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PROPERTY NSW

**HUNTERS HILL  
REMEDATION**

CONSTRUCTION  
NOISE AND  
VIBRATION  
MANAGEMENT PLAN

**wsp**

MAY 2021

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## Hunters Hill Remediation Construction Noise and Vibration Management Plan

Property NSW

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# GLOSSARY

<b>Term</b>	<b>Description</b>
<b>Noise Terms</b>	
Acoustic barrier	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc used to reduce noise, without eliminating it.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
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.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibels (dB)	<p>The level of noise is measured objectively using a sound level meter. This instrument has been specifically developed to mimic the operation of the human ear. The human ear responds to minute pressure variations in the air. These pressure variations can be likened to the ripples on the surface of water but of course cannot be seen.</p> <p>The pressure variations in the air cause the eardrum to vibrate and this is heard as sound in the brain. The stronger the pressure variations, the louder the sound is heard.</p> <p>The range of pressure variations associated with everyday living may span over a range of a million to one. On the top range may be the sound of a jet engine and on the bottom of the range may be the sound of a pin dropping.</p> <p>Instead of expressing pressure in units ranging from a million to one, it is found convenient to condense this range to a scale 0 to 120 and give it the units of decibels.</p>
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 in is denoted as dB(A). Most environmental noise is measured using the a filter.
dB(C); C-weighted decibels	C weighted adjustments are relatively flat across lower frequencies, and as such are better suited for the assessment of low frequency noise.
Diffraction	The distortion around solid obstacles of waves travelling past.
Frequency	Of a periodic quantity: the time rate of repetition. The reciprocal of the period. Frequency is measured in hertz (Hz).

<b>Term</b>	<b>Description</b>
Loudness	A 3dB increase represents a doubling of the sound pressure, however an increase of about 10dB is required before the sound will subjectively appear to be twice as loud. That is, a sound of 85dB is twice as loud as a sound of 75dB which is twice as loud as a sound of 65dB and so on. That is, the sound of 85dB is four times as loud as a sound of 65dB. The smallest change which can be readily heard is approximately 2dB. An increase beyond 5dB is considered to represent the level at which a change in loudness begins to be clearly perceived.
L <sub>10</sub>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L <sub>90</sub>	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L <sub>90</sub> noise level expressed in units of dB(A).
L <sub>eq</sub>	Equivalent sound pressure level – the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. The sound weighting of the noise measurement is commonly added, for example L <sub>Aeq</sub> or L <sub>Ceq</sub> .
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound exposure level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L <sub>eq</sub> sound levels over any period of time and can be used for predicting noise at various locations.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of sound pressure, expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Structure-borne noise	Vibration propagating through solid structures in the form of compression or bending waves, heard as sound.

### **Vibration Terms**

Acceleration	A vector quantity that specifies the time derivative of velocity.
Accelerometer	A pickup that converts an input acceleration to an output (usually electrical) that is proportional to the input acceleration.
Ambient vibration	The all-encompassing vibration associated with a given environment, usually a composite of vibration from many sources, far and near.
Amplitude	The maximum value of a sinusoidal quantity.
Complex wave	The resultant form of a number of sinusoidal waves that are summed together forming a periodic wave.
Crest factor	The ratio of the peak value to the RMS value.

<b>Term</b>	<b>Description</b>
Cycle	The complete range of states or values through which a periodic phenomenon or function passes before repeating itself identically.
Displacement	A vector quantity that specifies the change of position of a body or particle with respect to a reference frame.
Frequency	The reciprocal of the period when the independent variable is time.
Harmonic	Of a periodic quantity. A sinusoidal quantity whose frequency is an integral multiple of the fundamental frequency of the quantity.
Hertz (Hz)	Units in which frequency is expressed. Synonymous with cycles per second.
Peak value	The maximum value of a quantity during a given interval.
Peak-to-peak value (PPV)	Of an oscillating quantity. The algebraic difference between the extreme values of the quantity.
Periodic vibration	A periodic quantity whose values recur for certain equal increments of the independent variable.
Resonance	Of a system in forced oscillation. The condition of the system when any change in the frequency of excitation, however small the change, causes a decrease in a response of the system.
Resonance frequency	A frequency at which resonance occurs.
RMS	Root mean square of the acceleration value of the vibration source. This measure allows for the magnitude of the vibration, regardless of its direction.
Spectrum	A description of a quantity as a function of frequency or wavelength.
Transducer	A device that receives energy from one system and supplies energy, of either the same or a different kind, to another system in such a manner that the desired characteristics of the input energy appear at the output.
Velocity	A vector quantity that specifies the time derivative of displacement.
Wavelength	Of a periodic wave. The distance, measured perpendicular to the wave front in the direction of propagation, between two successive points on the wave that are separated by one period.

# 1 INTRODUCTION

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## 1.1 PURPOSE, SCOPE AND OBJECTIVES

Property NSW has been granted conditional approval to complete remediation work at Nelson Parade, Hunters Hill in New South Wales (NSW) (the project). The project seeks to excavate contaminated soil down to bedrock on three government owned lots at 7,9 and 11 Nelson Parade, adjoining foreshore land and some targeted areas on neighbouring properties 5, 13 and 15 Nelson Parade, hunters Hill.

The remediation works will be overseen by the Australian Nuclear Science and Technology Organisation (ANSTO) and will be independently reviewed by a Site Auditor accredited by the NSW EPA under the *Contaminated Land Management Act 1997* (CLM Act).

