Appendix D

Noise and Vibration Management Sub Plan

STW-JHC-PLN-00-EN-002-000004

Western Harbour Tunnel – Stage 3A

2 November 2022

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Document status

Revision	Date	Prepared by	Reviewed by	Remarks
A	01/05/2022	Chris Blyth	Charles Scarf Kathy Lloyd	Internal revision
B	17/06/2022	Chris Blyth	Kathy Lloyd	External revision for ER and TfNSW
C	15/07/2022	Chris Blyth	Kathy Lloyd Adrian Broger	External revision updated to address TfNSW and AA comments
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01	17/10/2022	Chris Blyth	Adrian Broger	External revision updated to address DPE comments
02	02/11/2022	Chris Blyth	Adrian Broger	External revision updated to address DPE comments

Distribution of controlled copies

This Noise and Vibration Management Plan (NVMP) as part of the Stage 3A CEMP is available to all personnel and subcontractors via the Project document control management system. An electronic copy can be found on the Project website.

Contents

List of Tables

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
ABL	Assessment Background Level
Acoustic enclosure / shed	Can include an engineered and designed shed or enclosure, with airborne noise pathways minimised and treated where feasible and reasonable, endeavouring to achieve the Noise Management Levels in the Interim Construction Noise Guidelines (DECC, 2009). Example treatments include noise curtains, shipping containers, acoustic barriers or fast operating doors to limit breakout noise from enclosures
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.
Ancillary facility	A temporary facility for construction of the CSSI including an office and amenities compound, construction compound, material crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory, material stockpile area and car parking facilities. *Note: where an approved management plan contains a stockpile management protocol, a material stockpile area located within the construction boundary is not considered to be an ancillary facility*
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime, 2016)
CNVIS	Construction Noise and Vibration Statements
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now EPA)
DECC	DECC Department of Environment and Climate Change (now EPA)
DECCW	DECCW Department of Environment, Climate Change and Water (now EPA)
DPE	NSW Department of Planning and Environment (formerly DPIE)

Abbreviations	Expanded Text
DPIE	NSW Department of Planning, Industry Environment (now known as DPE)
EIS	Environmental Impact Statement
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979*
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environmental Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Highly noise intensive works	Works on the surface which are defined as annoying under the Interim Construction Noise Guideline (DECC, 2009) including: (a) use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work; (b) grinding metal, concrete or masonry; (c) rock drilling; (d) line drilling;

Abbreviations	Expanded Text
	(e) vibratory rolling; (f) bitumen milling or profiling; (g) jackhammering, rock hammering or rock breaking; and (h) impact piling
ICNG	Interim Construction Noise Guideline (DECC, 2009)
IPIAP	Independent Property Impact Assessment Panel
JHCPB	John Holland CPB Contractors
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
LA (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LA1 (1min)	The A-weighted noise level from the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 1% of the 1 minute measurement period.
LA90 (15min)	The A-weighted noise level excluding the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 90% of the 15 minute measurement period.

Abbreviations	Expanded Text
Low Impact	Includes: (a) site establishment work approved under a **Site Establishment Management Plan**; (b) operation of ancillary facilities if the **ER** has determined the operational activities will have minimal impact on the environment and community; (c) minor clearing and relocation of native vegetation, as identified in the documents listed in **Condition A1**; (d) installation of mitigation measures including erosion and sediment controls, temporary exclusion fencing for sensitive areas and at property treatments (including the implementation of the NIP); (e) property acquisition adjustment work including installation of property fencing, and relocation and adjustments of utilities to property including water supply and electricity; (f) relocation and connection of utilities where the relocation or connection has a minor impact to the environment as determined by the ER; (g) archaeological testing under the *Code of practice for archaeological investigation of Aboriginal objects in NSW (DECCW, 2010)* or archaeological monitoring undertaken in association with **(a) - (f)** above to ensure that there is no impact on heritage items; (h) the relocation of Cape Don and Baragoola historic vessels as permitted subject to **Condition E53**; (i) adjustment of Cammeray Golf Course as identified in **Condition E101** and relocation of the Cammeray Golf Club dam / harvesting scheme subject to **Condition E209**; (j) noise barrier / wall between Massey and Amherst Street, Cammeray as identified in **Condition E183** and **Appendix C**; (k) maintenance of existing buildings and structures required to facilitate the carrying out of the CSSI; and (l) other activities determined by the **ER** to have minimal environmental impact which may include but not be limited to construction of minor access roads, temporary relocation of pedestrian and cycle paths and the provision of property access. Notwithstanding the following works are **not** Low Impact Work: (a) where heritage items (excluding those impacted by activities (h). (i) and (j) above), or threatened species or threatened ecological communities (within the meaning of the *Biodiversity Conservation Act 2016 or Environment Protection and Biodiversity Conservation Act 1999*) are affected or potentially affected by any low impact work, that work is construction, unless otherwise determined by the Planning Secretary in consultation with Heritage NSW, EESG or DPI Fisheries (in the case of impact upon fish, aquatic invertebrates or marine vegetation); and (b) any night time (hours as defined by the ICNG) work that exceeds noise management levels as identified in **Condition E68(b)(i)** The low impact work described in this definition becomes construction with the approval of a Construction Environmental Management Plan.
MCoA	Minister's Condition of Approval

Abbreviations	Expanded Text
Minister, the	Minister for Planning and Homes
MWD	Minimum working distance
NCA	Noise Catchment Area
NIP	Noise Insulation Program - *Western Harbour Tunnel and Warringah Freeway Upgrade* (TfNSW October 2020)
NML	Noise management level
Noise Mitigation	Feasible and reasonable measures that would minimise or avoid noise impacts
NVMP	Noise and Vibration Management Plan (this Plan)
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
Project, the	Western Harbour Tunnel – Stage 3A
Project Area	The construction footprint defined by the planning approval, relevant to Stage 3A
RBL	The Rating Background Level for each period is the medium value of the Assessment Background Level (ABL) values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening, night and shoulder period)
REMM	Revised Environmental Management Measure
Roads and Maritime	Former Roads and Maritime Services (now part of Transport for NSW)
RMS	Former Roads and Maritime Services (now part of Transport for NSW)
Sensitive land user(s) / Sensitive receiver(s)	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres and passive recreation areas (including outdoor grounds used for teaching). Receivers that may be considered to be sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces) and industrial premises as identified by the Planning Secretary
SSD	State Significant Development
SSI	State Significant Infrastructure

Abbreviations	Expanded Text
Standard construction hours	Hours during which construction work is permitted by the MCoA. Further defined in Section 6.2
Surface-based tunnelling support activity	Surface works and activities that are required to be undertaken outside standard construction hours in order to maintain 24/7 mainline tunnelling activities including, but not limited to, plant and equipment maintenance, spoil, water, grout, concrete and ventilation management. Note that shaft and decline excavations are not included in this definition.
TfNSW	Transport for NSW
WHT	Western Harbour Tunnel (component of the Western Harbour Tunnel and Warringah Freeway Upgrade project)
WHT Stage 3A	The Project
Works	Any physical work to construct or facilitate the construction of the CSSI, including low impact work, environmental management measures and utility works. However, does not include activities that informs or enables detailed design of the CSSI and generates noise that is no more than 5 dB(A) above the rating background level (RBL) at any sensitive land user(s)

Note: Refer to *Instrument of Approval - SSI-8863* for additional abbreviations and definitions relevant to the Project.

1 Introduction

1.1 Context

This Noise and Vibration Management Sub-Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for Stage 3A the Western Harbour Tunnel project (the Project) a component of the Western Harbour Tunnel and Warringah Freeway Upgrade project.

This NVMP has been prepared for the Project to address the relevant requirements of the Minister's Conditions of Approval (MCoA) for the Western Harbour Tunnel and Warringah Freeway Upgrade project (SSI #8863), the Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement dated January 2020 (the EIS), the Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions Report dated September 2020 (the RtS) and applicable guidance and legislation.

This plan describes how the Project proposes to manage potential noise and vibration impacts during the construction of Stage 3A (for further details on staging, refer to the latest Staging Report. Other construction stages, and operational impacts and management measures, are not included within this NVMP.

1.2 Background and project description

The Western Harbour Tunnel and Warringah Freeway Upgrade project comprises a new motorway tunnel connection across Sydney Harbour, and an upgrade of the Warringah Freeway to integrate the new motorway infrastructure with the existing road network and to enable future connection to the proposed Beaches Link and Gore Hill Freeway Connection project.

The Western Harbour Tunnel (WHT) will connect the approved M4-M5 Link in Rozelle to the Warringah Freeway at North Sydney/Cammeray.

The Western Harbour Tunnel and Warringah Freeway Upgrade project is being constructed in three stages. The Project (Stage 3A) includes the following key features:

- A portion of the twin mainline tunnels connecting the M4-M5 at Rozelle to the Warringah Freeway, near Cammeray, of about 2 kilometres long and commencing from the stub tunnels at the M4-M5 Link in Rozelle and terminating underground at Birchgrove
- Ventilation cavern and tunnel excavation in Rozelle
- Limited in tunnel operational infrastructure including road pavement and drainage to enable the Stage 3B works.

The construction of the Project will be supported by two surface based ancillary facilities, located at the Western Harbour Tunnel cut and cover structure in Rozelle (WHT12) and at White Bay in Rozelle (WHT3).

The EIS was prepared to assess the impacts of construction and operation of the Western Harbour Tunnel and Warringah Freeway Upgrade project. As part of the EIS development, a Noise and Vibration Impact Assessment (Appendix G (Technical working paper: Noise and Vibration*)* of the EIS) was prepared to address noise and vibration issues. The findings of the noise and vibration impact assessment were summarised in Chapter 10 (Construction noise and vibration) and Chapter 11 (Operational noise and vibration) of the EIS.

A RtS report was prepared in response to submissions received on the EIS. The RtS includes clarifications as well as further detail relating to noise and vibration management issues of the

Project. The EIS environmental management measures were revised and included in Part D of the RtS report, with specific noise and vibration mitigation measures contained in Table 3-2 of this Plan.

The Western Harbour Tunnel and Warringah Freeway Upgrade project was declared to be Critical State Significant Infrastructure (CSSI) by the then Minister for Planning and Public Space on 9 November 2020 and approved by the then Minister for Planning and Public Space on 21 January 2021.

The administration of provisions under the *NSW Environmental Planning and Assessment Act 1979* including the Western Harbour Tunnel and Warringah Freeway Upgrade project's planning consent (SSI#8863) is now under the portfolio of the NSW Minister for Planning and Homes (the Minister).

The documents listed in the planning approval concluded that during the construction phase of the Western Harbour Tunnel and Warringah Freeway Upgrade project, sensitive receivers in the vicinity of the Project would be impacted by noise and vibration from construction works, however these impacts would be managed through the implementation of mitigation and management measures described in this NVMP.

The Project description is provided in Section 1.2 of the CEMP.

1.3 Scope of the Sub-Plan

The scope of this NVMP is to describe how potential noise and vibration impacts during construction of the Project will be managed..Operational impacts and measures do not fall within the scope of this Plan.

1.4 Environmental management systems overview

The environmental management system overview is described in Section 1.5 of the Project CEMP.

1.5 Interface with other planning documents

This NVMP is one of several plans and documents established to manage construction of the Project. The key documents that interface with the NVMP are outlined in Table 1-1.

Table 1-1 Key interfaces with the NVMP

Plan	Interface
Construction Environmental Management Plan for the Project	• Provides details on overall project staging, interactions between Sub-Plans of the CEMP, and management of cumulative impacts • Provides a framework for how the construction works will be managed • Identifies procedures, processes and management systems that will apply in relation to construction activities • Provides environmental planning and controls for construction including environmental risk assessment, regulatory requirements, protection measures and sustainability requirements

Plan	Interface
Community Communication Strategy and Complaints Management System (CCS)	• Describes how community and stakeholder engagement will be managed and facilitates communication about construction of the project with the community as well as relevant councils and agencies • Specifies the process for receiving, addressing, resolving and recording complaints as well as outlines the process required in the escalation of a complaint to an independent mediator

2 Purpose and objectives

2.1 Purpose

The purpose of this NVMP is to describe how potential noise and vibration impacts during construction of the Project will be managed.

This NVMP has been prepared to address the applicable statutory requirements and aims to ensure that the commitments in the planning approval are met with regard to impacts to noise and vibration.

2.2 Objectives

The objective of the NVMP is to ensure all mitigation and management measures relevant to noise and vibration are properly implemented.

To achieve this objective, the Project will undertake the following:

- Ensure appropriate controls and procedures are implemented during construction activities to address potential noise and vibration impacts along the Project corridor, as well as manage risks from analysis of relevant construction activities as per MCoA C2(d)(ii) which states "*manage the risks identified in the risk analysis undertaken in subsection (c) of this condition"*
- Ensure appropriate measures are implemented to address the relevant MCoA requirements outlined in Table 3.1 and the safeguards detailed in the Response to Submissions report (RtS) and outlined in Table 3.2
- Ensure the requirements of the Project's Environment Protection Licence (EPL) are met
- Implement relevant legislation and other requirements described in Section 3.1 of this NVMP.

Furthermore, the Project will aim to meet the performance outcomes stated in the documents listed in Condition A1 that are relevant to noise and vibration impacts, as required by MCoA C2(d)(i). These are as identified in Table 2-1 below.

Table 2-1 Performance outcomes Identified in the EIS relevant to this Plan

Performance Outcome	How Addressed	Records	Source
Noise and vibration – Amenity			
Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity. Increases in noise emissions and vibration affecting nearby properties and other sensitive receivers during	Include effective management of construction noise and vibration in accordance with relevant guidelines, for example through the use of acoustic sheds Minimise surface activity and associated noise at tunnelling sites (noting that once tunnelling starts the majority of the work at these sites would be underground)	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Monitoring records	EIS – Chapter 28 (Table 28-4)

Performance Outcome	How Addressed	Records	Source
operation of the project are effectively managed to protect the amenity and well-being of the community.	• Implement the noise and vibration measures in Section 9 of this Plan which have been developed in accordance with the guidelines in Section 3.1.3 • Undertake training, inspections, auditing and reporting in accordance with Section 10 of this Plan and Section 3.5 & 3.9 of the CEMP. Minimise impacts to the local community by: - Control noise and vibration at the source - Control noise and vibration on the source to receiver transmission path - Control noise and vibration at the receiver - Implement practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers • Implement the noise and vibration measures in Section 9 of this Plan Undertake training, inspections, auditing and recording in accordance with Section 10 of this Plan and Section 3.5 & 3.9 of the CEMP.	Complaints register	
Noise and vibration – Structural			
Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal	- Control vibration on the source to receiver transmission path - Implement practicable and reasonable measures to minimise vibration impacts of construction activities on structures - Carry out building / structure condition surveys for properties (and heritage assets) within the	Weekly environmental inspection records Construction Noise and Vibration Impact Statements	EIS – Chapter 28 (Table 28-4)

Performance Outcome	How Addressed	Records	Source
places and environmental heritage. .	zone of influence of tunnel settlement prior to the commencement of construction • Implement the noise and vibration measures in Section 9 of this Plan • Undertake training, inspections, auditing and recording in accordance with Section 10 of this Plan and Section 3.5 & 3.9 of the CEMP.	Monitoring records Complaints register Pre and Post condition surveys	

2.3 Targets

The following targets have been established for the management of noise and vibration impacts during the Project construction activities:

- Ensure full compliance with the relevant legislative requirements, MCoA and environmental management measures (REMMs)
- Meet Infrastructure Sustainability Council of Australia (ISCA) requirements
- Meet EPL noise and vibration requirements
- Implementation of feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009)

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation and regulatory requirements

Legislation relevant to noise and vibration management for this Project includes:

- *Protection of the Environment Operations Act 1997 (NSW)*
- *Environmental Planning & Assessment Act 1979 (NSW)*

All legislation relevant to this NVMP is included in Appendix A1 of the CEMP.

3.1.2 Licences / Permits

An Environment Protection Licence (EPL) will be obtained for the Project. Noise and vibration conditions will be incorporated into this NVMP once issued.

3.1.3 Guidelines

The main guidelines, specifications and policy documents relevant to this plan include:

- RMS Specification G36 – Environmental Protection (Management System) (Transport for NSW, June 2017)
- RMS Construction Noise and Vibration Guidelines (Roads and Maritime, 2016)
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Dept. of Environment, Climate Change and Water 2011
- Noise Policy for Industry (NPfI), Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites
- Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard 1055:2018 Acoustics – Description and Measurement of Environmental Noise
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80 Hz)

- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-2016 Structural vibration Part 3: Effects of vibration on Structures

3.2 Minister's Conditions of Approval

The MCoA relevant to this Plan are listed Table 3-1 below. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 3-1: Minister's Conditions of Approval

MCoA No.	Condition Requirements	Document Reference	How Addressed
General			
A5	Where the terms of this approval require a document or monitoring program to be prepared or a review to be undertaken in consultation with identified parties, evidence of the consultation undertaken must be submitted to the Planning Secretary with the document. The evidence must include: (a) documentation of the engagement with the party identified in the condition of approval that has occurred before submitting the document for approval; (b) a log of the dates of engagement or attempted engagement with the identified party; (c) documentation of the follow-up with the identified party where engagement has not occurred to confirm that they do not wish to engage or have not attempted to engage after repeated invitations; (d) outline of the issues raised by the identified party and how they have been addressed; and (e) a description of the outstanding issues raised by the identified party and the reasons why they have not been addressed.	Table 4-1	This NVMP has been prepared in consultation with the relevant agencies identified in MCoA C4(b). A summary of consultation is included in Table 4-1.

MCoA No.	Condition Requirements	Document Reference	How Addressed
A20	**Boundary Screening** Boundary screening must be erected between ancillary facilities and are adjacent to sensitive land user(s) for the duration of the ancillary facility is in use unless otherwise agreed with relevant affected residents, business operators or landowners. All Boundary screening must minimise visual impacts on adjacent sensitive land user(s).	Table 9-1 – NVMP13	Mitigation measures have been provided in Section 9.1 to construct boundary screening (including noise barriers) to reduce construction noise impacts on adjacent sensitive receivers during works where reasonable and feasible.
Acoustics Advisor			
A29	A suitably qualified and experienced Acoustics Advisor(s) (AA) in noise and vibration management, who is independent of the design and construction personnel, must be nominated by the Proponent and engaged for the duration of work (as required by Condition A32) and for no less than six months following completion of construction of the CSSI.	Section 3.4	A suitably qualified and experienced Acoustics Advisor has been nominated and engaged for the duration of works and for no less than six months following completion of construction. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3.1 of the CEMP.
A30	Work must not commence until an AA has been nominated by the Proponent and approved by the Planning Secretary.	Section 3.4	A suitably qualified and experienced Acoustics Advisor has been nominated and engaged for the duration of works and for no less than six months following completion of construction. The Acoustic Advisor will be approved by DPIE. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3.1 of the CEMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
A31	The Proponent must cooperate with the AA by: (a) providing access to noise and vibration monitoring activities as they take place; (b) providing for review of noise and vibration plans, assessments, monitoring reports, data and analyses undertaken; and (c) considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.	Section 3.4	A suitably qualified and experienced Acoustic Advisor has been nominated and engaged for the duration of works and for no less than six months following completion of construction. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3.1 of the CEMP. The AA will be invited to all ER inspections where upcoming works and monitoring will be discussed. The Project will be available and cooperate with the AA regarding monitoring and data requests. The AA will be provided with noise and vibration plans, assessments, and monitoring reports, as requested. Following any inspections by the AA, the Project will work with the AA in relation to identified actions and close out.

MCoA No.	Condition Requirements	Document Reference	How Addressed
A32	The Proponent may nominate additional suitably qualified and experienced persons to assist the lead AA for the Planning Secretary's approval.	Section 3.4	A suitably qualified and experienced Acoustic Advisor has been nominated and engaged for the duration of works and for no less than six months following completion of construction. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3.1 of the CEMP. If required, the Project may nominate additional suitably qualified and experienced persons to assist the lead AA for the Planning Secretary's approval.
A33	Any activities generating noise in excess of 5 dB(A) above the 'Noise affected' Noise Management Levels (NMLs) derived from the Interim Construction Noise Guideline (DECC, 2009) (ICNG) must not commence until an AA, nominated under Condition A29 of this approval, has been approved by the Planning Secretary.	Section 3.4	Any activities generating noise above NMLs will not commence until an Acoustic Advisor has been approved by the DPIE. The Acoustic Advisor was approved by DPIE prior to the commencement of any works. Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3.1 of the CEMP.
A34	The approved AA must: (a) receive and respond to communication from the Planning Secretary in relation to the performance of the CSSI in relation to noise and vibration; (b) consider and inform the Planning Secretary on matters specified in the terms of this approval relating to noise and vibration;	Section 3.4	Details regarding the roles and responsibilities of Acoustic Advisor are outlined in Section 3.3.1 of the CEMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(c) consider and recommend, to the Proponent, improvements that may be made to avoid or minimise adverse noise and vibration impacts; (d) review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures; (e) review all noise and vibration documents required to be prepared under the terms of this approval and, should they be consistent with the terms of this approval, endorse them before submission to the Planning Secretary (if required to be submitted to the Planning Secretary) or before implementation (if not required to be submitted to the Planning Secretary); (f) regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this approval to ensure implementation is in accordance with what is stated in the document and the terms of this approval; (g) notify the Planning Secretary of noise and vibration incidents in accordance with Conditions A43 and A45 of this approval; (h) in conjunction with the ER, the AA must: (i) as may be requested by the Planning Secretary or Community Complaints Mediator (required by Condition B12), help plan, attend or undertake audits of noise and vibration management of the CSSI including briefings, and site visits,		

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(ii) in the event that conflict arises between the Proponent and the community in relation to the noise and vibration performance of the CSSI, follow the procedure in the Community Communication Strategy approved under Condition B2 to attempt to resolve the conflict, and if it cannot be resolved, notify the Planning Secretary, (iii) consider relevant minor amendments made to the Ancillary Site Establishment Management Plan, CEMP, relevant sub-plans and noise and vibration monitoring programs that require updating or are of an administrative nature, and are consistent with the terms of this approval and the management plans and monitoring programs approved by the Planning Secretary and, if satisfied such amendment is necessary, endorse the amendment, (this does not include any modifications to the terms of this approval), (iv) review the noise impacts of minor construction ancillary facilities, and (v) prepare and submit to the Planning Secretary and other relevant regulatory agencies, for information, a Monthly Noise and Vibration Report detailing the AA's actions and decisions on matters for which the AA was responsible in the preceding month. The Monthly Noise and Vibration Report must be submitted within seven days following the end of each month for the duration of the AA's engagement for the CSSI, or as otherwise agreed by the Planning Secretary.		
Construction Environmental Management Plan			

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th><th>How Addressed</th></tr>
<tr><td>C4</td><td>CEMP Sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP Sub-plan. Details of all information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant CEMP Sub-plan, including copies of all correspondence from those agencies as required by Condition A5.
<table>
<tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant government agencies to be consulted for each CEMP Sub-plan</th></tr>
<tr><td>(b)</td><td>Noise and vibration</td><td>NSW Health, relevant council(s)</td></tr>
</table></td><td>This document</td><td>This NVMP has been prepared in accordance with the relevant agencies identified in this condition and the Inner West Council. It describes how the Project will manage noise and vibration during construction works on the project.
A summary of consultation is included in Table 4-1</td></tr>
<tr><td rowspan="3">C5</td><td colspan="3">The CEMP Sub-plans must state how:</td></tr>
<tr><td>(a) the environmental performance outcomes identified in the documents listed in Condition A1 will be achieved;</td><td>Section 2.2</td><td>This NVMP was prepared in accordance with the environmental performance outcomes identified in the documents listed in the EIS and RtS as outlined in Section 2.2.</td></tr>
<tr><td>(b) the mitigation measures identified in the documents listed in Condition A1 will be implemented;</td><td>Table 3-2
Table 9-1</td><td>Relevant environmental management measures are detailed in Table 3-2 and including where and how they are addressed in this Plan.
Measures to achieve these requirements are detailed in Section 9 of this Plan.</td></tr>
</table>

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(c) the relevant terms of this approval will be complied with; and	Table 3-1	Details regarding how the Project will comply with the relevant terms of approval are listed in this Table, including references to the relevant sections of this NVMP.
	(d) issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed through SMART principles.	Section 9.1 Table 9-1 Environmental Risk Assessment Workshop (Section 3.2.1 of the CEMP)	Noise and vibration issues requiring management during construction of the Project have been identified through the EIS, RtS and Environmental Risk Assessment Workshop. These issues, including cumulative impacts, have been outlined in Appendix C of the CEMP. Environmental risk analysis will be ongoing and regularly reviewed in accordance with 2.15 of the CEMP. Noise and vibration issues, including are detailed in Section 7 of this Plan. Management measures identified in Table 9-1 of this NVMP have been developed with consideration of SMART principles.
C9	The CEMP Sub-plans must be submitted to the Planning Secretary for approval along with, or subsequent to, the submission of the CEMP but in any event, no later than one month before construction.	Section 2 of the CEMP	The CEMP Sub-plans will be submitted for approval to DPIE with or subsequent to the final submissions of the CEMP for DPIE approval.
C10	Construction must not commence until the CEMP and all CEMP Sub-plans have been approved, unless otherwise agreed by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary, including any minor amendments	Section 2 of the CEMP	Construction of the Project will not commence until the CEMP and all Sub-plans as per the Staging Report have approved, unless it is otherwise agreed by

<table>
<tr><th>MCoA No.</th><th>Condition Requirements</th><th>Document Reference</th><th>How Addressed</th></tr>
<tr><td></td><td>approved by the ER must be implemented for the duration of construction. Where construction of the CSSI is staged, construction of a stage must not commence until the CEMP and sub-plans for that stage have been endorsed by the ER and approved by the Planning Secretary.</td><td></td><td>the Secretary. The CEMP and CEMP Sub-plans will be implemented for the duration of construction.</td></tr>
<tr><td colspan="2">Construction Monitoring Programs</td><td></td><td></td></tr>
<tr><td>C11</td><td>The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of construction of the CSSI against the performance predicted in the documents listed in Condition A1 or in the CEMP:
<table>
<tr><th></th><th>Required Construction Monitoring Program</th><th>Relevant government agencies to be consulted for each Construction Monitoring Program</th></tr>
<tr><td>(a)</td><td>Noise and Vibration Monitoring Program</td><td>EPA</td></tr>
</table></td><td>Appendix D2</td><td>A Noise and Vibration Monitoring Program has been prepared as Appendix D2 of this NVMP.</td></tr>
<tr><td>C12</td><td>Each Construction Monitoring Program must provide:
(a) details of baseline data available;
(b) details of baseline data to be obtained and when;
(c) details of all monitoring of the project to be undertaken;
(d) the parameters of the project to be monitored;
(e) the frequency of monitoring to be undertaken;</td><td>Appendix D2</td><td>A Noise and Vibration Monitoring Program has been prepared as Appendix D2 of this NVMP.</td></tr>
</table>

