Construction Noise and Vibration Management Plan

SMWSTCTP-AFJ-1NL-NV-PLN-000001 Revision 8

Sydney Metro West – Central Tunnelling Package

ACOUSTICS ADVISOR ENDORSEMENT
SYDNEY METRO WEST (SSI 10038)

Review of	**Central Tunnelling Package:** Construction Noise and Vibration Management Plan (CNVMP), including Noise and Vibration Monitoring Program	**Reviewed document reference:**	SMWSTCTP-AFJ-1NL-NV-PLN-000001 Revision: 08 Dated: 13 July 2022
Prepared by:	Larry Clark Alternate Acoustics Advisor		
Date of issue:	28 July 2022		

As approved Alternate Acoustics Advisor for the Sydney Metro West project, I have reviewed and provided comment on previous revisions of the Construction Noise and Vibration Management Plan (CNVMP) for the Central Tunnelling Package. The CNVMP incorporates the Noise and Vibration Monitoring Program required by approval conditions C14 to C16.

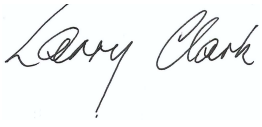
The CNVMP does not include detailed predictions of noise and vibration impact; these are provided in Detailed Noise and Vibration Impact Statements (DNVISs) prepared in accordance with Condition D43.

Revision 03 of the CNVMP was submitted for DPE Approval. Revision 4 included minor amendments of an administrative measure, to update the document to include the requirements of AFJV's Environment Protection Licence (EPL 21610). Revisions 5 and 6 were editorial in nature, to clarify some text. Revision 7 was an update to include tunnelling construction phase B2 and revision 8 addresses stakeholder comments.

In response to my comments on revision 7, I note AFJV's email advice that:

- The number of awakenings requirement of Conditions of Approval (CoA) D38(c) will be addressed in Out of Hours Works (OOHWs) applications
- The timing of cross passage excavation and other details of ground borne noise mitigation will be included in the tunnelling DNVIS

On that basis I am satisfied that my comments have been adequately addressed and I endorse revision 8 of the CNVMP in accordance with Condition of Approval A36(e).



Larry Clark, Metro West Alternate Acoustics Advisor

HBI Healthy Buildings International Pty Ltd
A.C.N. 003 270 693 A.B.N. 39 003 270 693

Suite 2.06, Level 2
29-31 Solent Circuit
Norwest, NSW 2153

Tel: 61 (02) 9659 5433
e-mail: hbi@hbi.com.au
Web:

www.hbi.com.au

Carolyn Riley
Director Sustainability, Environment
& Planning
Metro West - Sydney Metro
Transport for NSW
PO Box K659
HAYMARKET NSW 1240

28 July 2022

REF: CNVMP REV8

Dear Carolyn

RE: Sydney Metro Central Tunnelling Package: Construction Noise and Vibration Management Plan (CNVMP Rev 8)

I refer to Sydney Metro's (SM) submission of the following document required by Condition C5 and C16 of the Sydney Metro West Infrastructure Approval (SSI 10038) which was approved by the Department of Planning, Industry and Environment (DPIE) on 11 March 2021:

- Sydney Metro West, Central Tunnelling Package Construction Noise and Vibration Management Plan (CNVMP Rev 08 dated 13 July 2022).

It is noted that:

- The Construction Noise and Vibration Management Plan (SMWSTCTP-AFJ-1NL-NV-PLN-000001 Revision 8), is an updated version of the CNVMP that had previously been approved by DPE on 20 December 2021 (Rev 3 dated 6 December 2021). The CNVMP incorporates the Noise and Vibration Monitoring Program required by approval conditions C14 to C16. The amendments in Rev 8 of the CNVMP consider the scope of Tunnelling Works as defined in the Sydney Metro West Phasing Report as Phase B2.
- Sydney Metro has reviewed and commented on previous versions of the document and do not have any further comments on this revision.
- The CNVMP (Rev 08) was endorsed by the Acoustic Advisor on 28 July 2022.

As the approved Environmental Representative for the Metro West and as required by Condition A30(d)i, based on the above, the Construction Noise and Vibration Management Plan (Rev 8) as amended to cover Phase B2 Tunnelling Works is endorsed for submission to DPE for their consideration for Approval.

Yours sincerely

Michael Woolley
Environmental Representative – Sydney Metro West
CC: John Ieroklis, Matthew Marrinan, Ben Armstrong

DOCUMENT APPROVAL

	Prepared By	Reviewed By	Approved By
Name:	Gregor Wilson	Erran Woodward	Erran Woodward
Position:	Environmental Advisor	Environment Manager	Environment Manager
Date:	13/7/22	13/7/22	13/7/22

REVISION HISTORY

Rev:	Date:	Pages:	By:	Description:
00	18/08/21	All	EW	For consultation
01	7/10/21	All	AS	For approval
02	27/10/21	All	AS	For ER endorsement
03	06/12/21	All	EW	For DPIE Approval
04	16/3/22	2, 11, S.5	AS	Update to reflect EPL
05	31/03/22	3.2, 3.5	JM	Update in response to AA Comments
06	06/04/22	3.5	JM	Update in response to AA Comments
07	10/6/22	All	GW	Revised to include Phase B2 for ER review
08	13/7/22	All	GW	Revised to address stakeholder comments

