



Stage 2, Ivanhoe Estate

Construction Noise and Vibration Management Plan

Building C3, Epping Road,
Macquarie Park
SSD-15822622

Parkview

Report number: 230694-Ivanhoe C3-CNVMSB_BW_R0
Date: 8 December 2023
Version: For Information

Project Number: 230694

DOCUMENT CONTROL

Project Name	Stage 2, Ivanhoe Estate
Project Number	230694
Report Reference	230694-Ivanhoe C3-CNVMSB_BW_R0
Client:	Parkview

Revision	Description	Reference	Date	Prepared	Checked	Authorised
0	For Information	230694-Ivanhoe C3-CNVMSB_BW_R0	8 December 2023	Ben White	Matt Furlong	Ben White

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1 INTRODUCTION

Pulse White Noise Acoustics (PWNA) has been engaged to prepare a Construction Noise and Vibration Management Plan (CNVMP) for the construction activities to be undertaken as part of the Ivanhoe Estate, Macquarie Park, Stage 2 Building C3 project including item B37 of the SSD-15822622.

Onsite unattended and attended noise levels have previously been determined for the project and included in the Acoustic Logic *Proposed Residential Development, Ivanhoe Stage 2, Macquarie Park – Development Application Environmental Noise Impact Assessment* with reference 20210325.1/1607/A/R7/GW and dated 16/7/2021 and referenced in the projects SSD consent. The details of the acoustic survey included in the Acoustic Logic report have been used in this assessment.

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

The author of this report is a director of Pulse White Noise Acoustics who is a member of the Australian Acoustic Society, details including Ben's CV and membership of the AAS are included in Appendix B.

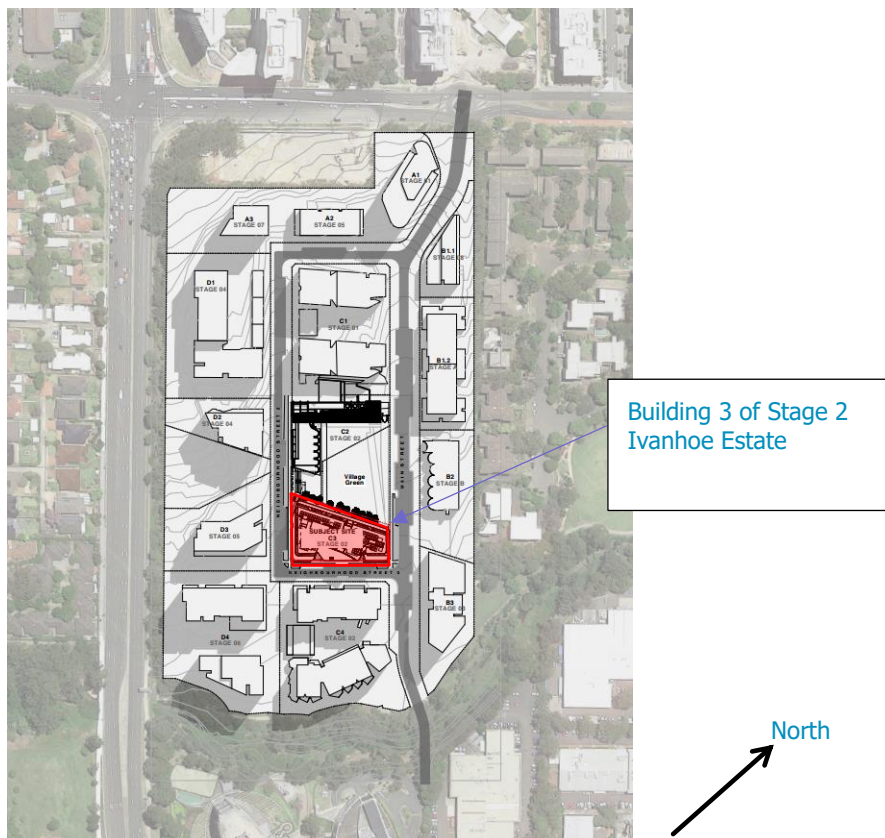
1.1 Site Layout and Development Overview

The proposed Stage 2 of Midtown Macquarie Park including buildings C2, C3 and C4. This report includes the construction noise and vibration management for the construction stages of Building C3 of the Midtown site which includes a 16 story residential building with 3 basement levels and includes retail tenancies on the ground floor of the project.

The Building C3 project is included within the SSD-15822622 approval.

The site is located within the Stage 2 Ivanhoe Estate, Epping Road, Macquarie Park site. The location of Building C3 is detailed in the Figure below.

