vibration, the criteria either correspond to human comfort, building damage or scientific and medical equipment. The application of these procedures is discussed in Section 5.1.3.

### 5.1.2 Allocation of Noise Management Procedures

For residences, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs (refer to Section 3). The allocation of these procedures is summarised in Table 28 below.

**Table 28 Allocation of noise management procedures – residential receivers**

Construction Hours	Exceedance over NML (dB)	Management Procedures (see definition above)
<b>Standard Hours</b> Mon – Fri: 7:00 am to 6:00 pm Sat: 8:00 am – 1:00 pm	0 - 10	GMM
	> 10	GMM, PN, V <sup>1</sup> , CMS, SN, AC
	≥ 75dBA	GMM, PN, V <sup>1</sup> , CMS, SN, AC, RO
<i>Note 1 Verification monitoring to be only undertaken upon complaints received from affected receivers</i>		

Please note the following regarding the allocation of these procedures:

- The exceedances have been estimated as part of the acoustic assessment, and these are summarised in Section 4.1
- The allocation of procedures is based on the assumptions used for noise level predictions (refer to Section 4.1). Consequently, these allocations can be further refined once onsite works are undertaken and further development of the construction program.
- For non-residential receivers (such as educational), management measures are provided in Section 5.2.4.

### 5.1.3 Allocation of Vibration Management Procedures

Table 29 below summarises the vibration management procedures to be adopted based on exceedance scenarios (i.e., whether the exceedance occurs over human comfort criteria, building damage criteria, or criteria for scientific and medical equipment). Please note these management procedures apply for any type of affected receiver (i.e., for residences as well as non-residential receivers).



**Table 29 Allocation of vibration management procedures**

Construction Hours	Exceedance Scenario	Management Procedures
Standard Hours Mon – Fri: 7:00 am to 6:00 pm Sat: 8:00 am – 1:00 pm	Over human comfort criteria (refer to Section 3)	GMM, PN, V, RO
	Over building damage criteria (refer to Section 3)	GMM, V, AC, RO

## 5.2 Site Specific Noise Mitigation Measures

### 5.2.1 Respite Periods

Predicted noise levels outlined in Section 4.1 indicate that in some cases when works are being undertaken within proximity of receiver boundaries, exceedances above the Noise Management Levels (NMLs) may occur. In addition, in accordance with Condition C8 respite periods are recommended for noisy activities. As such, the following respite conditions are recommended in accordance with Condition C8 or when works extended periods of noisy works are affecting a surrounding receiver above the HNAL of 75dBA. See below.

**Table 30 Recommended Respite Periods**

Monday to Friday	Saturday
<b>7:00am to 9:00am – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. (Respite Period)</b>	<b>8:00am to 9:00am – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. (Respite Period)</b>
9:00am to 12:00pm – C8 listed works permitted.	9:00am to 12:00pm – C8 listed works permitted.
<b>12:00pm to 2:00pm – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. (Respite Period)</b>	<b>12:00pm to 1:00pm – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. (Respite Period)</b>
2:00pm to 5:00pm – C8 listed works permitted.	
<b>5:00pm to 6:00pm – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. (Respite Period)</b>	

**Note:** Recommended respite periods for noisy works has been formulated in accordance with Condition C8 from the Notice of Determination – Approval.

### 5.2.2 General Comments

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

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





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

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

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

### 5.2.3 Noise Monitoring

Unattended noise monitoring is proposed to be undertaken in accordance with the Acoustic Studio in the site's Noise and Vibration Impact Assessment submitted as part of the SSD Application, report reference: *20221027 SVM3451.0002.Rep.docx* (dated 27 October 2022). Outlined in section 8.6 of the Acoustic Studio Report is recommendation to undertake noise monitoring at the closest residential receiver to the site works, see below.

As site works will concurrently be undertaken on the CWPS site and simultaneously on the CHS site a single (1) noise monitor will be provided for the nearest potentially worst affected receiver to the works on the CWPS site and a single (1) noise monitor will be provided to the nearest potentially worst affected receiver to the works on the CHS site, as per below.

**8.6 Noise and vibration monitoring**

**8.6.1 Noise monitoring**

The Contractor is to implement environmental noise monitoring at the locations described below.

- School buildings on site closest to the site works
- Closest residential receivers to the site works

An allowance of 1.5 days per week, at least, is to be dedicated to monitoring of noise and vibration for the first four weeks of construction works.

Further monitoring is to be reviewed after this time or sooner should it be deemed necessary by the acoustic consultant and the Project Manager. This is to take place mainly at the above locations although other locations and plant and equipment monitoring are to take place as and when necessary. If results indicate vibration levels exceeding allowable VMLs appropriate action is to be taken.