This Construction Noise and Vibration Management Plan (CNVMP) has been developed for Property NSW and forms part of the wider Remediation Environmental Management Plan (REMP) for the Project. The purpose of this sub plan is to:

- Identify the relevant noise and vibration legislative requirements
  - Summarise potential noise and vibration impacts in reference to the previous assessment
  - Outline systems and management measures to reduce or eliminate identified noise or vibration impacts
  - Outline the responsibilities of those involved in the control of noise and vibration impacts
  - Outline an effective monitoring framework to assess the effectiveness of the controls implemented.
- 

## 1.2 RELEVANT GUIDELINES

This CNVMP has been prepared with reference to the Noise and Vibration Assessment (NVA) for the Project (WSP, 2020). The findings of that report have been summarised in Section 4.

Noise and vibration guidelines for construction activities are based on publications managed by the New South Wales (NSW) Environment Protection Authority (EPA). The EPA guidelines applicable to this assessment include:

- *Interim Construction Noise Guideline* (Department of Environment and Climate Change (DECC), 2009), (ICNG)
- *NSW Road Noise Policy* (Department of Environment and Climate Change and Water (DECCW), 2011), RNP
- *Assessing Vibration: a technical guideline* (DECC, 2006), (AVaTG)
- *British Standard 6472-1: 2008, Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting* (BS 6472-1)
- *German Standard 4150-3 Structural Vibration, Part 3: Effects of Vibration on Structures* (DIN 4150-3)
- *NSW Noise Policy for Industry* (EPA, 2017), (NPfI)

## 2 PROJECT DESCRIPTION

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### 2.1 PROJECT OVERVIEW

The Project is for the remediation of the former Radium Hill Company site at Nelson Parade, Hunters Hill in New South Wales (NSW) (the Project). It comprises the following proposed works:

- 1 Remediation works at the Project site (Remediation Works) being works to excavate contaminated soils down to bedrock on:
  - a three government owned lots at 7,9 and 11 Nelson Parade
  - b the adjoining foreshore land, and
  - c some targeted areas on neighbouring private properties
- 2 The remediation works will be overseen by ANSTO and will be independently reviewed by a site Auditor accredited by the NSW EPA under the CLM Act.

The Project site is in a residential area of Nelson Parade, Hunters Hill with established residences on both the eastern and western sides of the roadway. The Parramatta River, which flows into Sydney Harbour, is on the southern boundary of the Project site, and the Nelson Parade roadway is on the northern boundary. Residential properties are located on the opposite side of Nelson Parade

The Remediation Site is tiered from Nelson Parade down to the harbour over a 25-metre drop. The Remediation Site is divided into two distinct areas: the upper terraces and the foreshore area, with a sandstone cliff of approximately 10 metres separating the two. A man-made seawall separates the Remediation Site from the harbour.

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### 2.2 NOISE SENSITIVE RECEIVERS

The site is in a residential area and is surrounded to the north, east and west by adjacent residential properties. The nearest noise sensitive receivers are presented in Figure 2.1. These receivers are representative of potentially worst affected receivers close to the works.

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### 2.3 VIBRATION SENSITIVE RECEIVERS

The site at 11 Nelson Parade, Hunters Hill contains a multi-level residential dwelling atop a sandstone cliff system that extends beyond the site in an east-west direction. The base of the cliff contains a small, overgrown green space that extends to the harbour wall.

The graffiti consists of the inscription 'SS Titus/ May 7 / 1884 in a white pigmented material directly applied to the sandstone surface of the cliff face.

It is positioned roughly 5 metres above the ground level and can currently be viewed from the existing scaffold at a distance of roughly 2 - 3 metres.



<b>Figure 2.1</b> Hunters Hill Receiver IDs	Author: RW			<b>Legend</b>  Study area  Receivers  Noise Monitoring Locations	<b>Hunters Hill Remediation</b>
Date: 03/06/2020	Approved by: BI		1:1,000 at A3	Assessed receivers 	
To be read in conjunction with WSP document:		PS119437-200528-ACO-NVIA <small>Map Source: NSW SIX Maps</small>		<small>© WSP Australia Pty Ltd ("WSP"). Copyright in the drawings, information and data recorded ("the information") is the property of WSP. This document and the information are solely for the use of the authorised recipient and this document may not be used, copied or reproduced in whole or part for any purpose other than that which it was supplied by WSP. WSP makes no representation, undertakes no duty and accepts no responsibility to any third party who may use or rely upon this document or the information. NCSI Certified Quality System to ISO 9001. © APPROVED FOR AND ON BEHALF OF WSP Australia Pty Ltd.</small>	

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## 2.4 SCOPE OF WORKS

The Project would be divided into five primary remediation phases. These are summarised below (as relevant to noise and vibration), and discussed in more detail in the REMP.

### 2.4.1 PHASE 1A – SITE SURVEY AND FURTHER SITE ESTABLISHMENT

The key activities at this phase include security fencing, establishment of environmental controls and safety barriers, improving stair access to the rear of the property, demolition of the front of No. 11 house and associated gardens to create a new entrance to the premises.

### 2.4.2 PHASE 1 – CONSTRUCTION OF CLEAN SITE ACCESS

Establishment of clean ‘remediated’ hardstand is essential to create a clean entry/exit at the site which would eliminate any risk associated with cross contamination. An engineered slab on the remediated upper terrace would remain a clean zone throughout works (subject to ongoing ANSTO assessment). A screened crane landing zone would be established, where loads can be assessed and cleaned if required before being moved into clean zone. The area is proposed to be located at the Nelson Parade entrances to No’s 7, 9 and 11.

### 2.4.3 PHASE 2 – COMMISSIONING CRANE, PREPARATION OF BAG STORAGE AND TREE REMOVAL

Following the construction of the remediated hardstand access area and establishment of the Remediation Site entrance / exit gates in Phase 1, the contractor would commence full establishment and commissioning of the tower crane proposed for the remedial works.

### 2.4.4 PHASE 3 – STORMWATER WORKS AND SITE INFRASTRUCTURE INSTALL

The Phase 3 works would involve clearing most site vegetation, installing the WTP and sewer main and establishing site wide storm water management controls.