Figure 1 Location of Building C3 within Stage 2 Ivanhoe Estate

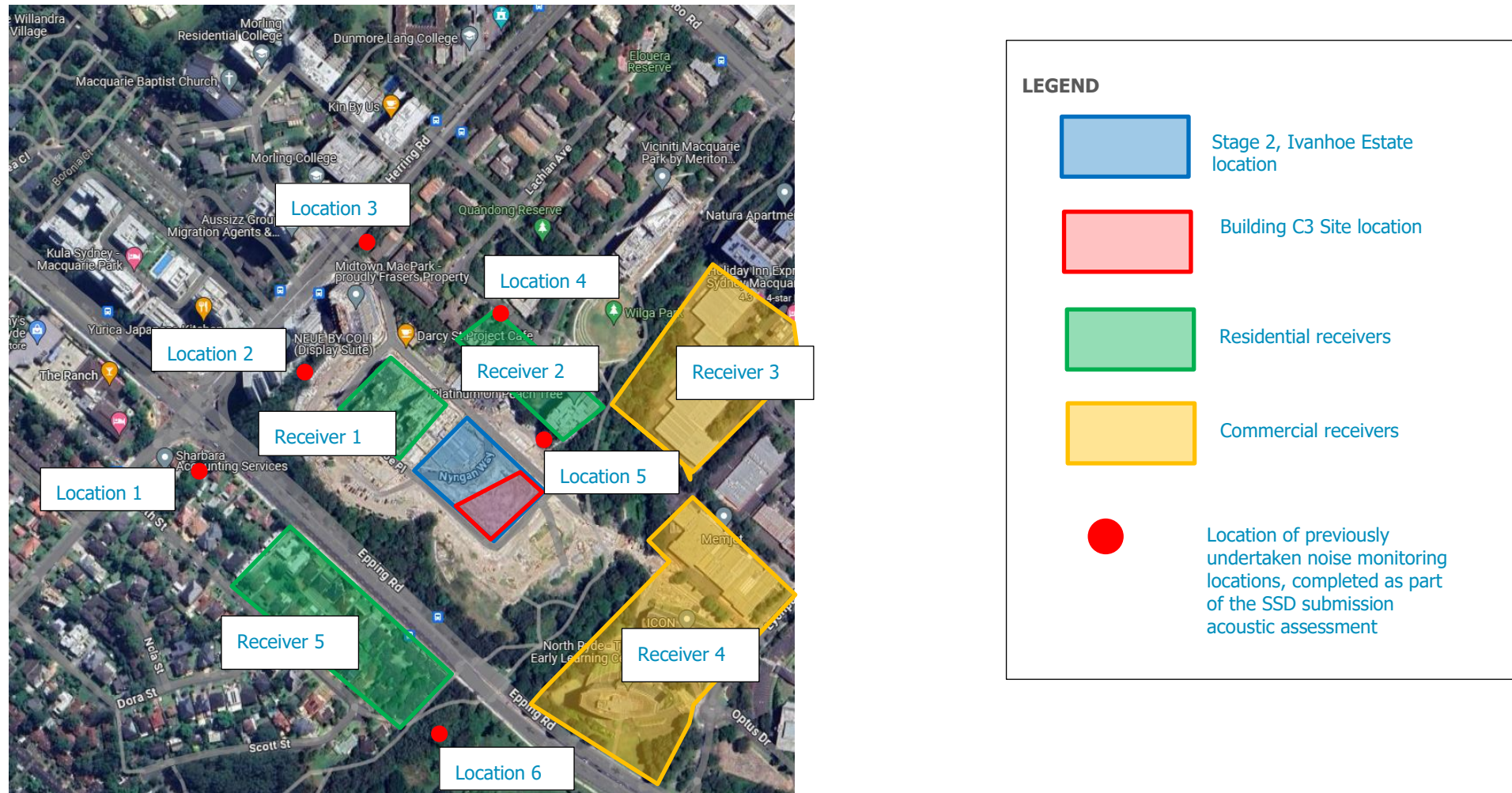


Existing receivers within proximity of the site, which are included in this construction noise and vibration management plan, include both residential and a commercial properties within proximity of the project.

Details of the nearest sensitive receivers to the site have been identified below.

- Receiver 1:** Future residential dwelling location within Building C1 of Stage 1 of the Ivanhoe Estate.
- Receiver 2:** Existing residential receivers located to the north of the site.
- Receiver 3:** Commercial receivers located within the building to the north east of the site.
- Receiver 4:** Commercial receivers located within the building to the east of the site.
- Receiver 5:** Existing residential dwellings located to the south of the site, located to the southern side of Epping Road.

Details of the site location and surrounding receivers is included in the following figure.

Figure 2 Site Map, Measurement Locations and Surrounding Receivers

1.2 SSD Compliance

This report has been undertaken in accordance with the requirements of Item B37 of the project's conditions of consent.

Details of conditions of consent and sections of the report which include the required items required by the consent are included in the table below.

Table 1 SSD Compliance Table

SSD Condition number	Requirement	Report Reference for Satisfaction
B37	<i>Prior to the commencement of any works, a Construction Noise and Vibration Management Plan (CNVMP) prepared by a suitably qualified person shall be submitted to the Certifying Authority. The CNVMP must be prepared in consultation with, and address the relevant requirements of the EPA. The CNVMP shall address (but not be limited to):</i>	-
(a)	<i>be prepared in accordance with the EPA's Interim Construction Noise Guideline</i>	Sections 4.1
(b)	<i>identify nearby sensitive receivers and land uses;</i>	Sections 1.1
(c)	<i>identify the noise management levels for the project;</i>	Section 4.1.1
(d)	<i>identify the construction methodology and equipment to be used and the key sources of noise and vibration;</i>	Section 6
(e)	<i>details of all reasonable and feasible management and mitigation measures to be implemented to minimise construction noise and vibration;</i>	Section 6.1.1 and 6.1.2
(f)	<i>be consistent with and incorporate all relevant recommendations and noise and vibration mitigation measures outlined in the Stage 2 DA Acoustic Assessment, prepared by Acoustic Logic, dated July 2021</i>	Section 6

(g)	<i>ensure all potentially impacted sensitive receivers are informed by letterbox drops prior to the commencement of construction of the nature of works to be carried out, the expected noise levels and duration, as well as contact details for a construction community liaison officer; and</i>	Section 6.5.2
(h)	<i>include a suitable proactive construction noise and vibration monitoring program which aims to ensure the construction noise and vibration criteria in this consent are not exceeded.</i>	Section 6.4

2 EXISTING ACOUSTIC ENVIRONMENT

Measured noise levels from the attended noise survey undertaken as part of the Acoustic Logic *Proposed Residential Development, Ivanhoe Stage 2, Macquarie Park – Development Application Environmental Noise Impact Assessment* with reference 20210325.1/1607/A/R7/GW and dated 16/7/2021 and referenced in the projects SSD consent have been used in this assessment.

As part of the Acoustic Logic *Proposed Residential Development, Ivanhoe Stage 2, Macquarie Park – Development Application Environmental Noise Impact Assessment* background noise levels within the vicinity of the site has been undertaken in accordance with the NSW EPA's *Noise Policy for Industry*.