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(f) the location of monitoring; (g) the reporting of monitoring results and analysis results against relevant criteria; (h) details of the methods that will be used to analyse the monitoring data; (i) procedures to identify and implement additional mitigation measures where the results of the (j) monitoring indicate unacceptable project impacts; (k) a consideration of SMART principles; (l) any consultation to be undertaken in relation to the monitoring programs; and (m) any specific requirements as required by Conditions C13 to C16.		
C13	The Noise and Vibration Monitoring Program must include: (a) noise and vibration monitoring locations determined in consultation with the AA to confirm construction noise and vibration levels; (b) for the purposes of (a), noise monitoring must be undertaken during the day, evening and night-time periods and within the first month of work as well as throughout the construction period and cover the range of activities being undertaken at the sites; (c) a protocol for reviewing the implemented management and mitigation measures, based on the monitoring results, to confirm they are consistent with the CEMP Subplan	Appendix D2	A Noise and Vibration Monitoring Program has been prepared as Appendix D2 of this NVMP.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(Condition C4b), and to identify any additional management and mitigation measures that must be implemented; and (d) a process to undertake real time noise and vibration monitoring. The results of the monitoring must be readily available to the construction team, Proponent, ER and AA. The Planning Secretary and EPA must be provided with access to the results on request.		
C17	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C11. Details of all information requested by an agency during consultation must be provided to the Planning Secretary as part of any submission of the relevant Construction Monitoring Programs, including copies of all correspondence from those agencies as required by Condition A5.	Section 4	A Noise and Vibration Monitoring Program has been prepared in consultation with the relevant agencies and is included as Appendix D2 of this NVMP.
C18	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one month before the commencement of construction.	Appendix D2 Section 2.4	The construction monitoring programs will be reviewed and endorsed by the ER prior to submission to the Planning Secretary.
C19	Unless otherwise agreed with the Planning Secretary, construction must not commence until all of the relevant Construction Monitoring Programs have been approved by the Planning Secretary, and all relevant baseline data for the specific construction activity has been collected.	Appendix D2 Section 4	Baseline monitoring undertaken as part of the EIS process.
C20	The Construction Monitoring Programs, as approved by the Planning Secretary including any minor amendments approved by the ER must be implemented for the duration of construction and for any longer period set out in the monitoring program or specified by the Planning Secretary, whichever is the greater.	Appendix D2 Section 2.1	Monitoring Program will apply for the duration of the Project's construction works

MCoA No.	Condition Requirements	Document Reference	How Addressed
C21	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	Appendix D2 Section 9, Table 2	Monitoring will be reported on a six-monthly basis within a Construction Monitoring Report.
Land Use Survey			
E65	A detailed land use survey must be undertaken to confirm sensitive land user(s) (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration, construction ground-borne noise and operational noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area before the commencement of work which generates construction or operational noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Noise and Vibration CEMP Sub-plan required by Condition C4.	Section 5.1	A land use survey was carried out, as part of the EIS, refer Appendix D1. Additional detailed land use surveys will be undertaken to confirm any changes in sensitive land user(s) as the construction program progresses. The results of the additional surveys will be included in Appendix D1.
Construction Hours			

MCoA No.	Condition Requirements	Document Reference	How Addressed
E66	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays	Section 6.2	Works will only be scheduled and undertaken during the approved construction hours stated in this condition unless permitted in MCoA E68 or an EPL. Details regarding the approved construction hours are outlined in Section 6.2. The nominated construction hours, restrictions and general requirements for any OOHW will be addressed in the project inductions and specific training or toolboxes, as required and as stated in Section 9.
Highly Noise Intensive Work			
E67	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasing and recommencing any of the work.	Section 6.2	Highly noise intensive works that result in an exceedance of the applicable NML will only be scheduled and undertaken at the stated hours, unless otherwise permitted by an EPL or MCoA E68, as outlined in Section 6.2 and Appendix D3 (OOHW protocol) of this NVMP. Only applicable for surface works.
Variation to Work Hours			

MCoA No.	Condition Requirements	Document Reference	How Addressed
E68	Notwithstanding Conditions E66 and E67 work may be undertaken outside the hours specified in any of the following circumstances: (a) Safety and Emergencies, including: (i) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (ii) where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm. On becoming aware of the need for emergency work in accordance with Condition E68(a)(ii), the Proponent must notify the AA, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. (b) Low impact, including: (i) construction that causes $L_{Aeq(15\ minute)}$ noise levels: • no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or (ii) construction that causes $L_{AFmax(15\ minute)}$ noise levels no more than 15 dB(A) above the rating background level at any residence; or (iii) construction that causes:	Section 6.2 Appendix D3	An Out of Hours Work (OOHW) Protocol has been prepared in Appendix D3 of this Plan to address the circumstances which works may be undertaken outside the hours. The Project will notify the Acoustic Advisor, the ER and the EPA on becoming aware of the need for emergency works, as outlined in the OOHW Protocol included in Appendix D3 of this Plan.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	• continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or • intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). (c) By Approval, including: (i) where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E69; or (iii) negotiated agreements with directly affected residents and sensitive land user(s). (d) By Prescribed Activity, including: (i) tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or (ii) delivery of material that is required to occur outside of standard construction hours in Condition E66 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for		

MCoA No.	Condition Requirements	Document Reference	How Addressed
	receivers in the proximity of Bay Road and Balls Head Road, Waverton; or (iii) works within an acoustic shed where there is no exceedance of the NMLs; or (iv) trailer suction hopper dredging; or (v) along the Warringah Freeway corridor in accordance with Condition E88.		
Out-Of-Hours Work Protocol – Works Not Subject to an EPL			
E69	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of work which is outside the hours defined in Conditions E66, and that are not subject to an EPL. The Protocol must be approved by the Planning Secretary before commencement of the Out-of-Hours Work. The Protocol must be prepared in consultation with the ER, AA and EPA. The Protocol must provide: (a) identification of low and high-risk activities and an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where: (i) the ER and AA review all proposed out-of-hours activities and confirm their risk levels, (ii) low risk activities can be approved by the ER in consultation with the AA, and (iii) high risk activities that are approved by the Planning Secretary; (b) a process for the consideration of out-of-hours work against the	Section 6.2 Appendix D3	An OOHW Protocol has been included in Appendix D3 of this NVMP to identify a process for the consideration, management and approval of works which are outside the standard construction hours, and that are not subject to an EPL. The Protocol will be approved by the DPIE before commencing the out of hours works and will be prepared in consultation with the ER, EPA and the Acoustic Advisor. Out-of-hours-works not subject to an EPL, will be scheduled, approved and undertaken in accordance with the OOHW Protocol (Appendix D3) prepared in accordance with MCoA E69.

MCoA No.	Condition Requirements	Document Reference	How Addressed
	relevant NML and vibration criteria; (c) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of Condition E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events; (d) procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided; and (e) notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works. This condition does not apply if the requirements of Condition E68(b) are met.		
Construction Noise Management Levels and Vibration Criteria			
E70	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration objectives:	Section 6	Mitigation measures outlined in Section 9 of this Plan will be implemented with the aim of achieving the construction NMLs and vibration criteria. The residential receptor NMLs for project works is included in Section 6 of this Plan. Any works identified as exceeding the
	(a) construction 'Noise affected' NML established using the Interim Construction Noise Guideline (DECC, 2009);	Section 6.3 Table 6-5	

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(b) vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure);	Section 6.5.1 Table 6-7 Table 6-8	NMLs and/or vibration criteria will be managed in accordance with this Plan.
	(c) Australian Standard AS 2187.2 - 2006 “Explosives - Storage and Use - Use of Explosives”;	Section 6	
	(d) BS 7385 Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2” as they are “applicable to Australian conditions”; and	Section 6.5.2	
	(e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Any work identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the Noise and Vibration CEMP Sub-plan. *Note: The ICNG identifies ‘particularly annoying’ activities that*	Section 6.5.3	

MCoA No.	Condition Requirements	Document Reference	How Addressed
E71	Mitigation measures must be applied when the following residential ground-borne noise levels are exceeded: (a) evening (6:00 pm to 10:00 pm) — internal LAeq(15 minute): 40 dB(A); and (b) night (10:00 pm to 7:00 am) — internal LAeq(15 minute): 35 dB(A). The mitigation measures must be outlined in the Noise and Vibration CEMP Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E69	Section 6.3.3 Table 6-4 Section 9 Table 9-1 - NVMP 21-22	Mitigation measures outlined in Section 9 will be implemented with the aim of achieving the construction NMLs and vibration criteria. Ground-borne noise management levels are presented in Section 6.3.3. Any works identified as exceeding the NMLs and/or vibration criteria will be managed in accordance with this Plan.
E72	Noise generating work in the vicinity of potentially-affected community, religious, educational institutions, noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	Section 6.3 Section 9 Table 9-1- NVMP17	A mitigation measure has been provided in Section 9 to avoid sensitive periods when undertaking noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration sensitive businesses and critical working areas.
E73	At no time can noise generated by construction exceed the National Standard for exposure to noise in the occupational environment of an eight-hour (8hr) equivalent continuous A-weighted sound pressure level of LAeq,8h of 85 dB(A) for any employee working at a location near the CSSI	Section 6.3.1	Noise generated by construction will not exceed the National Standard for exposure to noise in the occupational environment for any employee working at a location near the project. Noise criteria are outlined in Section 6.3.
Construction Noise and Vibration Mitigation and Management			
E74	Industry best practice construction methods must be implemented where reasonably practicable to ensure that noise levels are minimised. Practices must include, but are not limited to:	Section 9.1	Mitigation measures have been provided in Section 9 which will be implemented

MCoA No.	Condition Requirements	Document Reference	How Addressed
	(a) use of regularly serviced low sound power equipment;	Table 9-1 - NVMP5	during construction works to minimise noise levels.
	(b) early occupation and later release of road carriageways and construction sites;	Table 9-1 – NVMP10	
	(c) scheduling of noisiest works before 11.00 pm Sunday to Thursday and before 12 midnight Friday and Saturday;	Table 9-1 – NVMP11	
	(d) temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities such as rockhammering and concrete cutting; and	Table 9-1 – NVMP13	
	(e) use of alternative construction and demolition techniques.	Table 9-1 – NVMP1	
E75	Construction Noise and Vibration Impact Statements (CNVIS) must be prepared for any work that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in Condition E70 and Condition E71 at any residence outside construction hours identified in Condition E66, or where receivers will be highly noise affected. The CNVIS must include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the CNVIS must be provided to the AA and ER prior to the commencement of the associated works. The Planning Secretary may request a copy/ies of CNVIS.	Section 8.2 Table 9-1 - NVMP1	CNVIS(s) will be prepared before works commence that may exceed the NMLs and / or vibration criteria, as detailed in Section 8.2 and Table 9-1. The CNVIS will include specific mitigation measures identified through consultation with affected sensitive land user(s) which will be implemented for the duration of the works.

MCoA No.	Condition Requirements	Document Reference	How Addressed
E76	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before work that generates vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owners and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Noise and Vibration CEMP Sub-plan required by Condition C4 and the Community Communication Strategy required by Condition B1.	Section 9.1 Table 9-1 – NVMP19	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage will be notified before works that generate vibration commences in the vicinity of those properties, as detailed in Section 9.1. Pre-construction building/structure condition surveys will be offered for all properties identified as being at risk of exceeding the screening criteria.
Construction Noise Mitigation - Acoustic Sheds			
E77	All surface based tunnelling support activities that generate noise levels above the noise management levels in Condition E70 must occur within an acoustic shed	Section 9.1 Table 9-1 – NVMP14	See Table 9-1.
E78	All acoustic sheds must be designed and used so that activities carried out within them do not result in the exceedance of the NMLs.	Section 9.1 Table 9-1 – NVMP15	See Table 9-1.
Construction Vibration Mitigation – Heritage			
E79	The Proponent must conduct vibration testing during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances (MWDs) to prevent cosmetic damage. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction	Appendix D2 Table 9-1 – NVMP29	Vibration testing will be conducted during vibration generating activities that have the potential to impact on heritage items, as outlined in the Noise and Vibration Monitoring Program (Appendix D2).

MCoA No.	Condition Requirements	Document Reference	How Addressed
	methodology and, if necessary, implement additional mitigation measures.		
E80	Advice from a heritage specialist must be sought on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures.	Appendix D2	The advice of a heritage specialist will be sought, as detailed in the Noise and Vibration Monitoring Program included in Appendix D2.
Utility Coordination and Respite			
E82	All work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponent must: (a) reschedule any work to provide respite to impacted noise sensitive land user(s) so that the respite is achieved in accordance with Condition E83; or (b) consider the provision of alternative respite or mitigation to impacted noise sensitive land user(s); and (c) provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation. The consideration of respite must also include all other CSSI, SSI and SSD projects which may cause cumulative and/or consecutive impacts at receivers affected by the delivery of the CSSI.	Section 9.7 Appendix D3	All works, including those undertaken by third parties (such as utility relocations), will be coordinated to ensure respite periods are provided, as identified in Section 9.7 and the OOHW Protocol included in Appendix D3 of this Plan.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Out-of-Hours Works – Community Consultation on Respite			
E83	In order to undertake out-of-hours work outside the hours specified under Condition E66, the Proponent must identify appropriate respite periods for the out-of-hours work in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with: (a) a progressive schedule for periods no less than three months, of likely out-of-hours work; (b) a description of the potential work, location and duration of the out-of-hours work; (c) the noise characteristics and likely noise levels of the work; and (d) likely mitigation and management measures which aim to achieve the relevant noise management levels under Condition E70 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers). The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour work must be provided to the AA, ER, EPA and the Planning Secretary. *Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the rating background noise level at any residence*	Section 6.2 Section 9.4.1 Section 9.4.2	Appropriate respite periods will be identified for out of hours works as described in Section 9.4.1 and 9.4.2. The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out of hours works will be provided to the Acoustic Advisor, EPA and DPIE.
Blasting			

MCoA No.	Condition Requirements	Document Reference	How Addressed
E95	Blasting associated with the CSSI must only be undertaken during the following hours: (a) 9:00am to 5:00pm, Monday to Friday, inclusive; (b) 9:00am to 1:00pm on Saturday; and (c) at no time on Sunday or public holidays; or (d) as authorised through an EPL. This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.	NA	Blasting is not currently proposed for Stage 3A of the WHT. Should this change, the NVMP and other relevant plans will be updated to address this condition.
E96	A Blast Management Strategy must be prepared and must include: (a) sequencing and review of trial blasting to inform blasting; (b) regularity of blasting; (c) intensity of blasting; (d) periods of relief; and (e) blasting program.	NA	Blasting is not currently proposed for Stage 3A of the WHT. Should this change, the NVMP and other relevant plans will be updated to address this condition.
E97	The Blast Management Strategy must be endorsed by a suitably qualified and experienced person.	NA	Blasting is not currently proposed for Stage 3A of the WHT. Should this change, the NVMP and other relevant plans will be updated to address this condition.

MCoA No.	Condition Requirements	Document Reference	How Addressed
E98	The Blast Management Strategy must be prepared in accordance with relevant guidelines and in consultation with the EPA, in order to ensure that all blasting and associated activities are carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive land user(s).	NA	Blasting is not currently proposed for Stage 3A of the WHT. Should this change, the NVMP and other relevant plans will be updated to address this condition.
E99	The Blast Management Strategy must be submitted to the Planning Secretary for information no later than one month before the commencement of blasting. The Strategy as submitted to the Planning Secretary, must be implemented for all blasting activities.	NA	Blasting is not currently proposed for Stage 3A of the WHT. Should this change, the NVMP and other relevant plans will be updated to address this condition.

MCoA No.	Condition Requirements	Document Reference	How Addressed
Condition Survey			
E107	The Proponent must offer pre-construction surveys and must undertake and prepare Preconstruction Condition Survey Reports where the offer is accepted, on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in Condition E102 and the CNVIS required by Condition E75 or as directed by the Independent Property Impact Assessment Panel (IPIAP) established under Condition E111. The Pre-construction Condition Survey Reports must be prepared by a suitably qualified and experienced person(s) and must be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works	Section 9.5 Table 9-1 – NVMP30 and NVMP31	This has been included as management measure NVMP44 in Table 9-1 of this Plan. Property surveys and issues rectification are outlined in Section 9.5
E108	Where pre-construction surveys have been undertaken in accordance with Condition E107, subsequent post-construction surveys must be undertaken to assess damage to the surface and sub-surface structures that may have resulted from construction within three months of landowner(s) requests.	Section 9.5 Table 9-1 - NVMP30 and NVMP31	This has been included as management measure NVMP44 in Table 9-1 of this Plan. Property surveys and issues rectification are outlined in Section 9.5
E109	The results of the post-construction surveys undertaken under Condition E108 must be documented in Post-construction Condition Survey Reports for each surface and sub-surface structure surveyed. The Post-construction Condition Survey Reports must be prepared by a suitably qualified and experienced person(s). Copies of the Post-construction Condition Survey Reports must be provided to the owner(s) of the structures surveyed no later than four months following the completion of construction activities that have the potential to impact on the subject surface / subsurface structure.	Section 9.5 Table 9-1 - NVMP30 and NVMP31	Property surveys and issues rectification are outlined in Section 9.5

MCoA No.	Condition Requirements	Document Reference	How Addressed
E110	Where damage has been determined to occur as a result of the project, the Proponent must carry out rectification at its expense and to the reasonable requirements of the surface and sub-surface structure owner(s) within 12 months of completion of construction unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.	Section 9.5 Table 9-1 – NVMP30 and NVMP31	Property surveys and issues rectification are outlined in Section 9.5
E111	The Proponent must establish an IPIAP before works that have the potential to result in property impacts commence. The IPIAP must comprise geotechnical and engineering experts independent of the design and construction team. The IPIAP will be responsible for independently reviewing Pre- and Post-construction Condition Survey Report templates prepared under Conditions E107 and E109, any Pre- and Post-construction Condition Survey Reports where there is a dispute, and the resolution of property damage disputes, and the establishment of ongoing settlement and vibration monitoring requirements. The Planning Secretary must be notified of the members of the IPIAP prior to the commencement of any works which may potentially result in property impacts.	Section 9.5	Requirements of the IPIAP are included in Section 9.5
E112	Either the affected owner or the Proponent may refer unresolved disputes arising from potential and/or actual property impacts to the IPIAP for resolution. All costs incurred in establishing and implementing the IPIAP must be borne by the Proponent regardless of which party makes a referral to the IPIAP. The findings and recommendations of the IPIAP are final and binding on the Proponent.	Section 9.5	Requirements of the IPIAP are included in Section 9.5
E113	The governance framework for the IPIAP must be made publicly available on the CSSI's project page as required by Condition B15.	Section 9.5	Requirements of the IPIAP are included in Section 9.5

3.3 Revised Environmental Management Measures

Relevant Revised Environmental Management Measures (REMMs), as identified in Part D of the RtS, are listed in Table 3-2 below. This includes reference to required outcomes, the timing of when and how the commitment applies, and where it has been addressed in the NVMP.

Table 3-2: Environmental management measures relevant to this NVMP

Issue	Ref #	Commitment	Timing	Document reference
Construction noise and vibration impacts	CNV1	A Construction Noise and Vibration Management Plan will be developed for the project. This plan will:	Pre-construction	This NVMP
		(a) Identify relevant criteria and management levels in relation to noise and vibration		Section 6
		(b) Identify noise and vibration sensitive receivers and features in the vicinity of the project		Section 5.1, Appendix D1
		(c) Include standard and additional mitigation from the Construction Noise and Vibration Guideline (Roads and Maritime, 2016a) and detail how and when these will be applied in the project		Section 9
		(d) Describe the approach that will be adopted for carrying out location and activity specific construction noise and vibration impact assessments to assist with designing and selecting of the appropriate mitigation and management measures		Section 8.2 Table 9-1 – NVMP1
		(e) Include protocols that will be adopted to manage works required outside standard construction hours		Section 9.2, Appendix D3
		(f) Detail the methodology and approach for managing residual construction noise impacts		Section 9.6

Issue	Ref #	Commitment	Timing	Document reference
		(g) Detail the process for managing construction vibration, including heritage structures considering all types of vibration generating works, including blasting		Section 9.3 Section 9.1 Table 9-1 – NVMP23, 26-29
		(h) Outline the procedures and approach for noise and vibration monitoring to be carried out to confirm construction noise and vibration levels in relation to noise and vibration management		Appendix D2 Table 9-1 – NVMP26-29
		(i) Where feasible and reasonable, detail how construction noise impacts from concurrent or consecutive nearby construction works associated with the project will be managed.		Table 9-1 – NVMP 32-34
		The Construction Noise and Vibration Management Plan will be implemented for the duration of construction of the project		Section 1.3
Construction noise and vibration impacts	CNV2	Detailed Construction Noise and Vibration Impact Statements will be carried out for all construction support sites and major construction works required for the project prior to the commencement of construction. The Statements will consider the proposed site layouts and noise and vibration generating activities that will take place during all major stages of the construction support site, assess predicted noise and vibration levels against the relevant management levels, and incorporate feasible and reasonable mitigation and management measures in accordance with the requirements of the Interim Construction Noise Guideline (DECC, 2009) and the	Pre-construction	Section 8.2 Table 9-1 – NVMP1

Issue	Ref #	Commitment	Timing	Document reference
		Construction Noise and Vibration Guideline (Roads and Maritime, 2016a).		
Construction noise and vibration impacts during out of hours work	CNV3	An out of hours works protocol will be developed for the construction of the project. The protocol will include:	Pre-construction	Section 9.2, Appendix D3 Table 9-1 NVMP12
		a) Details of works required outside standard construction hours, including acceptable justifications for works outside of standard construction hours, what types of works are allowed to take place outside of construction hours, and justifications of why the activities are required outside standard construction hours		Section 6.2 Appendix D3
		b) Details of the assessment and approval process (internal and external) for works proposed outside standard construction hours		Appendix D3
		c) Noise and vibration mitigation and management measures that are to be considered and implemented where appropriate to manage potential impacts associated with works outside standard construction hours		Table 9-1 Appendix D3
		d) The noise and vibration impact assessment processes that will be followed to identify potentially affected receivers, clarify potential impacts and determine appropriate mitigation and management measures. The protocol will be prepared in consultation with the Department of Planning, Industry and Environment and the NSW		Section 8.2 Table 9-1 – NVMP1

Issue	Ref #	Commitment	Timing	Document reference
		Environment Protection Authority, and independently endorsed. The project protocol will be implemented during the duration of the construction of the project.		
Construction noise and vibration impacts	CNV4	Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that: a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements b) Noise and vibration impacts are being appropriately managed c) Mitigation measures are effective.	Construction	Table 9-1 – NVMP26
Construction noise and vibration impacts	CNV5	Where feasible and reasonable, unless compliance with the relevant traffic noise criteria can be achieved, or alternative arrangements have been agreed with affected receivers, construction vehicle movements will not occur on local roads beyond those required for direct access to construction sites.	Pre-construction and construction	Table 9-1 – NVMP3
Construction vibration impacts	CNV6	Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels. Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with	Pre-construction and construction	Section 8.5.1 Section 9.3 Table 9-1 – NVMP26

Issue	Ref #	Commitment	Timing	Document reference
		a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.		
Construction ground-borne noise impacts	CNV7	Feasible and reasonable measures will be implemented to minimise ground-borne noise where exceedances are predicted.	Construction	Table 9-1 – NVMP21-22
Construction impacts from surface road works	CNV8	Mitigation measures will be implemented for surface road works, local area and utility works, where construction activities are predicted to exceed noise management levels at receivers. Where feasible and reasonable the approaches that will be used include: a) Carrying out works during the daytime period when near residential receivers b) Selection of plant and equipment to minimise noise and vibration impacts c) Management of plant and equipment to minimise the generation of noise and vibration impacts d) Community consultation, engagement and notification e) Detailed programming and respite protocols f) Where out of hours works are required, programming the noisiest activities to occur during the less sensitive time periods g) Out of hours works protocols h) Limiting timing of noise intensive work i) Use of portable noise barriers around particularly noisy equipment such as concrete saws and rock hammers in	Construction	Table 9-1 Stage 3A consists of primarily tunnel excavation and limited in-tunnel infrastructure. This REMM is not anticipated to be relevant. Nonetheless, these measures are generally incorporated throughout this plan and Table 9-1.

Issue	Ref #	Commitment	Timing	Document reference
		cases where it will effectively reduce noise levels at nearby receivers j) Management of construction traffic to minimise movements during the night periods along local roads k) Establishing minimum vibration buffer distances for vibration intensive works l) Vibration and blasting trials and/or monitoring along with building condition surveys.		
Cumulative construction noise impacts	CNV10	Construction noise from concurrent and consecutive construction works will be managed to minimise cumulative construction noise impacts. Where feasible and reasonable the approaches that will be used include:	Construction	Table 9-1
		a) Coordinating work between project construction sites and construction works to avoid cumulative noise impacts		Table 9-1 - NVMP32
		b) Consideration of additional at source or near source mitigation where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts		Table 9-1 - NVMP33
		c) Community consultation throughout the project to gauge construction key noise impacts and issues and any unknown impacts from concurrent or consecutive sets of constructions works		Table 9-1 - NVMP34
		d) Incorporating additional noise mitigation and management measures with consideration of cumulative		Table 9-1 - NVMP33

Issue	Ref #	Commitment	Timing	Document reference
		and consecutive construction noise impacts based upon coordination between projects.		
Aboriginal heritage – vibration impacts	AH2	The following process will be carried out to confirm where vibration monitoring at terrestrial AHIMS sites within 50m of the Project construction footprint will be required: • Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound • Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound • A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second. Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.	Pre-construction and construction	Table 9-1 – NVMP28
Aboriginal heritage – vibration impacts	AH3	Vibration monitoring will be carried out at AHIMS sites that have been identified as requiring monitoring in accordance with the process outlined in mitigation measure AH2. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites.	Construction	Table 9-1Table 9-1 – NVMP29

Issue	Ref #	Commitment	Timing	Document reference
Aboriginal heritage – vibration impacts	AH4	If vibration monitoring identifies that vibration levels exceed 2.5 millimetres per second at AHIMS sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition surveys may include further photogrammetry and 3D-capture techniques.	Construction	Table 9-1 – NVMP29
Ground movement impacts	SG4	Pre-construction building/structure condition surveys will be offered and prepared for properties (and heritage assets) within the zone of influence of tunnel settlement (for example within the 5 millimetre predicted surface settlement contour and within 50 metres of surface works) and within the minimum working distances for cosmetic and structural damage due to vibration. The surveys will be carried out by a suitably qualified person prior to the commencement of the tunnelling and vibration-intensive activities in the vicinity with the potential to affect the building/structure. Within three (3) months of the completion of construction activities that have the potential to impact on the subject surface/subsurface structure, all property owners of buildings for which a preconstruction building condition survey was carried out will be offered a second building condition survey. Where an offer is accepted, post-construction building condition surveys will be carried out by a suitably qualified person. The results of the surveys will be documented in a post-construction building condition survey report for each building surveyed. Copies of building condition survey reports will be provided to the	Pre-construction and Post-construction	Table 9-1 – NVMP30 Refer also to the Groundwater Management Sub-Pan

Issue	Ref #	Commitment	Timing	Document reference
		owners of the buildings surveyed within one (1) month of the survey being completed. Any property damage caused by the project will be rectified.		