### 2.4.5 PHASE 4 – DEMOLITION AND REMEDIATION WORKS

Phase 4 works comprise the following:

- Excavation and remediation of the mid Terrace (Stage 4A)
- Removal of pool and outdoor patio and remediation (Stage 4B)
- Foreshore excavation, sea wall support, validation, and foreshore backfilling (Stage 4C)
- Bagged material will be transported for storage on upper terraces and loaded into shipping containers. Filled containers will be loaded onto semi-trailers for transport to a licenced transfer facility near Port Botany for storage prior to overseas disposal.

### 2.4.6 PHASE 5 – REMEDIATION WORKS – COMPLETION OF EXCAVATION AND DEMOBILISATION

The Phase 5 Remediation works have been identified as the closing phase of the Project. The works comprise the following:

- Disconnection of services
- Establishment of new temporary site sheds
- Removal of all identified asbestos containing building materials by a licenced asbestos removalist

- Demolition and remediation of the number 11 Nelson Parade building
- Excavation of contaminated soil/fill remaining within the foreshore area
- Treatment of residual water within the basin through the WTP
- Removal and off-site disposal of any residual sediment within the WTP
- Validation of entire site
- Demobilisation of equipment and services and handover.

# 3 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT CRITERIA

## 3.1 CONSTRUCTION NOISE

Construction noise management levels are given in the NSW *Interim Construction Noise Guideline* (ICNG) (DECCW 2009) and are based on measured background noise to minimise the annoyance from construction. The management levels represent the level at which when exceeded, the measures outlined in the ICNG should be implemented.

### 3.1.1 PROJECT APPROVAL CONDITIONS

Conditions of Project Approval (08\_0008) have been provided. These are set out below:

#### **NOISE**

##### **Hours of Work**

**B29** The Proponent must comply with the hours detailed in Table 2 unless otherwise agreed in writing by the Planning Secretary.

**Table 2 Hours of Work**

Activity	Day	Time
Site establishment, remediation works, private property works and demobilisation	Monday – Friday	7 am to 6 pm
	Saturday	8 am to 1 pm

**B30** Works outside of the hours identified in Condition A1 may be undertaken in the following circumstances:

- (a) works that are inaudible at the nearest sensitive receivers;
- (b) works agreed to in writing by the Planning Secretary;
- (c) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or
- (d) where it is required in an emergency to avoid the loss of lives, property or to prevent environmental harm.

##### **Construction Noise Limits**

**B31** The project must be constructed to achieve the construction noise management levels detailed in the *Interim Construction Noise Guideline* (DECC, 2009) (as may be updated or replaced from time to time).

**B32** The Proponent must implement all feasible and reasonable noise mitigation measures for the project including the measures detailed in the statement of commitments in Appendix 2. Any activities that could exceed the construction noise management levels established for the project in accordance with the *Interim Construction Noise Guideline* (DECC, 2009) must be identified in the *Noise and Vibration Management Plan* required by Condition C2(e), together with specification of all feasible and reasonable contingency mitigation measures that will be implemented.

#### **VIBRATION**

##### **Vibration Criteria**

**B33** Vibration caused by the project at any residence or structure outside the site must be limited to:

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

**B34** The limits in Condition A5 apply unless otherwise outlined in a *Noise and Vibration Management Plan*, approved as part of the REMP required by Condition B33 of this approval.

### 3.1.2 CONSTRUCTION NOISE MANAGEMENT LEVELS

Table 0.1 defines noise management levels (NMLs) as specified in the ICNG and how they are applied for residential receivers. NMLs are the level of noise above which receivers are considered to be ‘noise affected’. They are based on the measured rating background level (RBL) as defined in the NPfI plus an additional allowance of 10 dB during standard hours and 5 dB outside of standard hours.

Where construction noise levels are above 75 dBA at residential receivers during standard hours, they are considered ‘highly noise affected’ and require additional considerations to mitigate potential impacts.

Table 0.1 Interim Construction Noise Guideline construction noise management levels for residential receivers and working hours

TIME OF DAY	NML $L_{EQ,15MIN}^{1,2}$ DBA	HOW TO APPLY
<b>Recommended standard hours:</b> Monday–Friday 7.00 am–6.00 pm Saturday 8.00 am– 1.00 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. <ul style="list-style-type: none"> <li>— Where the predicted or measured <math>L_{eq,15min}</math> dBA is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</li> <li>— The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.</li> </ul>
	Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. <p>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:</p> <ul style="list-style-type: none"> <li>— times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences)</li> <li>— if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.</li> </ul>
<b>Outside recommended standard hours</b>	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.</p>

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

Table 0.2 presents the noise management levels for residential receivers affected by the remediation works. These are based on the background noise monitoring presented in the NVA.

Table 0.2 Project specific criteria for residential properties

PERIOD	RBL DBA	NOISE MANAGEMENT LEVEL $L_{EQ,15MIN}$ DBA	HIGHLY NOISE AFFECTED LEVEL $L_{EQ,15MIN}$ DBA
Day	34	44	75

### 3.1.3 CONSTRUCTION HOURS

Remediation works are scheduled to be undertaken during the day period (7.00 am to 6.00 pm Monday to Friday and Saturdays 8.00 am to 1.00 pm). As these are during Standard construction hours (as outlined in Table 0.1), NMLs for out of hours work are not discussed in this document.

## 3.2 OFF-SITE ROAD TRAFFIC NOISE MANAGEMENT LEVELS

The proposed Project works require vehicle movements on the local and collector roads to facilitate the removal of cleared material and the delivery of equipment and staff.

The NSW EPA Road Noise Policy (RNP) has been used to assess the noise from traffic generated by the proposed Project works. The RNP guidelines are applicable for traffic movements generated during the remediation works Project works.

The main route providing access to the proposed project site is along Nelson Parade via Woolwich Road.