The Rating Background Noise Level (RBL) is the background noise level used for assessment purposes and includes the 90th percentile of the daily background noise levels during each assessment period, being day, evening and night. The RBL LA90 (15minute) and LAeq noise levels presented within the Acoustic Logic *Proposed Residential Development, Ivanhoe Stage 2, Macquarie Park – Development Application Environmental Noise Impact Assessment* are summarised in



Table 2.

Table 2 Measured Ambient Noise Levels corresponding to the NPI's Assessment Time Periods

Measurement Location	Daytime ¹ 7:00 am to 6:00 pm	Evening ¹ 6:00 pm to 10:00 pm	Night-time ¹ 10:00 pm to 7:00 am
	LA ₉₀ ² (dBA)	LA ₉₀ ² (dBA)	LA ₉₀ ² (dBA)
Measurement Location 1	54	52	41
Measurement Location 2	48	43	34
Measurement Location 3	56	49	37
Measurement Location 4	45	43	37
Measurement Location 5	43	41	39
Measurement Location 6	50	48	36
<i>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</i> <i>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.</i>			

Measured noise levels in accordance with the time periods defined by the NSW EPA RNP 2011 are presented below.

Table 3 Measured Ambient Noise Levels corresponding to the "RNP" Assessment Time Periods

Receiver Location	Daytime ¹ 7:00 am to 10:00 pm	Night-time ¹ 10:00 pm to 7:00 am
	LA _{eq} (whole period) ² (dBA)	LA _{eq} (whole period) ² (dBA)
Receiver Location 1	48	34
Receiver Location 2	45	37
Receiver Location 3	43	39
Receiver Location 4	43	39
Receiver Location 5	50	36
<i>Note 1: For Monday to Sunday, Daytime 7:00 am – 10:00 pm; Night-time 10:00 pm – 7:00 am.</i> <i>Note 2: The LA_{eq} is the energy average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.</i>		

3 PROJECT SSD REQUIREMENTS

This CNVSP has been prepared in accordance with the SSDA 15822622 consent condition B37 which includes the following:

CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

- B37. Prior to the commencement of any works, a **Construction Noise and Vibration Management Plan (CNVMP)** prepared by a suitably qualified person shall be submitted to the Certifying Authority. The CNVMP must be prepared in consultation with, and address the relevant requirements of the EPA. The CNVMP shall address (but not be limited to):
- (a) be prepared in accordance with the EPA's *Interim Construction Noise Guideline*
 - (b) identify nearby sensitive receivers and land uses;
 - (c) identify the noise management levels for the project;
 - (d) identify the construction methodology and equipment to be used and the key sources of noise and vibration;
 - (e) details of all reasonable and feasible management and mitigation measures to be implemented to minimise construction noise and vibration;
 - (f) be consistent with and incorporate all relevant recommendations and noise and vibration mitigation measures outlined in the Stage 2 DA Acoustic Assessment, prepared by Acoustic Logic, dated July 2021
 - (g) ensure all potentially impacted sensitive receivers are informed by letterbox drops prior to the commencement of construction of the nature of works to be carried out, the expected noise levels and duration, as well as contact details for a construction community liaison officer; and
 - (h) include a suitable proactive construction noise and vibration monitoring program which aims to ensure the construction noise and vibration criteria in this consent are not exceeded.
- Prior to the commencement of works, a copy of the **CNVMP** demonstrating compliance with the above must be submitted to the Planning Secretary.

4 NOISE AND VIBRATION CRITERIA

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

4.1 Construction Noise Objectives

Relevant construction noise objectives applicable to this project are outlined below.

4.1.1 NSW EPA (Former DECC) Interim Construction Noise Guideline (ICNG) 2009

Noise objective 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 4 below.

Table 4 NMLs for quantitative assessment at residences

Time of Day	Noise Management Level $L_{Aeq}(15\text{minute})^{1,2}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. - Where the predicted or measured $L_{Aeq}(15\text{minute})$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. - The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. - Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: - Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. - If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside the recommended standard hours above	Noise affected RBL + 5 dB	- A strong justification would typically be required for works outside the recommended standard hours. - The proponent should apply all feasible and reasonable work practices to meet the noise affected level. - Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should notify the community.
offices, retail outlets: external	$L_{Aeq}(15\text{ min})$ 70 dB(A)	- When in use - During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.
<i>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.</i> <i>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 Industrial Noise Policy (EPA 2000).</i>		

Construction noise levels at other noise receivers are outlined below:

- Construction noise levels within classrooms other educational institutions is not recommended to exceed 45dBA $L_{Aeq,15\text{minute}}$ when measured internally.

- Construction noise levels at offices and retail outlets are not recommended to exceed 70dBA LAeq,15minute, when measured externally.

Based on the measured background noise levels summarised in Section 1.2, and the NMLs outlined above, the construction noise criteria to be used in this assessment are listed in Table 5.

Table 5 NMLs as basis for the acoustic assessment

Receiver Types	NML, dB LAeq(15minute)		
	<u>Standard Hours</u> Monday to Friday: 7:00am to 6:00pm Saturday: 8:00am to 1:00pm		<u>Outside Standard Hours</u> All hours not listed in the adjacent column.
Receiver 1 – Residential	NAFL: 58 (RBL (48) + 10dB)	HNAL: 75	RBL + 5dB
Receiver 2 – Residential	NAFL: 55 (RBL (45) + 10dB)		
Receiver 3 – Commercial	NAFL: 70		
Receiver 4 – Commercial	NAFL: 70		
Receiver 5 – Residential	NAFL: 60 (RBL (50) + 10dB)		

4.2 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.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

4.2.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from AV-TG. This type of impact can be further categorised and assessed using the appropriate criterion as follows:

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

Table 6 Continuous vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day or night-time	0.0050	0.010	0.10	0.20
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
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 7 Impulsive vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Critical working areas (e.g. hospital operating theatres, precision laboratories)	Day or night-time	0.0050	0.010	0.10	0.20
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Table 8 Intermittent vibration impacts criteria (m/s^{1.75}) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Critical working areas (e.g. hospital operating theatres, precision laboratories)	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

4.2.2 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).

4.2.3 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 below.

