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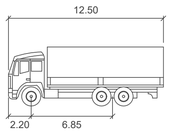


HRV

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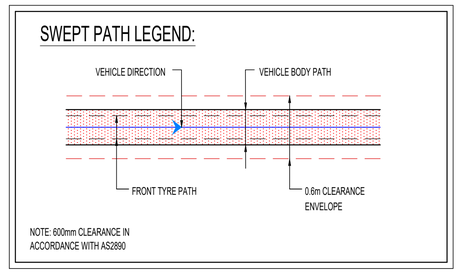
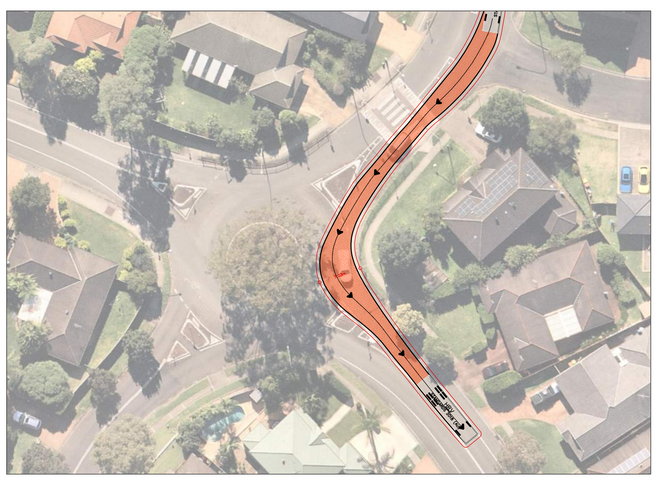
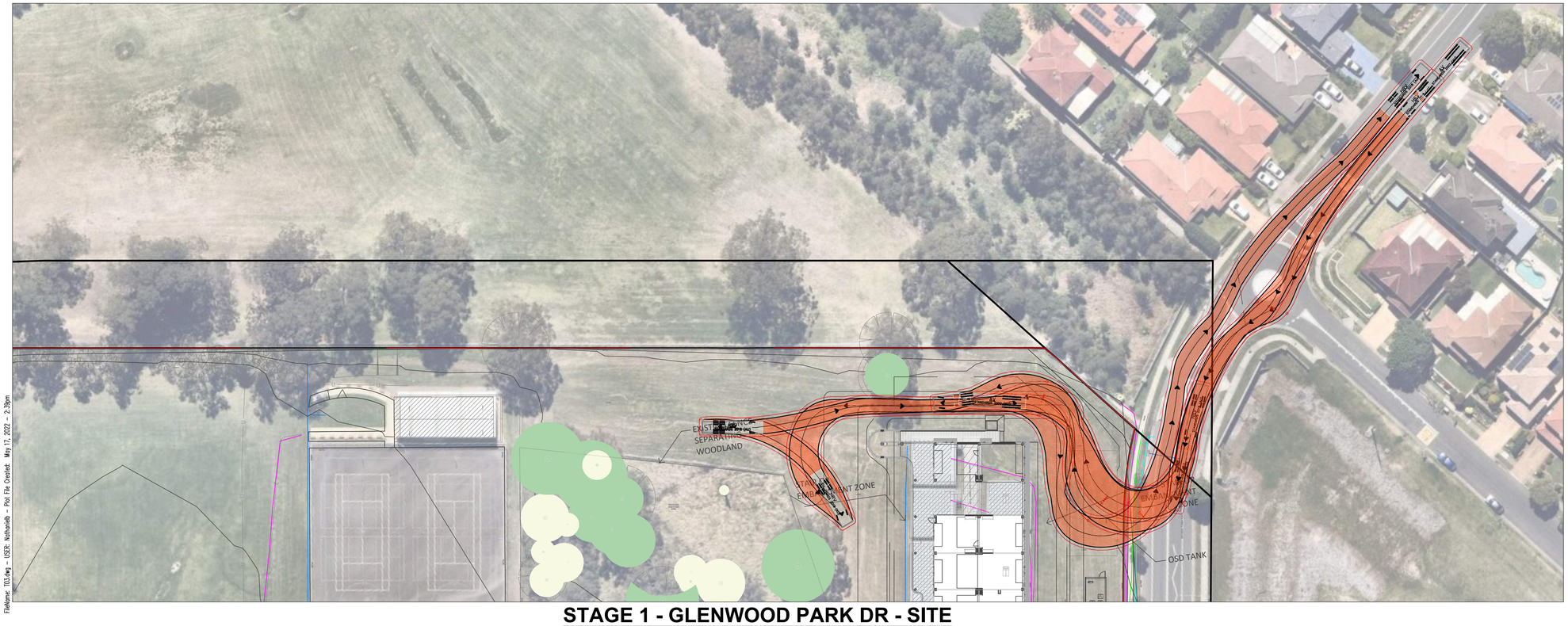


## STAGE 1 - GLENWOOD PARK DR - TARWIN AVE




## STAGE 1 - GLENWOOD PARK DR - SITE

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| Rev | Description | Eng | Draft | Date |
|---|---|---|---|---|
| P1 | PRELIMINARY | NB | NB | 17.05.22 |

**PRELIMINARY**
NOT TO BE USED FOR CONSTRUCTION

Architect
PTW
LEVEL 11, 88 PHILIP STREET
SYDNEY NSW 2000

Engineer
TTW Structural Civil Traffic Façade
612 9439 7288 | 48 Chandos Street St Leonards NSW 2065