The project related roads have been classified as follows:

- Nelson Parade, Prince George Parade, Tیره Street and Gladstone Avenue - existing local roads.
- Woolwich Road - existing collector road.

Table 0.3 presents the road traffic noise criteria from the RNP for land use developments with a potential to create additional traffic on an existing road. The external noise criteria are applied 1 m from the external facades of the affected building and at a height of 1.5 m from the most affected storey.

Table 0.3 Road Noise Policy assessment criteria

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	ASSESSMENT CRITERIA	
		DAY (7.00 AM TO 10.00 PM)	NIGHT (10.00 PM TO 7.00 AM)
Local road	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{eq,1hr}$ 55 dBA	$L_{eq,1hr}$ 50 dBA

ROAD CATEGORY	TYPE OF PROJECT/LAND USE	ASSESSMENT CRITERIA	
		DAY (7.00 AM TO 10.00 PM)	NIGHT (10.00 PM TO 7.00 AM)
Collector/sub-arterial/arterial/freeway	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{eq,15hr}$ 60 dBA	$L_{eq,9hr}$ 55 dBA

In addition, the RNP application notes state that where an existing receiver is affected by a land use development, the increase in road traffic noise above the existing road noise level should be limited to 2 dB. This applies where the existing noise level is either above or within 2 dB of the criteria presented in Table 0.3.

### 3.3 GROUND VIBRATION MANAGEMENT LEVELS

Vibration during the proposed works is considered an intermittent source associated with two main types of impact:

- Disturbance at receivers.
- Potential architectural/structural damage to buildings.

Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

#### 3.3.1 HUMAN EXPOSURE TO GROUND VIBRATION

Assessing Vibration: a technical guideline 2006 (AVTG) provides guidance for assessing human exposure to ground vibration. In consideration to British Standard BS6472:1992, the guideline recommends Vibration Dose Value (VDV) levels, to achieve a low probability of annoyance or disturbance at affected residential land use. Table 0.4 presents the adopted VDV vibration goals for the residential receivers.

Table 0.4 Residential ground vibration criteria

LOCATION	DAY VIBRATION DOSE VALUE $M/S^{-1.75}$	
	PREFERRED	MAXIMUM
Residential receivers	0.20	0.40

#### 3.3.2 STRUCTURAL GROUND VIBRATION

To evaluate the effects of vibration on structures and buildings, the NSW guidance references German Standard DIN 4150: Part 3-1999. Dependent upon the dominant frequency of vibration, assessed in Hertz (Hz), structural vibration limits are established at the foundation of nearest buildings.

The adopted DIN 4150 structural vibration goals in Table 0.5 are considered conservative for all works. Dominant frequency of vibration for construction and remediation type work is typically <100 Hz.

No commercial/industrial buildings were identified in the study area, and as such only criteria for dwellings, heritage items and residential structures are presented.

Table 0.5 Ground vibration criteria to prevent structural damage

STRUCTURE	STRUCTURE VIBRATION CRITERIA PPV MM/S		
	1-10 HZ	10-50 HZ	50-100 HZ
Dwellings and residences of similar occupancy	5	5-15	15-20
Heritage items	3		

# 4 SUMMARY OF NOISE AND VIBRATION IMPACTS

Noise and vibration impacts were determined in the Noise and Vibration assessment for the project (WSP, 2020). This section summarises the results of that assessment.

## 4.1 CONSTRUCTION HOURS AND DURATION

Remediation works are scheduled to be undertaken during the day period (7.00 am to 6.00 pm Monday to Friday and Saturdays 8.00 am to 1.00 pm) over a 13-month period.

## 4.2 ASSESSMENT METHODOLOGY

A noise propagation model was established utilising the SoundPLAN (Version 8) noise modelling software for the Project works. The site and surrounding environment were digitised to create a 3-dimensional model of the study area. Assumptions and inputs to this model are described in the NVA.

## 4.3 PREDICTED NOISE LEVELS

The remediation scenarios assessed are presented in Section 0 and the modelled equipment noise levels are presented in Appendix A-2.

Table 4.1 presents the worst-case predicted noise levels for each work stage. Where noise levels exceed the Noise Management Level and the Highly Affected noise level they are highlighted in yellow and orange respectively.

Table 4.1 Worst case predicted noise levels per Phase

RECEIVER	PREDICTED NOISE LEVEL PER PHASE $L_{EQ, 15MIN}$ dBA							
	1A	1B <sup>1</sup>	2	3 <sup>1</sup>	4A <sup>1</sup>	4B	4C	5
Receiver 1	71	71	75	80	75	66	72	66
Receiver 2	64	73	81	83	84	78	84	72
Receiver 3	64	72	78	78	79	71	76	64
Receiver 4	72	74	80	84	81	73	79	71
Receiver 5	38	47	53	57	56	49	54	41
Receiver 6	56	67	72	70	72	62	67	55
Receiver 7	42	47	54	61	64	65	62	57
Receiver 8	64	66	72	76	73	65	71	61
Receiver 9	57	61	66	69	68	61	66	54

(3) Predictions for Phases 2, 3 4A, and 4C include a +5 dBA penalty for annoying characteristics of construction plant.

Table 4.1 shows noise levels ranging from 38 to 84 dBA are predicted at the nearest residential receivers R1 to R9. Where noise levels are above 75 dBA, the ICNG indicates that this level of noise may result in a strong community reaction.

The potentially worst affected receiver is R2 where worst case noise levels are predicted to exceed the highly noise affected level for all remediation phases with the exception of 2, 3, 4A, 4B, 4C and 5. Additionally, R3 and R4 are expected to be particularly impacted with highly noise affected levels being exceeded for phases 2, 3, 4A and 4C. The main contributors to noise levels are chain saw, tree chipper, concrete saw, tower crane, and delivery and container trucks.