**Note:** In relation to noise monitoring and mitigation strategies for onsite construction works and impacts to other surrounding school buildings within the CWPS and CHS sites will be managed directly between Roberts Co (Managing Contractor) and SINSW/Schools directly, outside this management plan.

In relation to the exact locations the monitors are to be provided, this is to be determine by PWNA and Roberts Co once site works commence and all contributing factors can be considered, power, security, accessibility etc.

The survey methodology and equipment will comply with the monitoring requirements as discussed in Australian Standard AS 1055.1-1997. Reporting is recommended to be undertaken which should include the following noise descriptors: LA90, LA10, and LAeq.



## 5.2.4 Noise Mitigation Measures for Non-Residential Receivers

Where exceedances have been identified in Section 4, the following mitigation measures are recommended:

- Undertake general mitigation measures as discussed in Section 5.7.
- Issue project updates to tenants in affected premises. The updates can include overview of current and upcoming works, as well as advanced warning of potential disruptions.
- Signage to be posted in order to provide stakeholders information regarding project details, emergency contacts and enquiry contact information.

## 5.2.5 Alternate Equipment or Process

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

In some cases, the investigation may conclude that the use of other equipment is not possible, however, a different process could be undertaken.

## 5.2.6 Acoustic Enclosures/Screening

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

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

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

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

## 5.3 Vibration Mitigation Measures

### 5.3.1 General Comments

As part of the CNVMSP, the following vibration mitigation measures should be implemented:

- Any vibration generating plant and equipment is to be in areas within the site in order to lower the vibration impacts (where feasible).
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment.
- Use lower vibration generating items of construction plant and equipment; that is, smaller capacity plant, where feasible
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Schedule a minimum respite period in accordance with Condition 8.



- Use only dampened rock breakers and/or “city” rock breakers to minimise the impacts associated with rock breaking works.

### 5.3.2 Vibration Monitoring

Unattended vibration monitoring is proposed to be undertaken in accordance with the Acoustic Studio in the site’s Noise and Vibration Impact Assessment submitted as part of the SSD Application, report reference: 20221027 SVM3451.0002.Rep.docx (dated 27 October 2022), which reads:

**8.6.2 Vibration monitoring**

A vibration monitoring system is to be implemented if required. This system would monitor vibration levels when there is potential for them to change. This could happen in various situations, such as, changes in equipment and activities or changes to work procedures that might affect existing vibration control measures. The monitoring procedure would be carried out with appropriate equipment so that results obtained are readily comparable with results obtained earlier. If results indicate vibration levels exceeding VMLs appropriate action is to be taken.

Based on the onsite works and recommendations of the SSD Acoustic Report, vibration monitoring is not proposed to be undertaken, with exception of below.

**Note:** Notwithstanding above, Condition C17 which reads:

#### ***Vibration Criteria***

*C17. Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition C16.*

As per above, if Vibratory compactors are utilised within 30m of a residential building, monitoring should be provided.

All vibration measurements are to be undertaken in accordance with the methodologies outlined in British Standard 7385-1:1990 Evaluation and measurement for vibration in buildings, DIN V 4150-1 Vibrations in Building; Influence On Persons In Buildings and DIN 4150-1 Effects On Structures.

If an exceedance above the management criteria is identified, an alert will be issued to the project team, who will assess whether it is at a 'Warning' or a 'Halt' level. If it is a 'Halt' level exceedance, the project team will complete a Noise and Vibration Investigation Checklist (see Appendix B) to determine the appropriate course of action. A summary of the available alternate mitigation measures is to be provided as part of the monthly report. However, we do note in some cases alternate methodologies may not be available or cannot be implemented due to other project constraints.

### 5.4 SINSW Complaints management process as outlined in the Community Communication Strategy (CCS)

All communications and complaints management processes will be undertaken in accordance with the SINSW Community Communication Strategy (CCS), refer to that document for processes.

### 5.5 Community Engagement (Condition B15, (d) & (e))

In addressing the requirement for the community consultation when formulating onsite noise and vibration mitigation measures in accordance with Condition B15(d) and (e) we note the following:



1. Condition B15(d) reads:

*Condition B15(d) – "Strategies that have been developed with the community for managing high noise generating works."*

2. SINSW prepared and issued the following letter which was distributed to nearby residential properties around the site via a letter box drop. This letter was distributed late November 2023.

**Figure 12 SINSW Works Notification – 14<sup>th</sup> November 2023**

NSW Department of Education – School Infrastructure

## Carlingford West Public School and Cumberland High School

Works notification | 14 November 2023

### Managing construction impacts: your feedback

Draft Conditions of Consent have been issued by the Department of Planning and Environment for the Carlingford West Public School and Cumberland High School project.

These draft conditions require School Infrastructure NSW and our contractor to prepare a Construction Noise and Vibration Management Sub Plan (CNVMSP)

The CNVMSP outlines how construction impacts to nearby local residents will be managed.