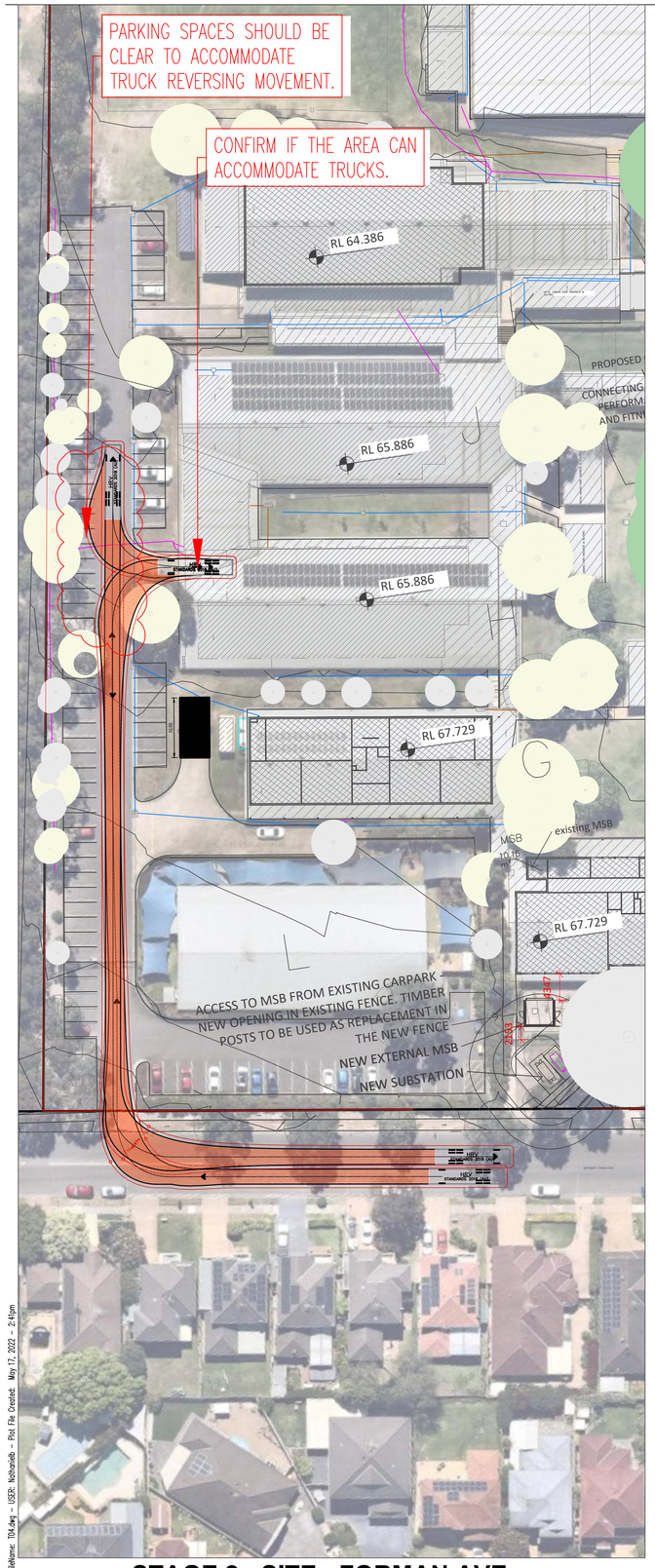
Project
GLENWOOD HIGH SCHOOL

Sheet Subject
SWEPT PATH ANALYSIS
HEAVY RIGID VEHICHLE (HRV)
(STAGE 1)

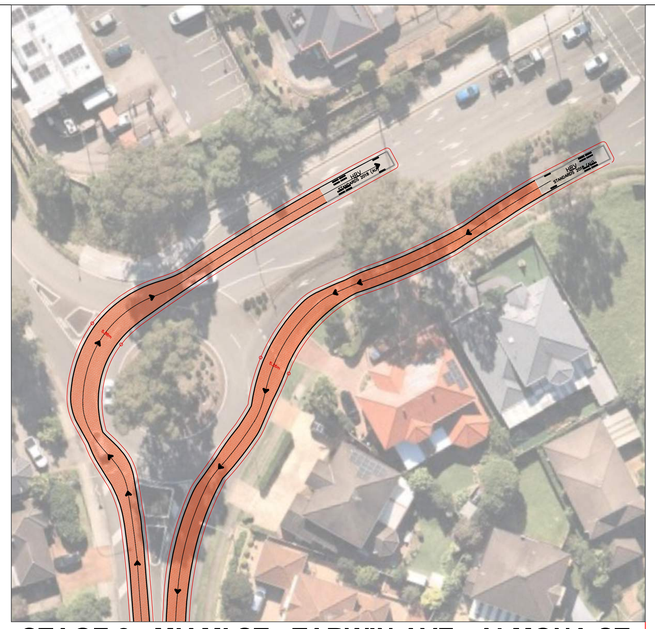
| Scale : A1 | Drawn | Authorised |
|---|---|---|
| 1:500 | NB | - |

| Job No | Drawing No | Revision |
|---|---|---|
| 211530 | T03 | P1 |

Plot File Created: May 17, 2022 - 2:39pm




## STAGE 2 - SITE - FORMAN AVE

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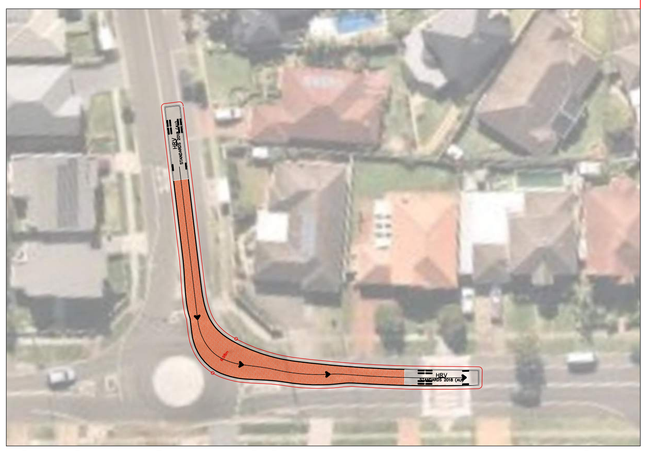