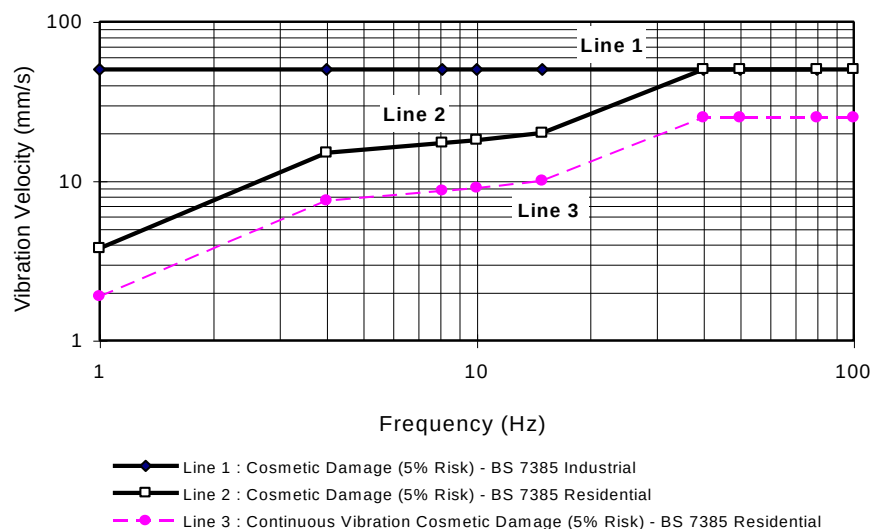
Table 9 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Line in Figure 3	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 9 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such that it results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 9 may need to be reduced by up to 50% (refer to Line 3 in Figure 3).

Figure 3 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 9, 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 the 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 9 should not be reduced for fatigue considerations.

4.2.4 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 10. The criteria are frequency dependent and specific to particular categories of structures.

Table 10 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 ¹	
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>				

4.3 Construction Vibration Criteria

Based on the details included in the sections above the project specific vibration criteria to protect the surrounding residential receivers from structural or architectural damage includes the following:

1. Project construction vibration criteria at all surrounding building structures – 7 mm/s

5 NOISE AND VIBRATION ASSESSMENT

5.1 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 11 below.

Table 11 Summary of predicted sound power levels

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Sound Power Level per Task (dBA re 1pW)
Site Establishment Works	Mobile crane	110	113
	Power hand tools	109	
	Semi Rigid Vehicle ¹	105	
Ground Works	Excavator	112	119
	Hand held jack hammer ¹	111	
	Dump truck ¹	104	
	Concrete saw ¹	114	
	Skid steer	110	
	Power hand tools	109	
Structure	Hand held jack hammer ¹	106	117
	Concrete saw ¹	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 ¹	104	
	Dump truck ¹	104	
	Concrete saw ¹	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.



5.2 Predicted Construction Noise Levels

Predicted construction noise levels are presented below for each of the surrounding receivers in accordance with the NSW EPA ICNG.

Note:

- Predicted noise levels presented below are given in a range, this includes the expected minimums as well as the maximums.
- With regards to the maximum noise levels in the range, these are typically experienced when plant/works are within close proximity to a boundary. In our experience whilst these levels above NML's and considered intrusive they will only occur for a short time and is not a representation of noise levels during the entire construction period.

**Table 12 Receiver 1 – Summary of preliminary predicted construction noise levels – Residence to the east of the site**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted <u>Individual</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Predicted <u>Combined Noise</u> Level at Receiver dBA L _{Aeq} 15 minutes	Noise Management Levels dBA L _{Aeq} 15 minutes	Summary of Result				
Site Establishment Works	Mobile crane	113	52 to 58	59 to 73	<u>Standard Construction Hours</u> <u>58 dB(A) L_{Aeq} 15 min</u> <u>Highly Noise Affected Level</u> <u>Standard Construction Hours</u> <u>75 dB(A) L_{Aeq} 15 min</u>	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.				
	Power hand tools		51 to 57							
	Semi Rigid Vehicle		48 to 54							
Ground Works and Demolition	Excavator	119	54 to 60	64 to 78			Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report.			
	Handheld jack hammer		49 to 55							
	Dump truck		47 to 53							
	Concrete saw		57 to 63							
	Skid steer		52 to 58							
	Power hand tools		51 to 57							
Structure	Handheld jack hammer	117	49 to 55	63 to 77						
	Concrete saw		57 to 63							
	Power hand tools		51 to 57							
	Welder		43 to 49							
	Concrete pump truck		52 to 58							
	Concrete agitator truck		50 to 56							
Internal Works	Power hand tools	109	51 to 57	55 to 69						
Common and External Works	Concrete agitator truck	117	50 to 56	63 to 77						
	Saw cutter		47 to 53							
	Dump truck		47 to 53							
	Concrete saw		57 to 63							
	Power hand tools		51 to 57							

**Table 13 Receiver 2 – Summary of predicted construction noise levels – Residence to the north of the site**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted <u>Individual</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Predicted <u>Combined Noise</u> Level at Receiver dBA L _{Aeq} 15 minutes	Noise Management Levels dBA L _{Aeq} 15 minutes	Summary of Result					
Site Establishment Works	Mobile crane	113	58 to 76	61 to 79	<u>Standard Construction Hours</u> <u>55 dB(A) L_{Aeq} 15 min</u> <u>Highly Noise Affected Level</u> <u>Standard Construction Hours</u> <u>75 dB(A) L_{Aeq} 15 min</u>	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.					
	Power hand tools		57 to 75								
	Semi Rigid Vehicle		53 to 71								
Ground Works and Demolition	Excavator	119	60 to 78	66 to 84			Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report.				
	Handheld jack hammer		54 to 72								
	Dump truck		52 to 70								
	Concrete saw		62 to 80								
	Skid steer		58 to 76								
	Power hand tools		57 to 75								
Structure	Handheld jack hammer	117	54 to 72	65 to 83							
	Concrete saw		62 to 80								
	Power hand tools		57 to 75								
	Welder		49 to 67								
	Concrete pump truck		58 to 76								
	Concrete agitator truck		56 to 74								
Internal Works	Power hand tools	109	57 to 75	57 to 75							
Common and External Works	Concrete agitator truck	117	56 to 74	65 to 83							
	Saw cutter		52 to 70								
	Dump truck		52 to 70								
	Concrete saw		62 to 80								
	Power hand tools		57 to 75								