3.4 Acoustics Advisor

Details regarding the roles and responsibilities of Acoustics Advisor are outlined in Section 3.3 of the CEMP. The AA will be invited to all ER inspections where upcoming works, monitoring and analysis of monitoring results will be discussed. The Project will be available and cooperate with the AA for monitoring and data requests. The AA will be provided with noise and vibration plans, assessments and monitoring reports, as well as access to noise and vibration monitoring activities as they take place where possible and requested.

Following any inspections by the AA, the Project will work with the AA in relation to identified actions and close these out within the agreed timeframe. The Project will consider any recommendations to improve practices raised by the AA. The Project will demonstrate, to the satisfaction of the AA, why any recommendation is not adopted.

If required, the Proponent may nominate additional suitably qualified and experienced persons to assist the lead AA for the Planning Secretary's approval.

4 Consultation

4.1 Consultation for NVMP Preparation

This NVMP has been developed and finalised in consultation with the agencies outlined in MCoA C4(b), and in accordance with MCoA A5, including NSW Health and Inner West Council.

The Noise and Vibration Monitoring Program included in Appendix D2 has been finalised in consultation with the NSW Environment Protection Authority (EPA) as required by MCoA C11(a), and in accordance with MCoA A5.

The Out of Hours Works (OOHW) Protocol included in Appendix D3 has been developed and finalised in consultation with the ER, AA and EPA in accordance with MCoA E69.

Consultation with each agency, including responses received and how any issues raised were addressed in the development of this Plan are summarised in Table 4-1.

Ongoing consultation with relevant councils noted in Table 3 and other stakeholders, including any unique local receivers, may be carried out for issues pertaining to the Project's noise and vibration impacts, including the identification of appropriate respite periods for out-of-hours works (OOHW) with affected receivers identified in the noise assessment.

Community feedback and complaints relating to noise and vibration will be dealt with in accordance with the Community Communication Strategy (CS) and the Complaints Management System.

4.2 Out of Hours Work Respite Consultation

Ongoing consultation pertaining to the Project's noise and vibration impacts will be required with relevant councils and other stakeholders, including the identification of appropriate respite periods for OOHW with affected receivers identified in the noise assessment. This process is further outlined in the OOHW Protocol (refer Appendix D3)

Consultation will be conducted in accordance with the Community Communication Strategy (CCS) and CoA E83 (refer Section 9.4). The CCS outlines how the Project will engage with and notify the community of upcoming works. In accordance with the CCS Appendix B – Out of Hours Communication Framework the following suite of communication tools will be considered as part of OOHW respite consultation, where required:

- OOHW notifications (letterbox drops and emails)
    - Providing overarching community notification of upcoming OOHW
- OOHW notices (email, SMS, phone calls and flyers)
    - Reminder to potentially affected residents of commencement of OOHW
- Face to face meetings
- Negotiated agreements
- Alternative accommodation letters of offer
    - Offer alternative accommodation to highly noise affected residents
- Website updates
    - Providing a list of upcoming OOHW

- Phone calls
    - Providing personalised contact and tailored advice about upcoming OOHW.

4.3 Endorsement and approval

In accordance with Section 2 of the CEMP, the Environmental Representative (ER) and Acoustic Advisor endorsed this NVMP prior to lodgement to DPIE for approval. This NVMP was lodged with DPE for approval at least one month prior to the commencement of construction works.

4.4 Other ongoing consultation

Any other ongoing consultation with agencies, where required, will be undertaken in accordance with Section 9 of this Plan. Community feedback and complaints relating to noise and vibration will be managed in accordance with the Community Communication Strategy and Complaints Management System.

Table 4-1 Summary of consultation undertaken for the development of this Plan

Agency	Project	Date correspondence received	Key issues	Where addressed / how addressed	Outstanding issues / why not addressed
NVMP (this Plan)					
NSW Health	14/7/2022 - Phone call Message left with NSW Health representative with project details. 19/7/2022 – phone call with NSW Health to provide overview of project and offer briefing of Stage 3A. 19/7/2022 – NVMP provided formally via email. 19/7/2022 – NVMP provided formally via Planning Portal. 25/7/2022 – project led briefing with NSW Health. 15/8/2022 – phone call with NSW Health rep from Northern Sydney LHD confirming no comments on the Stage 3A works from their department.	3/08/2022 – Letter provided via email regarding the NVMP. NSW Health noted the reduction in impacts for this stage and no comments on the NVMP.	No comment	N/A	N/A
Inner West Council	6/7/2022 - Initial contact with IWC to overview the management plans and organise a briefing to be run by the Project. 19/7/2022 - Submission of NVMP to IWC formally via email 19/7/2022 – submission of NVMP formally via Planning Portal 18/7/22 - Project briefing held with key members from IWC to overview Stage 3A.	16/08/2022 – email received from the IWC noting no comments on the NVMP.	No comment	N/A	N/A

	16/8/2022 – follow up email to IWC to check whether any comments on the plan would be provided				
Noise and Vibration Monitoring Program (Appendix D2 of this Plan)					
EPA	6/7/2022 - Call to EPA advising of imminent submission of management plans for consultation. A briefing on the Project scope was offered and ultimately accepted by the EPA officer. 19/7/2022 – Formal submission of NVMP to EPA via email. 19/7/2022 – Formal submission of NVMP to EPA via Planning Portal. 18/7/22 Call to EPA, message left, to discuss management plan consultation and to set a date for a briefing. 28/7/2022 – Project briefing presented to representatives of the EPA to outline Stage 3A. 9/8/2022 – Follow up email to EPA to determine if comments would be provided.	10/8/2022 – EPA formal response via email noting they have no comments.	No comment	N/A	N/A
OOHW Protocol (Appendix D3 of this Plan)					
EPA	6/7/2022 - Call to EPA advising of imminent submission of management plans for consultation. A briefing on the Project scope was offered and ultimately accepted by the EPA officer. 19/7/2022 – Formal submission of	10/8/2022 – EPA formal response via email noting they have no comments.	No comment	N/A	N/A

	NVMP to EPA via email. 19/7/2022 – Formal submission of NVMP to EPA via Planning Portal. 18/7/22 Call to EPA, message left, to discuss management plan consultation and to set a date for a briefing. 28/7/2022 – Project briefing presented to representatives of the EPA to outline Stage 3A. 9/8/2022 – Follow up email to EPA to determine if comments would be provided.				

5 Existing environment

The Project is located within the Inner West local government area (LGA).

The areas surrounding the project alignment and construction support sites are mostly residential, except for clusters of commercial and industrial receivers around White Bay.

The acoustic environment in these residential areas is mostly influenced by noise from the major arterial roads such as the City-West Link, Victoria Road as well as local transport activities.

Traffic volumes on these main roads, and resulting noise levels, are generally highest in the morning between 7.00 am and 9.00 am, and lowest between 2.00 am and 3.00 am. Traffic noise on major arterial roads is more continuous, rather than intermittent.

Noise generated by shops, restaurants, employment and entertainment areas can influence the surrounding acoustic environment and may contribute to higher ambient noise levels which locally mask road traffic noise.

5.1 Sensitive receivers

A land use survey was carried out, as part of the EIS, to identify the receiver types and uses of buildings that could potentially be impacted by noise or vibration from the Project. The survey was carried out to assist with defining appropriate management objectives for the sensitive receivers (refer Appendix D1). An additional review has been undertaken and integrated into the Project GIS and online 3D noise and vibration management software (Gatewave).

Where future receivers were identified as likely to be in place during the construction period, these have been assessed as the likely future use. In order to meet the requirements of MCoA E65 additional land use surveys of current noise-sensitive receivers at the time of construction would be carried out to confirm all potentially affected receivers.

These additional detailed land use surveys will confirm any changes in sensitive receivers as the construction program progresses. The results of the additional surveys will be included in Appendix D1.

As the Project is being constructed within a developed urban area, the Project is surrounded by sensitive receivers. The noise and vibration-sensitive receivers are generally separated into the following major categories, with further details of the breakdowns of categories and noise and vibration objectives presented in Section 6:

- Residential receivers (including mixed use buildings and aged care facilities)
- Other noise and vibration-sensitive receivers, including:
  - Classrooms at schools and other educational institutions
  - Hospital wards and operating theatres
  - Places of worship
  - Childcare centres
  - Active recreation areas (e.g. sports fields/activities which generate their own noise and are generally less sensitive to external noise)
  - Passive recreation areas (e.g. areas used for low intensity and low noise producing activities which have the potential to be impacted by external noise such as reading or meditation)
  - Community centres
  - Special noise and/or vibration-sensitive receivers (e.g. laboratories, recording studios)
- Commercial premises (including offices and retail outlets)
- Industrial premises

5.2 Noise Catchment Areas

To facilitate the assessment of noise impacts from the Project, receivers along the route have been divided into Noise Catchment Areas (NCAs). NCAs group individual sensitive receivers by common traits such as existing noise environment and location in relation to the Project. The project has been divided into 12 NCAs which are presented in Appendix D1.

5.3 Ambient Noise

During preparation of the EIS noise monitoring was carried out along the Project extent to quantify the existing noise environment in areas where receivers may potentially be affected by construction noise. Appendix G, Figure 2-1 of the EIS identifies the 12 long-term noise monitoring locations applicable to the project. Noise management levels (NMLs) for the assessment of construction noise are derived from measurements of existing noise levels in an area. The rating background level (RBL) is used to determine noise management levels at residential receiver locations.

The long-term noise monitoring results for the Project are presented in Table 5-1

Table 5-1 Long-term noise monitoring results

Monitoring location ID	NCA	Address	L_{A90} Rating Background Level (RBL)			L_{Aeq} Ambient noise		
			Day	Evening	Night	Day	Evening	Night
L1	1.5	22 The Crescent, Annandale	51	45	33	66	65	60
L2	1.5	2/277 Johnston Street, Annandale	50	47	36	65	64	59
L3	3.3	16 Railway Parade, Annandale	50	51	44	58	58	53
L4	5.3	109 Denison Street, Rozelle	49	46	37	61	60	53
L5	2.1	14 Oxley Street, Glebe	51	52	45	57	55	52
L6	4.3	28 Lilyfield Road, Rozelle	52	52	45	58	58	55
L7	10.1	203/38 Refinery Drive, Pyrmont	48	45	44	52	49	48
L8	7.1	31 Cambridge Street, Rozelle	43	41	34	57	57	48
L9	9.1	C13/1 Buchanan Street, Balmain	49	49	46	54	51	49
L10	8.1	23 Smith Street, Rozelle	42	44	38	54	53	48
L11	11.4	31 Wharf Road, Birchgrove	40	42	37	52	48	43
L12	12.1	9 Numa Street, Birchgrove	46	45	40	58	56	53

6 Noise and vibration criteria for NSW

The MCoA require construction noise and vibration be managed in accordance with the standards and guidelines outlined in MCoA E70 and listed in Section 3.1.3. Relevant elements of these documents are summarised and discussed in the following sections.

6.1 Construction noise and assessment objectives

As outlined in MCoA E70, the Interim Construction Noise Guideline (DECC, 2009) provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works
- Focus on applying all ‘feasible’ and ‘reasonable’ work practices to minimise construction noise impacts
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours
- Reduce time spent dealing with complaints at the project implementation stage
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

6.2 Approved construction work hours

Approved working hours for the Project are defined by MCoA E66 to 69, MCoA E83 and MCoA E88. An EPL will be obtained for the Project, any conditions relating to approved hours of work will be incorporated into Table 6-1 below once the EPL is issued.

Table 6-1 Construction working hours

MCoA	Construction Activity	Working hours applicable to Condition		
		Monday to Friday	Saturday	Sunday/ Public holiday
E66	Works must be undertaken during the following hours: (a) 7:00 am to 6:00 pm Mondays to Fridays, inclusive (b) 8:00 am to 6:00 pm Saturdays (c) at no time on Sundays or public holidays	7:00am to 6:00pm	8:00am to 6:00pm	No work[1]
E67	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML[3] at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday (b) between the hours of 8:00 am to 1:00 pm Saturday (c) if continuously, then not exceeding three hours, with a minimum cessation of work of not less than one hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasing and recommencing any of the work.	8:00am to 6:00pm (plus respite[2])	8:00am to 1:00pm (plus respite[2])	No work[1]
E68	Notwithstanding Conditions E66 and E67 work may be undertaken outside the hours specified in any of the following circumstances (Refer Section 9.3 and Appendix D3): (a) Safety and Emergencies, including:	6.00pm to 7.00am	6.00pm to 8.00am Sunday	8.00am to 7.00am Monday (8.00am

MCoA	Construction Activity	Working hours applicable to Condition		
		Monday to Friday	Saturday	Sunday/ Public holiday
	i. for the delivery of materials required by the NSW Police Force or other authority for safety reasons ii. where it is required in an emergency to avoid injury or the loss of life, to avoid damage or loss of property or to prevent environmental harm On becoming aware of the need for emergency work in accordance with Condition E8(a)ii, the Proponent must notify the AA, the ER, the Planning Secretary and the EPA of the reasons for such work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. (b) Low impact, including: i. construction that causes $L_{Aeq(15\ minute)}$ noise levels: • no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or ii. construction that causes $L_{AFmax(15\ minute)}$ noise levels no more than 15 dB(A) above the rating background level at any residence; or iii. construction that causes: • continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or • intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). (c) By Approval, including:			Monday on public holidays)

MCoA	Construction Activity	Working hours applicable to Condition		
		Monday to Friday	Saturday	Sunday/ Public holiday
	i. where different construction hours are permitted or required under an EPL in force in respect of the Project; or ii. works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition E69; or iii. negotiated agreements with directly affected residents and sensitive land user(s). (d) By Prescribed Activity, including: i. tunnelling (excluding cut and cover tunnelling and surface works) and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or ii. delivery of material that is required to occur outside of standard construction hours in Condition E66 to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton; or iii. works within an acoustic shed where there is no exceedance of the NMLs; or iv. trailer suction hopper dredging; or v. along the Warringah Freeway corridor in accordance with Condition E88.			
E69	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of work which is outside the hours defined in Conditions E66, and that are not subject to an EPL (Refer Section 9.3 and Appendix D3). The Protocol must be approved by the Planning Secretary before commencement of the Out-of-Hours Work. The Protocol must be prepared in consultation with the ER, AA and EPA. The Protocol must provide: (a) identification of low and high-risk activities and an approval process that considers the	6.00pm to 7.00am	6.00pm to 8.00am Sunday	8.00am to 7.00am Monday (8.00am Monday on public holidays)

MCoA	Construction Activity	Working hours applicable to Condition		
		Monday to Friday	Saturday	Sunday/ Public holiday
	risk of activities, proposed mitigation, management, and coordination, including where: (i) the ER and AA review all proposed out-of-hours activities and confirm their risk levels, (ii) low risk activities can be approved by the ER in consultation with the AA, and (iii) high risk activities that are approved by the Planning Secretary; (b) a process for the consideration of out-of-hours work against the relevant NML and vibration criteria; (c) a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of Condition E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events; (d) procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided; and (e) notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works. This condition does not apply if the requirements of Condition E68(b) are met.			
E83	In order to undertake out-of-hours work outside the hours specified under Condition E66, the Proponent must identify appropriate respite periods for the out-of-hours work in consultation with the community at each affected location on a regular basis.	6.00pm to 7.00am	6.00pm to 8.00am Sunday	8.00am to 7.00am Monday (8.00am

MCoA	Construction Activity	Working hours applicable to Condition		
		Monday to Friday	Saturday	Sunday/ Public holiday
	This consultation must include (but not be limited to) providing the community with: (a) a progressive schedule for periods no less than three months, of likely out-of-hours work; (b) a description of the potential work, location and duration of the out-of-hours work; (c) the noise characteristics and likely noise levels of the work; and (d) likely mitigation and management measures which aim to achieve the relevant noise management levels under Condition E70 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers). The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour work must be provided to the AA, ER, EPA and the Planning Secretary. Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above the rating background noise level at any residence Refer Appendix D3 – OOHW Protocol			Monday on public holidays)

Notes:

1. No work unless permitted and approved in accordance with an EPL
2. Minimum respite in continuous blocks of no more than 3 hours, with at least 1 hour respite between each block of work generating high noise impact, where the location of the work and activities is likely to impact the same noise sensitive receivers; except as expressly permitted by another condition of this licence.
3. Highly noise intensive work restrictions apply to surface works only. The applicable NML for residential receivers is the highly noise affected level of 75dB(A)

6.3 Quantitative noise assessment criteria

6.3.1 Airborne Noise

As outlined in MCoA E73, noise generated by construction must not exceed the National Standard for exposure to noise in the occupational environment of an eight-hour (8hr) equivalent continuous A-weighted sound pressure level of LAeq,8h of 85 dB(A) for any employee working at a location near the CSSI. An assessment of impacts and any monitoring requirements will be contained in the CNVIS documents outlined in Section 8.

6.3.1.1 Residential Receivers

The noise management levels (NMLs) for residential receivers set in accordance with the Construction Noise and Vibration Guideline are provided in Table 6-2. Construction noise impacts on residential receivers are assessed using these noise management levels, set with reference to time of day and background noise (Rating Background Level (RBL)). The RBL for each location was determined based on the quietest period of the day, evening or night assessment period in accordance with the NPfI.

Where noise levels are above the noise management levels, reasonable and feasible noise mitigation needs to be considered. Reasonable and feasible noise mitigation includes site specific measures for noise management, mitigation and treatment measures such as construction noise barriers, acoustic sheds, acoustic enclosures, and restricted construction hours and activities.

Where exceedances of the NMLs are expected, the additional mitigation measures outlined in the CNVG will be implemented to mitigate residual impacts, refer Section 9.6.

There is also a highly noise affected level for construction, above which further mitigation needs to be considered, such as additional consultation and notification, additional respite periods, and alternative accommodation.

Table 6-2 Construction noise management levels – residential receivers

Time of Day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to Apply
Approved construction hours[2]: Monday to Friday 7 am to 6 pm Saturday 8 am to 6 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:

Time of Day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to Apply
		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 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside approved construction hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 (ICNG).

Notes:

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. Approved construction hours are Monday to Friday 7 am to 6 pm and Saturday 8 am to 6 pm, no work on Sundays or public holidays. Refer CoA E66.

6.3.1.2 Non-residential receivers

The noise management levels for non-residential receivers set in accordance with the Interim Construction Noise Guideline are provided in Table 6-3. These levels apply only during hours when the non-residential premises are being used.

The difference between an internal noise level and the external noise level is about 10 dB(A), which provides a conservative assumption when windows are open for ventilation. Buildings where windows are fixed or can remain closed as a relevant mechanical ventilation plant is ensuring suitable ventilation within the building may achieve a greater noise level performance.

Table 6-3 Noise management levels at other noise sensitive land uses

Land Use	Where objective applies	Noise management level $L_{Aeq,15min}$
Classrooms at schools, and other educational institutions	Internal noise level	45 dB(A)
Hospital wards and operating theatres	Internal noise level	45 dB(A)
Places of worship	Internal noise level	45 dB(A)

Land Use	Where objective applies	Noise management level $L_{Aeq,15min}$
Childcare centre (sleeping areas, assuming open window)	External noise level	50 dB(A)
Active recreation areas (e.g. sports fields/activities which generate their own noise and are generally less sensitive to external noise)	External noise level	65 dB(A)
Passive recreation areas (e.g. area used for low intensity and low noise producing activities which could be impacted by external noise such as reading or meditation)	External noise level	60 dB(A)
Community centres	Depends on the intended use of the centre.	Refer to the 'maximum' internal levels in AS2107 for specific uses.
Commercial premises (including offices and retail outlets)	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)
Special noise and/or vibration sensitive (eg laboratories, recording studios)	Depends on the intended use	Refer to the 'maximum' internal levels in AS2107 for specific uses.

6.3.1.3 Sleep Disturbance Criteria

Considering the ICNG and RNP guidance, a night-time sleep disturbance 'screening criterion' noise goal of RBL +15 dB(A) (external) is used to identify the receivers where there is potential for sleep disturbance over more than two consecutive nights.

Where the sleep disturbance screening criterion is exceeded, further assessment is conducted to determine whether the 'awakening reaction' level of L_{Amax} 65 dB(A) (external) would be exceeded and the likely number of these events. The awakening reaction level is the level above which sleep disturbance is considered likely.

6.3.2 Construction Traffic noise

For locations within the construction footprint, where noise levels would increase by more than 2 dB(A) due to construction traffic volumes or a temporary re-route due to a road closure, further assessment will be completed as per the Noise Criteria Guideline (Roads and Maritime, 2015).

6.3.3 Ground-borne noise

Ground-borne noise is generated by vibration transmitted through the ground into a structure and is more likely to be noticeable during the evening and night periods, when masking by airborne noise is less likely. Ground-borne noise objectives set in accordance with the Construction Noise and Vibration Guideline are provided in Table 6-4.

Table 6-4 Ground-borne noise objectives

Receiver Type	Ground-borne noise objectives $L_{Aeq,15min}$
Residential (day – 7am to 6pm)	Not applicable
Residential (evening – 6pm to 10pm)	40 dB(A) internal
Residential (night – 10pm to 7am)	35 dB(A) internal
Hospital wards and operating theatres	45 dB(A)
Childcare centres (sleeping areas)	40 dB(A)
Classrooms at schools and other educational institutions	45 dB(A)
Places of worship	45 dB(A)
Community centre	45 dB(A)
Commercial premises (including offices)	50 dB(A)
Commercial premises (including retail outlets)	55 dB(A)
Other noise sensitive receivers	Refer to the 'maximum' internal levels in AS/NZS 2107 for specific uses

6.4 Adopted project noise management levels

The project-specific noise objectives for each representative monitoring location for works within and outside approved working hours are presented in Table 6-5.

Figures showing the locations of the referenced NCAs as well as noise sensitive receivers are shown in Appendix D1.

Table 6-5 Adopted project noise management levels

NCA Reference	Reference Logger	Approved Hours (RBL + 10 dB)	Outside approved hours: Out of Hours Works (OOHW) (RBL + 5)			Screening Level, L_{Amax} (RBL+15dB)
		Day	Day	Evening	Night	Night
1.1	L2	60	55	52	41	51
1.2	L2	60	55	52	41	51
1.3	L2	60	55	52	41	51
1.4	L2	60	55	52	41	51
1.5	L2	60	55	52	41	51
2.1	L5	61	56	56	50	60
3.1	L3	60	55	55	49	59
3.2	L3	60	55	55	49	59
3.3	L3	60	55	55	49	59

NCA Reference	Reference Logger	Approved Hours (RBL + 10 dB)	Outside approved hours: Out of Hours Works (OOHW) (RBL + 5)			Screening Level, L_{Amax} (RBL+15dB)
		Day	Day	Evening	Night	Night
3.4	L3	60	55	55	49	59
4.1	L6	62	57	57	50	60
4.2	L6	62	57	57	50	60
4.3	L6	62	57	57	50	60
4.4	L6	62	57	57	50	60
4.5	L6	62	57	57	50	60
5.1	L4	59	54	51	42	52
5.2	L4	59	54	51	42	52
5.3	L4	59	54	51	42	52
6.1	L41	73	68	63	48	58
6.2	L41	73	68	63	48	58
6.3	L41	73	68	63	48	58
6.4	L41	73	68	63	48	58
6.5	L41	73	68	63	48	58
7.1	L8	53	48	46	39	49
7.2	L8	53	48	46	39	49
8.1	L10	52	47	47	43	53
9.1	L9	59	54	54	51	61
9.2	L9	59	54	54	51	61
10.1	L7	58	53	50	49	59
10.2	L7	58	53	50	49	59
11.1	L11	50	45	45	42	52
11.2	L11	50	45	45	42	52
11.3	L11	50	45	45	42	52
11.4	L11	50	45	45	42	52
11.5	L11	50	45	45	42	52
11.5	L11	50	45	45	42	52
12.1	L12	56	51	50	45	55
12.2	L12	56	51	50	45	55

Notes:

1. As per section 2.3 of the NPfI, as the community generally expects greater control of noise during the more sensitive evening and night-time periods than during the less sensitive daytime period, the project noise management levels for evening are set at no greater than daytime level, and the night-time is set to be no greater than the day or evening levels.
2. Evening/night shoulder period is from 10pm to 12am Monday to Sunday
3. Morning shoulder period is from 5am to 7am Monday to Friday, 6am to 8am Saturday, Sunday and Public holidays

Residential receivers may have been provided (either by the Noise Insulation Program, by past projects or independently designed-and-built) with at-property treatments which allow windows to be fixed or kept closed. In these cases, the noise benefit achieved by the property treatment can be considered in the assessment of construction airborne noise impacts at these individual receivers and the external residential noise management levels can be conservatively increased by 10dB. Higher adjustments may be adopted, if a qualified acoustic consultant has determined that windows and facades of individual buildings provide a higher level of sound attenuation than 20dB and if it can be demonstrated or reasonable assumed that the windows are fixed or kept closed.

6.5 Vibration criteria

Construction vibration is associated with three main types of impact:

- Disturbance to building occupants
- Potential damage to buildings
- Potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

6.5.1 Human exposure to vibration

Tactile vibration potentially disturbing human occupants of buildings is managed by reference to Assessing Vibration; a technical guideline (DECC, 2006). This document provides criteria which are based on the British Standard BS 6472-2008 Evaluation of human exposure to vibration in buildings (1-80Hz).

Vibration sources are defined as Continuous, Impulsive or Intermittent. Table 6-6 provides a definition and examples of each type of vibration.

Table 6-6 Types of vibration

Types of vibration	Definition	Examples
Continuous	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity
Impulsive	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing the duration is short (typically less than 2 seconds)	Infrequent: Activities that create up to three distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.

Types of vibration	Definition	Examples
Intermittent	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, they would be assessed against impulsive vibration criteria.

Preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and are reproduced below in Table 6-7.

Table 6-7 Preferred and maximum levels for human comfort (continuous and impulsive vibration)

Location	Assessment period[1]	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration[3] (weighted rms Acceleration, m/s2, 1-80Hz)					
Critical areas[2]	Day or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration[3] (Weighted rms Acceleration, m/s2, 1-80Hz)					
Critical areas[2]	Day or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92

Notes:

1. Daytime is 7.00am to 10.00pm and night-time is 10.00pm to 7.00am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of their policy and other guidance documents (e.g. relevant standards) and should be referred to. Source: BS 6472-2008
3. Source: Table 2.2, Assessing Vibration; a technical guideline, Department of Environment and Climate Change 2006.

Preferred and maximum values for human comfort are presented in Table 6-8.

Table 6-8 Preferred and maximum levels for human comfort (intermittent vibration)

Location	Assessment period[1]	Preferred values	Maximum values
Intermittent vibration[3] (Vibration Dose Values, VDV, m/s1.75, 1-80Hz)			
Critical areas[2]	Day or night-time	0.10	0.20
Residences	Daytime	0.20	0.40
	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day or night-time	0.40	0.80
Workshops	Day or night-time	0.80	1.60

Notes:

1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas, as noted in BS 6472–1992
3. Source: Table 2.4, Assessing Vibration; a technical guideline, Department of Environment & Climate Change 2006.