CONTENTS

FIGURES

TABLES

GLOSSARY / ABBREVIATIONS

Abbreviation	Description / Definition
AA	Acoustics Advisor
AFJV	Acciona Ferrovial Joint Venture (the Contractor)
AS/NZS	Australia/New Zealand Standards
Amendment Report	Sydney Metro West Westmead to The Bays and Sydney CBD Amendment Report Concept and Stage 1 (2020
CEMF	Construction Environmental Management Framework (Appendix C to the Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report Concept and Stage 1 (2020))
CEMP	Construction Environmental Management Plan
CNVS	Sydney Metro Construction Noise and Vibration Standard
Construction	Includes all work required to construct Stage 1 of the CSSI as described in the documents listed in Condition A1 of Schedule 3, including commissioning trails of equipment and temporary use of any part of the CSSI, but excluding Low Impact Work. *Note: As defined in Table 1 of SSI 10038 Infrastructure approval for the Project.*
CoA	Minister's Conditions of Approval (as relevant to Sydney Metro West Concept and Stage 1)
CTP	Central Tunnelling Package
DECC	Former Department of Environment and Climate Change (NSW) now NSW Office of Environment and Heritage.
DPE	NSW Department of Planning and Environment (former NSW Department of Planning, Industry and Environment)
EIS	Sydney Metro West Concept and Stage 1 Environmental Impact Statement (April 2020)
EMS	Environmental Management System
EPA	NSW Environment Protection Authority
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act, 1999*
EPL	NSW Environment Protection Licence under the *Protection of the Environment Operations Act 1997*.
ER	Independent Environmental Representative appointed under the Minister's Condition of Approval
ESCP	Erosion and Sediment Control Plan
EWMS	Environmental Work Method Statements
Hold point	Is a verification point that prevents work from commencing prior to release.
ICNG	Interim Construction Noise Guideline (DECC 2009)

Abbreviation	Description / Definition
L_{A90}	The noise level exceeded 90% of the measurement period, typically considered the average minimum noise level and used to establish background noise levels
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level over a 15-minute period.
$L_{A\ (max)}$	The A-weighted maximum noise level, measured using the fast time weighting on a sound level meter.
Minister, the	NSW Minister for Planning and Public Spaces
NCA	Noise Catchment Area
NML	The Noise Management Level ($L_{Aeq\ (15min)}$) providing a target noise level, where, if exceeded, all reasonable and feasible noise mitigation and management measures would be considered for implementation.
OCCS	Overarching Community Consultation Strategy
Planning Secretary	The Planning Secretary of the Department of Planning, Industry and Environment
POEO Act	*NSW Protection of the Environment Operations Act 1997*
Project	Sydney Metro West Concept and Stage 1
RBL	The Rating Background Level for each period is the median value of the LA90 values for the period over all of the days measured. There is an RBL value for each period (day, evening and night).
Relevant Councils	Any or all local government councils as relevant including Inner West Council, City of Canada Bay, Strathfield City Council, Burwood Council and City of Parramatta Council
REMM	Revised Environmental Mitigation Measure
RNP	Road Noise Policy (EPA 2011)
Submissions Report	Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report Concept and Stage 1 (2020)
SWL	Sound Power Level the acoustic power output of a source expressed in decibels. Sound power level is calculated from measured sound pressure levels.
Sound Pressure Level	This is the level of noise, usually expressed in dB(A), as measured by a standard sound level meter with a pressure microphone.
VDV	Vibration Dose Value

1 INTRODUCTION

1.1 BACKGROUND

Sydney Metro is Australia's biggest public transport program. Services on the North West Metro Line between Rouse Hill and Chatswood started in May 2019. The Sydney Metro network also includes Sydney Metro City & Southwest, Sydney Metro West and Sydney Metro Western Sydney Airport.

Sydney Metro West is a new 24 kilometre metro line between Westmead and the Sydney CBD. This infrastructure investment will double the rail capacity of the Greater Parramatta to Sydney CBD corridor with a travel time target between the two centres of about 20 minutes.

The planning approvals and environmental impact assessment for Sydney Metro West has been split into a number of stages recognising the size of the project. This includes:

- Stage 1 – Concept and all major civil construction works including station excavation and tunnelling between Westmead and The Bays. Planning approval for this stage was granted in March 2021.
- Stage 2 – All major civil construction works including station excavation and tunnelling from The Bays to Sydney CBD
- Stage 3 – Tunnel fit-out, construction of stations, ancillary facilities and station precincts, and operation and maintenance of the Sydney Metro West line

An Environmental Impact Statement (EIS) (Jacobs/Arcadis, 2020) for the Concept and Stage 1 (herein referred to as the Project) assessed the noise and vibration impacts in response to the Secretary Environmental Assessment Requirements issued by the Department of Planning, Industry and Environment. The construction noise and vibration assessment is included in Chapter 11 and Technical Paper 2 of the EIS. The Project was approved on 11 March 2021 (SSI 10038).

1.2 SCOPE

The Noise and Vibration Management Plan (NVMP) forms part of the civils Construction Environmental Management Plan (CEMP). This Plan outlines how Acciona Ferrovial Joint Venture (AFJV) will comply with and implement the applicable 'Project requirements' for the Central Tunnelling Package (CTP) and identify how AFJV will manage the construction noise and vibration impacts during construction of the CTP civils construction phase B1 and tunnelling construction phase B2 (in accordance with the Sydney Metro Phasing Report).

This NVMP outlines how AFJV will comply with and implement the applicable elements from the following documents, collectively referred to herein as the 'Project requirements':

- NSW Minister for Planning and Public Spaces Conditions of Approval
- Revised Environmental Mitigation Measures (REMMs) and the
- Sydney Metro Construction Environmental Management Framework (CEMF), including Construction Noise and Vibration Standard (CNVS)

2 OBJECTIVES AND TARGETS

The objective of the Noise and Vibration Management Plan is to ensure all Project requirements relevant to noise and vibration are implemented as well as:

- Environment Protection Licence (EPL 21610) issued on 18 February 2022
- Sydney Metro Construction Noise and Vibration Standard
- All relevant legislation and guidelines (identified in Section 3.1)

Construction will not commence until the CEMP, sub-plans and construction monitoring program are approved/and or endorsed by the ER in accordance with CoAs C10 and C21. The CEMP and CEMP sub-plans and associated construction monitoring program will be implemented for the duration of construction of the CTP.