**Table 14 Receiver 3 - Summary of predicted construction noise levels – Commercial Receivers to the northeast**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted <u>Individual</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Predicted <u>Combined</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Noise Management Levels dBA L _{Aeq} 15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	52 to 58	59 to 73	<u>Standard Construction Hours</u> <u>70 dB(A) L_{Aeq} 15 min</u> <u>Highly Noise Affected Level</u> <u>Standard Construction Hours</u> <u>75 dB(A) L_{Aeq} 15 min</u>	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.
	Power hand tools		51 to 57			
	Semi Rigid Vehicle		48 to 54			
Ground Works and Demolition	Excavator	119	54 to 60	64 to 78		
	Handheld jack hammer		49 to 55			
	Dump truck		47 to 53			
	Concrete saw		57 to 63			
	Skid steer		52 to 58			
	Power hand tools		51 to 57			
Structure	Handheld jack hammer	117	49 to 55	63 to 77		
	Concrete saw		57 to 63			
	Power hand tools		51 to 57			
	Welder		43 to 49			
	Concrete pump truck		52 to 58			
	Concrete agitator truck		50 to 56			
Internal Works	Power hand tools	109	51 to 57	55 to 69		
Common and External Works	Concrete agitator truck	117	50 to 56	63 to 77		
	Saw cutter		47 to 53			
	Dump truck		47 to 53			
	Concrete saw		57 to 63			
	Power hand tools		51 to 57			

**Table 15 Receiver 4 - Summary of predicted construction noise levels – Commercial Receivers to the northeast**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted <u>Individual</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Predicted <u>Combined</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Noise Management Levels dBA L _{Aeq} 15 minutes	Summary of Result
Site Establishment Works	Mobile crane	113	52 to 58	56 to 61	<u>Standard Construction Hours</u> <u>70 dB(A) L_{Aeq} 15 min</u> <u>Highly Noise Affected Level</u> <u>Standard Construction Hours</u> <u>75 dB(A) L_{Aeq} 15 min</u>	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver. Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report.
	Power hand tools		51 to 57			
	Semi Rigid Vehicle		48 to 54			
Ground Works and Demolition	Excavator	119	54 to 60	61 to 66		
	Handheld jack hammer		49 to 55			
	Dump truck		47 to 53			
	Concrete saw		57 to 63			
	Skid steer		52 to 58			
	Power hand tools		51 to 57			
Structure	Handheld jack hammer	117	49 to 55	61 to 66		
	Concrete saw		57 to 63			
	Power hand tools		51 to 57			
	Welder		43 to 49			
	Concrete pump truck		52 to 58			
	Concrete agitator truck		50 to 56			
Internal Works	Power hand tools	109	51 to 57	52 to 57		
Common and External Works	Concrete agitator truck	117	50 to 56	60 to 65		
	Saw cutter		47 to 53			
	Dump truck		47 to 53			
	Concrete saw		57 to 63			
	Power hand tools		51 to 57			

**Table 16 Receiver 5 - Summary of predicted construction noise levels – Residence located to the west**

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted <u>Individual</u> Noise Level at Receiver dBA L _{Aeq} 15 minutes	Predicted <u>Combined Noise</u> Level at Receiver dBA L _{Aeq} 15 minutes	Noise Management Levels dBA L _{Aeq} 15 minutes	Summary of Result			
Site Establishment Works	Mobile crane	113	52 to 58	56 to 61	<u>Standard Construction Hours</u> <u>60 dB(A) L_{Aeq} 15 min</u> <u>Highly Noise Affected Level</u> <u>Standard Construction Hours</u> <u>75 dB(A) L_{Aeq} 15 min</u>	Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.			
	Power hand tools		51 to 57						
	Semi Rigid Vehicle		48 to 54						
Ground Works and Demolition	Excavator	119	54 to 60	61 to 66			Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report.		
	Handheld jack hammer		49 to 55						
	Dump truck		47 to 53						
	Concrete saw		57 to 63						
	Skid steer		52 to 58						
	Power hand tools		51 to 57						
Structure	Handheld jack hammer	117	49 to 55	61 to 66					
	Concrete saw		57 to 63						
	Power hand tools		51 to 57						
	Welder		43 to 49						
	Concrete pump truck		52 to 58						
	Concrete agitator truck		50 to 56						
Internal Works	Power hand tools	109	51 to 57	52 to 57					
Common and External Works	Concrete agitator truck	117	50 to 56	60 to 65					
	Saw cutter		47 to 53						
	Dump truck		47 to 53						
	Concrete saw		57 to 63						
	Power hand tools		51 to 57						

5.3 Construction Traffic Noise Assessment

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.

It is proposed that the construction traffic would access the site via Binalong Road to the east of the site. All construction traffic will access the site and use the surrounding roadways in accordance with the site Construction Management plan.

5.4 Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in Section 4.2, it is recommended that the indicative safe distances listed in table below should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking measurements of vibration levels generated by construction and demolition equipment by the contractor.

Additionally, any vibration levels should be assessed in accordance with the criteria discussed in Section 4.2.

Table 17 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

6 NOISE AND VIBRATION MANAGEMENT PLAN

6.1 Acoustic Management Procedures

Table 18 below summarises the management procedures recommended for airborne noise and vibration impact. These procedures are also further discussed in the report as well as recommended mitigation measures. Hence, where applicable, links to further references are provided in Table 18.