To assess the potential for vibration impact on human comfort, an initial screening test will be completed based on peak velocity units, as this metric is also used for the cosmetic building damage vibration assessment. This screening test is a conservative approach as it is based on the continuous vibration velocity criteria (i.e. vibration that continues uninterrupted for a defined assessment period) whilst construction works are mostly intermittent. The initial screening test for vibration disturbance to building occupants, based on the peak particle velocity (ppv, mm/s) are presented in Table 6-9. If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

Table 6-9 Construction vibration disturbance to building occupants – initial screening test

Place and Time	Maximum peak velocity, mm/s (>8Hz)
Critical areas (day or night)1	0.28
Residential buildings 16 hr day	0.56
Residential buildings 8 hr night	0.40
Offices, schools, educational institutions and places of worship (day or night)	1.10
Workshops (day or night)	2.20

6.5.2 Structural damage to buildings

Potential structural damage of buildings by vibration is typically managed by ensuring vibration impacting the structure does not exceed certain limits and standards, such as British Standard 7385: Part 2 and German Standard DIN 4150-3. As outlined in the Roads and Maritime's CNVG, guidance for cosmetic damage of structures is provided in the British Standard 7385: Part 2, while German Standard DIN 4150-3 has criteria of particular reference for heritage structures.

There is no current Australian Standard for assessing structural building damage caused by vibration.

British Standard BS 7385: Part 2 Evaluation and measurement of vibration in buildings can be used as a guide to assess the likelihood of building damage from ground vibration. The standard suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur. Damage consists of minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement render, enlargement of existing cracks and separation of partitions or intermediate walls from load-bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS 7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4 Hz to 250 Hz, being the range usually encountered in buildings. At frequencies below 4 Hz, a maximum displacement value is recommended. The values set in the standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50 per cent. Table 6-10 sets out the BS 7385 safe limits for cosmetic damage.

Table 6-10 BS 7385 cosmetic damage safe limits

Line	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	50 mm/s

Line	Type of building	Peak component particle velocity in frequency range of predominant pulse	
		4 Hz to 15 Hz	15 Hz and above
2	Un-reinforced 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

The limits presented in Table 6-9 above relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, then the guide values in Table above may need to be reduced by up to 50 percent. This is especially applicable at the lower frequencies where lower guide values apply.

On this basis, the following vibration level (PPV) has been adopted as the assessment criteria for sound structures:

- Reinforced or framed structures – 25 mm/s
- Unreinforced or light framed structures – 7.5 mm/s.

For assessment purposes, a conservative vibration damage screening level of 7.5 mm/s has been adopted for sound structures to identify where further investigation is required.

For structures where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be done during detailed design to determine the applicable safe vibration level and approach to construction near the structure.

6.5.3 Heritage items

Heritage items are considered on a case-by-case basis, and care should be taken as these structures can be difficult to repair in the case of damage. British Standard BS 5228-2:2009 states that ‘a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive’ (p.39) when compared to other structures.

Where a structure is found to have defects, or is structurally unsound following an inspection, maximum vibration criteria are to be established for that specific structure for works to not further damage the structure. As stated previously, German Standard DIN 4150: Part 3 provides guidance for structures that are sensitive to vibration (eg structurally unsound).

A conservative vibration cosmetic damage screening level (peak component particle velocity) for heritage buildings/structures can be set to 2.5mm/s (the more stringent criterion in the German Standard DIN 4150-2016 Structural Vibration Part 3: Effects of Vibration on Structures). This screening level will allow potentially impacted heritage structures to be identified.

If a heritage structure is predicted to be exposed to vibration levels above the conservative vibration screening level of 2.5mm/s, further investigation would be undertaken to determine whether the structure is structurally unsound. Where a heritage building is deemed to be sensitive to vibration impacts, the more stringent DIN 4150-2016 Group 3 guideline values can be applied. Otherwise, structural damage vibration limits based on BS 7385 can be applied.

6.5.4 Damage to vibration-sensitive equipment

Some high technology manufacturing facilities, hospitals and laboratories use equipment that is highly sensitive and susceptible to vibration, for example scanning electron microscopes and

micro-electronic manufacturing facilities. In addition, buildings housing sensitive computer or telecommunications equipment may require assessment against stricter criteria than those nominated for building damage.

There is no explicit guidance on acceptable vibration levels for sensitive equipment, so recommended vibration levels should be obtained from instrument manufacturers. In the absence of equipment-specific data provided by manufacturers, generic vibration limits can be used to assess the impact of vibration-generating activities on buildings housing vibration-sensitive equipment.

Vibration Criterion (VC) curves are often referred to as they are generic and apply to all tools/equipment types within each category. The VC curves are defined over the frequency range eight to 100Hz.

Table 6-11 summarises a range of suitable vibration limits that are applicable to buildings housing vibration-sensitive equipment which may potentially be affected by construction works associated with the project.

Table 6-11 Acceptable vibration limits on building structure housing sensitive equipment

Equipment requirements	Vibration limit[1] mm/s		Description of Use
	rms	Peak[4]	
Computer areas[2]	0.7	1.0	Barely perceptible vibration. Adequate for computer equipment accommodation environments.
Medical[2,3]	0.1	0.14	Vibration not perceptible. Suitable in most instances for microscopes to 100X and for other equipment of low sensitivity.
VC-A[3]	0.05	0.07	Vibration not perceptible. Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc

Notes:

1. As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz. Vibration measured on the building structure near vibrating equipment or in areas containing sensitive equipment
2. Based on AS 2834 Computer Accommodation
3. Gordon CG Generic Vibration Criteria for Vibration-sensitive Equipment
4. In the absence of Peak limits, rms limits are converted to Peak by conservatively assuming the vibration signal is sinusoidal and random with a nominal crest factor of 1.414.

6.5.5 Existing rail tunnels

Any development that occurs within a distance of 25 metres horizontally from first reserve (dependent on tunnel dimensions), as defined in Asset Standards Authority (ASA) standard Development Near Rail Tunnels (ASA 2018), must consider vibration impacts on existing rail tunnels. The assessment requirement is a maximum peak particle velocity (PPV) of 15 mm/s at the tunnel lining for brick or mass concrete in good condition, or maximum PPV of 20 mm/s at the tunnel lining for cast iron, steel or concrete segment lining.

6.5.6 Damage to buried utilities

Section 5.3 of DIN 4150: Part 3 sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework. These values, which apply at the wall of the

pipe, are reproduced and presented in Table 6-12. As part of detailed design, these vibration limits would be considered to minimise the potential for damage to buried utilities from vibration impacts.

Table 6-12 Acceptable vibration limits for effects of short-term vibration on buried pipework

Line	Pipe Material	Guideline values for vibration velocity measured on the pipe, mm/s
1	Steel (including welded pipes)	100
2	Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
3	Masonry, plastic	50

Notes:

1. Consideration must also be given to pipe junctions within the building structure as potential substantial changes in mechanical loads on the pipe must be considered.

For long-term vibration, the vibration limits presented in Table 6-12 should be halved.

Recommended vibration goals for electrical cables and telecommunication utilities such as fibre optic cables range from 50 mm/s to 100 mm/s. Although cables may sustain these vibration levels, the utilities they are connected to, such as transformers and switch blocks, may not. If such equipment is encountered during the construction process, an individual vibration assessment would be carried out addressing impact on the utility, and consultation with the utility provider, to confirm specific vibration requirements.

6.5.7 Minimum Working Distances for Vibration Intensive Works

Minimum working distances (MWD) for typical vibration intensive construction equipment are provided in the CNVG and are shown in Table 6-13. The minimum working distances are for both cosmetic damage (from BS 7385 and DIN 4150) and human comfort (from AVTG). They are calculated from empirical data which suggests that where work is further from receivers than the quoted minimum distances then impacts are not considered likely.

Table 6-13 Recommended Minimum Working Distances from Vibration Intensive Equipment

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (AVTG)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Vibratory Roller	<50 kN (1–2 tonne)	5 m	11 m	15 m to 20 m
	<100 kN (2–4 tonne)	6 m	13 m	20 m
	<200 kN (4–6 tonne)	12 m	25 m	40 m
	<300 kN (7–13 tonne)	15 m	31 m	100 m
	>300 kN (13–18 tonne)	20 m	40 m	100 m
	>300 kN (>18 tonne)	25 m	50 m	100 m
Compactor[1]	32t (non-vibratory)	15 m	30 m	40 m

Plant Item	Rating/Description	Minimum Distance		
		Cosmetic Damage		Human Response (AVTG)
		Residential and Light Commercial (BS 7385)	Heritage Items (DIN 4150, Group 3)	
Bulldozer[1]	D10 with ripper	2 m	10 m	20 m
Excavators[1]	<30 tonne (travelling/digging)	10 m	15 m	15 m
Small Hydraulic Hammer	300 kg (5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	900 kg (12 to 18 t excavator)	7 m	15 m	23 m
Large Hydraulic Hammer	1,600 kg (18 to 34 t excavator)	22 m	44 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	5 m to 40 m	20 m
Impact Piling[1]	Typical driven pile	20 m	30 m	110 m
	338kJ per stroke (23 tonne hammer with 1.5m stroke)	70 m	140 m	330 m
Piling Rig – Bored	≤ 800 mm	2 m (nominal)	5 m	4 m
Jackhammer	Hand held	1 m (nominal)	3 m	2 m
Truck Traffic[1]	On uneven construction haul roads	5 m	10 m	20 m
Concrete Saw[4]	On roads and pavements	1 m	2 m	2 m

Notes:

1. Additional MWDs included from the EIS.
2. Additional MWDs included from the Stage 1A Early Works NVMP.

The minimum working distances are indicative and will vary depending on the particular item of equipment and local geotechnical conditions. The distances apply to cosmetic damage of typical buildings under typical geotechnical conditions. Use of plant within the recommended minimum working distances will be undertaken in conjunction with initial location and plant specific testing to identify the appropriate site and activity specific minimum working distance.

7 Environmental aspects and impacts

7.1 Construction activities

The Project will involve a range of activities incorporating various heavy machinery, plant and equipment that will operate in a number of locations across the Project. In order to assess the level of potential impact on noise and vibration sensitive receivers, the broad categories of construction activity likely to interact with these receivers are identified below:

Key construction activities would include:

- Site establishment
    - Establishment of construction facilities including site building.
    - Minor utilities installation, protection and connection
    - Installation of site fencing, environmental controls (including noise attenuation and project erosion and sediment controls) and traffic management controls
    - Establishment of construction support sites (including temporary site accesses) and acoustic sheds, where required.
- Tunnel works
    - Excavation of tunnel construction accesses (declines and shafts)
    - Construction of driven tunnels, ventilation passages and cross passage excavation
- Tunnel support activities
    - Workshop, deliveries, maintenance and storage

7.2 Spoil Handling Staging

Spoil handling will be undertaken within the completed WHT cut and cover and dive structure. No spoil handling resulting in noise levels above the NML will be undertaken on the surface.

7.3 Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on a number of factors. Typically, these might include:

- The type of plant and equipment in use
- The number of plant and equipment simultaneously in use
- Proximity to sensitive receivers
- Topography and other physical barriers
- Hours/duration of construction works
- Ground condition
- The condition of sensitive receivers
- Cumulative impacts from other project's works
- Proximity of heavy traffic areas such as the highway
- Presence of existing background noise (e.g. from heavy traffic areas).

Noise and vibration impacts attributable to the Project are anticipated (refer Table 7-1). Chapter 9 provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment.

Table 7-1 Noise and Vibration impact summary

Construction Activity	Potential Impact	NCA affected	Risk Level prior to mitigation	Mitigation measures	Risk Level following mitigation
Site establishment	Noise and vibration impacts to sensitive receivers adjoining the compounds including out-of-hours impacts	NCA4.2, NCA3.3	Moderate	Partial enclosure of noisier activities within the cut-and-cover structures, relocation of spoil handling activities inside the tunnel, installation of fan attenuators, restrictions on heavy vehicle movements	Minor
	Construction fatigue impacting sensitive receivers and broader community	NCA4.2, NCA3.3	Moderate	Community consultation and notification	Minor
Tunnel works	Vibration impacts leading to structural damage or cosmetic damage	There are no structures within minimum working distances for cosmetic damage during tunnelling works.	Negligible	N/A	Negligible

Construction Activity	Potential Impact	NCA affected	Risk Level prior to mitigation	Mitigation measures	Risk Level following mitigation
	Vibration impacts leading to human discomfort criteria exceedance	NCA4.4, NCA4.3, NCA5.3, NCA7.1, NCA6.1, NCA6.2, NCA6.3	Moderate	Use of low vibration plant such as roadheaders to excavate tunnel benches as much as practicable	Minor
	Regenerated noise impacts on nearby receivers, including out-of-hours impacts, resulting in sleep disturbance or community complaints	NCA4.4, NCA4.3, NCA5.3, NCA7.1, NCA6.1, NCA6.2, NCA6.3	Moderate	Use of low vibration plant such as roadheaders to excavate tunnel benches as much as practicable	Minor
	Vibration leading to damage of heritage items	There are no heritage structures within minimum working distances for cosmetic damage during tunnelling works.	Negligible	N/A	Negligible

Construction Activity	Potential Impact	NCA affected	Risk Level prior to mitigation	Mitigation measures	Risk Level following mitigation
Tunnel support activities	Noise and vibration impacts to sensitive receivers adjoining the compound including out-of-hours impacts	NCA3.3	Moderate	Partial enclosure of noisier activities within the cut-and-cover structures, relocation of spoil handling activities inside the tunnel, installation of fan attenuators, restrictions on heavy vehicle movements	Minor

7.3.1 Indicative Timing

As described in the latest Staging Report, construction of the Western Harbour Tunnel and Warringah Freeway Upgrade project commenced in 2021, with completion of construction expected in 2027. Construction of Stage 3A will approximately commence in late 2022 and continue until early 2025 (refer Table 7-2). .

Table 7-2 Indicative Key Construction Dates

Construction Portion	Indicative Start Date	Indicative Finish Date
Excavation	Q4 2022	Q1 2025

8 Construction noise and vibration assessment

The Western Harbour Tunnel and Warringah Freeway Upgrade Appendix G (Technical Working Paper: Noise and Vibration) of the EIS detailed a construction noise and vibration impact assessment. This was completed using three-dimensional models which included all noise sources, receiver locations, topographical and man-made features, and feasible and reasonable noise mitigation measures developed for this project. Models were developed for each of the major stages of construction across the project based on preliminary site layouts and reasonable worst case construction plant and equipment. Feasible and reasonable noise treatment measures and management methods were identified and incorporated into the models to assist in attenuating and managing noise from construction activities.

It was acknowledged in the EIS that actual noise levels would vary greatly depending on a range of factors including the location of the construction works within each construction works area, the distance between noise sources and nearby receivers, the noise intensity of works taking place and the time of day specific activities take place.

8.1 Construction activities assessed in the EIS

Construction noise from major works areas for the Project are assessed in detail in Section 5.2 through to Section 5.8 and Section 5.11 through to 5.12 of Appendix G (Technical Working Paper: Noise and Vibration) of the EIS.

8.2 Construction noise impacts

Site-specific construction noise and vibration impact statements (CNVIS) will be prepared by an appropriately qualified and experienced acoustic consultant. In accordance with MCoA E75, CNVIS will be prepared for any work that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in MCoA E70 and E71 at any residence outside construction hours identified in MCoA E66, or where receivers will be highly noise affected.

The CNVIS will include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the CNVIS will be provided to the AA and ER for endorsement prior to the commencement of the associated works. The Planning Secretary may request a copy/ies of CNVIS.

The CNVIS will address:

- Scope of work covered by CNVIS
- Justification for OOHW (where required)
- Nearest noise and vibration sensitive land user(s), based on land use survey
- Construction noise and vibration objectives (outlined in Section 6.1)
- Construction noise and vibration assessment
- Specific mitigation measures and preferred management measures, including noise barriers and acoustic enclosures as relevant
- Additional mitigation measures as described in Section 9.6
- Noise and vibration monitoring requirements
- Community notification requirements.

Noise and vibration monitoring data will be collected throughout the delivery of the project construction works in accordance with the Noise and Vibration Monitoring Program (Appendix D2) and the CNVIS. This will allow for ongoing review and verification of the predictive model.

The key construction activities to be included in the CNVIS documents for the project are listed below:

- Mainline tunnel excavation
- Ventilation passages excavation
- Cross passage excavation
- Limited road pavement and associated works

The following process for assessing construction noise and vibration will be implemented during preparation of each CNVIS.

1. Determine noise and vibration objectives for each key construction area:
    - Identify noise and vibration sensitive receivers
    - Determine relevant noise and vibration objectives, with reference to Section 5.1
2. Identify construction stages for each key construction area:
    - Identify construction aspects and key activities, including:
        - Site location
        - Times of operation
        - Activities involved
        - Plant and equipment (including size/type)
    - Identify construction works in the vicinity of the project. Liaise with the Utilities Coordination Manager and other construction projects in the vicinity of the works to ensure cumulative noise and vibration impacts are managed, in particular for OOHW.
3. Predict noise and vibration impacts

Airborne construction noise

- Determine $L_{Aeq(15\ minute)}$ sound power levels for plant and equipment based on operating scenarios for input to noise model
- Establish noise model for construction activity. The noise model should include:
    - Height and location of sources and receivers
    - Distance attenuation (incorporating noise reflections, ground absorption)
    - Effects of noise shielding (topography, buildings, fence, barriers etc.)
    - Effects of standard noise mitigation measures
    - Evaluate façade transmission loss of affected receivers to determine internal noise levels
- Calculate the $L_{Aeq(15\ minute)}$ noise levels (external and internal) from the proposed construction activities at each receiver and compare these with the construction noise objectives
- For night-time activities, calculate the maximum (L_{Amax}) noise levels and compare with the sleep disturbance criterion (RBL +15), applied at the external façade and determine whether the ‘awakening reaction' level of L_{Amax} 65 dB(A) (external) would be exceeded.

The number of noise awakening events also needs to be predicted in accordance with CoA E69(c).

Construction vibration

- Determine the location of each plant or equipment item in relation to each receiver
- Where vibration intensive equipment could potentially be operating in close proximity to receivers, determine whether this is within the minimum working distances (refer to Chapter 10 of the EIS). Note that minimum working distances may differ for heritage items
- Where plant and equipment may operate within minimum working distances, or for heritage items:
    - Use vibration levels versus distance prediction curves for each plant item
    - Determine the vibration likely to occur at each building location
    - For highly sensitive, equipment, assessment may need to incorporate structural response of building and particular sensitivities of equipment

4. Assess noise and vibration impacts. Where predicted noise and vibration exceeds the objectives identified in Step 1:
    - Identify key hours of impact for affected sensitive receivers (refer to Section 5.1)
    - Implement appropriate reasonable/feasible standard mitigation measures (refer to Section 9)
    - Predict noise and vibration impact at receivers, incorporating nominated mitigation measures, based on the expected noise reduction from mitigation measures
    - Consider additional mitigation measures and apply as appropriate.

8.3 Noise management tool (Gatewave)

A 3D construction noise and vibration management tool, Gatewave (www.gatewave.com.au), has been developed for the Project to allow defined work areas and activities to be planned, assessed and managed as construction works progress. It would also allow cumulative noise impact from other aspects of the Project or, where relevant, noise from other construction projects, to be assessed and managed in accordance with this NVMP.

Gatewave incorporates ground elevation contours, building heights, the built environment and atmospheric conditions to predict construction noise in accordance with the International Standard ISO 9613-2:1996 implementing quality standard ISO 17534-1:2015. All sensitive receivers identified by the land use survey (see Section Appendix B) are integrated into the Gatewave tool.

The tool allows:

- Flexibility in assessing specific scenarios of local area works,
- Assessment where works are undertaken at multiple locations, and
- Multiple combinations of equipment that may be used during each stage of works in the suburban environment that would be encountered.

CNVISs prepared for the Project would establish the overall impacts associated with worksites, ancillary facilities and tunnelling excavation. The Project environment team would use Gatewave to manage construction noise and vibration impact by defining specific work areas/activities in the CNVIS as construction progresses and identifying:

- Sensitive receivers where predicted noise levels are above the NMLs so that, where there are residual impacts even after all feasible and reasonable mitigation measures have been adopted, mitigation and management measures can be applied in accordance with this CNVMP; and

- Buildings/structures within minimum working distances established for cosmetic damage and human annoyance so that appropriate mitigation and management measures can be applied in accordance with this NVMP.

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Verification and adjustment of the prediction tool will occur throughout construction via monitoring. Noise and vibration monitoring data will be collected in accordance with the Noise and Vibration Monitoring Program (refer to Appendix D2). This feedback loop will ensure the prediction tool is verified and adjusted as required to ensure accuracy across the various sections of the Project alignment.

Note: The noise management tool does not replace the CNVIS. CNVIS documents will be stand-alone and definitive documents that guide the deployment of specific mitigation measures and practices at each site.

8.4 Ground-borne construction noise

Ground-borne noise objectives are presented in Table 6-4. The estimated number of potential ground-borne affected receiver buildings from road header tunnelling and rock hammer tunnelling are summarised in Sections 5.2.4, 5.3.4, 5.5.4, 5.7.4, 5.8.4, 5.11.1.1 and 5.11.1.2 of Appendix G (Technical working paper: Noise and vibration) of the EIS.

Ground-borne noise affected receiver buildings will require, as a minimum, letterbox notification to advise that tunnelling would be occurring and that noise levels are likely to be clearly audible during tunnelling works. It should be noted that even when the ground-borne noise levels achieve the objectives, they may still be audible or perceivable within residences. However, as tunnelling progresses, the tunnelling equipment approaches or moves away from individual receiver locations. The noise levels are expected to drop away as the tunnelling moves further away from the receiver, with individual receivers potentially exposed to noise levels above the ground-borne noise management levels for only relatively short periods of time.

As stated earlier in Section 8.2, in accordance with MCoA E75, CNVIS will be prepared for any work that may exceed the ground-borne noise levels specified in E71 at any residence outside construction hours identified in MCoA E66.

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8.5 Construction vibration

8.5.1 Vibration assessment

The vibration generated from construction works for the Project would vary depending on the level and type of activity carried out. The major construction activities that would include vibration-intensive works would be:

- Driven tunnel excavation
- Tunnel cross passage and ventilation excavation

Where vibration intensive activities are required, site-specific buffer distances for these activities (e.g. compaction, rock hammering) will be measured on sites where plant and equipment are likely to operate close to or within the typical MWDs. Site-specific buffer distances will then be maintained to comply with relevant vibration limits.

Vibration impacts from roadheader tunnelling are predicted to be below the vibration limit for human disturbance at all receivers. Vibration from roadheader tunnelling therefore presents a minor risk of impact. Across the Project it is assumed that vibration-intensive activities such large rock hammers could be used as part of the excavation for the mainline tunnels and cross

passages. The typical MWDs for other vibration-intensive plant items that may be used in the works are presented in Table 6-13 (Section 6.5.7).

The number of receiver buildings that are within the MWDs across the major works areas have been assessed and are presented in Section 5.3.5, 5.4.5, 5.5.5, 5.6.5, 5.7.5, 5.8.5 and 5.11.2 of Appendix G (Technical Working Paper: Noise and Vibration) of the EIS. Potential vibration impacts to receivers would depend on vibration source levels, the separation distance, the intervening soil and rock strata, dominant frequencies of vibration and the receiver structure.

As noted above, site-specific construction noise and vibration impact statements (CNVIS) will be prepared in accordance with MCoA E75. While works are ongoing vibration testing would be completed in accordance with MCoA E79.

9 Environmental mitigation and management measures

9.1 Noise and vibration mitigation and management measures

Noise and vibration associated with the construction of the Project has the potential to impact sensitive receivers within and adjacent to the construction footprint. In order to avoid, mitigate and/or minimise these potential impacts, a range of environmental requirements and control measures are identified in the various environmental documents, including the EIS and other Transport for NSW guidance documents. Specific measures and requirements to address noise and vibration are outlined in Table 9-1.

This section has been developed in consideration of the SMART Principles – Specific, Measurable, Achievable, Relevant and Time-based. Risk assessments for the Project, including the development of the REMMs as part of the detailed environmental risk analysis undertaken throughout the development of the EIS and RtS, as well as lessons learnt from previous major projects delivered by Transport for NSW in highly urbanised environments, have contributed to the development of this Plan. On this basis, the measures developed for the Project are considered to be relevant and achievable for the Project and would be monitored against specific, measurable and time-based targets through the Noise and Vibration Monitoring Program (refer Appendix D2)

Management and mitigation measures relevant to the Project are outlined in Table 9-1. These will be implemented to minimise noise and vibration impacts and ensure all commitments and requirements of the project approval are met. These specific management and mitigation measures have been developed to address the requirements of applicable legislation, the MCoA and commitments of the REMMs.