The predicted worst case noise impacts are more than 20 dB above the existing measured day time ambient noise levels ( $L_{eq}$  52 – 56 dBA) on Nelson Parade. Project works would be clearly audible at the external façade of neared residences and may cause disturbance and annoyance to occupants at nearest residences to the site boundary and north of Nelson Parade.

Noise levels at the receivers are highly dependent on the number and type of plant operating and the location of mobile plant on site. The noise levels presented in Table 4.1 represent a worst-case scenario where mobile plant operate simultaneously and are located at the closest positions to the receivers within the site boundary. It is expected that noise levels from the site would frequently be less than the worst case predicted levels when noise sources are either not operated simultaneously or located in other parts of the site, further from the receivers.

Based on the proposed duration of Project works, anticipated exceedance of noise management levels and likelihood for disturbance at nearest receivers, the proponent should implement all feasible and reasonable noise management and mitigation measures to provide continuous reduction and control of noise.

To assist in targeting mitigation of worst case predicted noise impacts at nearest receivers, noise contour map for Phase 3 remediation works is presented in Appendix A-1.

Table 4.2 presents the affected receiver locations for each phase.

Table 4.2 Affected receivers

STAGE	AFFECTED RECEIVERS	
	PREDICTED EXCEEDANCE OF NML	HIGHLY NOISE AFFECTED
1A	1, 2, 2A, 4, 5 Gladstone Avenue 1, 2, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15, 16, 18, 19, 29 Nelson Parade 17 Prince George Parade	-
1B	1, 2, 2A, 3, 4, 5, 6 Gladstone Avenue 1, 2, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 29 Nelson Parade 15, 17, 19 Prince George Parade	-
2	1, 2, 2A, 3, 4, 5, 6 Gladstone Avenue 1, 2, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 23, 27, 29 Nelson Parade 15, 17, 19 Prince George Parade	2 Gladstone Avenue 5, 8 Nelson Parade
3	1, 2, 2A, 3, 4, 5, 6, 6A Gladstone Avenue 1, 2, 3, 4, 6, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 27, 29 Nelson Parade 11, 15, 17, 19 Prince George Parade	2 Gladstone Avenue 5, 8, 10, 13 Nelson Parade
4A	1, 2, 2A, 3, 4, 5, 6, 6A Gladstone Avenue 1, 2, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 23, 25, 27, 29 Nelson Parade 15, 17, 19 Prince George Parade	2 Gladstone Avenue 5, 8 Nelson Parade

STAGE	AFFECTED RECEIVERS	
	PREDICTED EXCEEDANCE OF NML	HIGHLY NOISE AFFECTED
4B	1, 2, 2A, 3, 4, 5, 6, Gladstone Avenue 1, 2, 3, 4, 6, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 27, 29 Nelson Parade 15 Prince George Parade	5 Nelson Parade
4C	1, 2, 2A, 3, 4, 5, 6, 6A Gladstone Avenue 1, 2, 3, 4, 5, 6, 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 21, 23, 25, 27, 29 Nelson Parade 15, 17, 19 Prince George Parade	2 Gladstone Avenue 5, 8 Nelson Parade
5	1, 2, 2A, 3, 4, 5 Gladstone Avenue 1, 2, 3, 4, 6, 8, 10, 12, 13, 14, 15, 17, 18, 19, 29 Nelson Parade 15 Prince George Parade	-

## 4.4 PREDICTED OFF-SITE ROAD TRAFFIC NOISE

During the proposed Project works, heavy vehicles will access the site via the local and collector roads, specifically Nelson Parade, Prince George Parade / Tiree Street, Gladstone Avenue and Woolwich Road.

It is anticipated that hourly vehicle traffic from construction will consist of up to six heavy vehicle movements per hour during the most transport-intensive stages of construction. Table 4.3 presents the predicted increase in traffic noise as a result of heavy vehicles travelling on roads in the vicinity of the project. The increase in traffic noise was calculated using the CoRTN prediction method assuming a speed of 50 km/h, dense graded asphalt pavement surface and an existing heavy vehicle percentage of 5% for local roads and 10% for collector roads.

Table 4.3 Construction heavy vehicle traffic noise increase

ROAD	EXISTING TRAFFIC VOLUMES		WITH CONSTRUCTION TRAFFIC VOLUMES		% INCREASE IN TRAFFIC VOLUMES		PREDICTED INCREASE IN NOISE LEVEL DB	
	AM	PM	AM	PM	AM	PM	AM	PM
Woolwich Road (west of Gladstone Ave)	637	547	643	553	0.9	1.1	0.2	0.3
Gladstone Avenue (between Woolwich Rd and Prince Edward Parade)	79	70	85	76	7.6	8.6	1.9	2.4
Prince Edward Parade (west of Gladstone Ave)	41	36	47	42	14.6	16.7	3.2	3.8
Prince Edward Parade / Nelson Parade (east of Gladstone Ave)	32	34	38	40	18.8	17.6	3.6	3.5

(4) AM indicates the period between 8.00 am and 9.00 am and PM is the period 3.00 pm to 4.00 pm

(5) Traffic volumes for Woolwich Road assume a 2% growth per annum from the volumes reported in the 2012 assessment through to 2020. Other traffic volumes for local roads are assumed not to have increased.

As indicated by Table 4.3,  $L_{eq, 1hr}$  traffic noise levels are predicted to increase up to 4 dB during the works. Traffic noise increase on Woolwich Road is predicted to be imperceptible when construction traffic is combined with the existing traffic. The increase in noise is most evident on the side-streets such as Prince Edward Parade, where current local traffic volumes are low. This localised change in noise will likely be noticeable to the residents living on this street, occurring during the works then returning to current noise levels outside of site hours, and when the works are complete.