Table 18 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 6 For noise impact, also refer to Section 6.1 For vibration impact, also refer to Section 6.3.1
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 6.
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 6 and Section 6.2.3. For vibration impact, refer to Section 6.3.2
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders	Refer to Section 6.6
Specific Notification	SN	Individual letters or phone calls to notify stakeholders that noise levels are likely to exceed noise objectives. Alternatively, contractor could visit stakeholders individually in order to brief them in regards to the noise impact and the mitigation measures that will be implemented.	Refer to Section 6.
Respite Offer	RO	Offer provided to stakeholders subjected to an ongoing impact.	-
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).	-

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 6.1.1

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 6.1.2.

6.1.1 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 19 below.

Table 19 Allocation of noise management procedures – residential receivers

Construction Hours	Exceedance over NML (dB)	Management Procedures (see definition above)
Approved Construction Hours	0 - 3	GMM
Mon – Fri: 7:00 am to 7:00 pm	4 - 10	GMM, PN, V ¹ , CMS, AC
Sat: 8:00 am – 1:00 pm	> 10	GMM, PN, V, CMS, SN, AC
Outside Standard Hours	0 - 10	GMM, AC
Mon – Fri: 7:00 am to 8:00 am	11 - 20	GMM, PN, V ¹ , CMS, AC
Sat: 7:00 am to 8:00 am	> 20	GMM, PN, V, CMS, SN, RO, AC
<i>Notes</i>		
1. Verification monitoring to be undertaken upon complaints received from affected receivers		

Please note the following regarding the allocation of these procedures:

- In addition to the above the projects *Conditions of Consent*, item C5, require works to include the following:
 - Rock Breaking, rock hammering, sheet piling and similar activities may only be carried out between the following hours:
 - 9am to 12 midday – Monday to Friday.
 - 2 pm to 5pm – Monday to Friday.
 - 9am to 12 midday – Saturday's.
- The exceedances have been estimated as part of the acoustic assessment, and these are summarised in Section 5.2.
- The allocation of procedures is based on the assumptions used for noise level predictions (refer to Section 5.1). Consequently, these allocations can be further refined once additional details of the construction program become available.

6.1.2 Allocation of Vibration Management Procedures

Table 20 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 20 Allocation of vibration management procedures

Construction Hours	Exceedance Scenario	Management Procedures
Approved Construction Hours	Over human comfort criteria (refer to Section 3)	GMM, PN, V, RO
	Over building damage criteria (refer to Section 3)	GMM, V, AC
Outside Standard Hours	Over human comfort criteria (refer to Section 3)	GMM, SN, V, RO, CMS
	Over building damage criteria (refer to Section 3)	GMM, V, AC

6.2 Site Specific Noise Mitigation Measures (including High Noise Affected Levels)

Predicted noise levels outlined in section 5.1 indicate exceedances above the Noise Management Levels (NMLs) as well as the Highly Noise Affected Level (HNAL) when in proximity to a boundary. To militate against any exceedances, the site will need to introduce periods of respite for activities which are creating noise levels above the HNAL and including activities such as piling, hydraulic hammering and the like (i.e. greater than 75dBA). See below.

Table 21 Recommended Respite Periods

Monday to Friday	Saturday
7:00am to 8:00am – No noisy works (<u>Respite Period</u>)	8:00am to 9:00am – No noisy works (<u>Respite Period</u>)
8:00am to 12:30am – Works	9:00am to 12:00pm – Works
12:30am to 1:30pm – No noisy works (<u>Respite Period</u>)	12:00pm to 1:00pm – No noisy works (<u>Respite Period</u>)
1:30pm to 3:30pm – Works	
3:30pm to 4:30pm – No noisy works (<u>Respite Period</u>)	
4:30pm to 6:00pm – Works	

6.2.1 General Mitigation Measures

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. Works will be undertaken in conjunction with the Community Communication Strategy, as required by Item B7 of the Conditions of Consent.

All construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding residential precincts outside of the construction hours of works outlined in the consent conditions, including item C1, which includes the following:

- 7am to 7pm Monday to Friday
- 8am to 4pm Saturdays

6.2.2 Noise Monitoring

Noise monitoring will be performed by an acoustical consultant directly engaged by the contractor.

Noise monitoring is recommended to be undertaken by attended noise measurements at the start of any new phase of works (i.e. demolition, excavation or remediation works etc.). The statistical parameters to be measured should include the following noise descriptors: LAmin, LA90, LA10, LA1, LAmax and LAeq. Unattended noise measurements should be conducted over consecutive 15 minute periods at the commencement of demolition and ground works on the site.

This monitoring should also be complemented by undertaking attended noise measurements in order to:

- Differentiate between construction noise sources and other extraneous noise events (such as road traffic and aircraft noise)
- Note and identify any excessive noise emitting machinery or operation.

In addition to the above detailed measurements, should any complaints be received which have not been determined previously, it should be confirmed by conducting additional attended noise measurements.

The survey methodology and any equipment should comply with the requirements discussed in Standard AS 1055.1-1997.

6.2.3 Noise Mitigation Measures for Non-Residential Receivers

Where exceedances have been identified in Section 3, the following mitigation measures are recommended:

- Undertake general mitigation measures as discussed in Section 6.
- 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. These updates can also be issued through an email distribution list or via social media and in accordance with consent condition B7 requiring a Community Communication Strategy.
- Signage to be posted in order to provide stakeholders information regarding project details, emergency contacts and enquiry contact information in accordance with consent condition C1 requiring a site notice.

6.2.4 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. The assessment is required to be undertaken in coordination with the contractors undertaking the works to be conducted.

6.2.5 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) and proactive mechanical maintenance.