Table 9-1: Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
Construction Noise and Vibration Impact Statements (CNVIS)						
NVMP1	Detailed Construction Noise and Vibration Impact Statements (CNVIS) will be carried out for all construction support sites and major construction works required for the project prior to the commencement of construction. The Statements will consider the proposed site layouts and noise and vibration generating activities that will take place during all major stages of the construction support site, assess predicted noise and vibration levels against the relevant management levels, and incorporate feasible and reasonable mitigation and management measures in accordance with the requirements of the Interim Construction Noise Guideline (DECC, 2009) and the Construction Noise and Vibration Guideline (Roads and Maritime, 2016a). Reasonable and feasible mitigations will consider use of alternative construction and demolition techniques	CNVIS	Prior to construction	Tunnel Environment Lead	REMM CNV2 E74(e)	CNVIS
Training and Inductions						
NVMP2	Training will be provided to relevant Project personnel, including relevant subcontractors on noise and vibration requirements from this NVMP through inductions, toolboxes or targeted training. Training will cover the following:	Induction materials	Prior to construction Construction	Environment Manager	Industry practice	Induction records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• Nominated construction hours, restrictions and general requirements for OOHW • Avoiding shouting and minimise talking loudly, loud radios and slamming vehicle doors when arriving and departing work • Avoiding communicating and signalling using horns • Where practical switch off when not used rather than left idling for prolonged periods • All site personnel will be responsible for managing noise from their work activities and to work in a manner that will minimise noise emissions • The process for seeking approval for out-of-hours works •					
Construction Traffic and Construction Plant Noise						
NVMP3	Where feasible and reasonable, unless compliance with the relevant traffic noise criteria can be achieved, or alternative arrangements have been agreed with affected receivers, construction vehicle movements will not occur on local roads beyond those required for direct access to construction sites.	Noise and Vibration Monitoring Program CNVIS	Construction	Environment Manager Project Manager	REMM CNV5	Monitoring records
NVMP4	All construction plant and equipment used on site will be fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications.	Manufacturer's specifications	Construction	Supervisor/ Foreman	G36	Plant inspection record

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP5	All construction plant and equipment used on the site will be maintained in an efficient condition, in accordance with the manufacturers' specification. If a piece of plant or equipment is found to exceed the noise levels included in modelling, the following will occur: • If available and appropriate, a quieter piece of plant or equipment will be used in place of the offending plant/equipment • On-site mitigation (e.g. noise blankets) will be reviewed • The noise assessment will be repeated with the accurate noise level of the plant/equipment	Manufacturer's specifications CNVIS	Construction	Supervisor/ Foreman	G36 E74(a)	Plant inspection record Site inspection records Plant maintenance records
NVMP6	All construction plant and equipment used on the site will be operated in a proper and efficient manner.	Operator training SWMS	Construction	Supervisor/ Foreman	G36	Site inspection records Safety inspection records SWMS Plant operator training records and records of inductions

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP7	Non-tonal movement alarms will be used in place of tonal reversing alarms. .	Plant risk assessment Toolbox talk SWMS	Construction	Supervisor/ Foreman	G36	Plant inspection records SWMS Site inspection records
NVMP8	Plant and machinery will be switched off when it is not in use for more than 15 minutes	Induction materials Toolbox talk	Construction	Supervisor/ Foreman	Industry practice	Induction records Site inspection records
NVMP9	Additional temporary screening or enclosures will be considered for plant and equipment where additional measures are required to meet relevant NMLs, or where plant and equipment is known to exceed the NMLs	CNVIS	Construction	Project Manager Foreman / Supervisor	Industry practice	Monitoring records CNVIS
General Construction Hours						
NVMP10	Construction activities associated with the Project will be carried out in accordance with the hours in the NVMP. Early occupation and later release of road carriageways and construction sites will be	Induction materials	Construction	Project Manager	MCoA E66, E67, E68 CoA E74 (b)	Induction records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	considered, where feasible and approved by the asset owner to minimise noise impacts to receivers.					Site inspection records ROLs
NVMP11	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be carried out: • Between 8:00 am and 6:00 pm Monday to Friday • Between 8:00 am and 1:00 pm Saturday • In continuous blocks not exceeding three (3) hours each with a minimum respite from those activities and works of not less than one (1) hour between each block. Noisiest works will be scheduled before 11.00 pm Sunday to Thursday and before 12 midnight Friday and Saturday. Only applicable for surface works.	Induction materials Project EPL	Construction	Project Manager Environment Manager	MCoA E67, E74(c)	Induction records Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP12	OOHW is to be carried out in accordance with: • Project Out-of-Hours-Works Protocol, or • Project EPL	Induction materials OOHW Protocol (Appendix D3) Project EPL	Construction	Project Manager Environment Manager	MCoA E69 REMM CNV3 EPL (Appendix D3)	Induction records OOHW Permits Site inspection records
Noise barriers and acoustic sheds						
NVMP13	Noise barriers (such as site hoardings) will be constructed around ancillary facilities that are adjacent to sensitive land users where reasonable and feasible for the duration of the ancillary facility use or agreed with relevant affected properties. Temporary noise barriers will be used around noisy equipment and activities such as rock-hammering and concrete cutting.	CNVIS	Prior to construction Construction	Project Manager	MCoA A20, E74, E74(d)	Site inspection records
NVMP14	All surface based tunnelling support activities that generate noise levels above the noise management levels in Condition E70 must occur within an acoustic shed.	Acoustic shed/s	Construction	Project Manager	MCoA E77	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP15	All acoustic sheds must be designed and used within them do not result in the exceedance of the NMLs with the airborne noise pathways minimised and treated where feasible and reasonable, to achieve the Noise Management Levels in the Interim Construction Noise Guideline referenced in Condition E70. This would include the following considerations: - All significant noise producing equipment that would be used during the night-time would be inside the sheds, where feasible and reasonable. - Noise generating ventilation systems such as compressors, scrubbers, tunnel fans, would be located inside the sheds and external air intake/discharge ports would be appropriately acoustically treated; and - The doors of acoustic sheds would be kept closed during the night-time period. Where night-time vehicle access is required at sites with nearby residences, the entrances would be designed and construction to minimise noise breakout.	Acoustic shed/s	Construction	Project Manager	MCoA E78	Monitoring records
Consultation and Complaints Management						
NVMP16	Residences/sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Strategy. Information provided will include:	Community Strategy CEMP	Prior to construction Construction	Communications & Stakeholder Manager Environment Manager	MCoA E83	Community notifications

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• The types of activities to be undertaken • The timing of activities including expected start and finish • The location of activities • Details of the community information line and how to make an enquiry and/or complaint.					
NVMP17	Where noise assessments predict noise levels above the NMLs at community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas, consultation with the potentially affected receiver will be undertaken to identify sensitive periods and minimise impacts. Where noise levels are above the NML, these activities will not be timetabled with sensitive periods unless agreed with the affected receivers at no cost to the affected institution	CNVIS	Prior to construction Construction	Project Manager Communications & Stakeholder Manager	MCoA E72	Consultation records
NVMP18	All complaints will be managed in accordance with the CCS and EPL.	Community Communication Strategy	Construction	Communications & Stakeholder Manager	G36 Sect 3.7.4	Complaints register
NVMP19	Owners and occupiers at risk of exceeding the screening criteria for cosmetic damage will be notified before works that generate vibration commence in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and	Vibration Screening Criteria Drawings	Prior to construction Construction	Project Manager Environment Manager	MCoA E76	Consultation records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	occupiers will be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.	Community Communication Strategy		Communications & Stakeholder Manager		
NVMP20	Monitoring will be undertaken in response to complaints where requested by the resident and where the Project is not in possession of noise monitoring data in the vicinity of the complainants location.	Noise and Vibration Monitoring Program (Appendix D2)	Construction	Communications & Stakeholder Manager Environment Manager	Industry practice	Monitoring records
Ground-borne Noise Mitigation Measures						
NVMP21	Specific notifications will be provided to receivers where the ground-borne noise levels are predicted to exceed the evening and night-time NML.	Community Communication Strategy	Construction	Communications & Stakeholder Manager	MCoA E71	Community notifications
NVMP22	A ground-borne noise assessment will be undertaken for tunnel excavation. Ground-borne noise mitigation measures will be implemented in accordance with the assessment, this NVMP and relevant MCoA.	NVMP	Construction	Environment Manager	MCoA E70, E71	Construction Noise & Vibration Impact Statement
Vibration Mitigation Measures						
NVMP23	Vibration generating activities will be managed through the establishment of minimum buffer distances to achieve screening levels.	NVMP	Pre-construction	Foreperson	REMM CNV6	Detailed assessments

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	Where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed. Any damage caused by the project will be rectified.	Assessments for heritage items as required	and Construction	Environment Manager	REMMs NAH22	Reporting
Survey, Monitoring and Reporting						
NVMP26	Noise and vibration monitoring will be carried out in accordance with the Project's Noise and Vibration Monitoring Program. Construction noise and vibration impacts will be monitored periodically throughout all stages of the construction support sites to ensure that: a) Impacts are consistent with the noise and vibration levels detailed in the relevant Construction Noise and Vibration Impact Statements b) Noise and vibration impacts are being appropriately managed c) Mitigation measures are effective.	Noise and Vibration Monitoring Program (Appendix D2)	Construction	Environmental Manager	Industry practice REMMs AH3, AH4, CNV4	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NVMP27	Verification monitoring will be carried out during the initial stages of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions and that the mitigation and management measures that have been implemented are appropriate.	Noise and Vibration Monitoring Program (Appendix D2) CNVIS	Construction	Environment Manager	REMM CNV4 Industry practice	Monitoring records
NVMP28	The following process will be carried out to confirm where vibration monitoring at terrestrial AHIMS sites within 50m of the Project construction footprint will be required: • Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound • Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound • A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second.	Site condition surveys	There are no AHIMS listed sites within 50m of the footprint. Implement if one is discovered.	Environment Manager	REMM AH2	Aboriginal site condition surveys

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.					
NVMP29	The contractor will conduct vibration monitoring before and during vibration generating activities that have the potential to impact on heritage items (including Aboriginal cultural heritage). Monitoring will identify MWDs to prevent cosmetic damage. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites. If vibration monitoring identifies that vibration levels exceed 2.5 mm/s at Aboriginal cultural heritage sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition surveys may include further photogrammetry and 3D-capture techniques	Noise and Vibration Monitoring Program (Appendix D2)	Construction	Environment Manager	MCoA E79, REMMs AH3, AH4	Monitoring records
NVMP30	The contractor will offer pre-construction condition surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model.	Communications Strategy	Prior to Construction Construction	Project Manager	G36 Sect 4.7	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	The surveys and subsequent condition survey reports will be prepared by a suitable qualified and experienced person and will be provided to owners of the structure prior to the commencement of potentially impacting works. Where a pre-construction survey was undertaken, owners can request a post-construction survey which will be provided within three months of the request. Any property damage caused by the project will be rectified.				MCoA E107, E108, E109, E110, SG4	Condition survey reports
NVMP31	The condition survey report will include as a minimum: • Photograph of the subject building • Record site details – approximated age, construction, site slope and provision for drainage, presence of trees • Types of defects and their positions and extents on the floor plan • Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks • Details of the inspector's qualification and expertise	Communications Strategy	Prior to Construction Construction	Project Manager	G36 Sect 4.7	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
Other Mitigation Measures						
Impact From Concurrent Works						
NVMP32	Work will be coordinated between project construction sites and / or non-project construction works to avoid cumulative noise impacts where reasonable and feasible.	N/A	Construction	Utilities Coordination Manager Project Manager Environment Manager	REMMs CNV1 (i) and CNV10	Meetings with relevant authorities
NVMP33	Additional at source or near source mitigation will be considered where construction noise levels may result in cumulative construction noise impacts, where programming is not practical to avoid cumulative noise impacts.	N/A	Construction	Project Manager Environment Manager	REMMs CNV1 (i) and CNV10	Site inspection records
NVMP34	Community consultation will be undertaken throughout the project to gauge impacts from construction noise and any unknown impacts from concurrent or consecutive sets of construction works.	N/A	Construction	Project Manager Communications & Stakeholder Manager	REMMs CNV1 (i), CNV8 (d) and CNV10	Community notification

9.2 Management procedures for OOHW

In accordance with MCoA E69 and NVMP20, an Out-of-Hours Work (OOHW) Protocol will be prepared in consultation with the EPA, ER and AA and approved by the Planning Secretary before commencement of OOHW that are not subject to an EPL. The OOHW Protocol defines the process for seeking approval for out of hours works, including consultation (refer Appendix D3).

The protocol will address out of hours works which are not subject to the EPL and will include a process for approval and hold points relating to:

- identification of low and high-risk activities and an approval process that considers the risk of activities, proposed mitigation, management, and coordination including where:
    i. the ER and AA review all proposed out-of-hours activities and confirm their risk levels
    ii. low risk activities can be approved by the ER in consultation with the AA
    iii. high risk activities that are approved by the Planning Secretary
- a process for the consideration of out-of-hours work against the relevant NML and vibration criteria
- a process for selecting and implementing mitigation measures for residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of CoA E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) would be exposed to, including the number of noise awakening events
- procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party, to ensure appropriate respite is provided
- notification arrangements for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.

All OOHW (except in emergency situations) will be documented on the relevant OOHW Form.

9.3 Vibration Screening Criteria for properties and heritage items

9.3.1 Properties

Properties at risk of cosmetic damage would be identified through review of the proposed vibration intensive construction activities and the vibration screening criteria nominated in Sections 6.5.2 and 6.5.3. In accordance with MCoA E76, owners and occupiers of identified properties will be notified before works that generate vibration commence near these properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a monthly schedule of potential exceedances for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.

9.3.2 Non-Aboriginal Heritage items

As required by REMM CNV6, where vibration levels are predicted to exceed the screening levels, a more detailed assessment of the impacted structure and attended vibration monitoring will be carried out to ensure vibration levels remain below appropriate limits for that structure.

For heritage items, the more detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.

Any damage caused by the project will be rectified.

The detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is protected. During detailed design, the construction methodology will be refined as needed to ensure the adopted criteria and site-specific minimum working distances for all vibration-intensive activities (eg Compaction, rock hammering, piling) can be met.

During construction, site-specific buffer distances will be maintained to comply with relevant vibration limits for cosmetic damage, and vibration monitoring will be carried out to ensure vibration levels remain below the appropriate limits for the structure.

9.3.3 Aboriginal cultural heritage items

Aboriginal cultural heritage items will be managed in accordance with REMMs AH2, AH3, AH4 and AH10, as detailed below:

The following process will be carried out in accordance with REMM AH2 to confirm where vibration monitoring at terrestrial AHIMS sites within 50m of the Project construction footprint will be required:

- Terrestrial Aboriginal site condition surveys will be completed using photogrammetry and 3D-capture techniques to determine which AHIMS sites are considered to be structurally unsound
- Where this determination cannot be made, the AHIMS site will be considered to be structurally unsound
- A screening of vibration intensive activities within 50 metres of structurally unsound sites will be carried out to identify activities that have the potential to exceed vibration levels of 2.5 millimetres per second.

Sites identified as being both structurally unsound and having potential for exceedance in vibration levels of 2.5 millimetres per second will be identified as requiring vibration monitoring.

Vibration monitoring will be carried out at AHIMS sites that have been identified as requiring monitoring in accordance with the process outlined in mitigation measure AH2. Where possible, works will be conducted in a manner to minimise vibration levels, to less than 2.5 millimetres per second at all structurally unsound AHIMS sites (REMM AH3).

If vibration monitoring identifies that vibration levels exceed 2.5 millimetres per second at AHIMS sites that have been identified as requiring monitoring, a site visit will be organised with a representative from Metro LALC to record any changes to the integrity of the site that may have resulted from construction vibration, and updated site cards must be prepared accordingly. Condition surveys may include further photogrammetry and 3D-capture techniques (REMM AH4).

9.4 Communication and consultation

9.4.1 Proactive consultation and notification

Residents, property owners, businesses and community facilities near construction sites will have a wide range of unique needs and concerns regarding construction impact. the Project will engage through multiple channels to notify and build understanding of the likely impacts of airborne noise, ground-borne noise and vibration, and the reasonable and feasible options available to mitigate these impacts, including respite. In accordance with MCoA E83, consultation with the affected community must be undertaken on a regular basis.

9.4.2 Consultation with sensitive receivers

Sensitive receivers such as community, religious, educational institutions and noise and vibration sensitive businesses and critical working areas (e.g. theatres, laboratories and operating theatres) potentially affected by the Project will be consulted to develop timetables of works and specific mitigation measures to satisfy MCoA E83. The outcomes of this consultation will be fed back into the construction noise and vibration management system and will assist with the final timetabling, respite periods and detailed design of mitigation measures for the site, where reasonable and feasible.

In addition, the contractor will consult with proponents of other construction works near the Project worksites and take reasonable steps to coordinate works to minimise cumulative noise and vibration impact and coordinate respite for affected sensitive receivers, to satisfy MCoA E82 and E83.

Consultation will be conducted in accordance with the Communication Strategy and CoA E83. It will include the provision of the following information to affected receivers:

- A progressive schedule of likely out-of-hours work for a period of no less than three (3) months,
- A description of the potential out-of-hours, including location and duration,
- The noise characteristics and likely noise levels of the works, and
- Likely mitigation and management measures.

The outcomes of the community consultation, the identified respite periods and the scheduling of the likely OOHW will be provided to the AA, ER, EPA and the Secretary.

9.5 Property surveys, issues rectification and the IPIAP

In line with MCoA 107, the contractor will offer and undertake pre-construction condition surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in MCoA E102 or as identified in the CNVIS. The pre-construction condition surveys and reports will be prepared by a suitably qualified and experienced person(s) and the report will be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works.

Where pre-construction condition surveys have been undertaken in accordance with MCoA E107, subsequent post-construction condition surveys will be offered and undertaken where accepted by the landowner to assess damage to the surface and sub-surface structures that may have resulted from the construction of the Project within three months of the landowner(s) requests. (MCoA E108).

The results of the surveys will be documented in Pre-construction and Post-construction Condition Survey Reports for each surface and sub-surface structure surveyed. Copies of the Condition Survey Reports will be provided to the owner(s) of the structures surveyed for review prior to the commencement of potentially impacting works and no later than four months following the completion of construction that have the potential to impact the subject structure. Where damage has been determined to occur as a result of the Project, rectification would occur at the Contractors expense and to the reasonable requirements of the surface and sub-surface structure owner(s) within twelve months of completion of construction unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.

As required by MCoA E111, Transport for NSW will establish an Independent Property Impact Assessment Panel (IPIAP) before works that have the potential to result in property impacts commence. The IPIAP must comprise geotechnical and engineering experts independent of the design and construction team. The IPIAP will be responsible for independently reviewing Pre- and Post-construction Condition Survey Report templates prepared under Conditions E107 and E109, any Pre- and Post-construction Condition Survey Reports where there is a dispute, and the

resolution of property damage disputes, and the establishment of ongoing settlement and vibration monitoring requirements. The Planning Secretary will be notified of the members of the IPIAP prior to the commencement of any works which may potentially result in property impacts.

Either the affected owner or Transport for NSW may refer unresolved disputes arising from potential and/or actual property impacts to the IPIAP for resolution. All costs incurred in establishing and implementing the IPIAP must be borne by the Proponent regardless of which party makes a referral to the IPIAP. The findings and recommendations of the IPIAP are final and binding on the Proponent (MCoA E112).

The governance framework for the IPIAP will be made publicly available on the CSSI's project page as required by Condition B15 (MCoA E113).

9.6 Additional noise and vibration mitigation measures

In instances where noise levels are still predicted to exceed the NML at receivers, after the application of noise mitigation and management measures (refer to Section 9.1), the CNVG directs that the Project should consider implementing the additional mitigation measures such as (refer to Appendix D3 of the CNVG for more detail):

- Notification (letterbox drop or equivalent) detailing work activities, time periods of which these will occur, impacts and mitigation measures
- Specific notifications, which provide additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops
- Phone calls, which detail relevant information to identified/affected stakeholders and provide personalised contact, tailored advice and the opportunity to comment on the proposed work
- Individual briefings, which inform stakeholders about the impacts of high noise activities and mitigation measures, and provide personalised contact, tailored advice and the opportunity to comment on the proposed work
- Respite offers, to provide residents with respite from an ongoing impact
- Respite period 1, where out-of-hours construction noise in OOHW Period 1 is generally limited to no more than three consecutive evenings per week
- Respite period 2, where night-time construction noise in OOHW Period 2 is generally limited to two consecutive nights
- Duration respite, which is where the work duration, number of evenings and/or nights is increased so the Project can be completed more quickly
- Alternative accommodation, options may be provided for residents living close to construction works that are likely to incur unreasonably high impacts over an extended period of time (i.e. more than 2 consecutive nights). This is not applicable for highly intrusive activities occurring in the evening/night shoulder period and early morning period.
- Alternative construction methodology, and/or
- Verification, including measurement of the background noise level and construction noise.

The relevant Additional Mitigation Measures Matrix (AMMM) from the CNVG are to be used to determine the additional measures to be implemented at residential receivers. The AMMM for airborne noise is reproduced in Table 9-2 and the AMMM for the ground-borne noise and ground-borne vibration are reproduced in Table 9-3 and Table 9-4.

The AMM for airborne noise is based on external noise levels when applied to residential receivers. If the Project confirms that a residential receiver has been provided (either by the NIP, by past projects or independently designed-and-built) with at-property treatments which allow windows to be fixed or kept closed, then the trigger level for AMM may be adjusted to account for reduced internal noise levels. The AA must be consulted to approve any adjustments to the external AMM airborne noise trigger level for residential receivers.

Table 9-2: Airborne Noise - Additional Mitigation Measures Matrix

Predicted Airborne ($L_{Aeq, 15min}$) noise level at receiver			**Additional Mitigation Measures**
Perception	**dBA above RBL**	**dBA above NML**	**Type[1]**
All hours			
75 dBA or greater			N,V,PC,RO
Approved Hours: Mon - Fri (7am - 6pm), Sat (8am - 6pm), Sun/Pub Hol (Nil)			
Noticeable	5 to <10	0	-
Clearly Audible	10 to <20	<10	-
Moderately Intrusive	20 to 30	10 to 20	N, V
Highly Intrusive	> 30	> 20	N, V
OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 6pm - 10pm), Sun/Pub Hol (8am - 6pm)			
Noticeable	5 to <10	< 5	-
Clearly Audible	10 to <20	5 to <15	N, R1, DR
Moderately Intrusive	20 to 30	15 to 25	V, N, R1, DR
Highly Intrusive	> 30	> 25	V, IB, N, R1, DR, PC, SN
OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6pm - 7am)			
Noticeable	5 to <10	< 5	N
Clearly Audible	10 to <20	5 to <15	V, N, R2, DR
Moderately Intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR
Highly Intrusive	> 30	> 25	AltA, V, IB, N, PC, SN, R2, DR

Notes:

1. AltA = Alternative Accommodation, V = Verification, IB = Individual Briefings, N = Notification, R1 = Respite period 1, R2 = Respite Period 2, DR = Duration Respite, PC = Phone Calls, SN = Specific Notifications.
2. NML = Noise Management Level, HA = Highly Affected (>75 dBA – applies to residences only).

Table 9-3: Ground-borne Noise - Additional Mitigation Measures Matrix

Predicted Ground-borne ($L_{Aeq, 15min}$) noise level at receiver		**Additional Mitigation Measures**	
Perception	**dBA above GB NML**	**Type[1]**	**Apply to[2]**
Approved Hours: Mon - Fri (7am - 6pm), Sat (8am - 6pm), Sun/Pub Hol (Nil)			
N/A	Vibration only applicable during approved hours		
OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 6pm - 10pm), Sun/Pub Hol (8am - 6pm)			
Clearly Audible	<10	N	All
Moderately Intrusive	10 to 20	V, N, R1, DR, SN	All
Highly Intrusive	>20	V, IB, N, PC, SN, R1, DR	All
OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6pm - 7am)			
Clearly Audible	<10	V, N, SN	All
Moderately Intrusive	10 to 20	AltA, V, IB, N, PC, RP, SN, R2, DR	All
Highly Intrusive	>20	AltA, V, IB, N, PC, RP, SN, R2, DR	All

Notes:

1. AltA = Alternative Accommodation, V = Validation of predicted levels, IB = Individual Briefings, N = Notification, R1 = Respite period 1, R2 = Respite Period 2, DR = Duration Respite, PC = Phone Calls, SN = Specific Notifications.
2. All affected receivers.

Table 9-4: Vibration - Additional Mitigation Measures Matrix

Predicted vibration level at receiver		Additional Mitigation Measures	
Perception	**Trigger**	**Type[1]**	**Apply to[2]**
Approved Hours: Mon - Fri (7am - 6pm), Sat (8am - 6pm), Sun/Pub Hol (Nil)			
Predicted Vibration Exceeds Human Comfort Vibration Management Levels (Table 6-8)		V, N, RO	All
Predicted Vibration Exceeds Structural Damage criteria (Table 6-10)		V, AC	All
OOHW Period 1: Mon - Fri (6pm - 10pm), Sat (7am - 8am & 6pm - 10pm), Sun/Pub Hol (8am - 6pm)			
Predicted Vibration Exceeds Human Comfort Vibration Management Levels (Table 6-8)		V, IB, N, RO, PC, RO, SN	All
Predicted Vibration Exceeds Structural Damage criteria (Table 6-10)		V, AC	All
OOHW Period 2: Mon - Fri (10pm - 7am), Sat (10pm - 8am), Sun/Pub Hol (6pm - 7am)			
Predicted Vibration Exceeds Human Comfort Vibration Management Levels (Table 6-8)		AltA, V, IB, N, PC, RO, SN	All
Predicted Vibration Exceeds Structural Damage criteria (Table 6-10)		V, AC	All

Notes:

1. AltA = Alternative Accommodation, AC = Alternative Construction Methodology, V = Validation of predicted levels, IB = Individual Briefings, N = Notification, RO = Respite Offer (project specific), PC = Phone Calls, SN = Specific Notifications.
2. All affected receivers.

9.7 Respite

In accordance with CoA E82, all work undertaken for the delivery of the Project, including those undertaken by third parties (such as utility relocations) and other Critical/State Significant Infrastructure, and State Significant Development, must be coordinated to ensure respite periods are provided. Where reasonable and feasible, the Project will:

- Reschedule any work to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with CoA E83; or
- Consider the provision of alternative respite or mitigation to impacted noise sensitive land user(s); and
- Provide documentary evidence to the Acoustic Advisor in support of any decision made by the Project in relation to respite or mitigation. This will be provided as part of the OOHW permit (refer Annexure 1).

Further respite requirements are outlined in Appendix D3.

10 Compliance management

10.1 Roles and responsibilities

The Project Team's organisational structure and overall roles and responsibilities as well as the Environmental Representative, Acoustic Advisor and required specialists are outlined in Section 3.3 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 9 of this NVMP.

10.2 Training

All employees, contractors and utility staff will undergo site induction training relating to noise and vibration management issues. The induction training will address site and/or construction activity specific impacts relating noise and vibration management, including:

- Existence and requirements of this Plan
- Relevant legislation and guidelines
- Normal construction hours and exemptions
- The process for seeking approval for OOHW, including consultation
- Location of noise sensitive areas
- Complaints reporting and recording
- How to implement noise and vibration management measures
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.

Further details regarding staff induction and training are outlined in Section 3.5 of the CEMP.

10.3 Monitoring and inspections

Inspections of sensitive areas and activities with the potential to generate noise and vibration impacts will occur for the duration of the Project. Requirements and responsibilities in relation to monitoring and inspections are documented in Section 3.9.1 and 3.9.2 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project, in accordance with the Project's Noise and Vibration Monitoring Program which is provided in Appendix D2.

Monitored noise and vibration levels will be analysed against the predictions made in the relevant noise and vibration assessment or using the Project's predictive tools. Where monitored noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Cease the noise generating source which causes the exceeded predictions
- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant, or if additional mitigation can be included in the site design
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm the modelling reflects the actual activity being undertaken

- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and using alternative construction methodology or a combination of these
- Review work practices to ensure compliance with the management levels set out in this NVMP
- Review and revise AMMs as necessary
- Ensure the learnings from the above are fed back into the noise modelling assessment process for fine-tuning
- Continue work where impacts can be reduced
- Communicate lessons learnt to relevant personnel

the Project will review the work or activity or combination of simultaneous works or activities as soon as practicable and where possible, modify the work or activity to prevent any recurrence. In the case of above prediction monitoring results, the need for modelling to be reviewed will also be considered. Lessons learnt will be communicated to relevant personnel in toolbox talks.

The above actions are also included in Appendix D4 (Noise and Vibration Exceedance – Corrective Procedure).

10.3.1 Noise and vibration monitoring

Noise and vibration monitoring will be undertaken in accordance with the Noise and Vibration Monitoring Program (Appendix D2), prepared in line with MCoA C11(a), MCoA C12 and MCoA C13.

10.4 Complaints

Complaints will be recorded and managed as detailed in Section 3.7.4 of the CEMP.

10.5 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this Plan, MCoA and other relevant approvals, licences and guidelines.

Audit requirements are detailed in Section 3.9.3 of the CEMP.

10.6 Incidents and Non-compliances

All incidents will be managed in accordance with Section 3.8 of the CEMP.

All non-compliances will be managed in accordance with Section 3.10 of the CEMP.

10.7 Reporting

Reporting requirements and responsibilities are documented in Section 3.9.4 and 3.9.5 of the CEMP. Additional reporting will also be generated as required in assessment documents and the Construction Noise Monitoring Program.

Specific reports prepared in response to noise and vibration will include:

- Reporting required in accordance with the POEO Act and Regulations
- Monthly Noise and Vibration Reports, prepared by the AA and submitted to the Secretary and other relevant regulatory agencies for information, which will detail the AA's actions and decisions on matters for which the AA was responsible in the preceding month

- Construction Noise and Vibration Monitoring reports identified in the Noise and Vibration Monitoring Program in Appendix D2.