In order to assess the environmental performance relating to noise and vibration during construction, environmental objectives and targets have been established. These objectives and targets have been developed with consideration of key performance outcomes for noise and vibration as specified in Chapter 27 of the Project EIS.

- The project minimises adverse impacts on acoustic amenity of the surrounding community by effectively managing construction noise and vibration (including airborne noise, ground-borne noise and blasting).
- 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 places and environmental heritage.

The CEMF has specific objectives in relation to noise and vibration that will apply to construction:

- Minimise unreasonable noise and vibration impacts on residents and businesses;
- Avoid structural damage to buildings or heritage items as a result of construction vibration; Undertake active community consultation; and
- Maintain positive, cooperative relationships with schools, childcare centres, local residentsand building owners.

The performance of the CTP will be monitored against the objectives and targets (refer to Section 3.3 of the CEMP) and performance monitoring will be documented in the compliance reporting and at least on an annual basis as part of auditing requirements (refer to Section 3.9 of the CEMP).

Outcomes and targets established to achieve the performance outcomes outlined in the Project EIS and CEMF are outlined in Table 2-1.

TABLE 2-1: OBJECTIVES AND TARGETS

Target	Measurement Tool	Key performance indicator
Implement all reasonable and feasible noise mitigation measures with the aim of achieving the construction noise and vibration management levels detailed project environmental documents.	Tool box and induction attendance Site inspection Verification monitoring Internal and external audits Complaint records	Site inspection records demonstrate mitigation measures are in place and/or implemented in ongoing manner. Monitoring records add observations of mitigation and identify exceedance of noise and vibration management levels. Induction and toolbox talks include noise and vibration obligations. Audit records demonstrate good performance.

Target	Measurement Tool	Key performance indicator
No damage to features of heritage conservation significance from vibration generated by the Project works	Building condition survey. Monitoring records. Site inspection.	Demonstrable implementation of effective management of construction vibration to avoid damage. Monitoring records establish cosmetic damage risk is managed. Pre- and post-condition surveys demonstrate no damage.
Effective community consultation, notification and complaints resolution.	Consultation records Complaints register	Consultation records demonstrate community are well informed, and feedback has been considered. Community complaints managed in accordance with Sydney Metro Construction Complaints Management System including timely response and close out.
Ensure full compliance with the relevant legislative requirements, CoA and REMM	Compliance tracking Internal and external auditing	No repeat non-conformances of CoA or REMMs

The EIS identified specific construction performance outcomes for the Project; those relevant to the management of vibration are included in Table 2-2. The performance outcomes provide general performance expectations, which are addressed throughout the NVMP and Noise and Vibration Monitoring Program.

TABLE 2-2. PERFORMANCE OUTCOMES

Performance Outcome Requirement	Sydney Metro West Construction Performance Outcomes	How Stage 1 addresses performance outcomes
The project minimises adverse impacts on acoustic amenity of the surrounding community by effectively managing construction noise and vibration (including airborne noise, ground-borne noise and blasting).	Construction noise and vibration impacts on local communities are minimised by controlling noise and vibration at the source, on the source to receiver path and at the receiver	Stage 1 would construction noise minimise impacts to the local community by: ▪ Controlling noise and vibration at the source ▪ Controlling noise and vibration on the source to receiver transmission path ▪ Implementing practicable and reasonable measures to minimise the noise and vibration impacts of construction activities on local sensitive receivers. This includes provision of acoustic sheds (or other acoustic measures) where night works are proposed.
Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively	Structural damage to buildings and heritage items from construction vibration is avoided.	Stage 1 would minimise impacts to structures by: ▪ Controlling vibration at the source ▪ Controlling vibration on the source to receiver transmission path

Performance Outcome Requirement	Sydney Metro West Construction Performance Outcomes	How Stage 1 addresses performance outcomes
managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage.		▪ Implementing practicable and reasonable measures to minimise vibration impacts of construction activities on structures.

3 ENVIRONMENTAL REQUIREMENTS

3.1 RELEVANT LEGISLATION AND GUIDELINES

The relevant legislation to this Noise and Vibration Management Plan is the Protection of the *Protection of the Environment Operations Act 1997* (POEO Act). Refer to Section 3.4.2 of the CEMP for a full list of legislation applicable to the CTP.

The relevant standards and guidelines relevant to noise and vibration management are summarised in Table 3-1.

TABLE 3-1: RELEVANT GUIDELINES

Environment impact	Relevant standard or guideline
Airborne noise	▪ NSW Interim Construction Noise Guideline (ICNG) ▪ Construction Noise and Vibration Standard (CNVS)
Sleep disturbance	▪ Construction noise – Noise Policy for Industry (NPfI) ▪ Construction Noise and Vibration Standard (CNVS) ▪ Road traffic noise – RNP and the Roads and Maritime Environmental Noise Management Manual (ENMM) Practice Note 3
Ground-borne noise	▪ NSW Interim Construction Noise Guideline (ICNG) ▪ Australian Standard AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors
Construction related road traffic noise	▪ No specific guidelines, but guidance taken from the NSW Interim Construction Noise Guideline (ICNG) and the NSW Road Noise Policy (RNP)
Vibration (disturbance to building occupants)	▪ NSW DECC's Assessing vibration; a technical guideline, published in February 2006 ▪ British Standard BS 6472-1:2008, Guide to evaluation of human exposure to vibration in buildings- Vibration sources other than blasting
Vibration (structural damage to buildings)	▪ British Standard 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration
Vibration (heritage structures)	▪ German Standard DIN 4150-3:2016 – Vibration in Buildings-Part 3:Effects on Structures
Vibration (sensitive scientific and medical equipment)	▪ ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control ▪ Gordon GC 28 September 1999 Generic Vibration Criteria for Vibration Sensitive Equipment ▪ Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration

3.2 PROJECT REQUIREMENTS

The CoA and CEMF requirements relevant to the preparation of this Plan are shown in Table 3-2. Other relevant environmental requirements relevant to the Noise and Vibration Management Plan are included in **Appendix A**.