6.3 Vibration Mitigation Measures

6.3.1 General Mitigation Measures

As part of the CNVMP, 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 to surrounding receivers.
- Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment to within the allowable time set within the consent conditions which include 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.
- Use lower vibration generating items of construction plant and equipment; that is, smaller capacity plant.
- Minimise conducting vibration generating works consecutively in the same area (if applicable).
- Schedule a minimum respite period of at least 30 minutes after a period of continuous 2 hours of work.
- Use only dampened rock breakers and/or “city” rock breakers to minimise the impacts associated with rock breaking works.
- Conduct attended measurements of vibration generating plant at commencement of works in order to validate the indicative safe working distances advised in Table 17 and, consequently, to establish safe working distances suitable to the project. Measurements should be conducted at the nearest affected property boundary. These safe working distances should be defined by considering the vibration criteria discussed in Section 4 (i.e., criteria for structural damage, human comfort and impact to scientific or medical equipment).

6.3.2 Vibration Monitoring

Vibration monitoring should be undertaken continuously at the nearest most affected structures.

The monitoring location would be on a stiff part of the structure (at the foundation) on the side of the structure adjacent to the subject demolition and construction works.

The vibration monitoring system will be configured to record the peak vibration levels and to trigger an alarm when predetermined vibration thresholds are exceeded. The thresholds correspond to an “Operator Warning Level” and an “Operator Halt Level”, where the Warning Level is 75% of the Halt Level. The Halt Level should be determined based on the vibration criteria for building contents and structure (detailed in section 4.2).

Exceedance of the “Operator Warning Level” would not require excavation or demolition work to cease, but rather, alerts the site manager to proceed with caution at a reduced force or load.

An exceedance of the “Operator Halt Level” would require the contractor to implement an alternative excavation technique pending further analysis of the vibration frequency content in order to determine any potential exceedance of the criteria.

The vibration monitoring equipment would be downloaded and analysed by the acoustical consultant monthly including reporting of the collected data.

Reports of the measured vibration levels and their likely impacts would be prepared by the acoustical consultant and issued to the contractor monthly.

Vibration monitoring should be undertaken including the following:

1. Vibration Monitoring to include long term continuous vibration logging.
2. Monitors set to record maximum vibration levels including Peak Particle Velocity (PPV) magnitudes.
3. Monitors are required to be SMS enabled such that any events recorded above 'alert levels can be instantaneously sent to suitable builder, acoustic consultant and contractor representatives.
4. In the event results re received above 'alert levels the following response to events are required as detailed in the table below.
5. Vibration monitoring should be undertaken for the periods including demolition, exaction and construction of the building structure including installation of concrete to ground floor as a minimum or on agreement with neighbouring stake holders in the event monitoring details no negative impacts during the construction of the project.

Table 22 Required Response to Vibration Events

Location/ Receiver Type	Event Type		
	Trigger	Alert	Alarm, Stop Work
Surrounding Residential Dwellings	6 mm/s	7 mm/s	8 mm/s
<i>See Section below for response to Event Types</i>			

The required response to recorded event types detailed in the table above are included in the following table.

Table 23 Required Response to Vibration Events

Event Type	Required Response
Trigger level	All events above the trigger level are required to be recorded by the vibration monitors.
Alert	Temporarily cease the vibration generating activity and assess the reason for vibration exceedances. Modify the related construction practice to prevent future exceedances. Keep records of subsequent breaches to demonstrate that vibrations for modified activity do not reach Alert Level. All <i>Alert</i> events are to be SMS messaged to the building contractor site manager, subcontractor and acoustic consultant.
Alarm	Stop Work Event All <i>Alarm</i> events are to be SMS messaged to a relevant Richard Crookes, subcontractor and acoustic consultant. The activity generating the vibration levels is to be stopped immediately. Suitable representatives of the building contractor, the relevant Subcontractor, Heritage Consultant and acoustic consultant. Vibration monitoring report to be completed. Visual assessment of affected property will be conducted to assess whether damage is evident. The item/s of work generating the vibration events is not be recommenced until an action plan is agreed and implemented.

6.4 Noise and Vibration Monitoring

As part of the management of noise from the proposed construction activities to be undertaken on the site the following noise and vibration monitoring is to be undertaken:

1. Noise Monitoring— Attended noise monitoring of excavation and construction activities is to be undertaken during the following periods:
 - a. Commencement of any rock breaking or sawing on the site.
 - b. In response to any ongoing complaints received from neighbours.
2. Vibration – Based on the proximity of the surrounding receivers to the works magnitudes of vibration resulting from construction activities required to be undertaken on the site are not expected to approach vibration limits detailed in Section 4.2 of this report, therefore permanent continuous vibration monitoring is not recommended.

Attended vibration monitoring is to be undertaken at the following periods:

- a. Commencement of any high vibration generating activities including hydraulic hammering, rock breaking or vibration rolling on the site.
- b. receiver location in the event complaints resulting from construction activities resulting from the perception of vibration are experienced by the occupants of buildings within the vicinity of the site.

6.5 Complaints Management Process and Community Communication

A complaints management process and community communications strategy is required to be included for the project, including those developed in compliance with the project Conditions of Consent, including items B11, B12, B13 and B14 which include the following:

COMPLAINTS AND ENQUIRIES PROCEDURE

- B11. Prior to the commencement of construction works for each building, or as otherwise agreed by the Planning Secretary, the following must be made available for community enquiries and complaints for the duration of construction:
- (a) a toll-free 24-hour telephone number(s) on which complaints and enquiries about the carrying out of any works may be registered;
 - (b) a postal address to which written complaints and enquiries may be sent; and
 - (c) an email address to which electronic complaints and enquiries may be transmitted.

COMMUNITY COMMUNICATION STRATEGY

- B12. A community Communication Strategy must be prepared to provide mechanisms to facilitate communication between the Applicant, the relevant Council and the community (including adjoining affected landowners and businesses, and others directly impacted by the development), during the design and construction of the development and for a minimum of 12 months following the completion of construction.
- B13. The Community Communication Strategy must:
- (a) identify people to be consulted during the design and construction phases;
 - (b) include the telephone number, postal address and email required in **Condition B11**
 - (c) set out procedures and mechanisms for the regular distribution of accessible information about or relevant to the development;
 - (d) provide for the formation of community-based forums, if required, that focus on key environmental management issues for the development;
 - (e) set out procedures and mechanisms:
 - (i) through which the community can discuss or provide feedback to the Applicant;
 - (ii) through which the Applicant will respond to enquiries or feedback from the community; and

- (iii) to resolve any issues and mediate any disputes that may arise in relation to construction and operation of the development, including disputes regarding rectification or compensation.