11 Review and improvement

11.1 Continuous improvement

As outlined in Section 3.12 of the CEMP, management reviews will be undertaken as part of the continual improvement process. The reviews will be initiated by the Environmental Manager and include relevant project team members and stakeholders. Continuous improvement of this plan and of monitoring requirements detailed in Section 10.3 of this Plan will be achieved by the ongoing evaluation of environmental management performance against planning approval requirements, environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance
- Determine the cause or causes of non-conformances and deficiencies
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies
- Verify the effectiveness of the corrective and preventative actions
- Document any changes in procedures resulting from process improvement
- Make comparisons with objectives and targets outlined in Section 2.2 and Section 2.3 of this Plan.

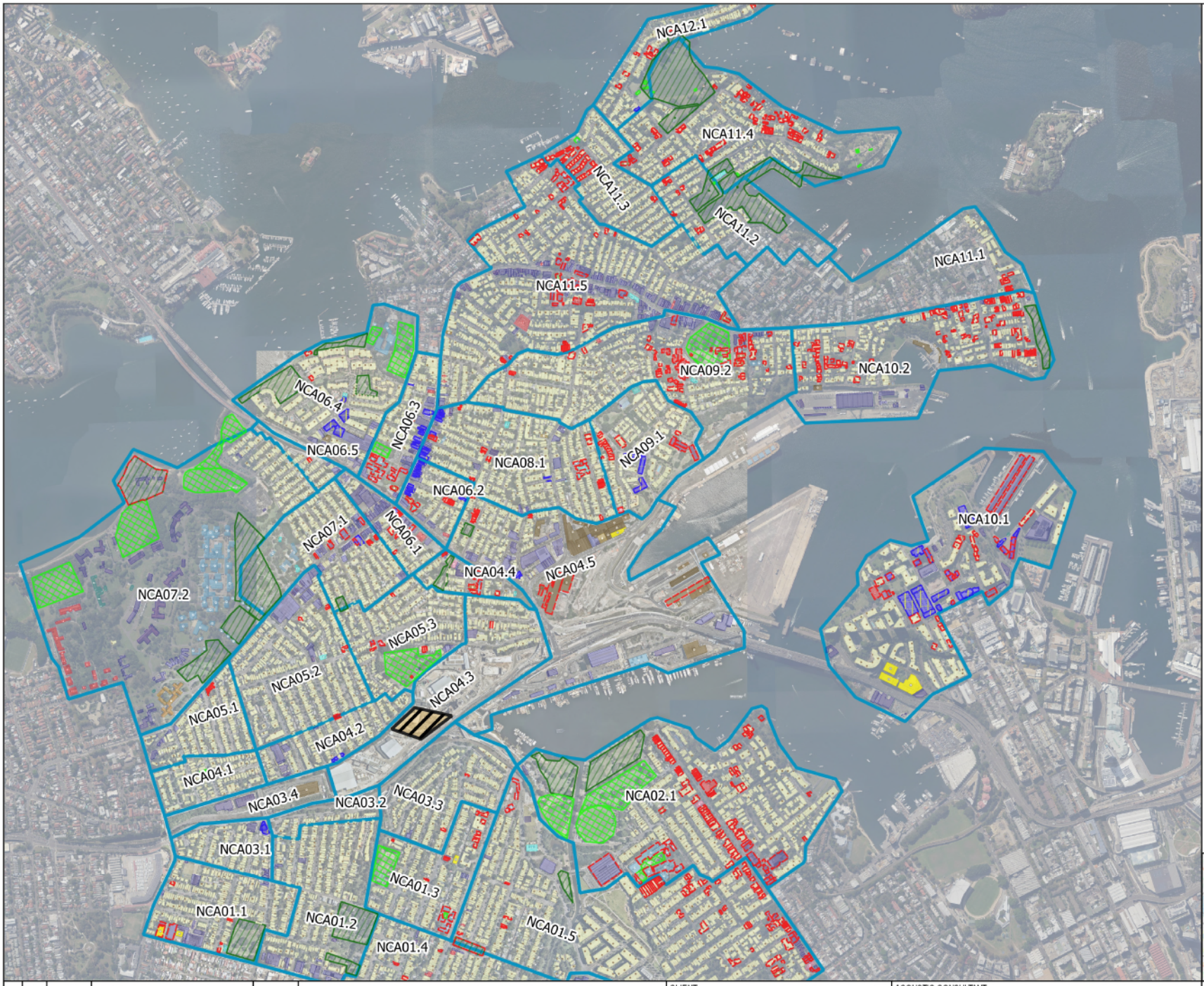
11.2 NVMP update and amendment

The processes described in Section 3.9 and Section 3.13 of the CEMP may result in the need to update or revise this Plan. This will occur whenever there is a change to the construction scope or methodology that may increase potential noise and vibration impacts or to address relevant updates to a related Sub-Plan or monitoring program (as identified in Table 1-1).

Any update of this Plan will require endorsement of the Transport for NSW Representative, the Environmental Representative and depending on the change, process outlined in Section 2 of the CEMP must be followed where approval from the Planning Secretary prior to implementation of the update is required.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 3.11.2 of the CEMP.

Appendix D1 - NCAs and sensitive receivers



LEGEND

Noise Sensitive Receivers

- Residential
- Mixed use
- Commercial
- Industrial
- Hotel/Motel/Hostel
- Medical facility
- Place of Worship
- Community centre
- Recording studio
- Library/Museum
- Childcare
- Educational
- Theatre/Auditorium
- Cinema
- Laboratory
- Flight simulator
- Horse Stable
- Recreational - Passive
- Recreational - Active
- Other
- Heritage

- Project NCAs
- Worksites

NCA	NML D(S)	NML D(O)	NML E	NML N
NCA01	60	55	52	41
NCA02	61	56	56	50
NCA03	60	55	55	49
NCA04	62	57	57	50
NCA05	59	54	51	42
NCA06	73	68	63	48
NCA07	53	48	46	39
NCA08	53	47	47	43
NCA09	59	54	54	51
NCA10	58	53	50	49
NCA11	50	45	45	42
NCA12	56	51	50	45

NCA: Noise Catchment Area
NML: Noise Management Level
D(S): standard construction hours from 7 am to 6 pm Monday to Friday and from 8 am to 6 pm Saturday
D(O): out-of-hours day period from 8 am to 6 pm Sunday and Public holidays - OOHW P1
E: evening period from 6 pm to 10 pm Monday to Sunday - OOHW P1
N: night-time period from 10 pm to 7 am Monday to Friday, from 10 pm am to 8 am Saturday, Sunday and Public holidays - OOHW P2

1,500 m
1,000
500
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0 200 400 600 800 1,000 m
1:14,000 @ A3

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	07/06/22	Prepare figures	MT

A3 Original | Co-ordinate System: MGA Zone 56 | FULL SIZE A3, REDUCED TO A4 | NOTE: Do not scale from this drawing.

CLIENT: JOHN HOLLAND, CPB CONTRACTORS

ACOUSTIC CONSULTANT: RENZO TONIN & ASSOCIATES
inspired to achieve
Ph (02) 8218 0500 Fax (02) 8218 0501

WESTERN HARBOUR TUNNEL

Land Use, NCAs and Worksites

Sheet 1 of 1

Land Use Revision Date: 15/Apr/2022
Plot Date: 07/06/22 - 10:47 Layout: TM599 LU Template
GIS File: R:\Assets\Syd\Projects\TM\551-TM600\TM599 mrt WHT - NTP\5 Calcs\00 GENERAL\01 GIS\TM599 - SS.qgz

Appendix D2 - Noise and Vibration Monitoring Program

Appendix D2

Noise and Vibration Monitoring Program

STW-JHC-PRG-00-NV-002-000001

Western Harbour Tunnel – Stage 3A

17 October 2022

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Document control

Revision	Date	Prepared by	Reviewed by	Remarks
A	04/05/2022	Chris Blyth	Kathy Lloyd	Internal revision
B	17/06/2022	Chris Blyth	Kathy Lloyd	External revision for ER and TfNSW
C	13/07/2022	Chris Blyth	Kathy Lloyd Adrian Broger	External revision updated to address AA comments
00	25/08/2022	Chris Blyth	Adrian Broger	For AA and ER endorsement
01	17/10/2022	Chris Blyth	Adrian Broger	External revision updated to address DPE comments

Distribution of controlled copies

This Noise and Vibration Monitoring Program as part of the CEMP is available to all personnel and sub-contractors via the Project document control management system. An electronic copy can be found on the Project website.

Contents

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
ABL	Assessment Background Level
Acoustic enclosure	Can include an engineered and designed shed or enclosure, with airborne noise pathways minimised and treated where feasible and reasonable, endeavoring to achieve the Noise Management Levels in the Interim Construction Noise Guidelines (DECC, 2009). Example treatments include noise curtains, shipping containers, acoustic barriers or fast operating doors to limit breakout noise from enclosures
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.
Ancillary facility	A temporary facility for construction of the CSSI including an office and amenities compound, construction compound, material crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory, material stockpile area and car parking facilities. *Note: where an approved management plan contains a stockpile management protocol, a material stockpile area located within the construction boundary is not considered to be an ancillary facility*
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime, 2016)
CNVIS	Construction Noise and Vibration Statements
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now EPA)
DEC	DECC Department of Environment and Climate Change (now EPA)
DECCW	DECCW Department of Environment, Climate Change and Water (now EPA)
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979*
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*

EPL	Environmental Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Highly noise intensive works	Works on surface which are defined as annoying under the Interim Construction Noise Guideline (DECC, 2009) including: (a) use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work; (b) grinding metal, concrete or masonry; (c) rock drilling; (d) line drilling; (e) vibratory rolling; (f) bitumen milling or profiling; (g) jackhammering, rock hammering or rock breaking; and (h) impact piling
ICNG	Interim Construction Noise Guideline (DECC, 2009)
IPIAP	Independent Property Impact Assessment Panel
JHCPB	John Holland CPB Contractors
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
LA (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LA1 (1min)	The A-weighted noise level from the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 1% of the 1 minute measurement period.
LA90 (15min)	The A-weighted noise level excluding the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 90% of the 15 minute measurement period.
MCoA	Minister's Condition of Approval
MWD	Minimum working distance
NCA	Noise Catchment Area
NML	Noise management level
Noise Mitigation	Feasible and reasonable measures that would minimise or avoid noise impacts
NVMP	Noise and Vibration Management Plan
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
Project, the	Western Harbour Tunnel – Stage 3A
Project Area	The area required to facilitate the construction of the Project (ie construction footprint)
RBL	The Rating Background Level for each period is the medium value of the Assessment Background Level (ABL) values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening, night and shoulder period)
REMM	Revised Environmental Management Measure
Roads and Maritime	Former Roads and Maritime Services, now part of Transport for NSW

RMS	Former Roads and Maritime Services, now part of Transport for NSW
Sensitive land user(s) / Sensitive receiver(s)	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres and passive recreation areas (including outdoor grounds used for teaching). Receivers that may be considered to be sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces) and industrial premises as identified by the Planning Secretary
SSD	State Significant Development
SSI	State Significant Infrastructure
Standard construction hours	Hours during which construction work is permitted by the MCoA. Further defined in Section 6.2 of the NVMP.
TfNSW	Transport for NSW
WFU	Warringah Freeway Upgrade (component of the Western Harbour Tunnel and Warringah Freeway Upgrade project)
WHT	Western Harbour Tunnel (component of the Western Harbour Tunnel and Warringah Freeway Upgrade project)
Works	Any physical work to construct or facilitate the construction of the CSSI, including low impact work, environmental management measures and utility works. However, does not include activities that informs or enables detailed design of the CSSI and generates noise that is no more than 5 dB(A) above the rating background level (RBL) at any sensitive land user(s)

Note: Refer to *Instrument of Approval - SSI-8863* for additional abbreviations and definitions relevant to the Project.

1 Introduction

1.1 Context

This Noise and Vibration Monitoring Program (monitoring Program) has been prepared for the Design and Construction of Western Harbour Tunnel Stage 3A Project (the Project).

This monitoring Program has been prepared to address the requirements of the Minister's Condition of Approval (CoA) C11(c), the Western Harbour Tunnel Warringah Freeway Upgrade Environmental Impact Statement (EIS) and the revised environmental management measures (REMM) listed in the Western Harbour Tunnel Warringah Freeway Upgrade Submissions and Preferred Infrastructure Report (SPIR) and all applicable guidance and legislation

1.2 Background and project description

The Western Harbour Tunnel Warringah Freeway Upgrade EIS (Renzo Tonin & Associates) assessed noise and vibration impacts on sensitive receivers and structures during construction and operation of the Project, within Chapter 10 and the Noise and Vibration Technical Working Paper (Appendix G of the EIS).

The EIS identified the potential for noise and vibration impacts during construction which are dependent on the types of construction activity in progress and the proximity of works to sensitive receivers. However, it concluded any potential impacts could be managed by tailored mitigation and management measures, including construction noise and vibration monitoring.

Please refer to Section 1.2 of the Construction Environmental Management Plan (CEMP) for Project description.

1.3 Scope of the monitoring program

The scope of this monitoring Program is to describe how the Project proposes to carry out noise and vibration monitoring during the construction of the Project. Monitoring will be undertaken for modelling verification at sensitive receivers, to assess compliance in response to complaints, for equipment spot checks and for the verification of acoustic shed effectiveness. For further information refer to Sections 5 and 6.

This Monitoring Program forms part of the Project's Noise and Vibration Management Plan.

Operational noise and vibration monitoring does not fall within the scope of this monitoring Program and therefore is not included within the processes contained within this monitoring Program.

1.4 Environmental management systems overview

The environmental management system overview is described in Section 1.5 of the CEMP.

2 Purpose and objectives

2.1 Purpose

The purpose of this monitoring Program is to describe how the Project proposes to conduct noise and vibration monitoring during construction of the Project.

This monitoring Program will apply for the duration of the Project's construction works, unless a longer period is specified by the Secretary of the Department of Planning and Environment (DPE).

2.2 Objectives

The key objective of the monitoring Program is to meet the requirements of the CoA's, and ensure all environmental management measures and licence/permit requirements relevant to noise and vibration monitoring are described, scheduled and assigned responsibility as outlined in:

- The EIS prepared for Western Harbour Tunnel and Warringah Freeway Upgrade,
- The SPIR prepared for Western Harbour Tunnel and Warringah Freeway Upgrade,
- CoA granted to the Project on 21 January 2021,
- Roads and Maritime QA Specification G36,The Project's Environment Protection Licence, and

All relevant legislation and other requirements described in Section 3.1 of this monitoring Program.

2.3 Consultation

This monitoring Program has been provided to NSW EPA in accordance with CoA C11 (c) for review and comment. A summary of the consultation undertaken is provided in Section 4.4 of the NVMP.

Community feedback and complaints relating to noise and vibration will be dealt with in accordance with the Noise and Vibration Management Plan (NVMP), Community Communication Strategy (CCS) and the Complaints Management System.

2.4 Endorsement and approval

In accordance with MCoA C18 and C19, the Environmental Representative (ER) and Acoustic Advisor will endorse this NVMoP prior to lodgement to DPE for approval. This NVMoP will be submitted to DPE for approval at least one month prior to the commencement of construction works.

3 Environmental requirements

3.1 Relevant legislation

3.1.1 Legislation

All legislation relevant to this monitoring Program is included in Section 3.1.1 of the NVMP.

3.1.2 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- Roads and Maritime QA Specification G36 – Environmental Protection 2017 (Management System).
- RMS Construction Noise and Vibration Guidelines (Roads and Maritime 2016)
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Dept. of Environment, Climate Change and Water 2011
- Noise Policy for Industry (NPfI), Environment Protection Authority 2017
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard 1055:2018 Acoustics – Description and Measurement of Environmental Noise
- AS 2012.1 Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Determination of compliance with limits for exterior noise
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1- 80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-3:2016 Vibration in buildings – Part 3: Effects on structures
- ISO 3744 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane
- ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane
- ISO 6393 Earth-moving machinery - Determination of sound power level - Stationary test conditions
- ISO 6395 Earth-moving machinery - Determination of sound power level - Dynamic test conditions.

3.2 Environmental Protection Licence monitoring requirements

Monitoring requirements under the EPL are covered outside this plan.

4 Baseline monitoring data

In accordance with CoA C19 construction works will not commence until all relevant baseline data has been collected.

As part of the EIS process, baseline noise monitoring was conducted between September 2016 and November 2017 at a total of 41 locations. The baseline noise monitoring locations were selected to be representative of the appropriate Noise Catchment Areas (NCAs) within and around the Project, across a mix of existing land uses including residential, commercial, industrial and open space. Noise management levels (NMLs) for the assessment of construction noise are derived from measurements of existing noise levels in an area. The rating background level (RBL) is used to determine noise management levels at residential receiver locations.

For further information regarding baseline noise monitoring refer to Section 5.3 of the NVMP and EIS Appendix G (Technical Working Paper: Noise and Vibration)

No further additional baseline monitoring is anticipated, however, if required, it will be undertaken in accordance with the relevant guidance and the NVMP will be updated as necessary and issued to DPE for approval.

5 Noise monitoring

5.1 Attended and unattended airborne noise monitoring

Attended monitoring of construction noise levels will be undertaken as follows:

- Monitoring will be carried out at locations identified in the CNVIS during the day, evening and night-time period and within the first month of construction.
- Monitoring will be carried out at the commencement of activities for which a location and activity specific noise and vibration impact assessment has been prepared which identifies that validation monitoring is required (Section 8.2 of the NVMP) to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions and that the management measures that have been implemented are appropriate,
- At the commencement of activities within an acoustic shed to confirm the actual acoustic performance of the shed is consistent with the predicted acoustic performance,
- Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact,
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with EPL Condition,
- As directed by an authorised officer of the EPA,
- As otherwise required by the CNVIS, Out-of-Hours Works (OOHW) Protocol or EPL,
- Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels, and
- Ongoing spot checks for noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with the maximum noise level goals for construction

equipment. Spot checks would be carried out as required on a case-by-case basis, such as in response to a plant/equipment specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment.

Long term unattended airborne noise monitoring location options will be discussed and determined with the AA regarding a suitable location and the effectiveness. The use of unattended airborne noise monitoring is detailed in Section 5.3.

Attended noise monitoring locations will vary and be determined on a case-by-case basis in the CNVIS, the Project's predictive noise and vibration tool, or in response to complaints. In accordance with the ICNG the duration and amount of noise monitoring will depend on the scale of the construction activities and extent of expected noise impacts. Noise monitoring will cover a representative period of the construction activity. A representative period is the stage of a construction activity where all the plant and equipment operating is consistent with the full range of plant and equipment modelled in the noise and vibration assessment, i.e. noise monitoring is not to be undertaken when the key noise contributing plant and equipment are turned off. The CNVIS identifies the representative periods.

Where possible, monitoring will be undertaken at the most affected noise sensitive receiver's location in proximity to the Project's construction activities. Noise monitoring locations will consider factors including:

- The location of previous monitoring sites,
- The proximity of the receiver to a Project worksite,
- The sensitivity of the receiver to noise,
- Background noise levels and
- The expected duration of the impact.
- Safety of the person/s undertaking the monitoring
- Validity of the noise monitoring readings/session

Monitored noise levels will then be analysed against the predictions made in the relevant CNVIS or using the Project's predictive tools. If monitored construction noise levels are found to be above modelling predictions Section 8 is to be followed.

5.1.1 Parameters to be monitored

All environmental noise monitoring will be taken with the following meter settings:

- Time Constant: Fast (i.e. 125 milliseconds),
- Frequency Weightings: A-weighting, and
- Sample period: 15 minutes.

Environmental noise monitoring (excluding spot checks of plant and equipment) will be recorded over 15-minute sample intervals, excluding periods of extraneous noise until a representative sample has been obtained. A representative sample will be determined by operator, who will be competent, suitability trained and experienced in undertaking noise measurements and familiar with the relevant Australian Standards. The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: L_{A90}, L_{Aeq}, L_{A10}, $L_{A(min)}$and $L_{A\ (max).}$

For spot checks of noise intensive plant and equipment, duration of monitoring will depend on the source of noise being monitored. Sources of continuous noise (such as generators), measurements will be monitored over one-to-two-minute intervals. For dynamic plant, such as front-end loaders, spot checks will capture a representative activity, such as one truck-and-dog load cycle.

5.2 Attended and unattended ground-borne noise monitoring

Attended monitoring of ground-borne construction noise levels will be undertaken as follows:

- At the first opportunity following the commencement of tunnelling and dive excavation to verify and, if necessary, update the ground-borne noise models,
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with the EPL, and
- As otherwise required by the CNVIS, OOHW Protocol or EPL.

Monitoring will be undertaken in the most affected habitable room of the residence or other sensitive building and will be conducted in conjunction with vibration measurements whenever practicable (refer to Section 6). The room selected for noise monitoring should be well shielded from airborne noise intrusions, such as road traffic noise to allow the ground-borne noise to dominate over non-construction generated airborne noise.

There may be instances where the resident does not allow access to monitor in the most suitable habitable room. In these instances, the Project will endeavour to monitor at the next most suitable available room or location, noting this in the monitoring form.

Given that ground-borne noise is mostly noticed during the evening or at night, noise loggers may also be left in place over night and picked up at a mutually agreed time with the resident. In these instances, noise loggers will record audio to allow for the identification construction noise contribution and the presence of any extraneous noise, if privacy concerns can be overcome.

Where the resident or receiver will not allow the noise logger to record audio, attended noise monitoring will be offered instead.

Measurements will be carried out by an appropriately trained and competent person in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures.

5.2.1 Parameters to be monitored

Ground-borne noise monitoring will be taken with the following meter settings:

- Time Constant: Fast (i.e. 125 milliseconds),
- Frequency Weightings: A-weighting, and
- Sample period: 15 minutes.

Ground-borne noise monitoring will be recorded continuously over a defined sample period, where every 1 minute the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: L_{A90}, L_{Aeq}, L_{A1} and $L_{A\,(max)}$.

5.3 Real-time (unattended) noise monitoring

Real-time (unattended) noise monitoring will be undertaken to satisfy CoA C13. The real-time noise monitors will be installed following approval of this monitoring Program.

In consultation with the AA, a real-time noise monitoring location will be determined where representative construction noise would be captured at the nearest sensitive receiver. An indicative location is presented in Figure 1.The monitor will be installed by a person appropriately trained in the measurement and assessment of construction noise and vibration,

who is familiar with the requirements of the relevant standards and procedures and the establishment of real-time monitoring equipment.

The real-time monitoring data will be readily available to JHCPB, Transport for NSW (TfNSW), the Environmental Representative (ER) and AA. The real-time monitoring data will be available to DPE and EPA on request following an initial screening review, to identify any anomalies or corruption in the dataset.

As receiver locations are heavily influenced by other extraneous noise sources including Light Rail, Aircraft as well as Traffic Noise from State, Regional and Local Roads, identifying a suitable location to monitor construction noise may prove challenging. During the first month of construction work, the permanent noise monitor may be moved to determine the most effective location for recording representative construction noise.

Attended measurements will be carried out at representative residential receiver locations to supplement and validate unattended noise monitoring data. It is likely that the project team will rely on attended noise measurements more than unattended noise logger data to fulfil the requirements to pro-actively monitor and manage noise from the site.

Where weather may have influenced noise results, the details of inclement weather will be provided in any reporting required.

5.3.1 Parameters to be monitored

Real-time unattended noise monitoring will be taken with the following meter settings:

- Time Constant: Fast (i.e. 125 milliseconds),
- Frequency Weightings: A-weighting, and
- Sample period: 15 minutes.

Real-time noise monitoring will be recorded over 15-minute sample intervals, where every 15 minutes the data is to be processed statistically in real-time and displayed. The minimum range of noise metrics include the following A-weighted noise levels: L_{A90}, L_{Aeq}, L_{A10} and $L_{A\ (max)}$.

Figure 1: Indicative real-time monitoring location

5.4 Out-of-hours Protocol monitoring requirements

The Out-of-Hours Works Protocol enables out-of-hours works (for works that are not subject to an EPL) under certain circumstances and prescribes requirements that must be complied with to undertake the works.

Typically, OOHW that is not subject to an EPL will involve service investigations, relocations and other works items that are not scheduled activities under the *Protection of the Environment Operations Act 1997* (POEO Act) (and associated regulations) and are outside the EPL premise boundary.

In accordance with the Protocol, noise monitoring must be undertaken in accordance with the requirements of the, work specific OOHW permit to validate predicted noise impacts. Section 5 of the Out-of-Hours Works Protocol identifies that noise verification monitoring would be undertaken when the impact classification is predicted to be moderately intrusive or highly intrusive (during OOHW period 1) or clearly audible, moderately intrusive or highly intrusive (during OOHW period 2)

5.5 Out-of-hours EPL monitoring requirements

During OOHW the Project will conduct attended noise monitoring as required by the Project EPL... Noise monitoring will be undertaken by a suitably qualified individual. All monitoring will be conducted in accordance with the RMS Construction Noise and Vibration Guidelines and Australian Standard AS2659.1 – 1988: Guide to the use of sound measuring equipment – Portable sound level meters. Monitoring data will be recorded using the project's Environmental Management System, with the results being submitted in the validation report to be submitted upon the trials completion.

Attended monitoring will be undertaken during the first two nights of each new activity at the closest affected Noise Catchment Areas (NCA). Monitoring will be undertaken for model verification at sensitive receivers, to assess compliance in response to complaints (if monitoring has not already been undertaken to assess compliance at a location closer to the works than the location of the complaint), equipment spot checks, verification of construction traffic, exceedances of predicted noise levels (PNL), changes in methodology or plant/equipment. Verification monitoring after exceedance will ensure continual compliance with model outputs.

5.6 Community agreement monitoring requirements

A validation monitoring plan must be submitted to the EPA or DPE (whichever is the appropriate regulatory authority) for approval as part of the community agreement documentation prior to any OOHW occurring where community agreement has been sought. Validation monitoring must be undertaken for any works that are the subject of a community agreement and must:

- be performed by a suitably qualified and experienced person; and
- be performed on at least the first 2 nights where OOHW will be undertaken.

5.7 Calibration, QA and competency

All monitoring will be undertaken by competent personnel, suitability trained and experienced in undertaking noise measurements.

Noise monitoring equipment used will be at least Type 1 instruments and calibrated in accordance with manufacturer specifications or relevant Australian Standards. The calibration of the monitoring equipment will be checked in the field before the noise measurement period. Records of monitoring equipment calibration will be maintained by the Project throughout the delivery of the Project.

All monitoring records will be retained throughout the delivery of the Project. Noise monitoring records will be completed to record:

- Date and time of measurement,
- Name of person undertaking the measurement,
- Type and model number of monitoring instrumentation,
- Results of field calibration checks,
- Time of day, length of measurement and any measurement time intervals,
- Monitoring location (including a sketched map/photo of area),
- Measurement location details and number of measurements at each location,
- Weather conditions during measurements,
- Operation and activities of the noise sources under investigation,
- Estimated contribution of the Project's activities, and
- Noise due to other extraneous and environmental sources (e.g. traffic, aircraft, trains, dogs barking, insects).

Noise monitoring will be undertaken and recorded in accordance with the relevant noise measurement requirements in the reference standards and documents in Section 3.1.2.