TABLE 3-2: COMPLIANCE TABLE - REQUIREMENTS FOR PREPARATION OF THIS NVMP

Project Planning Approval (dated 11 March (SSI 10038))		
C1	Construction Environmental Management Plans (CEMPs) and CEMP Sub-plans must be prepared in accordance with the Construction Environmental Management Framework (CEMF) included in the documents listed in Condition A1 of this schedule to detail how the performance outcomes, commitments and mitigation measures specified in the documents listed in Condition A1 of this schedule will be implemented and achieved during construction.	This Plan
C5	Of the CEMP Sub-plans required under Condition C1 of this schedule, the following CEMP Sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP Sub-plan. Details of issues raised by a government agency during consultation must be included in the relevant CEMP Sub-plan, including copies of all correspondence from those government agencies as required by Condition A6 of this schedule. Where a government agency(ies) request(s) is not included, the Proponent must provide the Planning Secretary / ER (whichever is applicable) justification as to why: a) Noise and vibration - SOPA (in respect of Sydney Olympic Park), Place Management NSW (in respect of The Bays) and relevant councils.	This Plan and Section 3.6
C6	The CEMP Sub-plans must state how:	
	(a) the environmental performance outcomes identified in the documents listed in Condition A1 of this schedule will be achieved;	Section 2 and Table 2-1
	(b) the mitigation measures identified in the documents listed in Condition A1 of this schedule will be implemented;	Section 9 and Appendix A
	(c) the relevant conditions of this approval will be complied with; and	This Table and Appendix A
	(d) issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed through SMART principles.	Issues including cumulative impacts have been detailed in Section 7.2 of this NVMP and Appendix C of the CEMP. Environmental risk analysis will be ongoing and regularly reviewed in accordance with Section 3.9 of the

Project Planning Approval (dated 11 March (SSI 10038))		
		CEMP to ensure effective management of noise and vibration impacts. Mitigation and management measures for these issues are listed in Table 20 and Appendix A of this Plan and Appendix B of the CEMP.
C7	With the exception of any CEMP Sub-plans expressly nominated by the Planning Secretary to be endorsed by the ER, all CEMP Sub-plans must be submitted to the Planning Secretary for approval.	Section 2
C8	The CEMP Sub-plans not requiring the Planning Secretary's approval must obtain the endorsement of the ER as being in accordance with the conditions of approval and all relevant undertakings made in the documents listed in Condition A1 of this schedule. Any of these CEMP Sub-plans must be submitted to the ER with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 2
C9	Any of the CEMP Sub-plans to be approved by the Planning Secretary must be submitted to the Planning Secretary with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 2
C10	Construction must not commence until the CEMP and all CEMP Sub-plans have been approved by the Planning Secretary or endorsed by the ER (whichever is applicable), unless otherwise agreed by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary or endorsed by the ER (whichever is applicable), including any minor amendments approved by the ER, must be implemented for the duration of construction. Where construction of Stage 1 of the CSSI is phased, construction of a phase must not commence until the CEMP and CEMP Sub-plans for that phase have been approved by the Planning Secretary or endorsed by the ER upon nomination by the Planning Secretary (whichever is applicable).	Section 2
C14	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 Stage 1 of the CSSI against the performance predicted in the documents listed in Condition A1 of this schedule or in the CEMP:	Appendix B Section 3.6 Blasting is not proposed.

Project Planning Approval (dated 11 March (SSI 10038))		
	(a) Noise and vibration - EPA, SOPA (in respect of Sydney Olympic Park), Place Management NSW (in respect of The Bays) and Relevant Council(s) (b) Blasting - SOPA (in respect of Sydney Olympic Park), Place Management NSW (in respect of The Bays) and Relevant Council(s) Note: The Blasting Construction Monitoring Program is only required to be prepared if blasting is proposed to be conducted during construction.	
C15	Each Construction Monitoring Program must provide: (a) details of baseline data available including the period of baseline monitoring; (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; (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 monitoring indicated unacceptable project impacts; (j) a consideration of SMART principles; and (k) any consultation to be undertaken in relation to the monitoring programs; and (l) any specific requirements as required by Conditions C16 to C17 of this schedule.	Appendix B
C16	The Noise and Vibration Construction Monitoring Program and Blasting Construction Monitoring Program must include: (a) noise and vibration monitoring determined in consultation with the AA to confirm the best achievable construction noise and vibration levels with consideration of all reasonable and feasible mitigation and management measures that will be implemented; (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; and (c) a process to undertake real time noise and vibration monitoring. The results of the monitoring must be readily available to the construction team, the Proponent, ER and AA.	Appendix B