- B14. Details demonstrating compliance with **Condition B11** and **Condition B12** must be submitted to the Certifying Authority and the Planning Secretary no later than one month before the commencement of any work.

6.5.1 Enquiries and complaints management

Community enquiries and complaints will be undertaken and managed by the building contractor in accordance with the requirements of item B11 and detailed above.

6.5.2 Community Notifications

Prior to the works onsite being undertaken, it is recommended that community consultation with the neighbouring affected parties be undertaken. These include the locations detailed in the figure below.

Figure 4 Required Community Notification Area



Communication notification, should not be limited to the beginning of the onsite works but throughout, providing the community with constant updates on the progress and upcoming works. In our experience these could include:

- Project website.
- Email notifications; and
- Letterbox drops.

6.5.3 Community Engagement

It is proposed that throughout the duration of the project, continued meetings with both the school principals will be undertaken on a regular basis to monitor and mitigate any impacts of construction noise and vibration on the school community.

Community engagement has been undertaken during the design and approvals basis of the project and detailed in the Community Communication Strategy in accordance with condition B12.

6.6 Complaints Management System

Should complaints arise they must be dealt with in a responsible and uniform manner, therefore, a management system to deal with complaints is detailed above. Complaints will be undertaken in compliance with Condition B11 of the consent.

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

6.8 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.

6.8.1 Additional Recommendations

- 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.

6.8.2 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.
- Operating plant and equipment in the quietest and most efficient manner.

6.8.3 On Site Noise Mitigation

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

6.8.4 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.

6.8.5 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.



6.8.6 Miscellaneous Recommendations

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.

It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards without compromising the safety of construction staff and members of the public.

No public address system should be used on site (except for emergency purposes).

7 CONCLUSION

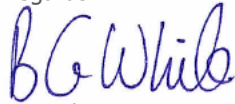
This report details the Construction Noise and Vibration Management Plan for the construction of the Pendle Hill to be undertaken as part of the Ivanhoe Estate, Macquarie Park, Stage 2 Building C3 project including item B37 of the SSD-15822622.

An assessment of noise and vibration impacts from the required processes to be undertaken during the construction period of the project (including ground works and construction) has been undertaken and suitable treatments, management controls, perioding 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 projects SSD Conditions and the relevant EPA's *Interim Construction Noise Guideline* and the projects *Consent* will be achieved.

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

Regards

A handwritten signature in blue ink that reads "BG White".

Ben White
Director

Pulse White Noise Acoustics



APPENDIX A: ACOUSTIC GLOSSARY

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; <table> <tr> <td>0dB</td><td>the faintest sound we can hear</td></tr> <tr> <td>30dB</td><td>a quiet library or in a quiet location in the country</td></tr> <tr> <td>45dB</td><td>typical office space. Ambience in the city at night</td></tr> <tr> <td>60dB</td><td>Martin Place at lunch time</td></tr> <tr> <td>70dB</td><td>the sound of a car passing on the street</td></tr> <tr> <td>80dB</td><td>loud music played at home</td></tr> <tr> <td>90dB</td><td>the sound of a truck passing on the street</td></tr> <tr> <td>100dB</td><td>the sound of a rock band</td></tr> <tr> <td>115dB</td><td>limit of sound permitted in industry</td></tr> <tr> <td>120dB</td><td>deafening</td></tr> </table>	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
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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 ₉₀ 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 Power Level, Lw dB	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																				



NAFL	Noise Affected Level - As referred to in the EPA's <i>Interim Construction Noise Guideline</i> as the affected noise level for the trigger of construction noise mitigation requirements.
HNAL	High Noise Affected Level – As referred to in the EPA's <i>Interim Construction Noise Guideline</i> .
AV-TG	NSW EPA <i>Assessing Vibration Technical Guideline</i> .

APPENDIX B – BEN WHITE CV AND AAS MEMBERSHIP

Curriculum Vitae – Benjamin White



Employment Experience:

Director – Pule White Noise Acoustics
Present

November 2020 –

Director - White Noise Acoustics:

March 2019 – Present

Director/Engineer - Acoustic Logic Consultancy:
July 2018

March 2001 –

Experience:

Ben White the Director of White Noise has over 17 years of experience in acoustic.

Ben has significant experience in providing acoustic services and expert advice in the following areas:

- Residential acoustic reports including aircraft noise (AS2021) assessments, traffic noise, train noise and vibration assessments.
- Noise emission assessments for various projects including assessments with planning requirements using EPA, Department of Planning, Council DCP's and similar regulatory requirements.
- Planning approvals including Development Applications for multi dwelling residential developments, commercial developments, hotels and boarding houses, places of entertainment, carparks, mixed use developments, shopping centres and the like.
- Expert court witness including Land and Environment Court and other expert witness work.
- Project planning and specifications for types of projects including residential, commercial, retail, hotel accommodation, warehouses and industrial developments and mixed-use projects.
- Project delivery for all types of projects including, design advice and project delivery requirements at all stages of projects during design and construction.
- Certification works including on site testing for the provision of certification of all types of projects including items required to comply with Part F5 of the BCA as well as project specific acoustic requirements.
- Mechanical design and advice for the treatments of mechanical services with project requirements.
- External façade design and specification.
- Specialised acoustic design advice including areas of projects.
- Issues with existing building include site surveys and audits as well as advice regarding rectification if required.

AUSTRALIAN ACOUSTICAL SOCIETY



This is to certify that

BENJAMIN WHITE

was admitted to the grade of

MEMBER

of the Australian Acoustical Society

on 27th October 2020

and is entitled to use the letters

M.A.A.S.

issued on 26th November 2020

S. Moore

President

[Signature]

General Secretary



This certificate remains the property of the Australian Acoustical Society