You can contribute to the development of strategies to effectively manage high noise construction impacts. Please send your feedback by 28 November 2023.

You can provide your feedback at <http://edu.nsw.link/CWPS-CHS-Construction> or by scanning the QR code.



**How we mitigate and reduce high noise construction impacts:**

- Respite periods
- Notifying surrounding neighbours before any expected high noise generating work
- Maximising the distance between noisy work and nearby residents
- Minimising multiple noisy work activities in the same area, orienting equipment away from nearby neighbours and minimising noisy plant work occurring simultaneously and adjacent to neighbouring properties
- Loading and unloading away from noise sensitive areas
- Where possible, changing the construction approach to quieter methods and using quieter equipment
- Installing solid construction hoarding or fencing around the site
- Installing noise monitoring at the closest residential neighbouring properties
- A process to receive noise complaints and respond to/ investigate those complaints to reduce reoccurrence

Thank you for your patience while we deliver this important infrastructure.

School Infrastructure NSW  
 Email: [schoolinfrastructure@det.nsw.edu.au](mailto:schoolinfrastructure@det.nsw.edu.au)  
 Phone: 1300 482 651  
[www.schoolinfrastructure.nsw.gov.au](http://www.schoolinfrastructure.nsw.gov.au)





	<p>For a Translation and Interpreting Service call 131 450 and ask them to call the Department of Education - School Infrastructure NSW on 1300 482 651.</p>
	<p>如果需要翻譯和口譯服務，請打電話 131 450，請他們打電話 1300 482 651 給新州教育部學校基礎設施處。</p>
	<p>如果需要翻譯和口譯服務，請打電話 131 450，請他們打電話 1300 482 651 給新州教育部學校基礎設施處。</p>

In response to the letter the following responses were received.

**Table 31 Summary of Community Feedback and Associated Plan Actions**

Respondent #	Summary of Comments Received	Consent Requirements/ Management Plan Actions
1	<p><b>1.</b> Arrival of trucks prior to permitted construction hours.</p>	<p>Construction related vehicles should not arrive onsite or surrounding residential streets outside of construction hours as defined by Condition C4 and C5.</p> <p>This is also in accordance with Condition C14 and captured as part of the site-specific <i>Construction Traffic and Pedestrian Management Plan</i> (Condition B19).</p>
	<p><b>2.</b> Idling of trucks in residential streets, prior to permitted construction hours.</p>	<p>Like above, Condition C14 limits the access of Construction Vehicles only during permitted construction hours (Condition C4 &amp; C5).</p>
2	<p><b>1.</b> Perform the work using quieter equipment to reduce disturbance for students and residents.</p>	<p>In accordance with the NSW EPA <i>Interim Construction Noise Guideline</i> (2009) if there are reasonable and feasible methodologies to use quieter equipment or machinery this will be explored. This is addressed in section 5.7.2 of this plan in accordance with the requirements of Condition C15.</p>
	<p><b>2.</b> Do not carry any work on weekends.</p>	<p>Construction works will only be undertaken onsite during the permitted construction hours as listed in Condition C4 and C5.</p> <p>To minimise impacts on surrounding residents' works are limited no works on Sunday and Public Holidays and a limited 8:00am and 1:00pm on Saturday.</p>
	<p><b>3.</b> Do not obstruct traffic during school days at the drop off and pick up hours.</p>	<p>Further detailed in the site-specific <i>Construction Traffic and Pedestrian Management Plan</i> (Condition B19) detailed mitigation measures have been developed to ensure minimal disruption to existing school operations and residents.</p> <p>These mitigation strategies have been developed in accordance with the requirements of Condition B19, C10 and C12.</p>
3	<p><b>1.</b> Limit of construction hours/works onsite.</p>	<p>Construction works will only be undertaken onsite during the permitted construction hours as listed in Condition C4 and C5.</p>
	<p><b>2.</b> Access of construction staff onsite prior to 7:00am.</p>	<p>In accordance with Condition C4 and C5 onsite construction activities including deliveries to and from site will only occur during permitted construction hours.</p> <p>All construction vehicles (excluding site personnel vehicles) will be contained solely within the site as per the requirements of Condition C10.</p> <p>Construction works will be permitted to access the site prior to the hours listed hours in C4 and C5 for the sole use of access site amenities (toilets, office, food areas etc.).</p>
	<p><b>3.</b> Construction staff parking in residential Streets.</p>	<p>In accordance with Condition B23 onsite provisions have been undertaken to allow for on-site parking to</p>