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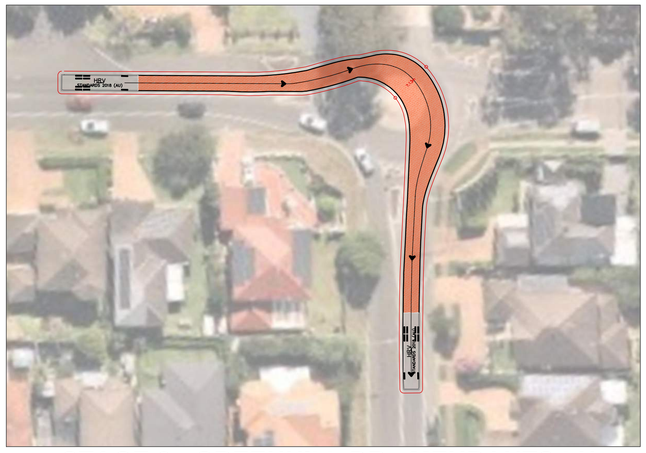
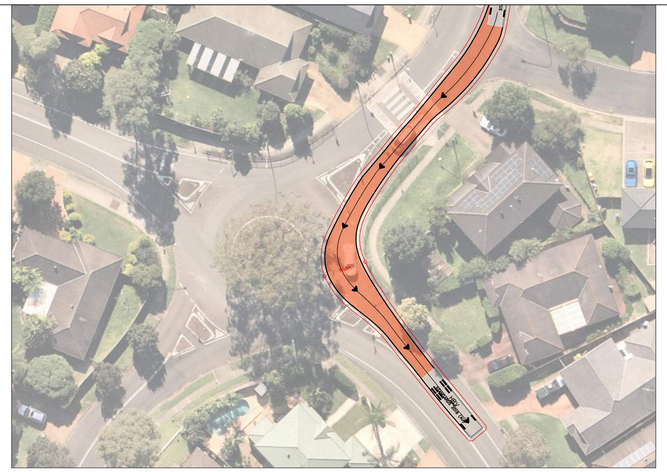



## STAGE 2 - GREENHILL DR - MEURANTS LN




## STAGE 1 - GLENWOOD PARK DR - TARWIN AVE


## STAGE 2 - GREENHILL DR - EQUESTRIAN ST


## STAGE 2 - GREENHILL DR- NORWEST BLVD

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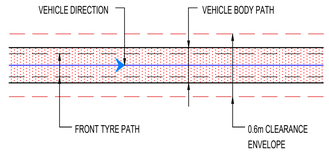


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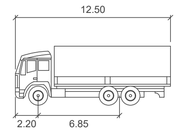


HRV

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PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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| P1 | PRELIMINARY | NB | NB | 17.05.22 |

Architect
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SYDNEY NSW 2000

Engineer
TTW Structural Civil Traffic Façade
612 9439 7288 | 48 Chandos Street St Leonards NSW 2065

Project
GLENWOOD HIGH SCHOOL

Sheet Subject
SWEPT PATH ANALYSIS
HEAVY RIGID VEHICLE (HRV)
(STAGE 2)

| Scale : A1 | Drawn | Authorised |
|---|---|---|
| 1:500 | NB | - |

| Job No | Drawing No | Revision |
|---|---|---|
| 211530 | T04 | P1 |

Plot File Created: May 17, 2022 - 2:41pm

# Appendix D – Relevant Curriculum Vitae (CV)

# Nathaniel Borja

## Traffic Engineer

Bachelor of Science in Civil Engineering

Nathaniel.Borja@ttw.com.au

## Experience

**2019 – Current**
Traffic Engineer, TTW, Sydney

**2018 – 2019**
Transport Engineer, Campbelltown City Council, Campbelltown

**2016 – 2018**
Transport Engineer, DCE, Abu Dhabi, UAE

**2013 – 2016**
Transport Engineer, CRTC, Abu Dhabi, UAE

**2012– 2013**
Estimation Engineer, Smartbox, Dubai, UAE

**2010– 2011**
Quantity Surveyor, CAPPMC, Abu Dhabi, UAE

**2007– 2009**
Quantity Surveyor, City Engineering, Dubai, UAE

### Accommodation + Residential

19-27 Cross Street, Double Bay
Cardinal Gilroy Village, Merrylands West
Majestic Apartments, Rouse Hill
Baxter Road Hotel, Mascot

### Community + Public

Sydney Football Stadium, Sydney
Ryde Central, Ryde
Luna Park, Milsons Point
Sydney Airport, Sydney
Brookvale Oval, Brookvale
St. Bartholomew's Cemetery, Prospect

### Commercial

458-468 George Street, Sydney
700 George Street, Sydney
1 Eden Park Drive, Macquarie Park
The Bond, Bella Vista

### Education

Smalls Road Public School, Ryde
Pendle Hill High School, Toongabbie
Carlingford West Public School, Carlingford
Cumberland High School, Carlingford
Parramatta East Public School, Parramatta
Macquarie Boys Technology High School, Parramatta
Greenwich Public School
- Kingslangley Road Campus and Greenwich Road Campus, Greenwich

UNSW Village Green, Kingsford
UNE, Parramatta

### Health

Concord Hospital, Concord
Liverpool Hospital, Liverpool
Headspace, Mount Druitt
Buronga HealthOne, Buronga
Wyong Hospital, Wyong
Sutherland Hospital, Sutherland
Bankstown-Lidcombe Hospital, Bankstown

# Appendix E – Authority Consultation

## Michael Babbage

**From:** Michael Babbage
**Sent:** Tuesday, 20 September 2022 6:31 PM
**To:** 'Andy Karklins'; 'Nadeem Shaikh'
**Cc:** Paul Yannoulatos; Amir Lahouti
**Subject:** Glenwood HS - CTMP for Council comment
**Attachments:** 220720 - GHS - Construction Traffic and Pedestrian Management Sub-Plan - Rev 4 [WIP] _ reduced.pdf

Hi Andy and Nadeem,

Further to our previous enquiry in July about John Palmer PS, we are also working with Richard Crookes Constructions on the redevelopment at **Glenwood High School** (SSD-23512960).

As per the consultation requirements under Condition B16(b) of the development consent, please find attached a working copy of Rev 4 of the CTPMSP. We are requesting any comments or feedback that you might have on the current plan, for consideration in any future updates to the document. This document is a developed version of the early strategies we presented at the second Transport Working Group meeting on 02/09/2021.

Could you please let us know if you have any comments, or alternatively if we should be speaking to anyone else within Council for consultation on this document instead of (or in addition to) yourselves.