All outdoor noise measurements will be undertaken with a windscreen over the microphone and measurements of noise will be disregarded when it is raining and/or the wind speed is greater than 5 m/s (18 km/h).

Where high background noise levels obscure construction noise contribution during attended noise measurements, operators will either: measure closer to the source and calculate back to the required position, or measure with the source noise off and then on (where possible) and calculate the difference or use the 'pause and cut' feature on the sound level meter to try to exclude as much of the extraneous noise as possible.

Where possible, noise monitoring is to be carried out at least 3.5 m from any reflective surface other than the ground and the preferred microphone/measurement height is 1.2-1.5 m above the ground.

Measurements taken inside buildings should be at least one metre from walls or other reflective surface, and about 1.5 metres from windows, where such instrument siting is possible.

6 Vibration monitoring

6.1 Short term attended and unattended vibration monitoring

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded or as determined by a vibration assessment,
- At the commencement of vibration generating activities that have the potential to impact on heritage items to confirm/identify the minimum working distances to prevent cosmetic damage,
- At the first opportunity following the commencement of tunnelling and dive excavation to verify and, if necessary update the ground vibration model,
- Where vibration sensitive locations are determined to fall within the 'minimum working distances' established for each item of plant, so to refine the indicative minimum working distances,
- Where appropriate in response to a vibration related complaint(s) (determined on a case-by- case basis) and in accordance with the EPL,
- As directed by an authorised officer of the EPA, and
- As otherwise required by the CNVIS, OOHW Protocol (Section6) or EPL (i.e. as directed by authorised officer of the EPA).

Vibration monitoring will be undertaken in accordance with the relevant vibration measurement requirements in the reference standards and documents in Section 3.1.2.

Where human comfort is a concern, vibration monitoring results will be assessed and reported against the values set out in Tables 2.2 and 2.4 of the EPA's Assessing Vibration – a technical guideline.

To assess the potential for vibration impact on human comfort, an initial screening test will be completed based on peak velocity units, as this metric is also used for the cosmetic building damage vibration assessment. This screening test is a conservative approach as it is based on the continuous vibration velocity criteria (i.e. vibration that continues uninterrupted for a defined assessment period) whilst construction works are mostly intermittent. The initial screening test for vibration disturbance to building occupants, based on the peak particle velocity (ppv, mm/s) are presented in Table 1. If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

Table 1 Construction vibration disturbance to building occupants – initial screening test

Place and Time	Maximum peak velocity, mm/s (>8Hz)
Critical areas (day or night)1	0.28
Residential buildings 16 hr day	0.56
Residential buildings 8 hr night	0.40
Offices, schools, educational institutions and places of worship (day or night)	1.10
Workshops (day or night)	2.20

Where property damage is a concern, vibration monitoring results will be assessed and reported against the British Standard 7385, as presented in the NVMP. For heritage structures, BS7385-2:1993 does not provide numerical vibration levels to prevent structural damage. The approach that will be adopted for the Project to assess and manage potential vibration impact on heritage structures is outlined in Section 6.5.3 of the NVMP. Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

- Vibration monitoring equipment shall be placed outside at the footings or foundations of the building of interest, closest to the vibrating plant,
- The surface should be solid and rigid to best represent the vibration entering the structure of the building under investigation,
- The vibration sensor or transducer shall not be mounted on loose tiles, loose gravel or other resilient surfaces,
- The vibration sensor or transducer shall be directly mounted to the vibrating surface using either bees wax or a magnetic mounting plate onto a steel washer, plate or bracket which shall be either fastened or glued to the surface of interest, and
- Where a suitable mounting surface is unavailable, then a metal stake of at least 300mm in length shall be driven into solid ground adjacent to the building of interest and the vibration sensor or transducer shall be mounted on that.

Where vibration monitoring is undertaken to measure tactile vibration levels, vibration monitoring results shall be assessed and reported against the acceptable values of human exposure to vibration set out in Tables 2.2 and 2.4 of the EPA's Assessing Vibration – a technical guideline.

The following information shall be recorded:

- Date and time of measurements,
- Name of person undertaking the measurements,
- Type and model number of instrumentation,
- Description of the time aspects of each measurement (i.e. sample times, measurement time intervals and time of day),
- Sketch/photo map of area and measurement location,
- Measurement location details and number of measurements at each location,
- Operation and load conditions of the vibrating plant under investigation, and
- Possible vibration influences from other sources (e.g. domestic vibrations, other mechanical plant, traffic, etc.).

Where attended vibration monitoring is not feasible, due to extended periods of vibration intensive works, an unattended vibration monitoring system will be installed where initial monitoring to establish safe buffer zones is insufficient to ensure goal levels are met, due to changing plant or unknow ground conditions. Unattended monitors will warn plant operators (e.g. via flashing light, SMS, etc.) that vibration is approaching levels where there is potential for cosmetic damage to buildings and structures.

Where unattended vibration monitors are left in place on a private property they will be picked up at a mutually agreed time with the resident.

Monitored vibration levels will be analysed against the predictions made in the relevant CNVIS or using the Project's predictive tools. For where monitored construction noise levels are found to be above modelling predictions or vibration goals are exceeded, refer to Section 9 for further information.

6.1.1 Parameters to be monitored

Vibration data will be processed statistically and stored in memory. The minimum range of vibration metrics to be stored in memory for later retrieval is the following:

- Root-Mean-Square acceleration (RMS), or
- Vector-sum peak-particle velocity (PPV).

All short term attended vibration monitoring will be recorded over a representative sampling interval where the worst-case vibration levels can be captured. Where unattended vibration monitoring is proposed, monitoring will be undertaken continuously whilst the vibrating plant is operational to capture the worst-case vibration levels within the pre-determined 'minimum working distance' from the potentially affected building. Typical 'minimum working distances' for construction equipment are presented in Table A-2 in Appendix A.

6.2 Real time (unattended) vibration monitoring

The final timing, duration and location of the real-time vibration monitoring will be confirmed in the relevant CNVIS, subject to risk assessment and (if monitoring required) property owner's permission. The monitoring location may vary throughout the works to suit the works location and risk of vibration impact, as identified in the CNVIS.

The monitor will be installed by a person appropriately trained in the measurement and assessment of construction noise and vibration, who is familiar with the requirements of the relevant standards and procedures and the establishment of real-time monitoring equipment.

The real-time monitoring data will be readily available to JHCPB, TfNSW, the ER and AA. The real- time monitoring data will be available to DPE and EPA on request following an initial screening review, to identify any anomalies or corruption in the dataset.

6.2.1 Parameters to be monitored

Real time vibration monitoring will continuously monitor PPV where the potential risk of cosmetic damage is identified.

6.3 Out-of-hours Protocol monitoring requirements

The Out-of-Hours Works Protocol enables out-of-hours works (for works that are not subject to an EPL) under certain circumstances and prescribes requirements that must be complied with to undertake the works.

Typically, OOHW that is not subject to an EPL will involve service investigations, relocations and other works items that are not scheduled activities under the *Protection of the Environment Operations Act 1997* (POEO Act) (and associated regulations) and are outside the EPL premise boundary.

If vibration intensive activities are proposed as OOHW and have the potential to impact on sensitive receivers or structures, they will be assessed for compliance with minimum working distances as defined in relevant Construction Noise and Vibration Impact Statements (CNVISs) (refer to Section 6.5.7 of the NVMP) including:

- Cosmetic structural damage impacts,
- Disturbance to building occupants due to vibration.

6.4 Calibration and QA

All monitoring will be undertaken by competent personnel, suitability trained and experienced in undertaking vibration measurements.

All vibration instruments will be calibrated in accordance with manufacturers specifications or relevant Australian Standards. Records of monitoring equipment calibration will be maintained by the Project.

All monitoring records will be retained throughout the delivery of the Project. Vibration monitoring records will be completed to record:

- Date and time of measurements,
- Name of person undertaking the measurements,
- Calibration dates of monitoring equipment,
- Type and model number of instrumentation,
- Time of day, length of measurement and measurement time intervals,
- Monitoring location (including a sketched map/photo of area),
- Measurement location details and number of measurements at each location,
- Operation and load conditions of the vibrating plant under investigation, and
- Possible vibration influences from other sources (e.g., domestic vibrations, other mechanical plant, traffic etc.).

7 Heritage-listed structures

In accordance with CoA E79, the Project will conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items, to identify minimum working distances to prevent cosmetic damage. Should vibration testing and monitoring show that the preferred values for vibration are likely to be exceeded, the Project will follow the process in Section 9.

Heritage items which have the potential to be impacted by vibration are identified in the Heritage Management Procedure (Appendix G of the CEMP). Vibration Screening Criteria drawings for vibration intensive ancillary facilities activities have been prepared in accordance with CoA E76 and included in the NVMP (section 9 of the NVMP) to identify the minimum working distances for heritage buildings during vibration intensive activities. Section 6.5.3 of the NVMP also provides further detail on the approach to managing potential vibration impacts on heritage structures. Vibration Screening Criteria drawings for tunnelling activities are provided in section 9 of the NVMP. Vibration modelling across the alignment indicates that a maximum vibration level of <0.28mm/s is predicted during roadheader excavation and a maximum vibration level of <1.1mm/s is predicted during rockhammer excavation. No heritage structure is predicted to be impacted during vibration generating activities, as the maximum predicted levels are below the potential cosmetic damage criteria identified in the relevant standards and documents in Section 3.1.2.

Vibration assessments prepared for the Project will also identify where monitoring should be conducted at heritage items.

The Project will seek the advice of the Project's heritage and noise and vibration specialists, on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage structures.

8 Continual improvement and corrective action

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS or using the Project's predictive tools. Where monitored construction noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Cease the noise and/or vibration generating activity which causes the exceeded predictions,
- Confirm the monitored levels are not being impacted by other noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment,
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant,
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment,
- Confirm that the modelling reflects the actual activity being undertake and adjust the modelling tool where required to ensure accuracy of the predicted level
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these,
- Review work practices to ensure compliance with the ICNG,
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning,
- Continue work where impacts can be reduced,
- Communicate lessons learnt to relevant personnel,.
- Providing to the AA for review where requested the monitoring reports, data and analyses undertaken. The Project will consider any recommendations to improve practices and demonstrating, to the satisfaction of the AA, where a recommendation is not adopted.

The Project will review the work or activity or combination of simultaneous works or activities and where possible, modify the work or activity to prevent any recurrence. Lessons learnt will be communicated to relevant personnel in toolbox talks.

9 Reporting of monitoring results

During construction, noise and vibration monitoring data will be collected, tabulated and assessed against the noise and vibration objectives identified in CNVIS. A Construction Monitoring Report will be submitted to DPE and EPA within 90 days of the end of the reporting period unless otherwise agreed with DPE and will be made publicly available.

Attended monitoring results will be provided to the AA,ER and EPA on request.

Reporting requirements associated with the Program for the construction phase of the Project are presented in Table 1.

Table 2 Reporting requirements

Schedule (during construction)	Requirements	Recipient (relevant authority)
Construction Monitoring Report	Data from real time noise and vibration monitoring will be reported on a six-monthly basis within a Construction Monitoring Report.	AA, DPE, EPA

EPL Validation Report	The validation report will be submitted to the EPA within 14 calendar days of the completion of the 'trial period' (refer to Section 5.4).	EPA
Preliminary Investigation Report and Follow-Up Investigation Report	Upon request from an EPA officer, the Preliminary Investigation Report will be submitted to the EPA by COB of the next business day following any noise or vibration monitoring. Where a detected exceedance of a noise goal or limit has occurred a Follow-Up Investigation Report shall be submitted to the EPA within 5 business days (unless otherwise approved by the EPA).	EPA

Separate from the Construction Monitoring Report, Validation Report and Preliminary Investigation Reports, additional records relating to noise and vibration training, toolbox talks, monitoring results and audit results are described in Section 3.5.2 & 3.9.1 of the CEMP. The complaints management and reporting procedure is described in Section 3.7.4 of the CEMP.

Appendix D3 - Out of Hours Work Protocol

Appendix D3

Out of Hours Works Protocol – works not subject to an EPL

STW-JHC-PRO-00-EN-002-000004

Western Harbour Tunnel – Stage 3A

17 October 2022

Document control

Revision	Date	Prepared by	Reviewed by	Remarks
A	01/05/2022	Chris Blyth	Kathy Lloyd	Internal revision
B	17/06/2022	Chris Blyth	Kathy Lloyd	External revision for ER and TfNSW
C	15/07/2022	Chris Blyth	Kathy Lloyd Adrian Broger	External revision updated to address ER comments
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Distribution of controlled copies

This OOHW Protocol as part of the CEMP is available to all personnel and sub-contractors via the Project document control management system. An electronic copy can be found on the Project website.

Contents

Tables

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
ABL	Assessment Background Level
Acoustic enclosure	Can include an engineered and designed shed or enclosure, with airbornenoise pathways minimised and treated where feasible and reasonable, endeavouring to achieve the Noise Management Levels in the Interim Construction Noise Guidelines (DECC, 2009). Example treatments includenoise curtains, shipping containers, acoustic barriers or fast operating doors to limit breakout noise from enclosures
Ambient noise	The all-encompassing noise associated within a given environment at agiven time, usually composed of sound from all sources near and far.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime, 2016)
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequencyof the human ear.
DEC	Department of Environment and Conservation (now EPA)
DECC	DECC Department of Environment and Climate Change (now EPA)
DECCW	DECCW Department of Environment, Climate Change and Water (nowEPA)
DP&E	NSW Department of Planning and Environment (now DPIE)
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation'sactivities, products or services that can interact with the environment.

Abbreviations	Expanded Text
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment,whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EMM	Environmental Management Measure
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself toachieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises fromthe environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environmental Protection Licence
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposedmeasures and their technological and associated operational application inthe NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Highly noise intensive works	Works which are defined as annoying under the Interim Construction NoiseGuideline (DECC, 2009) including: (a) use of power saws, such as used for cutting timber, rail lines, masonry,road pavement or steel work; (b) grinding metal, concrete or masonry; (c) rock drilling; (d) line drilling; (e) vibratory rolling;

Abbreviations	Expanded Text
	(f) bitumen milling or profiling; (g) jackhammering, rock hammering or rock breaking; and (h) impact piling
ICNG	Interim Construction Noise Guideline (DECC, 2009)
LAeq (15min)	The A-weighted equivalent continuous (energy average) A-weighted soundpressure level of the construction works under consideration over a 15- minute period and excludes other noise sources such as from industry, road, rail and the community.
LA (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a soundlevel meter.
LA1 (1min)	The A-weighted noise level from the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 1% of the 1-minute measurementperiod.
LA90 (15min)	The A-weighted noise level excluding the construction works under consideration, measured using the fast time weighting on a sound levelmeter, which is exceeded for more than 90% of the 15-minute measurement period.
MCoA	Minister's Condition of Approval
MWD	Minimum working distance
NCA	Noise Catchment Areas
NML	Noise management levels
NVMP	Noise and Vibration Management Plan
NVMoP	Noise and Vibration Monitoring Program
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard constructionhours
PPV	Peak Particle Velocity

Abbreviations	Expanded Text
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is thereforean RBL value for each period (day, evening, night and shoulder period)
Roads and Maritime	Roads and Maritime Services
SWL	Sound Power Level
Sensitive land user(s) / Sensitive receiver(s)	Includes residences, educational institutions (including preschools, schools,universities, TAFE colleges), health care facilities (including nursing homes,hospitals), religious facilities (including churches), childcare centres and passive recreation areas (including outdoor grounds used for teaching). Receivers that may be considered to be sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parksand camping grounds, restaurants, office premises, and retail spaces) andindustrial premises as identified by the Planning Secretary
SPL	Sound Pressure Level
SSD	State Significant Development
SSI	State Significant Infrastructure
TfNSW	Transport for NSW
Works	Any physical work to construct or facilitate the construction of the CSSI, including low impact work, environmental management measures and utility works. However, does not include activities that informs or enablesdetailed design of the CSSI and generates noise that is no more than 5dB(A) above the rating background level (RBL) at any sensitive land user(s)

Note: Refer to *Instrument of Approval - SSI-8863* for additional abbreviations and definitions relevant to the Project.

1 Introduction

1.1 Context

This Out-of-Hours Work Protocol (herein referred to as the Protocol) for the Western Harbour Tunnel Stage 3A (the Project) has been prepared in accordance with conditions of approval (CoA) E68(c)(ii) and E69. It defines the process for assessment and approval of work undertaken outside of standard construction working hours (out-of-hours work, OOHW) that is not subject to an EnvironmentProtection Licence (EPL).

All works undertaken during Stage 3A are anticipated to be performed subject to an EPL. Once obtained, a copy of the current EPL premise boundary will be available on the Project Website(https://caportal.com.au/rms/wht).

In the event OOHW are required that will not be subject to an EPL, this Protocol will be implemented for the duration of the activities not subjected to an EPL.

OOHW, that is not subject to an EPL, has the potential to exceed relevant noise management levels (NMLs) determined in accordance with the approach outlined in the Interim Construction Noise Guidelines (DECC, 2009) (ICNG). As OOHW has the potential to impact on the amenity of adjacentsensitive receivers, the work requires assessment and approval prior to commencement.

CoA E69 requires that this Protocol is prepared in consultation with the ER, AA and the EPA andapproved by the Planning Secretary.

1.2 Background and project description

The Western Harbour Tunnel and Warringah Freeway upgrade EIS (Jacobs/Arcadis 2020) assessed noise and vibration impacts on sensitive receivers and structures during construction and operation ofthe Project, within Chapter 10 and the Noise and Vibration Technical Working Paper (Appendix G ofthe EIS).

The EIS identified the potential for noise and vibration impacts during construction which are dependent on the types of construction activity in progress and the proximity of works to sensitive receivers. However, it concluded any potential impacts could be managed by tailored mitigation andmanagement measures, including construction noise and vibration monitoring. Please refer to Section 1.2 of the Construction Environmental Management Plan (CEMP) for the Project description.

2 Purpose and objectives

The CoA defines the approved working hours for the Project. The approved construction workinghours for the Project are defined in CoA E66 as being:

- 7:00 am to 6:00 pm Mondays to Fridays, inclusive;
- 8:00 am to 6:00 pm Saturdays; and
- At no time on Sundays or public holidays.

In accordance with CoA E69, this Protocol defines the process for the assessment and approval ofwork that is not subject to an EPL and needs to occur outside of the time periods stipulated above (i.e. needs to occur during an OOHW period).

This Protocol will apply to the two following OOHW periods:

- OOHW Period 1:
  - Monday to Friday: 6pm to 10pm;
  - Saturday: 7am to 8am and 6pm to 10pm; and
  - Sunday and Public Holidays: 8am to 6pm;
- OOHW Period 2:
  - Monday to Friday: after 10pm and prior to 7am;
  - Saturday: after 10pm and prior to 8am; and
  - Sunday and Public Holidays: after 6pm and prior to 8am.

2.1 Minister's Conditions of Approval

The MCoA that relate to construction noise and vibration and how they are being addressed by the Project are provided in the NVMP. MCoA relevant to this OOHW Protocol are provided in Table 1. A cross reference is included to indicate where each condition is addressed in this OOHW Protocol or other project management document.

Table 1 Minister's Conditions of Approval that address out of hours works

Reference	Relevant condition	Where addressed
A34	The approved AA must: (d) review all proposed night-time works to determine if sleep disturbance would occur and recommend measures to avoid sleepdisturbance or appropriate additional alternative mitigation measures	Section 5
E66	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays	Section 2
E67	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receivermust only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) if continuously, then not exceeding three hours, with a minimumcessation of work of not less than one hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one hour between ceasingand recommencing any of the work.	Section 4.4
E68	Notwithstanding Conditions E66 and E67 work may be undertakenoutside the hours specified in any of the following circumstances: (a) Safety and Emergencies, including: (i) for the delivery of materials required by the NSW Police Force orother authority for safety reasons; or (ii) where it is required in an emergency to avoid injury or the loss oflife, to avoid damage or loss of property or to prevent environmentalharm. On becoming aware of the need for emergency work in accordancewith Condition E68(a)(ii), the Proponent must notify the AA, the ER,the Planning Secretary and the EPA of the reasons for such work.The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work. (b) Low impact, including: (i) construction that causes LAeq(15 minute) noise levels: •	Section 1.1 Section 3.1 Refer to Section 6.2 ofNVMP

Reference	Relevant condition	Where addressed
	nomore than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, or • no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); or (ii) construction that causes LAFmax(15 minute) noise levels nomore than 15 dB(A) above the rating background level at any residence; or (iii) construction that causes: • continuous or impulsive vibration values, measured at the most affected residence are no more than the preferred values for humanexposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), or • intermittent vibration values measured at the most affected residence are no more than the preferred values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration:a technical guideline (DEC, 2006). (c) By Approval, including: (i) where different construction hours are permitted or requiredunder an EPL in force in respect of the CSSI; or (ii) works which are not subject to an EPL that are approved underan Out-of-Hours Work Protocol as required by Condition E69; or (iii) negotiated agreements with directly affected residents andsensitive land user(s). (d) By Prescribed Activity, including: (i) tunnelling (excluding cut and cover tunnelling and surface works)and tunnel fit out works (excluding surface works) are permitted 24 hours a day, seven days a week; or (iii)(iii)works within an acoustic shed where there is no exceedance ofthe NMLs; or (iv)	
E69	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of work which is outside the hours defined in Conditions E66, and that arenot subject to an EPL. The Protocol must be approved by the Planning Secretary before commencement of the Out-of-Hours Work. The Protocol must be prepared in consultation with the ER,AA and EPA. The Protocol must provide:	This document Annexure 1
	(a) identification of low and high-risk activities and an approval process that considers the risk of activities, proposed	Section 6

Reference	Relevant condition	Where addressed
	mitigation,management, and coordination, including where: (i) the ER and AA review all proposed out-of-hours activities andconfirm their risk levels, (ii) low risk activities can be approved by the ER in consultation withthe AA, and (iii) high risk activities that are approved by the Planning Secretary;	Section 6.1
	(b) a process for the consideration of out-of-hours work against therelevant NML and vibration criteria;	Section 3 Annexure 1
	(c) a process for selecting and implementing mitigation measuresfor residual impacts in consultation with the community at each affected location, including respite periods consistent with the requirements of Condition E83. The measures must take into account the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive land user(s) wouldbe exposed to, including the number of noise awakening events;	Section 4 Section 5 Section 7
	(d) procedures to facilitate the coordination of out-of-hours work including those approved by an EPL or undertaken by a third party,to ensure appropriate respite is provided; and	Section 4.5
	(e) notification arrangements for affected receivers for all approvedout-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works. This condition does not apply if the requirements of ConditionE68(b) are met.	Section 7
E70	Mitigation measures must be implemented with the aim of achievingthe following construction noise management levels and vibration objectives: (a) construction 'Noise affected' NML established using the InterimConstruction Noise Guideline (DECC, 2009); (b) vibration criteria established using the Assessing vibration: atechnical guideline (DEC, 2006) (for human exposure); (c) Australian Standard AS 2187.2 - 2006 "Explosives - Storage andUse - Use of Explosives"; (d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions";and (e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Any work identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance withthe Noise and Vibration CEMP	Noted

Reference	Relevant condition	Where addressed
	Sub-plan. Any work identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with thisSub-plan. Note: The ICNG identifies 'particularly annoying' activities thatrequire the addition of 5 dB(A) to the predicted level before comparing to the construction NML.	
E75	Construction Noise and Vibration Impact Statements (CNVIS) mustbe prepared for any work that may exceed the noise managementlevels, vibration criteria and/or ground-borne noise levels specified in Condition E70 and Condition E71 at any residence outside construction hours identified in Condition E66, or where receivers will be highly noise affected. The CNVIS must include specific mitigation measures identified through consultation with affected sensitive land user(s) and the mitigation measures must be implemented for the duration of the works. A copy of the CNVIS must be provided to the AA and ER prior to the commencement of the associated works. The Planning Secretary may request a copy/ies of CNVIS.	Section 4
E82	All work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponentmust: (a) reschedule any work to provide respite to impacted noise sensitive land user(s) so that the respite is achieved in accordancewith Condition E83; or (b) consider the provision of alternative respite or mitigation toimpacted noise sensitive land user(s); and (c) provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation. The consideration of respite must also include all other CSSI, SSIand SSD projects which may cause cumulative and/or consecutiveimpacts at receivers affected by the delivery of the CSSI.	Section 4.5
E83	In order to undertake out-of-hours work outside the hours specifiedunder Condition E66, the Proponent must identify appropriate respite periods for the out-of-hours work in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing thecommunity with: (a) a progressive schedule for periods no less than three months, oflikely out-of-hours work;	Section 5 Section 7

Reference	Relevant condition	Where addressed
	(b) a description of the potential work, location and duration of theout-of-hours work; (c) the noise characteristics and likely noise levels of the work; and (d) likely mitigation and management measures which aim to achieve the relevant noise management levels under Condition E70(including the circumstances of when respite or relocation offers willbe available and details about how the affected community can access these offers). The outcomes of the community consultation, the identified respiteperiods and the scheduling of the likely out-of-hour work must be provided to the AA, ER, EPA and the Planning Secretary. Note: Respite periods can be any combination of days or hours where out-of-hours work would not be more than 5 dB(A) above therating background noise level at any residence.	

3 OOHW Assessment Process

3.1 OOHW Justification

Construction work associated with the Project will be undertaken in accordance with the assessment and management approach outlined in the ICNG and the Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

The approved construction hours for the Project are outlined in CoA E66, where work is proposed outside of these hours, it must be appropriately justified with consideration to the ICNG. These requirements are reflected in CoA E68 for the Project. The ICNG outlines five categories of work thatmight be undertaken out of hours. OOHW may be required on public infrastructure projects, such ason road construction projects, to sustain the operational integrity of roads.

Justification for any activities proposed as OOHW must be established to the satisfaction of theEnvironmental Representative (ER) and the Acoustic Advisor.

As per CoA E69, all OOHW that are not subject to an EPL are regulated through this Protocol. This may include:

- Works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 “Risk Management –Principals and Guidelines”,
- Where the relevant road network operator has advised in writing that carrying out the works and activities could result in a high risk to road network operational performance,
- Where the relevant utility service operator has advised in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network,
- Where the Transport for New South Wales (TfNSW) Transport Management Centre (or otherroad authority) has advised in writing that a road occupancy licence is required and will not be issued for the works or activities during the hours specified in CoAs E66 and E67.

In the event of emergency works, the Project will endeavour to notify all affected noise and vibration sensitive receivers via email and the Project construction portal (https://caportal.com.au/rms/wht).

3.2 OOHW Permit

For any proposed OOHW, the following process will be carried out:

1. An OOHW Permit will be prepared that summarises the activities, equipment required, locationand duration, timing, predicted noise levels, standard mitigation measures and additional mitigation measures, and includes a detailed justification for works (in accordance with Section 3.1),
2. The OOHW Permit will be submitted to the Environment Team, who will undertake a noise and vibration assessment for the OOHW (refer to Section 4). Predicted noise impacts and appropriatemitigation measures will be determined as per Section 5 of this Protocol.
3. The Environment and Suitability Manager will determine whether the justificationfor the OOHW works is satisfactory.