Up to 16 light vehicles are expected to travel to and from the site for contractors to access the site. It is anticipated that these movements would happen primarily outside of the times of heavy vehicle movements. The façade noise level from 16 light vehicles in an hour passing a dwelling at 15 m travelling at 50 km/h was calculated as  $L_{eq, 1hr}$  50 dBA.

The RNP criteria is not expected to be exceeded by light vehicle traffic as the addition of the projects light vehicles would not cause an increase of more than 2 dB if the existing noise level is either above or within 2 dB of the  $L_{eq, 1hr}$  55 dBA criteria level.

As construction traffic noise will be perceptible at the residents in the local streets surrounding the site, noise management measures have been recommended in Section 5 to assist in minimising the potential for noise impacts.

## 4.5 ASSESSMENT OF GROUND VIBRATION IMPACTS

Assessment of potential ground vibration from remediation works has been undertaken for dominant vibration generating plant. Typical ground vibration levels detailed in Table 4.4 has referenced previous measurement and assessment of ground vibration from the previous assessment.

Potential received vibration levels are receiver specific dependent upon the ground strata conditions, dominant frequency of vibration and duration of vibration events. However, the levels presented in Table 4.4 are intended to be indicative of the expected typical levels from the construction plant used on site. It is understood that operation of such plant will not occur at distances of less than 10 metres from receiver structures.

Table 4.4 Predicted vibration levels

PLANT	PPV VIBRATION LEVEL (MM/S)		EVDV M/S <sup>1.75</sup>	
	10 m	20 m	10 m	20 m
Excavator	1	0.4	0.8	0.2

Notes Vibration levels taken from 2012 report.

Potential received ground vibration levels of up to 1 mm/s PPV at nearest receivers up to 10 m away from plant and machinery indicate that compliance is expected with the conservative structural vibration objectives of 5 mm/s to 20 mm/s and the heritage objective of 3 mm/s.

The vibration dose values presented in Table 4.4 indicate vibration is unlikely to be perceptible and cause disturbance to occupied residences or the heritage location. Ground vibration is expected to be compliant with adopted goals and have a low probability of causing annoyance or disturbance.

Where additional vibration intensive equipment is required to be used, further consideration of vibration impacts should be undertaken. Vibration intensive plant should not be used within 10 m of the area above the Titus Graffiti heritage structure.

# 5 NOISE AND VIBRATION MANAGEMENT MEASURES

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## 5.1 INTRODUCTION

The assessment outlined in Section 3.1 has predicted exceedances of project NMLs and the 'Highly impacted' noise level during the works. Exceedances of traffic noise guidelines have also been predicted on Gladstone Avenue., Prince Edward Parade and Nelson Parade.

No exceedances of ground vibration objectives are expected to occur.

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## 5.2 MANAGEMENT MEASURES

The noise mitigation and management measures outlined in Table 5.1 will be implemented to reduce the likelihood of noise impacts.

Table 5.1 Management controls

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
NV1	Noise and Vibration	Detailed community consultation would be undertaken with nearby noise affected residents to inform them of the proposed works, anticipated impacts and to investigate preferred times for construction works. This is to be undertaken at least 2 weeks before the start of works and should target the affected neighbourhood, in particular those receivers identified as noise affected in Section 4.3 (including along affected transport routes).	Contractor	Pre construction planning	Condition B32	Consultation records
NV2		Restriction of standard construction working hours to 7am and 6pm (Monday to Friday) and Saturdays 8am and 1pm, with no works on Sundays or public holidays. Where site specific conditions expressly require works outside these times, additional assessment and approvals would be sought by the Contractor.  Engines and plant will not be started, and on-site activities are not to be undertaken outside of the specified Project work hours. Non-noise generating Project works can be undertaken at staging areas where not adjacent to residential receivers.	Contractor	Pre construction planning / construction	Condition B29 Condition B30	Site diary
NV3		Locate plant and equipment to maximise the distance to nearby sensitive receptors, where reasonable and feasible.  Where practicable, loading and unloading would be carried out at the greatest feasible distance away from residential receivers, utilising on site structures for shielding.	Contractor	Pre construction planning / construction	Condition B32	Site diary

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
NV4		Examine and where reasonable and feasible, implement alternative work practices which generate less noise. For example, this could include grinding processes instead of scraping / hammering or the substitution of smaller equipment.	Contractor	Pre construction planning / construction	Condition B32	Construction planning
NV5		<p>Temporary barriers or screening around stationary and / or long-term noisy plant. These barriers should be installed without gaps and to disrupt a direct line of sight between the noise source and the noise sensitive receiver.</p> <p>Noise impact reduction of up to 6 dBA is potentially achievable where localised acoustic screens are located within 5 m of any activities or plant / equipment. Where possible, the top of screens should be at least 500 mm higher than the equipment. Screens should provide a solid façade with no gaps or openings, and utilise the following constructions:</p> <ul style="list-style-type: none"> <li>— Barrier materials should include a solid continuous material with a surface density of at least 10 kg/m<sup>2</sup> such as 9 mm plywood sheeting, installed on framing with joins between sheets sealed or overlapped, or a proprietary product such as Echobarrier or material of equivalent acoustic performance.</li> <li>— Wavebar or a similar loaded vinyl curtains can be installed on mesh fencing surrounding works locations to provide acoustic screening. Gaps between mesh</li> </ul>	Contractor	Pre construction planning / construction	Condition B32	Site diary / weekly inspection checklist