Thanks,
Michael

## Michael Babbage

**From:** Michael Babbage
**Sent:** Tuesday, 20 September 2022 6:35 PM
**To:** development.ctmp.cjp@transport.nsw.gov.au
**Cc:** Paul Yannoulatos; Amir Lahouti
**Subject:** Glenwood HS (SSD-23512960) - CTMP for TfNSW comment
**Attachments:** 220720 - GHS - Construction Traffic and Pedestrian Management Sub-Plan - Rev 4 [WIP] _ reduced.pdf

Hi TfNSW CTMP team,

As you may be aware, Richard Crookes Constructions will be working on the redevelopment at **Glenwood High School** under SSD-23512960. TTW are working with RCC for the construction traffic management of the project.

As per the consultation requirements under Condition B16(b) of the development consent, please find attached a working copy of Rev 4 of the CTPMSP. We are requesting any comments or feedback that you might have on the current plan, for consideration in any future updates to the document. This document is a developed version of the early strategies we presented to TfNSW representatives at a Transport Working Group meeting on 02/09/2021 (part of a series of pre-SSDA consultation meetings), and I know that TfNSW had also provided brief feedback in a submission during the SSDA process.

Could you please let us know if you have any comments, or if we should be directed to anyone specific within the TfNSW team.

Many thanks,
Michael

## 6.6 CONSTRUCTION NOISE & VIBRATION MANAGEMENT SUB-PLAN

The Construction Noise & Vibration Management Sub-Plan has been prepared by Pulse White Noise Acoustics.

Refer to the following page.

# Glenwood High School

# Construction Noise and Vibration Management Sub Plan

**Richard Crookes Constructions**

Report number: 220239-GHS-CNVMSP-220513-R1
Date: 8 September 2022
Version: For Information

Project Number: 220239

**PULSE WHITE NOISE ACOUSTICS** Level 5, 73 Walker Street, North Sydney NSW 2060
**P** 1800 4 PULSE (1800 478 573) **E** info@pwna.com.au **pwna.com.au** ABN 95 642 886 306

## DOCUMENT CONTROL

| | |
|---|---|
| **Project Name** | Glenwood High School |
| **Project Number** | 220239 |
| **Report Reference** | 220239-GHS-CNVMSP-220513-R1 |
| **Client:** | Richard Crookes Constructions |

| Revision | Description | Reference | Date | Prepared | Checked | Authorised |
|---|---|---|---|---|---|---|
| 0 | Issue 1 | 220239-GHS-CNVMSP-220513-R0 | 20 June 2022 | Ben White | Matt Furlong | Ben White |
| 0 | Issue 2 | 220239-GHS-CNVMSP-220513-R1 | 8 September 2022 | Ben White | Matt Furlong | Ben White |

PREPARED BY:

Pulse White Noise Acoustics Pty Ltd
ABN 95 642 886 306
Level 5, 73 Walker Street, North Sydney, 2060
1800 4 PULSE

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# 1 INTRODUCTION

Pulse White Noise Acoustics (PWNA) has been engaged to prepare a Construction Noise and Vibration Management Sub Plan (CNVMSP) for the construction activities to be undertaken as part of the Glenwood High School project including Item 10 of the REF and Item B17 of the project approvals including the SSD-23512960.

This assessment has been undertaken based on the previously completed by Aecom including the *Glenwood High School, Noise and Vibration Impact Assessment* with reference DOC No. 60659173-RPNV-01_C and dated 12 November, 2021 which has been included in the project submission and details background noise levels at the site.

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

Glenwood High School is located to the north of Forman Avenue and the west of Glenwood Park Drive. See Figure 1 below.

The proposed works on the site include upgrades and additions to the exiting school, including the following:

- Construction of a new three-storey building at the north-eastern portion of the site facing Glenwood Park Drive which will accommodate new learning spaces.
- Construction of one-storey performance pavilion.
- Refurbishment of existing Building Block A (ground floor only) to provide one new support unit within the space of an existing general learning space.
- Refurbishment of Building Block D (ground floor only) to provide an additional office space and storeroom.
- Refurbishment of Building Block E to re-purpose it on the ground floor for computer learning spaces, staff and administration spaces as well as upgrades to the library on the first floor.
- Refurbishment of Building Block J to re-purpose it from visual arts and performing arts to learning spaces and workshops for food tech and woods/metal unit.
- Demolition of existing botany room and construction of a new single storey pavilion comprising interview rooms and end-of trip facilities.
- The proposed development will also involve ancillary works at the site associated with the proposed upgrades.

The works to be undertaken as part of Glenwood High School includes the scope of works including the SSD-23512960 submission.

A summary of the proposed program for works to be completed on the site are included below.

1. Early Works – (Site Establishment & Sewer Diversion)
    - Site Establishment - Approximately 3 weeks
    - Inground Services – Approximal 6 Weeks
2. Stage 1 ( New Building & Performing Arts)
    - Bulk Earthworks & Piling - Approximately 6 weeks
    - Substructure - Approximately 9 weeks
    - Structure - Approximately 4 months
    - Envelope - Approximately 4 months
    - Internal Finishes & Services - Approximately 7 moths
    - External Works/Landscaping - Approximately 2 moths
3. Stage 2 (Buildings J, A, D & E)
    - Site Establishment - Approximately 2 weeks
    - Fitout Works - Approximately 3 months
    - Services - Approximately 3 months
    - Structure - Approximately 2 months
    - Envelope - Approximately 2 months

Residential receivers which are located within proximity to the site include a combination of single and two storey dwellings with windows overlooking the school property.

The nearest sensitive receivers to the site have been identified below.

| | |
|---|---|
| **Receiver 1:** | Residence to the north of the site at 278-270 Glenwood Park Drive and 17-11 Wheedon Street. |
| **Receiver 2:** | Residence to the north east of the site at 1-7 Shaun Street. |
| **Receiver 3:** | Residence to the east of the site located at 9-15 Kidman Street. |
| **Receiver 4:** | Residence to the east of the site located at 17-27 Kidman Street. |
| **Receiver 5:** | Residence to the south of the site located at 66-100 Forman Avenue. |

Details of the site location and surrounding receivers are detailed in following figure.