Project Planning Approval (dated 11 March (SSI 10038))		
	The Planning Secretary and EPA must be provided with access to the results on request.	
C18	With the exception of any Construction Monitoring Programs expressly nominated by the Planning Secretary to be endorsed by the ER, all Construction Monitoring Programs must be submitted to the Planning Secretary for approval.	Section 3.6
C19	The Construction Monitoring Programs not requiring the Planning Secretary's approval must obtain the endorsement of the ER as being in accordance with the conditions of approval and allundertakings made in the documents listed in Condition A1 of this schedule. Any of these Construction Monitoring Programs must be submitted to the ER for endorsement at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 3.6
C20	Any of the Construction Monitoring Programs which require Planning Secretary approval mustbe endorsed by the ER and then submitted to the Planning Secretary for approval at least one (1) month before the commencement of construction or where construction is phased no later than one (1) month before the commencement of that phase.	Section 2
C21	Unless otherwise agreed with the Planning Secretary, construction must not commence until thePlanning Secretary has approved, or the ER has endorsed (whichever is applicable), all of the required Construction Monitoring Programs and all relevant baseline data for the specific construction activity has been collected.	Section 2 and Appendix B
C22	The Construction Monitoring Programs, as approved by the Planning Secretary or the ER has endorsed (whichever is applicable), 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 monitoringprogram or specified by the Planning Secretary or the ER (whichever is applicable), whichever is the greater.	Appendix B
C23	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, ER and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program. *Note: Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.*	Appendix B
Construction Environmental Management Framework		
8.2a	Principal Contractors will develop and implement a Construction Noise and Vibration Management Plan for their scope of works consistent with the Interim Construction Noise	This Plan

Project Planning Approval (dated 11 March (SSI 10038))		
	Guidelines (Department of Environment and Climate Change, 2009). The Construction Noise and Vibration Management Plan will include as a minimum:	
	i. Identification of work areas, site compounds and access points;	Appendix E
	ii. Identification of sensitive receivers and relevant construction noise and vibration goals;	Section 4.3 and Section 6
	iii. Be consistent with, and include the requirements of the noise and vibration mitigation measures as detailed in the environmental approval documentation and the Sydney Metro Construction Noise and Vibration Standard (CNVS),	Sections 6, 8.2 and 9 and Appendix A
	iv. Details of construction activities and an indicative schedule for construction works, including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios) that have the potential to generate noise or vibration impacts on surrounding sensitive receivers, in particular residential areas;	Section 7 and Appendix E
	v. Identification of feasible and reasonable procedures and mitigation measures to ensure relevant vibrations and blasting criteria are achieved, including a suitable blast program;	Section 9 and Appendix A Blasting is not proposed
	vi. Community consultation requirements and Community notification provisions specifically in relation to blasting;	Section 9.5
	vii. The requirements of any applicable licence or approval (for example EPL);	Section 2
	viii. Additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week;	Section 8 and Section 9
	ix. Pre-construction compliance requirements and hold points;	Section 2, Section 4.3, Section 0 and Section 9.3, Section 10.3, CEMP.
	x. The responsibilities of key project personnel with respect to the implementation of the plan;	Section 10.1 and Table 9-1
	xi. Noise monitoring requirements;	Section 10.3 and Appendix B
	xii. Compliance record generation and management; and	Section 10.7, and Noise and Vibration Monitoring Program, Section 3.10 of the CEMP
	xiii. An Out of Hours Works Protocol applicable to all construction methods and sites.	Section 9.3 and Appendix D

3.3 REVISED ENVIRONMENTAL MITIGATION MEASURES

Refer to **Appendix A** for relevant Revised Environmental Mitigation Measures (REMMs).

3.4 LICENCES AND PERMITS

An Environment Protection Licence (EPL) for *Railway activities – railway infrastructure construction* and *Concrete works* under Schedule 1 of the POEO Act has been obtained for the CTP. This licence (no. 21610) was granted on 18 February 2022.

Out of Hours Works Applications will be managed in accordance with the EPL and/or the OOHW Protocol, refer to Section 8.3. In all cases OOHW will be required to be approved under an Out of Hours Permit approved (at the minimum) by the AFJV Environment Manager, AFJV Community Manager and relevant AFJV Construction Manager. It is noted that under certain circumstances endorsement may be required from the AA and approval may be required from the ER or EPA.

3.5 ACOUSTICS ADVISOR

As required by CoA A32 independent Acoustic Advisor (AA) is required to be engaged to oversee construction noise and vibration planning, modelling, management and reporting for the duration of the delivery of the Project. The AA has been appointed by Sydney Metro.

As required by CoA A34, AFJV will cooperate with the AA by:

- Providing access to noise and vibration monitoring activities as they take place
- Providing access to the complaints register if requested
- providing for review of noise and vibration documents required to be prepared under the conditions of this approval
- considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.

Full details surrounding the role of the AA per CoA A36 is provided in Section 10.1 of this CNVMP.

3.6 DOCUMENT CONSULTATION

The Noise and Vibration Management Plan and the Noise and Vibration Construction Monitoring Program (document number) required under CoA C14 was provided to:

- Sydney Olympic Park Authority (in respect of Sydney Olympic Park)
- Place Management NSW (in respect of The Bays)
- Inner West Council
- City of Canada Bay
- Strathfield City Council
- Burwood Council, and
- City of Parramatta Council

In addition, in line with CoA C14 the Noise and Vibration Construction Monitoring Program, included herein as **Appendix B** was provided to the EPA.

Details of issues raised by stakeholders during consultation is provided in **Appendix F** including copies of correspondence in accordance with Condition A6. It is noted that issues were raised by Place Management NSW and Sydney Olympic Park Authority with regards to asset management of sensitive structures including the White Bay Power Stations and areas of reclaimed land. AFJV recognises the sensitivity of these locations and concerns from stakeholders, and notes that these will be addressed through a process of ongoing consultation with relevant parties, including the transfer of information to further inform any potential impacts, as well as agreed management measures to be implemented where required. This process will continue throughout construction in accordance with CoA D101.

Community feedback and complaints relating to noise and vibration will be dealt with in accordance with Section 9.5 of the CNVMP and related documents, including the OCCS.

Refer to CEMP for more information regarding consultation during delivery of the CTP.