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
		fencing sections (gates, posts) should be covered.				
NV6		<p>Ensure deliveries are made during standard hours.</p> <p>Vehicles arriving outside these hours should be turned away and not allowed to queue on local roads.</p> <p>Trucks delivering or removing materials from site should not be permitted to queue or idle in the adjacent streets or on site for prolonged periods of time, or outside the hours of work.</p>	Contactor	Pre construction planning / construction	Condition B29 Condition B30	Site diary
NV7		Trucks operating to and from the project site should be scheduled as to avoid operating on local and collector roads during school pick-up and drop-off periods where feasible and reasonable.	Contractor	Construction	Condition B32	Traffic management plan
NV8		<p>Use non-tonal reversing/movement alarms such as broadband (non-tonal) alarms or ambient noise-sensing alarms for plant regularly reversing.</p> <p>Also set up the site traffic flow where possible to minimise reversing (e.g. forward in, forward out movements).</p>	Contactor	Pre construction planning / construction	Condition B32	Transport contract
NV9		Preparing community information leaflets outlining the expected level of noise impact, as well as the noise control considerations which will apply for this type of work. These should be delivered to the affected neighbourhood, in particular those receivers identified as noise affected in Section 4.3 (including along affected transport routes).	Contactor	Pre construction planning / construction	Condition B32	Consultation records

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
		Project information should be displayed in the front yard of 11 Nelson Parade (site office) detailing the project and relevant contact phone numbers.				
NV10		<p>Include respite periods during particularly noisy works. Typical items of plant subject to reduced operation during respite periods would include:</p> <ul style="list-style-type: none"> <li>— Chain saws and tree chipper</li> <li>— Concrete saws</li> <li>— Tower crane</li> <li>— Delivery and container trucks</li> <li>— Concrete trucks</li> </ul> <p>Guidance in the ICNG acknowledges that residences may be accepting of higher received noise impacts (i.e. forgo the option for respite periods) to enable required noise generating activities to be completed in a reduced timeframe, limiting the period for potential disturbance.</p> <p>Active engagement with the local community and residences on Nelson Parade should be undertaken to determine opinion on potential noise impacts and to assist with scheduling of worst case noise generating works to coincide with periods where less properties are occupied, such as during weekday standard working hours.</p>	Contactor	Pre construction planning / construction	Condition B32	Site diary
NV11		A summary of required noise and vibration management practices is to be provided to all staff	Contactor	Pre construction planning / construction	Condition B32 Condition B33	Induction records

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
		and contractors and be included during site inductions.				
NV12		Truck drivers should not use compression braking within the residential areas.	Contactor	Pre construction planning / construction	Condition B32	Transport contract
NV13		Where practical, simultaneous operation of high-noise generating plant (jackhammers, concrete saws, chainsaws) should be avoided and managed to reduce noise impacts, such as operating plant at different times or in separate areas of the worksite. Simultaneous operation of the following plant should be avoided where practicable (reduction in noise levels of 2 to 5 dBA may be achieved by doing so): <ul style="list-style-type: none"> <li>— Chain saw and tree chipper</li> <li>— Concrete saw</li> <li>— Tower crane</li> <li>— Delivery and container trucks.</li> <li>— Concrete truck.</li> </ul>	Contactor	Pre construction planning / construction	Condition B32	Site diary
NV14		Noise monitoring will be conducted in accordance with AS 1055 <i>Acoustics – Description and measurement of environmental noise</i> and the methodology outlined in Section 6.	Contactor	Construction	Condition B32	Noise monitoring records
NV15		Construction noise levels will be monitored in response to noise complaints and at the commencement of high noise works in order to verify compliance with the noise objectives	Contactor	Construction	Condition B32	Noise monitoring records

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
		<p>identified in Section 3. Anticipated high-noise works are noted in Section 6.</p> <p>Vibration monitoring is not required unless vibration intensive works are undertaken within 10 metres of vibration sensitive structures or where additional vibration intensive plant is required.</p>				
NV16		No unnecessary shouting or loud stereos/radios on site	Contactator	Construction	Condition B32	Site inspection records
NV17		No dropping of hard materials (such as rock) from height	Contactator	Construction	Condition B32	Site diary
NV18		<p>Where practicable, no plant or equipment will be left idling during operations</p> <p>All engine and enclosure panels on plant should be kept closed</p>	Contactator	Construction	Condition B32	Site inspection records
NV19		Any complaints will be recorded and managed in accordance to the procedure set out in the project Environmental Management Plan	Contactator	Construction	Condition B32	Complaints log
NV20		Property condition/dilapidation surveys are undertaken at the Titus graffiti heritage item, 5 Nelson Parade and 13 Nelson Parade immediately prior to the commencement of works, and at the conclusion of works. Such surveys should also be undertaken if vibration-intensive activities are to occur within 20 metres of another residence.	Contactator	Construction	Condition B33	Building condition survey reports

NO.	IMPACT	ENVIRONMENTAL SAFEGUARD AND MANAGEMENT	RESPONSIBILITY	TIMING	SOURCE / REFERENCE	EVIDENCE
NV21		Vibration intensive plant should not be used within 10 m of the are above the Titus Graffiti heritage structure.	Contactor	Construction	Condition B33	Site induction / site diary

# 6 MONITORING METHODOLOGY

Construction noise levels will be monitored in response to noise complaints and at the commencement of high noise works in order to verify compliance with the noise objectives identified in Section 3.

High-noise works will include:

- Vegetation removal in Stages 1A, 1, 2 and 3.
- Structural demolition at No. 11 Nelson Parade, and civil works for hardstand construction in Phase 1A.
- Cranage for tower crane construction in Stage 2.
- Excavation and cranage in Stage 3.
- Demolition, excavation and materials transport in Stage 4.
- Remainder of structural demolition at No. 11 Nelson Parade, excavation of foreshore in Stage 5.