**Figure 1 Site Map, Measurement Locations and Surrounding Receivers**

## 1.2 SSD Compliance

This report has been undertaken in accordance with the requirements of Item B17 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 |
|---|---|---|
| B17 | *B17. The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to, the following:* | - |
| (a) | *be prepared by a suitably qualified and experienced noise expert;* | Ben white is a director of Pulse White Noise Acoustics, Ben's CV and membership of the Australian Acoustic Society is included in Appendix B. |
| (b) | *describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009);* | Sections 4.1 |
| (c) | *describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;* | Section 6.1 and 6.2 |
| (d) | *include strategies that have been developed with the community for managing high noise generating works;* | Section 6.5.4and Section 6.5.5. |
| (e) | *describe the community consultation undertaken to develop the strategies in condition B17(d);* | Section 6.5.2 and included in the project *Community Communication Strategy.* |
| (f) | *include a complaints management system that would be implemented for the duration of the construction; and* | Section 6.6 |
| (g) | *include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B14* | Section 6.2.2 and Section 6.3.2 |

## 1.3 REF Requirements

This report all addresses the REF requirements, including item 10, which includes the following:

**10. CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN**

10.1. A Construction Noise and Vibration Management Plan is to be prepared by an appropriately qualified engineer prior to the commencement of works and implemented during the undertaking of works. The Construction Noise and Vibration Management Plan is to, but not be limited to:

a) Identify feasible acoustic controls or management techniques (use of screens, scheduling of noisy works, notification of adjoining land users, respite periods) when excessive levels may occur.

10.2. During preparation of the Construction Noise and Vibration Management Plan, consult with the school and other sensitive receivers to determine what areas (if any) of the these are particularly noise sensitive, and at what time.

# 2 EXISTING ACOUSTIC ENVIRONMENT

Environmental noise constantly varies in level with time. Therefore, it is necessary to measure noise in terms of quantifiable time periods with statistical descriptors. Typically environmental noise is measured over 15 minute periods and relevant statistical descriptors of the fluctuating noise are determined to quantify the measured level.

Noise (or sound) consists of minute fluctuations in atmospheric pressure capable of detection by human hearing. Noise levels are expressed in terms of decibels, abbreviated as dB or dBA, the "A" indicating that the noise levels have been frequency weighted to approximate the characteristics of normal human hearing. Because noise is measured using a logarithmic scale, 'normal' linear arithmetic does not apply, e.g. adding two sound sources of equal values result in an increase of 3 dB (i.e. 60 dBA plus 60 dBA results in 63 dBA). A change of 1 dB or 2 dB in the sound level is difficult for most people to detect, whilst a 3 dB – 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change roughly corresponds to a doubling or halving in loudness.

Specific acoustic terminology is used in this assessment report. An explanation of common acoustic terms is included in Appendix A.

This assessment has been undertaken based on the previously completed previously completed by Aecom *Glenwood High School, Noise and Vibration Impact Assessment* with reference DOC No. 60659173-RPNV-01_C and dated 12 November, 2021 which has been included in the projects SSD approvals. The background noise levels detailed in this report have been used as the basis of this report.

As part of the Aecom *Glenwood High School, Noise and Vibration Impact Assessment* background noise levels within the vicinity of the site have been assessed and are detailed in Section 2.1.4, table 5 of the report. The results detailed in the *Noise and Vibration Impact Assessment* have been used as the basis of this report and are summries below.

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 which are presented within the Aecom *Glenwood High School, Noise and Vibration Impact Assessment* are detailed in the table below.

**Table 2 Presented Background Noise Levels - Aecom *Glenwood High School, Noise and Vibration Impact Assessment***

| Location | Daytime 7:00 am to 6:00 pm | Evening 6:00 pm to 10:00 pm | Night-time 10:00 pm to 7:00 am |
|---|---|---|---|
| | $L_{A90}$[1] (dBA) | $L_{A90}$[1] (dBA) | $L_{A90}$[1] (dBA) |
| Residential Receivers to the site | 38 | 30 | 30 |

*Note 1: The $L_{A90}$ noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.*

### 2.1.1 Noise Survey Measurements

In addition to the previously undertaken Aecom *Glenwood High School, Noise and Vibration Impact Assessment* an acoustic noise survey of the site has been conducted as part of this assessment. The site survey has included attended noise survey which has been undertaken to supplement the SSD *Noise and Vibration Assessment.* The site noise survey was undertaken during a typical daytime period when construction on the site will be undertaken. The attended noise levels measurements were undertaken using a Bruel and Kjaer 2236C type meter. The meter was calibrated before and after testing and no significant drift was recorded. All noise level measurements were undertaken in accordance with the measurement requirements of the Australian Standard AS1055:2018 *'Acoustics - Description and measurement of environmental noise'.*

The attended and unattended noise locations were selected to obtain suitable noise levels for the assessment of background noise levels ($L_{90\,(t)}$) as well as the impact from traffic movements ($Leq_{(t)}$).

The existing noise survey was undertaken at the site on the 12th May 2022 during a typical daytime periods when construction would be undertaken. The results of the attended noise level measurements are detailed in the table below.

**Table 3 Measured ambient noise levels in accordance with the NSW NPI**

| Measurement Location | Time of measurement | Measured $L_{Aeq,\ 15min}$ dB(A) | Measured $L_{A90,\ 15min}$ dB(A) | Comments |
|---|---|---|---|---|
| **Glenwood Park Drive** | 4pm to 4.15pm | 65 | 44 | Noise levels resulting from natural noise sources and traffic noise from roadways within vicinity of the site |
| **Forman Avenue** | 4.20pm to 4.35pm | 65 | 42 | |
| **Shaun Street** | 4.40pm to 4.55pm | 63 | 42 | |

# 3 PROJECT SSD REQUIREMENTS

This CNVSP has been prepared in accordance with the SSDA 23512960 consent condition B17 as well as the projects REF, including the requirements detailed in Sections 1.2 and 1.3 above.