3.7 DOCUMENT APPROVAL

In line with CoA 20 the construction noise and vibration monitoring program will also be endorsed by the ER and AA and then submitted to the Planning Secretary for approval at least one (1) month before the commencement of construction or where construction is phased no laterthan one (1) month before the commencement of that phase.

Construction will not commence until the CEMP, sub-plans and construction monitoring program are approved/and or endorsed by the ER in accordance with CoAs C10 and C21. The CEMP and CEMP sub-plans and associated construction monitoring program will be implemented for the duration of construction of the CTP.

4 EXISTING ENVIRONMENT

4.1 CONSTRUCTION SITES

The CTP construction sites are located in the Inner West, Burwood, Canada Bay and Paramatta Local Government Areas (LGA). The construction sites are described in Table 4-1 including a brief description of the existing noise environment around these locations as identified in Section 2 of Technical Working Paper 2 in the Project EIS.

TABLE 4-1: CTP CONSTRUCTION SITES

Construction site	Locality	Existing noise environment
The Bays	The construction site is located to the east of the former White Bay Power Station and north of Anzac Bridge	Existing noise is controlled by road traffic noise from Victoria Road and the Western Distributor, and industrial noise from White Bay and Glebe Island. The area immediately surrounding the Construction Site is mainly commercial/industrial.
Five Dock	The works would use two separate sites located opposite each other on either side of Great North Road, near to the intersection with Second Avenue	Existing noise is generally controlled by road traffic on the surrounding road network. The area surrounding the Construction Site is a mixture of commercial, other sensitive and residential receivers, with the nearest receivers being close to the boundary of both the sites.
Burwood	The works will use two separate sites. The main Construction Site is located to the north of Parramatta Road and a smaller site to the south	Existing noise is controlled by road traffic. The area surrounding the construction site is mostly residential and the nearest receivers are near the northern boundary of the northern construction site and the southern boundary of the southern Construction Site. Commercial receivers are also adjacent to the site, along Parramatta Road, and are of general retail use.
North Strathfield	The Construction Site is located to the east of the existing North Strathfield Station and is adjacent to Queen Street	Existing noise is influenced by the surrounding road network and existing rail line. The area surrounding the Construction Site is generally suburban with a mixture of residential, commercial and educational receivers. The nearest receivers are opposite the site, across Queen Street. The commercial receivers adjacent to the Site are typically of retail use.
Sydney Olympic Park	The station Construction Site is located off Olympic Boulevard, south of the existing Olympic Park Rail Station	Existing noise is controlled by distant road traffic noise from the M4 Motorway and Homebush Bay Drive, some rail noise, and general noise from the sports and entertainment complex.

Noise Catchment Areas (NCAs) that reflect the land use of each area are summarised in Table 4-2 and illustrated in Figure 1. The NCAs are based on the Project EIS (detailed in Section 2 of Technical Working Paper 2) and are reflective of the ambient noise environment of that area, as well as the noise and vibration sensitivity of the surrounding land uses.

TABLE 4-2: NOISE CATCHMENT AREAS

NCA	Extent	Description
The Bays		
NCA20	West of Victoria Road, Rozelle	Mainly residential with some commercial receivers along Victoria Road and Lilyfield Road. 'Other sensitive' receivers include Sydney Community College, St Joseph's Catholic Church and Rosebud Cottage child care centre
NCA21	East of Victoria Road, towards Balmain	Mainly residential, with various commercial areas surrounding White Bay and Glebe Island. 'Other sensitive' receivers include Inner Sydney Montessori School and C3 Church Balmain
NCA22	South of Victoria Road, in Glebe	Commercial areas to the south of Victoria Road/Western Distributor and distant residential areas across Rozelle Bay
Five Dock		
NCA14	Five Dock, West of Great North Road	Mainly residential. Commercial receivers are along Great North Road. 'Other sensitive' receivers include Five Dock Public School, St Albans Anglican Church, Drummoyne Uniting Church and Awesome Church
NCA15	Five Dock, East of Great North Road	Mainly residential. Commercial receivers are along Great North Road and other receivers include Domremy Catholic Church
Burwood North		
NCA12	Burwood, North of Parramatta Road	Mainly residential, with some commercial areas along Parramatta Road. 'Other sensitive' receivers include Concord High School, St Mary's Catholic Primary School, St Marys Catholic Church and St Luke's Anglican Church
NCA13	Burwood, South of Parramatta Road	Mainly residential, with commercial areas along Parramatta Road and Burwood Road. 'Other sensitive' receivers include Sydney Central ENT, Bath Arms Hotel, Southern Cross Catholic College and Methodist Ladies College.
North Strathfield		
NCA10	North Strathfield, West of the existing rail corridor	Mainly residential. Commercial receivers are the M4 Motorway and in the west. 'Other sensitive' receivers include McDonald College and Our Lady of the Assumption Primary School

NCA	Extent	Description
NCA11	North Strathfield, East of the existing rail corridor	Mainly residential, with areas of commercial receivers along Queen Street and Concord Road. Strathfield North Public School is in the north
Sydney Olympic Park		
NCA08	Olympic Park, western portion	Major events precinct with commercial and sporting uses, with other sensitive receivers including hotels and educational facilities. Residential apartment blocks are in the south, east and west. Event patrons are also key sensitive receivers.
NCA09	Olympic Park, eastern portion	Major events precinct with mixture of commercial and residential. There are several high-rise residential apartment buildings near Australia Avenue. Event patrons are also key sensitive receivers.

4.2 TUNNELLING ALIGNMENT

The CTP tunnelling alignment is located in the LGAs of Inner West, Burwood, Canada Bay, Parramatta and Strathfield. The majority of the NCAs relevant to tunnelling are described in Table 4-2. The additional NCAs relevant to tunnelling are described in Table 4-3.