Environmental noise monitoring will be conducted by a qualified acoustic specialist and in accordance with *AS1055-2018: Acoustics - Description and measurement of environmental noise* (AS1055-2018), ICNG and NPfI guidelines. The results of monitoring will include:

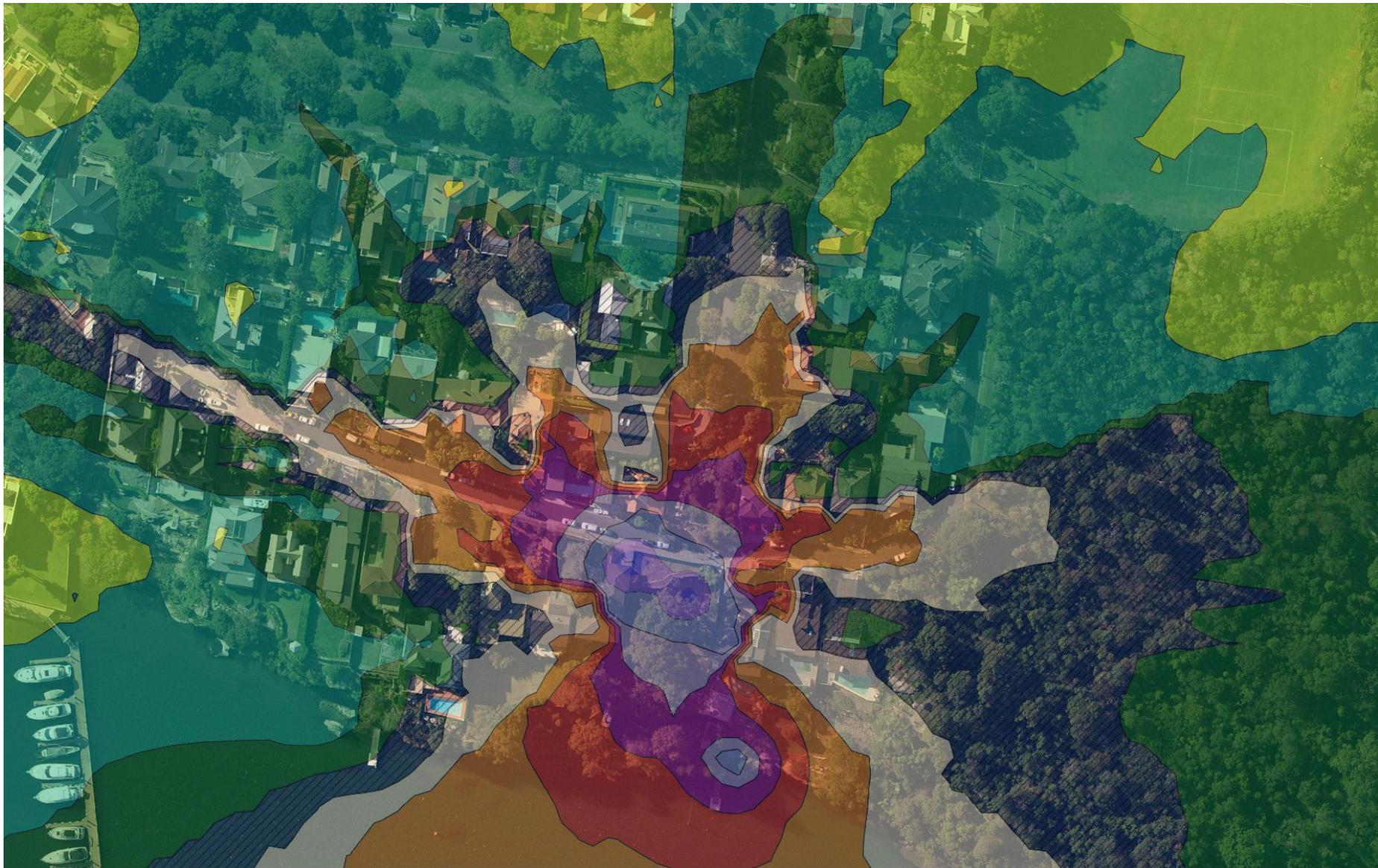
- Date, time and location of monitoring
- Name of person conducting the monitoring
- Statistical descriptors to be recorded for 15-minute intervals include  $L_{Aeq}$ ,  $L_{AMax}$  and  $L_{A90}$  levels and the primary noise sources contributing to each statistic
- Instrumentation to be fitted with wind shields, and calibrated prior to measurements to measure drift
- Details of site activity, environmental noise characteristics and weather to be noted
- Where required, noise monitoring of mobile plant to be carried out in accordance with AS2102.1 1990 *Acoustics- Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors- stationary test conditions*
- Noise instrumentation to comply with the requirements of AS 1259.2-1990. “*Acoustics- Sound Level Meters, Part 2- Integrating and Averaging*” and carry appropriate NATA certification.

All records are to be kept in accordance with the record keeping procedures outlined in the REMP and will be produced to any authorised officer upon request.

Where noise monitoring indicates exceedances of the project construction noise criteria outlined in Section 3, the non-conformance procedures outlined in the REMP shall be followed.

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**APPENDIX A-1**  
**PREDICTED CONSTRUCTION NOISE**  
**CONTOURS – STAGE 3**

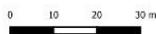


Map: Hunters Hill Phase 4

Author: APT

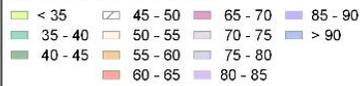
Date: 13/02/2019

Approved by: APB



1:1012 at A3

Noise level, dBA Leq period



Hunters Hill Remediation

Phase 4



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**APPENDIX A-2**  
**RECOMMENDED MAXIMUM EQUIPMENT**  
**NOISE LEVELS**

<b>PLANT</b>	<b>SOUND POWER LEVEL (DBA)</b>
Tower Crane (21t)	110
Mobile Crane (80-120t)	105
Telehandler (2.5t)	100
Delivery trucks (5-8t)	97
Delivery trucks (12t)	100
Container truck (stationary)	100
Chain saw	100
Tree chipper	114
Excavator (5t)	90
Posi-track bobcat (2t)	105
Hand tools	100
Concrete trucks	105
Concrete saw	112
Rock drill	113
Water treatment plant	102