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

*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 Industrial Noise Policy (EPA 2000).*

Construction noise levels at other noise receivers are outlined below:

- Construction noise levels within classrooms other educational institutions is not recommended to exceed 45dBA $L_{Aeq,15minute}$, 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 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 $L_{Aeq(15minute)}$ | | |
|---|---|---|---|
| | **Standard Hours**<br>**Monday to Friday: 7:00am to 6:00pm**<br>**Saturday: 8:00am to 1:00pm** | | **Outside Standard Hours**<br>**All hours not listed in the adjacent column.** |
| Residential Receivers | **NAFL: 48**<br>(RBL (38) + 10dB) | **HNAL: 75** | RBL + 5dB |

## 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 ($m/s^2$) 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 ($m/s^2$) 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.

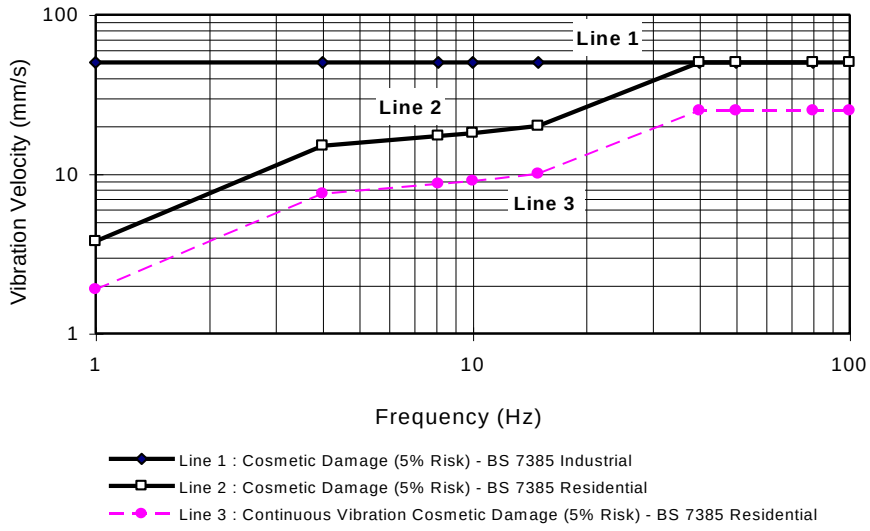
**Table 9 Transient vibration criteria as per standard BS 7385 Part 2 - 1993**

| Line in Figure 2 | 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 2).

**Figure 2 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 at the foundation at a frequency of | | | Vibration of horizontal plane of highest floor at all frequencies |
| | 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 |

*Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.*

# 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 10 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 and Demolition | 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/Refurbishment 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**

| Phase | Activity | Aggregate Sound Power Level (dBA re 1pW) | Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Criteria dBA $L_{Aeq\ 15\ minutes}$ | Summary of Result |
|---|---|---|---|---|---|---|
| Site Establishment Works | Mobile crane | 113 | 57 to 66 | 60 to 69 | **Standard Construction Hours** 38 + 10 = **48**<br><br>**Highly Noise Affected Level** Standard Construction Hours **75** | Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.<br><br>Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report. |
| | Power hand tools | | 56 to 65 | | | |
| | Semi Rigid Vehicle | | 47 to 56 | | | |
| Ground Works and Demolition | Excavator | 119 | 59 to 68 | 64 to 72 | | |
| | Handheld jack hammer | | 53 to 62 | | | |
| | Dump truck | | 46 to 55 | | | |
| | Concrete saw | | 56 to 65 | | | |
| | Skid steer | | 57 to 66 | | | |
| | Power hand tools | | 56 to 65 | | | |
| Structure | Handheld jack hammer | 117 | 48 to 57 | 62 to 71 | | |
| | Concrete saw | | 56 to 65 | | | |
| | Power hand tools | | 56 to 65 | | | |
| | Welder | | 48 to 57 | | | |
| | Concrete pump truck | | 57 to 66 | | | |
| | Concrete agitator truck | | 55 to 64 | | | |
| Internal Works | Power hand tools | 109 | 56 to 65 | 56 to 65 | | |
| Common and External Works | Concrete agitator truck | 117 | 55 to 64 | 61 to 70 | | |
| | Saw cutter | | 46 to 55 | | | |
| | Dump truck | | 46 to 55 | | | |
| | Concrete saw | | 56 to 65 | | | |
| | Power hand tools | | 56 to 65 | | | |

**Table 13 Receiver 2 – Summary of predicted construction noise levels**

| Phase | Activity | Aggregate Sound Power Level (dBA re 1pW) | Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Criteria dBA $L_{Aeq\ 15\ minutes}$ | Summary of Result |
|---|---|---|---|---|---|---|
| Site Establishment Works | Mobile crane | 113 | 55 to 65 | 61 to 68 | **Standard Construction Hours** 38 + 10 = **48**<br><br>**Highly Noise Affected Level** Standard Construction Hours **75** | Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.<br><br>Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report. |
| | Power hand tools | | 54 to 64 | | | |
| | Semi Rigid Vehicle | | 45 to 55 | | | |
| Ground Works and Demolition | Excavator | 119 | 57 to 67 | 62 to 71 | | |
| | Handheld jack hammer | | 51 to 61 | | | |
| | Dump truck | | 44 to 54 | | | |
| | Concrete saw | | 54 to 64 | | | |
| | Skid steer | | 55 to 65 | | | |
| | Power hand tools | | 54 to 64 | | | |
| Structure | Handheld jack hammer | 117 | 46 to 56 | 61 to 70 | | |
| | Concrete saw | | 54 to 64 | | | |
| | Power hand tools | | 54 to 64 | | | |
| | Welder | | 46 to 56 | | | |
| | Concrete pump truck | | 55 to 65 | | | |
| | Concrete agitator truck | | 53 to 63 | | | |
| Internal Works | Power hand tools | 109 | 54 to 64 | 54 to 64 | | |
| Common and External Works | Concrete agitator truck | 117 | 53 to 63 | 59 to 69 | | |
| | Saw cutter | | 44 to 54 | | | |
| | Dump truck | | 44 to 54 | | | |
| | Concrete saw | | 54 to 64 | | | |
| | Power hand tools | | 54 to 64 | | | |