		minimise construction staff parking in surrounding Streets.
	<b>4.</b> Location of Site Compound relative to neighbouring property.	In addressing the concerns raised in relation to the location and layout of the site compound several changes have occurred including an increase in the setback of the compound from the common boundary, an installation of an acoustic rated screen/barrier between the compound and the resident and relocation of pedestrian entry point to have greater distance to the residence. These are reflected in the site-specific <i>Construction Environmental Management Plan (CEMP)</i> .
	<b>5.</b> Acceptance of all listed mitigation measures proposed in the <i>November 2023 Works Notification</i> (see Figure 12).	All listed mitigation measures in the <i>November 2023 Works Notification</i> (see Figure 12) are reflected in this plan and will be adopted onsite. Refer to sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 and 5.7.
4	<b>1.</b> Limit of construction hours/works onsite.	Construction works will only be undertaken onsite during the permitted construction hours as listed in Condition C4 and C5.
	<b>2.</b> Dust Control.	Site-specific dust mitigation strategies have been development in the <i>Construction Environmental Management Plan (CEMP)</i> to mitigate dust impacts on surrounding neighbours in accordance with Condition B14.
	<b>3.</b> Building Design.	Not an item requiring addressing in construction related management plans.
	<b>4.</b> Complaint Process.	As detailed in section 5.4 of this plan all site related compliant management and community engagement will be undertaken in accordance with the SINSW Community Communication Strategy (CCS). The CCS outlines all procedures for Compliant Management and Community Engagement Procedures as required by Condition B9.
5	<b>1.</b> Formulation of reasonable Mitigation Measures	Sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 and 5.7 of this Plan have been developed specifically to minimise disruption to surrounding residents. These mitigation measures have been developed in accordance with Condition B15.
	<b>2.</b> Construction staff parking in residential Streets.	In accordance with Condition B23 onsite provisions have been undertaken to allow for on-site parking to minimise construction staff parking in surrounding Streets.

## 5.6 Contingency Plans

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

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most construction noise and vibration at the sensitive receivers; and



- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.

The Superintendent shall have access to view the Contractor's noise measurement records on request. The Superintendent may undertake noise monitoring if and when required.

## 5.7 General Mitigation Measures (Australia Standard 2436-2010)

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

### 5.7.1 Adoption of Universal Work Practices

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

### 5.7.2 Plant and Equipment

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics, where feasible.
- Operating plant and equipment in the quietest and most efficient manner.

### 5.7.3 On Site Noise Mitigation

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



### 5.7.4 Work Scheduling

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

### 5.7.5 Source Noise Control Strategies

Some ways of controlling noise at the source are:

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

### 5.7.6 Miscellaneous Comments

- Deliveries should be undertaken, where possible, during standard construction hours.
- Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site and monitor the profiles in use.
- "As per Consent Condition C15, where practicable, the use of "quackers" will be used to ensure noise impacts on surrounding noise sensitive receivers are minimised. This will not be implemented where it is deemed the use of quackers (as opposed to standard vehicle notification devices) would compromise the safety of construction staff or members of the public.
- No public address system should be used on site (except for emergency purposes).



## 6 CONCLUSION

Pulse White Noise Acoustics (PWNA) has been engaged by Roberts Co (NSW) Pty Ltd to prepare a site-specific Construction Noise and Vibration Management Sub-Plan (CNVMSP) for the construction of the Cumberland Education Precinct, which includes upgrades to Carlingford West Public School (CWPS) and Cumberland High School (CHS). The Project Sites are located at 59-73 Felton Road (CWPS) and 183 Pennant Hills Road (CHS), Carlingford with a common boundary between the schools.

This CNVMSP has been prepared to satisfy the requirements of Condition B15 of the consent conditions presented to this office given in the Notice of Determination – Approval issued for Development Application No. SSD-43065987.

An assessment of noise and vibration impacts from the required processes to be undertaken during the construction period of the project (including excavation and construction) has been undertaken and suitable treatments, management controls, periodic measurements and community engagement has been detailed in this report.

Providing the recommendations in this report are included in the construction of the site, compliance with the relevant EPA's Interim Construction Noise Guideline Objectives and condition B15 of the projects *Conditions of Consent* can be achieved.

For any additional information please do not hesitate to contact the person below.

Regards

A handwritten signature in blue ink, appearing to read 'M Furlong', is written over a faint circular stamp.

Matthew Furlong  
Principal Acoustic Engineer  
Pulse White Noise Acoustics



## APPENDIX A. APPENDIX A. ACOUSTIC TERMINOLOGY

The following is a brief description of the acoustic terminology used in this report:

Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	<i>A-weighted decibels</i> The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to <i>pitch</i> . Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
LMax	The maximum sound pressure level measured over a given period.
LMin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L <sub>90</sub> noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
dB (A)	'A' Weighted overall sound pressure level
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.



Sound Level, Lw dB	Power	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
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## **APPENDIX B. NOISE AND VIBRATION INVESTIGATION CHECKLIST**



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## **APPENDIX C. AUTHOR CURRICLULUM VITAE (CV)**