4. Approval of the OOHW Permit will follow the process outlined in Section 6 of this Protocol,
5. Community consultation and notification will be undertaken in accordance with the Community Communication Strategy, as outlined in Section 7 of this Protocol, and
6. Monitoring will be undertaken in accordance with Section 9 of this Protocol and the Project's Construction Noise and Vibration Monitoring Program.

4 OOHW Noise and Vibration Assessment

In accordance with CoA E69(b) this section outlines the noise and vibration assessment processwhere OOHW is assessed against the relevant NML and vibration criteria.

4.1 Noise

To manage potential impacts from noise and vibration during OOHW, a 3D construction noise and vibration management tool, Gatewave (www.gatewave.com.au), has been developed for the Project to allow defined work areas and activities to be planned, assessed and managed as construction works progress. It would also allow cumulative noise impact from other aspects of the Project or, where relevant, noise from other construction projects, to be assessed and managed in accordance with the NVMP.
Gatewave incorporates ground elevation contours, building heights, the built environment and atmospheric conditions to predict construction noise in accordance with the International Standard ISO 9613-2:1996 implementing quality standard ISO 17534-1:2015. All sensitive receivers identified by the land use survey are integrated into the Gatewave tool.
The tool allows:

- Flexibility in assessing specific scenarios of local area works,
- Assessment where works are undertaken at multiple locations, and
- Multiple combinations of equipment that may be used during each stage of works in the suburban environment that would be encountered.

CNVISs prepared for the Project would establish the overall impacts associated with worksites, ancillary facilities and tunnelling excavation. The Project environment team would use Gatewave to manage construction noise and vibration impact by defining specific work areas/activities in the CNVIS as construction progresses and identifying:
Sensitive receivers where predicted noise levels are above the NMLs so that, where there are residual impacts even after all feasible and reasonable mitigation measures have been adopted, mitigation and management measures can be applied in accordance with this CNVMP; and
Buildings/structures within minimum working distances established for cosmetic damage and human annoyance so that appropriate mitigation and management measures can be applied in accordance with this NVMP.

The results of the OOHW noise assessment, including the selection of reasonable and feasible management measures from the NVMP, ICNG and CNVG, will be considered by the Project construction team and the Environment Manager. This will be used to determine the appropriate approval pathway for the OOHW (refer Section 6 and Annexure 1). Ongoing monitoring and validationof predictive outputs will be undertaken as detailed in the NVMP. Monitoring and validation are to be undertaken in accordance with Section 5 and Section 9.

4.2 Vibration

If vibration intensive activities are proposed as OOHW and have the potential to impact on sensitivereceivers or structures, they will be assessed for compliance with minimum working distances as defined in relevant Construction Noise and Vibration Impact Statements (CNVISs) (refer to Section 6.5 of the NVMP) including:

- Cosmetic structural damage impacts,
- Disturbance to building occupants due to vibration.

Ongoing monitoring and validation of predictive outputs will be undertaken as detailed in the

NVMP. Monitoring and validation are to be undertaken in accordance with Section 5 and Section 9.

4.3 Ground-borne Noise

When assessing works under the Protocol, impacts to receivers will consider cumulative impacts if the receiver is also affected by ground-borne noise at residential levels identified in CoA E71; 40dB(A) 6pm-10pm and 35dB(A) 10pm-7am. Inputs to the assessment will use validated ground-borne noise predictions using the tools detailed in the NVMP.

4.4 Highly noise intensive work

As required by CoA E67, except as permitted by an EPL, highly noise intensive works that result in anexceedance of the applicable NML at the same receiver must only be undertaken:

- between the hours of 8:00 am to 6:00 pm Monday to Friday
- between the hours of 8:00 am to 1:00 pm Saturday
- if continuously, then not exceeding three (3) hours, with a minimum respite from those activities and works of not less than one (1) hour.

'Continuous' includes any period during which there is less than one (1) hour between ceasing andrecommencing any of the work.

For OOHW subject to this Protocol that involves the use of highly noise intensive equipment:

- Highly noise intensive equipment will be used prior to 10 pm where reasonable and feasible,
- Where the above cannot be achieved, the equipment will be used prior to midnight where reasonable and feasible, and
- The Project will consider use of alternative respite periods to minimise noise impacts,such as reduced respite periods to try and complete highly noise intensive works as early inthe night as possible.

In accordance with CoA E83, to identify the appropriate respite periods for work proposed under this Protocol, the Project will consult with the ER, AA and the community at each affected location. The affected locations will be identified from the Project's noise prediction tool outputs for the proposed OOHW. The outcomes of the consultation and the noise prediction tool outputs will also be used to identify appropriate mitigation measures to be implemented for the proposed OOHW. The process for stakeholder consultation for OOHW is further detailed in Section 7.

4.5 Coordination of OOHW

As part of the noise and vibration assessment process (in accordance with CoA E69(d)), the Project will ensure all OOHW permitted by either an EPL or this protocol are co-ordinated to implement appropriate respite and/or mitigation measures for potentially affected sensitive receivers.

To facilitate the coordination of out-of-hours work with other projects, the following actions will be undertaken throughout the construction phase:

- The Project will seek to identify any relevant third parties in proximity to proposed OOHW.This will primarily occur through consultation with DPE, relevant Councils and Utility providers.
- The Project to provide as much advance notice as possible regarding works to be

undertaken out of hours to any identified relevant third parties. Notice will be provided in writing and in accordance with the Community Communication Strategy and Community Action Plan

- The Project Manager, Utility Coordination Manager and/or Community Manager to communicate with relevant third parties. The frequency of communication is dependent on the nature of OOHW being proposed by both the Project and any relevant third parties
- If out-of-hours works from any relevant third parties are being undertaken in close proximity to proposed OOHW, the proposed OOHW will be reviewed to ensure appropriate respite periodsare provided.

In accordance with CoA E82, all work undertaken for the delivery of the Project, including those undertaken by third parties (such as utility relocations) and other Critical/State Significant Infrastructure, and State Significant Development, must be coordinated to ensure respite periods areprovided. The Project must:

- Reschedule any work to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with CoA E83; or
- Consider the provision of alternative respite or mitigation to impacted noise sensitive landuser(s); and
- Provide documentary evidence to the Acoustic Advisor in support of any decision made by the Project in relation to respite or mitigation. This will be provided as part of the OOHWpermit (refer Annexure 1).

It is noted that other projects / utility providers / etc. may also have their own procedures in placeregarding out-of-hours works. This procedure may need to be altered to consider external influences.

5 OOHW Noise and Vibration Management Procedures

Following the noise and vibration assessment process as described in Section 4, the most appropriate reasonable and feasible management measures will be determined in accordance withthe NVMP, ICNG, and the standard mitigation measures set out in Appendix B of the CNVG.

In addition, the CNVG directs that the Project should consider implementing the additional mitigation measures detailed in Appendix C of the CNVG where feasible and reasonable, and as outlined in Table 2 and Table 3 below.

In accordance with the CNVG, the additional mitigation measures (AMMs) are defined as follows:

- **Notification (N)**: consists of a letterbox drop (or equivalent) detailing work activities, timeperiods over which these will occur, impacts and mitigation measures.
- **Specific Notification (SN)**: provides additional information when relevant and informative tomore highly affected receivers than covered in general letterbox drops.
- **Phone Calls (PC)**: detailing relevant information made to identified/affected stakeholders.
- **Respite Offers (RO)**: to provide residents with respite from ongoing impact. In accordance with CoA E83 note, respite can be any combination of days or hours where out-of-hours workswould not be more than 5dBA above the rating background level (Table 2, noticeable category).
- **Respite Period 1 (R1)**: where out-of-hours construction noise in OOHW Period 1 is generallylimited to no more than three consecutive evenings per week.
- **Respite Period 2 (R2)**: where out-of-hours construction noise in OOHW Period 2 is generallylimited to two consecutive nights.
- **Duration Respite (DR)**: where an agreement with the community has been made, it may bebeneficial to increase the work duration, number of evenings or nights worked through Duration Respite so that the project can be completed more quickly (refer Section 7.1).
- **Alternative Accommodation (AltA)**: will be offered to residents living in close proximity to construction works that are likely to experience highly intrusive noise levels. The specifics ofthe offer will be identified on a case-by-case basis. Additional aspects for consideration shallinclude whether the highly intrusive activities occur throughout the night or before midnight.
- **Verification (V)**: includes the measurement of the background noise level and construction noise to verify that actual noise levels do not exceed predicted noise levels, and that appliedmitigation measures are appropriate.

Table 2 and Table 3 detail the relevant additional mitigation measures from the CNVG to be appliedduring OOHW.

It should be noted that the sensitive receivers may have personal circumstances, which means thatthe approach to specific additional mitigation measures in Table 2 and Table 3 may not be suitable.

In accordance with CoA A34(d),(e) and (f), the AA will regularly monitor and review the implementation of this OOHW protocol, including the nominated mitigation measures, and will consider and recommend and necessary improvements that may be made to avoid or

minimise adverse noise and vibration impacts. This will ensure that appropriate noise and vibration mitigationmeasures are applied throughout the delivery of the Project.

Table 2 Trigger for additional mitigation measures - airborne noise

Predicted airborne LAeq (15min) noise level at sensitivereceiver			**Additional mitigation measures**
Perception	dB(A) above RBL	dB(A) above NML–	Type[1]
All hours			
75 dB(A) or greater			N, V, PC, RO
OOHW period 1[2]			
Noticeable	5 to <10	<5	--
Clearly audible	10 to <20	5 to <15	N, R1, DR
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR
Highly intrusive	>30	>25	V, IB, N, R1, DR, PC, SN
OOHW period 2[3]			
Noticeable	5 to <10	<5	N
Clearly audible	10 to <20	5 to <15	V, N, R2, DR
Moderately intrusive	20 to 30	15 to 25	V, IB, N, PC, SN, R2, DR
Highly intrusive	>30	>25	AltA[4], V, N, PC, SN, R2, DR

Note:

1. AltA = Alternative Accommodation, V = Verification, IB = Individual Briefings, N = Notification, R1 = Respite period 1, R2 = Respite Period 2, DR = Duration Respite, PC = Phone Calls, SN = Specific Notifications.
2. OOHW Period 1 refers to Mon-Fri (6pm-10pm), Sat (7am-8am & 6pm-10pm), Sun/Pub Hol (8am-6pm).
3. OOHW Period 2 refers to Mon-Fri (10pm-7am), Sat (10pm-8am), Sun/Pub Hol (6pm-8am).

Temporary relocation to be offered where construction works are planned to extend over morethan two consecutive nights at that impact classification.

Table 3 Trigger for additional mitigation measures - vibration

Predicted vibration level at sensitive receiver	Additional mitigation measures	
	Type[1]	Apply to
OOHW period 1[2]		
Predicted Vibration Exceeds Human Comfort Screening Levels	V, IB, N, RO, PC, RO, SN	All affected receivers
Predicted Vibration Exceeds Structural Damage Screening Levels	V, AC	All affected receivers
OOHW period 2[3]		
Predicted Vibration Exceeds Human Comfort Screening Levels	AltA[4], V, IB, N, PC, RO, SN	All affected receivers
Predicted Vibration Exceeds Structural Damage Screening Levels	V, AC	All affected receivers

Note:

1. AltA = Alternative Accommodation, AC = Alternative Construction Methodology, V = Validation of predicted levels, IB = Individual Briefings, N = Notification, RO = Respite Offer (project specific), PC = Phone Calls, SN = Specific Notifications.
2. OOHW Period 1 refers to Mon-Fri (6pm-10pm), Sat (7am-8am & 6pm-10pm), Sun/Pub Hol (8am-6pm)
3. OOHW Period 2 refers to Mon-Fri (10pm-7am), Sat (10pm-8am), Sun/Pub Hol (6pm-8am)
4. Temporary relocation to be offered where construction works are planned to extend over two or more consecutive nights at that impact classification.

6 Approval of OOHW not subject to an EPL

6.1 Identification of Risk Level and Approval Process

In accordance with CoA E69(a)(ii), the Environmental Representative (ER) has the authority to approve low risk OOHW activities in consultation with the Acoustic Advisor. Any high risk OOHW activities must be approved by the Planning Secretary.

When it is identified that OOHW are required and are not subject to an EPL, the engineer responsible for the work will submit an OOHW Permit to the Environment Team. This OOHW Permit will include details of the proposed activity and justification for the need to carry out the work as OOHW.

Following this, the noise and vibration assessment process as described in Section 4 will be undertaken by a member of the Project Environment Team for the proposed OOHW. The outcomes of the noise and vibration assessment, including relevant management measures, will be forwarded to the Environment Manager who in consultation with the AA, will review the level of risk associated with the activity, the predicted impacts and the management measures to be implemented.

In accordance with CoA E69(a)(i), the ER and AA will review all proposed out-of-hours activities andconfirm their risk levels.

Low risk work is defined as:

1. OOHW assessed vibration to remain below human comfort limits at sensitive receivers, and
2. OOHW assessed to meet the perception classification of Noticeable (refer Table 2), **or**
3. OOHW assessed to meet the perception classification of Clearly Audible (refer Table 2) at anyone residential receiver for a maximum of:
    a. Three evenings and night periods in a calendar week with only two consecutive evenings andnight periods permitted
    b. A maximum of 10 evenings and nights periods in a calendar month.

If the duration limitations outlined above cannot be achieved, the proposed OOHW will be classified high risk. In this instance, the assessment of the proposed OOHW and the OOHW Permit will be issued to the Secretary for review and approval.

Applications for ‘high risk’ work for approval by the Secretary (CoA E69(d)(iii)) will include a noise assessment that comprises either a Construction Noise and Vibration Impact Statement (CNVIS) or noise modelling outputs and relevant management measures. The form of noise assessment required for each application will be determined based on the nature of the works (type, duration etc).

Following approval by the ER (in consultation with the AA) or the Secretary, the approved OOHW Permit will be provided to the relevant construction team by the Environment and Sustainability Manager (or delegate). On receipt of the approved OOHW Permit, any standard and additional mitigation measures that relate to the OOHW will be:

- Implemented prior to OOHW (such as specific conditions that relate to the community),
- Communicated to relevant workforce and site personnel before each shift to introduce/reinforce work restrictions, management measures and expected workforce behaviour, and

- Implemented during OOHW and monitored by the Environment Team to confirm/validate the noise predictions.

Prior to, and during the OOHW, the AA will verify that the above approach has been followed and advise opportunities for improvement in accordance with CoA A34(f) and CoA A34(c), respectively.

Following the OOHW, the Project will review any lessons learnt and monitoring data to help inform future OOHW activities and mitigation measures and minimise impacts.

7 OOHW Stakeholder Consultation and Communication

The Communications Team will use a range of communication tools to provide clear, effective and timely information to the predicted affected sensitive receivers and stakeholders. The method of communication will be chosen based on the nature of works and the potential impacts. All community consultation would be carried out in accordance with the Community Communication Strategy and as required by this Protocol.

In accordance with CoA E69(e), notification will be provided for affected receivers for all approved out-of-hours works and notification to the Planning Secretary of approved low risk out-of-hours works.
In accordance with CoA E83, copies of OOHW notifications would be provided to the ER, AA, DPI&E and EPA on a monthly basis. As required by the Communication Strategy, these OOHW notifications would also be available on the Project website.

Where required by the CNVG, the Project will notify potentially affected sensitive receivers and other stakeholders of planned OOHW. All OOHW notification shall be undertaken not less than 5 calendar days and not more than 14 calendar days before the work is to be carried out. As discussed in Section 4, the Project will identify appropriate respite periods for OOHW in consultation with the community at each affected location.

This consultation will be conducted in accordance with the Community Communication Strategy and CoA E83. Itwill include the provision of the following information to affected receivers:

- A progressive schedule of likely out-of-hours work for a period of no less than three (3)months,
- A description of the potential out-of-hours, including location and duration,
- The noise characteristics and likely noise levels of the works, and
- Likely mitigation and management measures.

The outcomes of the community consultation, the identified respite periods and the scheduling of thelikely OOHW will be provided to the AA, ER, EPA and the Planning Secretary.

7.1 Community Agreement

In accordance with CoA E68(c)(iii), variation to working hours may occur following negotiated agreements with affected residents and sensitive land user(s). If such negotiated agreements can bemade the overall duration of OOHW may be reduced. Negotiated agreements made in accordancewith CoA E68(c)(iii) would allow proposed OOHW to occur outside of the provisions of Respite 1 and Respite 2. This provision would allow for an accelerated program of OOHW by permitting additional OOHW shifts per week.

The Project may identify OOHW which would provide benefit to the community if completed through an accelerated program. In these instances, The Project may engage with and seek agreement from the noise affected community to conduct the works through this accelerated program.

The Project must engage with and seek agreement in writing from all sensitive receivers whichmodelling has predicted to be impacted by noise greater than the NML (this includes receivers that have previously declined to participate in agreements). The agreement must detail:

- The actual works proposed

- Expected impacts in clear, simple English based on noise modelling
- Expected duration of the works
- Any expected benefits for the receivers
- Any other concurrent OOHW that will be occurring
- Any other OOHW that will be occurring on the nights preceding and following the proposed works or, if the proposed work precedes or follows a weekend period, any other OOHW thatwill be occurring on the weekend.

Agreement must be reached with a substantial majority of potentially affected sensitive receivers. Community agreements will be undertaken in accordance with the Community Communications Strategy prepared under CoA B1. The Project must keep a record of all attempts made to contact sensitive receivers and requests made to the body corporate; these records must be kept for the duration of the OOHW. Where the Project is not able to contact a sensitive receiver, the receiver will be recorded as having no response.

7.2 Respite Consultation

Respite (for example Respite Period 1 and Respite Period 2 identified in Table 2 and Table 3) generally involves programming the works so they are undertaken in blocks so that any one receiver is not impacted by noise and vibration for continuous periods. In accordance with CoA E69(c) mitigation measures must consider the predicted noise levels and the likely frequency and duration of the out-of-hours works that sensitive receivers would be exposed to, including the number of sleep disturbance events.

Additionally, in accordance with CoA E82, the consideration of respite must also include all other Critical State Significant Infrastructure, State Significant Infrastructure and State Significant Development projects which may cause cumulative and/or consecutive impacts at receivers affectedby the delivery of the CSSI.

In accordance with CoA E83, where OOHW is required, the Project will identify appropriate duration respite periods for the OOHW in consultation with the community at each affected location,as identified by the assessment process outlined in Section 4. Based on the noise assessment, duration respite will be considered as a mitigation measure when the trigger levels in Table 2 are exceeded. This is identified as ‘DR’ in the table. OOHW notifications will provide contact details for receivers that wish to discuss further options outside the consultation described above.

The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hours works will be provided to the Acoustic Advisor, ER, EPA and Planning Secretary inthe form of a Community Respite Consultation Summary Report. These reports will be developed following each respite consultation event required under CoA E83.

8 External Approval Authorities for OOHW

8.1 Environmental Representative and Acoustics Advisor

In accordance with CoA E69 (a)(ii), if the proposed OOHW (that is not subject to an EPL) only includes low risk activities (refer to Section 6), the OOHW can be approved by the ER, in consultationwith the AA.

8.2 DPE

In accordance with CoA E69 (a)(iii), if the proposed OOHW (that is not subject to an EPL) includeshigh risk activities (refer to Section 6), approval of the OOHW will be sought from the Planning Secretary.

9 OOHW Monitoring

9.1 Noise and vibration monitoring

Noise and vibration monitoring of OOHW will be conducted and documented in accordance with the Project's Construction Noise and Vibration Monitoring Program (refer to Appendix D2 of the NVMP).

In accordance with the ICNG the duration and amount of noise monitoring will depend on the scale of the construction activities and extent of expected noise impacts. Noise monitoring will cover a representative period of the construction activity. A representative period is the stage of a construction activity where all the plant and equipment operating is consistent with the full range of plant and equipment modelled in the noise and vibration assessment, i.e. noise monitoring is not to be undertaken when the key noise contributing plant and equipment are turned off. The CNVIS will identify the representative periods.

Where possible, monitoring will be undertaken at the most affected noise sensitive receiver's location in proximity to the Project's construction activities. Noise monitoring locations will consider factors including:

- The location of previous and baseline monitoring sites,
- The proximity of the receiver to a Project worksite,
- The sensitivity of the receiver to noise,
- Access requirements/limitations
- Background noise levels and
- The expected duration of the impact.
- Safety of the monitoring location
- Validity of the noise monitoring readings/session

Monitored noise and vibration levels will be analysed against the applicable NMLs, vibration goals, and the predictions made in the relevant CNVIS or using the Project's predictive tools. Where monitored construction noise levels are found to be above modelling predictions or vibration goals areexceeded, corrective action will be taken (i.e. Stop work; review mitigation measures and revise appropriately). Refer to Section 10 of the Construction Noise and Vibration Monitoring Program for further information.

10 OOHW Monitoring

10.1 Management response

Where monitored noise and vibration levels are found to be above modelling predictions or vibrationgoals, the following actions will be undertaken:

- Cease the noise and/or vibration generating source which causes the exceedance,
- Confirm the monitored levels are not being impacted by other noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud/vibratory piece of equipment,
- Identify if the equipment can be swapped out for another piece of equipment or alternativeequipment or plant, or if additional mitigation can be included in the site design,
- Confirm that the modelling reflects the actual activity being undertaken,
- Implement other feasible and reasonable measures which may include reducing plant size,
- modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), utilising alternative construction methodology or a combination ofthese, and review/revise AMMs to ensure appropriate measures have been implemented,
- Refine the noise modelling assessment process based on the learnings. For example, if noiseor vibration predictions are lower/higher than expected, OOHW scheduling would be updated accordingly to comply with the numbers of nights permitted to be worked per week,
- Continue work where noise and/or vibration levels can be reduced and align with modellingpredictions or vibration goals, and
- Communicate lessons learnt to relevant personnel.

Previously recorded non-conformances will be considered prior to the approval of further OOHWpermits.

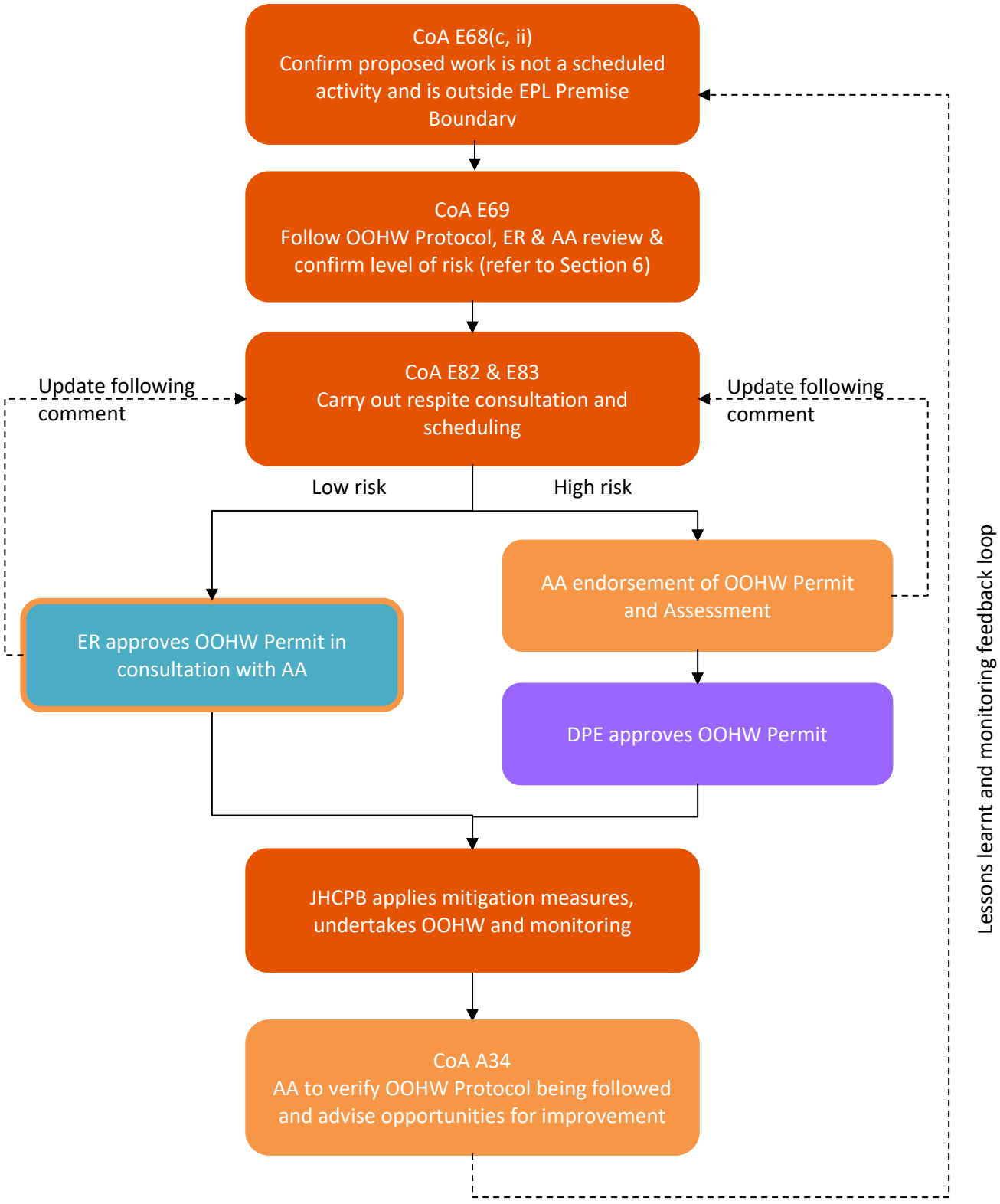
10.2 Reporting

Noise and vibration complaints will be reported in accordance with the Project CommunicationStrategy and any EPL requirements.

Construction Monitoring Reports will be prepared and submitted to DPIE and relevant regulatory authorities for information, in line with CoA C21 as described in Section 9 of the Noise and Vibration Monitoring Program.

The Acoustic Advisor provides a Monthly Noise and Vibration Report detailing the Acoustic Advisor’sactions and decisions on matters for which the Acoustic Advisor is responsible, in accordance with CoA A34(h)(v) and included in Section 3 of the CEMP.

Annexure 1 – OOHW Protocol Approval Flow Chart



Note: Where OOHW permits are not approved / endorsed the construction work must not proceed.

Appendix D4 – Noise and Vibration Exceedance - Corrective Procedure

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS or using the Project's predictive tools. Where monitored construction noise levels are found to be above modelling predictions or vibration goals are exceeded, the following actions will be undertaken:

- Cease the noise and/or vibration generating activity which causes the exceeded predictions
- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant or additional mitigation can be included in the site design
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm the modelling reflects the actual activity being undertaken and adjust the modelling tool where required to ensure accuracy of the predicted levels.
- Implement other feasible and reasonable measures which may include reducing plant size modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and using alternative construction methodology or a combination of these
- Review work practices to ensure compliance with the management levels set out in this NVMP
- Review and revise AMMs as necessary
- Ensure learnings from the above are fed back into the noise modelling assessment process for fine-tuning
- Continue work where impacts can be reduced
- Communicate lessons learnt to relevant personnel.

The Project will review the work or activity or combination of simultaneous works or activities as soon as practicable and where possible, modify the work or activity to prevent any recurrence. In the case of above prediction monitoring results, the need for modelling to be reviewed will also be considered. Lessons learnt will be communicated to relevant personnel in toolbox talks.