**Table 14 Receiver 3 - Summary of predicted construction noise levels**

| Phase | Activity | Aggregate Sound Power Level (dBA re 1pW) | Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Criteria dBA $L_{Aeq\ 15\ minutes}$ | Summary of Result |
|---|---|---|---|---|---|---|
| Site Establishment Works | Mobile crane | 113 | 58 to 65 | 61 to 68 | **Standard Construction Hours** 38 + 10 = **48**<br><br>**Highly Noise Affected Level** Standard Construction Hours **75** | Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.<br><br>Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report. |
| | Power hand tools | | 57 to 64 | | | |
| | Semi Rigid Vehicle | | 49 to 55 | | | |
| Ground Works and Demolition | Excavator | 119 | 60 to 67 | 65 to 71 | | |
| | Handheld jack hammer | | 55 to 61 | | | |
| | Dump truck | | 48 to 54 | | | |
| | Concrete saw | | 58 to 64 | | | |
| | Skid steer | | 58 to 65 | | | |
| | Power hand tools | | 57 to 64 | | | |
| Structure | Handheld jack hammer | 117 | 50 to 56 | 64 to 70 | | |
| | Concrete saw | | 58 to 64 | | | |
| | Power hand tools | | 57 to 64 | | | |
| | Welder | | 49 to 56 | | | |
| | Concrete pump truck | | 58 to 65 | | | |
| | Concrete agitator truck | | 56 to 63 | | | |
| Internal Works | Power hand tools | 109 | 57 to 64 | 57 to 64 | | |
| Common and External Works | Concrete agitator truck | 117 | 56 to 63 | 62 to 69 | | |
| | Saw cutter | | 48 to 54 | | | |
| | Dump truck | | 48 to 54 | | | |
| | Concrete saw | | 58 to 64 | | | |
| | Power hand tools | | 57 to 64 | | | |

**Table 15 Receiver 4 - Summary of predicted construction noise levels**

| Phase | Activity | Aggregate Sound Power Level (dBA re 1pW) | Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Criteria dBA $L_{Aeq\ 15\ minutes}$ | Summary of Result |
|---|---|---|---|---|---|---|
| Site Establishment Works | Mobile crane | 113 | 57 to 62 | 60 to 65 | **Standard Construction Hours** 38 + 10 = **48**<br><br>**Highly Noise Affected Level** Standard Construction Hours **75** | Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.<br><br>Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report. |
| | Power hand tools | | 56 to 61 | | | |
| | Semi Rigid Vehicle | | 47 to 52 | | | |
| Ground Works and Demolition | Excavator | 119 | 59 to 64 | 64 to 69 | | |
| | Handheld jack hammer | | 53 to 58 | | | |
| | Dump truck | | 46 to 51 | | | |
| | Concrete saw | | 56 to 61 | | | |
| | Skid steer | | 57 to 62 | | | |
| | Power hand tools | | 56 to 61 | | | |
| Structure | Handheld jack hammer | 117 | 48 to 53 | 62 to 67 | | |
| | Concrete saw | | 56 to 61 | | | |
| | Power hand tools | | 56 to 61 | | | |
| | Welder | | 48 to 53 | | | |
| | Concrete pump truck | | 57 to 62 | | | |
| | Concrete agitator truck | | 55 to 60 | | | |
| Internal Works | Power hand tools | 109 | 56 to 61 | 56 to 61 | | |
| Common and External Works | Concrete agitator truck | 117 | 55 to 60 | 61 to 66 | | |
| | Saw cutter | | 46 to 51 | | | |
| | Dump truck | | 46 to 51 | | | |
| | Concrete saw | | 56 to 61 | | | |
| | Power hand tools | | 56 to 61 | | | |

**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 Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$ | Criteria dBA $L_{Aeq\ 15\ minutes}$ | Summary of Result |
|---|---|---|---|---|---|---|
| Site Establishment Works | Mobile crane | 113 | 54 to 59 | 57 to 62 | **Standard Construction Hours** 38 + 10 = **48**<br><br>**Highly Noise Affected Level** Standard Construction Hours **75** | Works indicatively predicted to have the potential to exceed the noise management level when working near a receiver.<br><br>Mitigations of construction noise required to be undertaken including measures detailed in Section 6 of this report. |
| | Power hand tools | | 53 to 58 | | | |
| | Semi Rigid Vehicle | | 44 to 49 | | | |
| Ground Works and Demolition | Excavator | 119 | 56 to 61 | 61 to 66 | | |
| | Handheld jack hammer | | 50 to 55 | | | |
| | Dump truck | | 43 to 48 | | | |
| | Concrete saw | | 53 to 58 | | | |
| | Skid steer | | 54 to 59 | | | |
| | Power hand tools | | 53 to 58 | | | |
| Structure | Handheld jack hammer | 117 | 45 to 50 | 60 to 65 | | |
| | Concrete saw | | 53 to 58 | | | |
| | Power hand tools | | 53 to 58 | | | |
| | Welder | | 45 to 50 | | | |
| | Concrete pump truck | | 54 to 59 | | | |
| | Concrete agitator truck | | 52 to 57 | | | |
| Internal Works | Power hand tools | 109 | 53 to 58 | 53 to 58 | | |
| Common and External Works | Concrete agitator truck | 117 | 52 to 57 | 58 to 63 | | |
| | Saw cutter | | 43 to 48 | | | |
| | Dump truck | | 43 to 48 | | | |
| | Concrete saw | | 53 to 58 | | | |
| | Power hand tools | | 53 to 58 | | | |

## 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<br>For noise impact, also refer to Section 6.1<br>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.<br>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.<br>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.<br>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.<br>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**<br>Mon – Fri: 7:00 am to 7:00 pm<br>Sat: 8:00 am – 1:00 pm | 0 - 3 | GMM |
| | 4 - 10 | GMM, PN, V [1], CMS, AC |
| | > 10 | GMM, PN, V, CMS, SN, AC |
| **Outside Standard Hours**<br>Mon – Fri: 7:00 am to 8:00 am<br>Sat: 7:00 am to 8:00 am | 0 - 10 | GMM, AC |
| | 11 - 20 | GMM, PN, V [1], CMS, AC |
| | > 20 | GMM, PN, V, CMS, SN, RO, AC |

*Notes*

*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* 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 and 5.2). 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 5.2 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 |
|---|---|
| Prior to 9:00am – No noisy works (Respite Period) | Prior to 9:00am – No noisy works (Respite Period) |
| 9:00am to 12:00pm – Works | 9:00am to 12:00pm – Works |
| 12:00pm to 2:00pm – No noisy works (Respite Period) | After 12:00pm – No noisy works (Respite Period) |
| 2:00pm to 5:00pm – Works | |
| After 5pm – No noisy works (Respite Period) | |

Details of the required respite time include above are based on the requirements of the project SSD approval.