TABLE 4-3: ADDITIONAL TUNNELLING NOISE CATCHMENT AREAS

NCA	Extent	Description
NCA17	Five Dock and Rodd Point, east of Augusta Street	Residential only between Augusta Street and Henley Marine Drive. The remainder of the tunnel alignment within NCA17 is beneath Iron Cove.
NCA18	Iron Cove	N/A – with respect to NCA18 the tunnel alignment is beneath Iron Cove only.
NCA19	Lilyfield, west of Manning Street	Commercial receivers, tertiary education and a childcare facility within the Callan Park area. Residential receivers located to the south.

FIGURE 1: CTP WORKS AREA AND NOISE CATCHMENT AREAS

4.3 SENSITIVE RECEIVERS

In accordance with CoA D34 a detailed Land Use Survey was undertaken to confirm sensitive receivers (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration and construction ground-borne noise. The Land Use Survey is a live document that will be progressively updated throughout construction as required.

The survey brought the NSW cadastral database and identified land use details into a Geographic Information System (GIS). The GIS allows potentially critical areas that are sensitive to construction noise and vibration impacts to be easily identified and updated as land uses change during the Project timeline. The land-use data will be included into the noise and vibration modelling tool, to allow effective management of noise and vibration impacts on identified sensitive receivers. Current Land Use Survey are included in **Appendix C** and will be considered as part of the Detailed Noise and Vibration impact statements (DNVIS). Land Use Surveys will be updated progressively to capture potential ground-borne noise impacts as tunnelling progresses, and prior to the impacts of tunnelling.

4.4 AMBIENT NOISE ENVIRONMENT

Baseline noise levels were established as part of the Project EIS (Section 2, Technical Paper 2) through unattended background noise monitoring at representative locations. Refer to the Noise and Vibration Construction Monitoring Program (located in **Appendix B**) for maps showing the monitoring locations. A description of the measured noise environment is provided in Table 4-4.

Noise levels in the CTP works area generally display a typical diurnal trend with lower levels during the night-time than the daytime and evening periods (with some exceptions). This is characteristic of urban and suburban areas, where the ambient noise environment is primarily influenced by road traffic.

The baseline information was used to establish the Rating Background Level (RBL), which represents the average minimum background sound level for each measurement period, averaged over the measurement days. The RBL at each NCA is provided in Table 4-4.

TABLE 4-4: BACKGROUND NOISE MONITORING RESULTS

	Noise level (dBA)		
NCA	**Day**	**Evening**	**Night**
NCA8	48	48	46
NCA9	48	46	41
NCA10	47	47	44
NCA11	51	47	39
NCA12	43	43 (47)[3]	42
NCA13	48	48	44
NCA14	42	41	33
NCA15	43	43 (44)[3]	38
NCA16	36	36 (39)[3]	33
NCA17	43	43 (45)[3]	37
NCA18	48	45	37
NCA19	43	43	35
NCA20	51	51	45
NCA21	48	47	39

Notes:

1. The RBL values have been extracted from the EIS; refer to Table 4 in the EIS Technical Paper 2.
2. Daytime is 7:00am to 6:00pm, evening is 6:00pm to 10:00pm and night-time is 10:00pm to 7:00am.

3. During the EIS noise assessment, the monitoring level was found to be higher than the daytime. In this situation, the NPfI requires that the evening level be reduced to match the daytime.

5 CONSTRUCTION HOURS

The approved construction hours for the CTP are in accordance with CoA D35 and D36, the CNVS, and Condition L5 of the EPL. These are summarised in Table 5-1.

Works within the EPL premises boundary will be managed under the EPL conditions referenced below. Works outside of this boundary will be managed under the CoA conditions. The CNVS will apply both inside and outside of the EPL premises boundary. The premises maps are held on EPA Electronic Filed EF21/12027 and approved in writing by the EPA. The premises maps are also available, with the Environmental Protection Licence, on the Project Website.

Where possible, works will be completed during the standard construction hours prescribed in CoA D35. Where out of hours works are required, AFJV would endeavour to schedule works in accordance with the Sydney Metro Construction Noise and Vibration Standard (CNVS), being:

- Lower Impact: 6.00 pm till 10.00 pm weekdays 1.00 pm till 10.00pm Saturdays 8.00 am till 6.00 pm Sundays or Public Holidays
- Moderate Impact: 10.00 pm to 7.00 am Weekday Nights 10.00 pm to 8.00 am Saturdays.
- High Impact: 6.00 pm to 7.00 am Sundays and Public Holidays.

Detail on works permitted to be undertaken outside the approved construction hours (OOHW) are included in Table 5-2.

TABLE 5-1: APPROVED WORKING HOURS

Source	Construction	Applicable Working Hours		
		Monday to Friday	**Saturday**	**Sunday / Public Holiday**
CoA D35	Standard construction hours	7:00am to 6:00pm	8:00am to 6:00pm	At no time
CoA D36	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable Noise Management Level (NML) at the same receiver (such as rock breaking, rock hammering) must only be undertaken during the following times.	8:00am to 6:00pm	8:00am to 1:00pm	At no time
		if continuously, then not exceeding three (3) hours, with a minimum cessation of work of notless than one (1) hour.		
		'Continuous' includes any period during which there is less than a one-hour respite period between ceasing and recommencing any of the work.		