### 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.

Construction works are to be conducted in accordance with the Conditions of Consent, which includes item C15 and include the following:

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

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 C4, which includes the following:

- 7am to 6pm Monday to Friday
- 8am to 1pm 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: $L_{Amin}$, $L_{A90}$, $L_{A10}$, $L_{A1}$, $L_{Amax}$ and $L_{Aeq}$. 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 5, 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 0 (i.e., criteria for structural damage, human comfort and impact to scientific or medical equipment).

### 6.3.2 Vibration Monitoring

Vibration monitoring can 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 |
| *See Section below for response to Event Types* | | | |

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.<br><br>All *Alert* events are to be SMS messaged to the building contractor site manager, subcontractor and acoustic consultant. |
| Alarm | **Stop Work Event**<br>All *Alarm* events are to be SMS messaged to a relevant Richard Crookes, subcontractor and acoustic consultant.<br><br>The activity generating the vibration levels is to be stopped immediately.<br><br>Suitable representatives of the building contractor, the relevant Subcontractor, Heritage Consultant and acoustic consultant.<br>Vibration monitoring report to be completed. Visual assessment of affected property will be conducted to assess whether damage is evident.<br><br>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. 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 SINSW Complaints management process as outlined in the Community Communication Report (CCR)

### 6.5.1 Enquiries and complaints management

SINSW manages enquiries, and complaints in a timely and responsive manner and detailed in the SINSW Community Consolation Summary report.

Prior to project delivery, a complaint could be related to lack of community consultation, design of the project, lack of project progress, etc.

During project delivery, a complaint is defined as in regard to construction impacts – such as – safety, dust, noise, traffic, congestion, loss of parking, contamination, loss of amenity, hours of work, property damage, property access, service disruption, conduct or behaviour of construction workers, other environmental impacts, unplanned or uncommunicated disruption to the school.

As per our planning approval conditions, a complaints register is updated monthly and is publicly available on the project's website page on the SINSW website. The complaints register will record the number of complaints received, the nature of the complaints and how the complaint was resolved as detailed in the complaints handling procedure is set out in the Community Communication Strategy.

If the Community Communication Strategy Complaints Procedure/process is updated, that document and process takes precedence over this CNVMSP.

### 6.5.2 Complaints management process

All complaints will be conducted using the SINSW Community Communication Strategy for the project.

Any face to face complaints will be directed to the hotline as detailed in the Community Communication Strategy.

### 6.5.3 Complaints in common community languages

Complaints can be made in common community languages using the Translating and Interpreting Service (TIS), managed by the Department of Home Affairs. Community members can be connected to an interpreter by calling TIS on 131 450. TIS contact details are included on all project communications. Once TIS has the interpreter on the line, the interpreter and community member are connected to School Infrastructure and phone interpretation can begin. School Infrastructure NSW receives the complaint via the translator and begins the complaints management process as outlined above.

### 6.5.4 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 3 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.

### 6.5.5 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 B7.

## 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 conjunction with the SINSW complaints management system as detailed in the Community Consultant Summary Report and the Community Communication Strategy documents developed by SINSW to ensure compliance with Condition B7.

## 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 Sub Plan for the construction works to be undertaken at Glenwood High School.

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 relevant EPA's *Interim Construction Noise Guideline* and the projects *Consent* including the SSD 23512960 and the project REF will be achieved.

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

Regards

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;<br>0dB the faintest sound we can hear<br>30dB a quiet library or in a quiet location in the country<br>45dB typical office space. Ambience in the city at night<br>60dB Martin Place at lunch time<br>70dB the sound of a car passing on the street<br>80dB loud music played at home<br>90dB the sound of a truck passing on the street<br>100dB the sound of a rock band<br>115dB limit of sound permitted in industry<br>120dB deafening |
| dB(A) | *A-weighted decibels* 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 *pitch*. 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 *Interim Construction Noise Guideline* 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 *Interim Construction Noise Guideline.* |
| AV-TG | NSW EPA *Assessing Vibration Technical Guideline.* |

# APPENDIX B – BEN WHITE CV AND AAS MEMBERSHIP

# Curriculum Vitae – Benjamin White

## Employment Experience:

Director – Pule White Noise Acoustics November 2020 – Present

Director - White Noise Acoustics: March 2019 – Present

Director/Engineer - Acoustic Logic Consultancy: March 2001 – July 2018

## 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

General Secretary

AUSTRALIAN ACOUSTICAL SOCIETY A.C.N. 000 712 658 The Common Seal Of

This certificate remains the property of the Australian Acoustical Society

## 6.7 CONSTRUCTION WASTE MANAGEMENT SUB-PLAN

The Construction Waste Management Sub-Plan has been prepared by RCC& EcCell.

Refer to the following page.

environmental management
pty ltd

# CONSTRUCTION WASTE MANAGEMENT PLAN

## GLENWOOD HIGH SHOOL UPGRADE
## SSD-23512960

| | |
|---|---|
| Revision Number: | VERSION 3 |
| Report Date: | 26/08/2022 |
| Presented by: | JO DRUMMOND<br>ECCell Environmental Management<br>35 WAVERLEY CRESCENT<br>BONDI JUNCTION NSW 2022<br>www.eccellenvironmental.com.au |
| Submitted to: | Sam Lyons<br>Richard Crookes |