TABLE 5-2: WORKS PERMITTED OUTSIDE APPROVED WORKING HOURS

Condition	Description of works permitted outside Approved Working Hours
CoA D37	Works may be undertaken outside of the hours specified in CoA D35 and D36 in the following circumstances:
(a)	**Safety and Emergencies** i. for the delivery of materials required by the NSW Police Force or other authority for safety reasons, or ii. 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 iii. On becoming aware of the need for emergency work in accordance with (a)(ii) above, the AA, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable all noise and/or vibration affected sensitive land user(s) of the likely impact and duration of those work.
(b)	**Low Impact** i. Construction that causes LAeq(15 minute) noise levels o no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and o no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and ii. Construction that causes LAFmax(15 minute) noise levels no more than 15 dB(A) above the rating background level at any residence; or iii. Construction that causes o 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 o 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** i. Where different construction hours are permitted or required under an EPL in force in respect of the CSSI, or ii. For works which are not subject to an EPL that are approved under an Out-of-Hours Work Protocol as required by Condition D38 of this schedule, or iii. Where a negotiated agreements with directly affected residents and sensitive land user(s) has been agreed.
(d)	**By Prescribed Activity** i. tunnelling (excluding cut and cover tunnelling and surface works) are permitted 24 hours a day, seven days a week; or
	ii. not applicable

Condition	Description of works permitted outside Approved Working Hours
	iii. delivery of material that is required to be delivered outside of standard construction hours in Condition D35 of this schedule to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or
	iv. haulage of spoil except between the hours of 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or
	v. work within an acoustic shed where there is no exceedance of noise levels under Low impact circumstances identified in (b) above, unless otherwise agreed by the Planning Secretary.
EPL L5.1	**Standard construction hours** Unless permitted by another condition of this licence, works and activities must: a) only be undertaken between the hours of 7:00 am and 6:00 pm Monday to Friday; b) only be undertaken between the hours of 8:00 am and 6:00 pm Saturday; and a) not be undertaken on Sundays or Public Holidays.
EPL L5.2	**High Noise Impact Works** Unless permitted by another condition of this licence, any high noise impact works and activities that exceed the applicable Noise Management Level (NML) when measured at the boundary of the most affected noise sensitive receiver must only be undertaken: a) between 8:00 am and 6:00 pm Monday to Friday; b) between 8:00 am and 1:00 pm Saturday; and c) if high noise impact works are to be conducted continuously and the location of the works means that it is likely to impact the same receivers, then the works must be conducted in continuous blocks of no more than 3 hours, with at least a 1-hour respite between each block of continuous high noise impact work; except as expressly permitted by another condition of this licence. Note: For the purposes of this condition ‘continuous’ includes any period where there is a less than 1-hour respite between ceasing and recommencing of any work that is subject to this condition.
EPL L5.3	**Exemptions to standard construction hours for low noise impact works** Works and activities may be carried on outside of the hours specified in condition L5.1 if the works and activities do not cause, when measured at the boundary of the most affected noise sensitive receiver: a) LAeq(15 minute) noise levels greater than 5dB above the day, evening and night rating background level (RBL) at any residence in accordance with the ICNG; and b) no more than the "Noise affected" NMLs specified in Table 3 of the ICNG at other sensitve land user(s); and c) LA1(1 minute) or LAmax noise levels greater than 15dB above the night RBL for night works;

Condition	Description of works permitted outside Approved Working Hours
	d) the preferred continuous or impulsive vibration values greater than those for human exposure to vibration, set out for residences in Table 2.2 in Assessing Vibration: a technical guideline (DEC, 2006); and e) the preferred intermittent vibration values greater than those for human exposure to vibration, set out for Residences in Table 2.4 in Assessing Vibration: a technical guideline (DEC, 2006). For the purposes of this condition, the RBLs are those contained in an environmental assessment for the activities subject to this licence prepared under the Environmental Planning and Assessment Act 1979. Alternatively, the licensee may use another RBL determined in accordance with the Noise Policy for Industry (EPA, 2017) and provided to the EPA prior to carrying out any works or activities under this condition.
EPL L5.4	**Exemptions to standard construction hours in exceptional circumstances** a) The licensee may undertake works and activities outside of standard construction hours specified in condition L5.1 for: i. emergency works required to avoid injury to persons, the loss of life or property, or to prevent material harm to the environment; and ii. the delivery of oversized plant, structures or materials determined by the police or other authorised authorities to require special arrangements to transport along public roads. The licensee must, on becoming aware of the need to undertake emergency works under this condition notify the EPA's Environment Line as soon as practicable and submit a report to the EPA by 2:00 pm on the next business day after the emergency works commenced that describes: i. the cause, time and duration of the emergency; ii. action taken by or on behalf of the licensee in relation to the emergency; and iii. details of any measures taken or proposed to be taken by the licensee to prevent or mitigate against a recurrence of the emergency.
EPL L5.5	**Works outside of standard construction hours - Notification** The licensee must notify potentially affected noise sensitive receivers of works outside of standard construction hours not less than 5 calendar days and not more than 14 calendar days before those works are to be undertaken. a) The notification must: i. be undertaken by letterbox drop or email; and ii. be detailed on the project website. b) The notification required by this Condition must: i. clearly outline the reason that the work is required to be undertaken outside the hours specified in condition L5.1; ii. include a diagram that clearly identifies the location of the proposed works in relation to nearby cross streets and local landmarks; iii. include details of relevant time restrictions that apply to the proposed works; iv. clearly outline in plain English, the location, nature, scope and duration of the proposed works; v. detail the expected noise impact of the works on noise sensitive receivers; vi. clearly state how complaints may be made and additional information obtained; and vii. include the number of the telephone complaints line required by condition M7.1, an after hours contact

Condition	Description of works permitted outside Approved Working Hours
	viii. phone number specific to the works undertaken outside the hours specified in condition L5.1, and the project website address.
EPL L5.6	**24-Hour works** The following works are permitted to be undertaken 24 hours a day, 7 days per week: a) Tunnelling activities (excluding cut and cover tunnelling and surface works); and b) Haulage of spoil, and delivery of material that is required to be delivered outside of standard construction hours to directly support tunnelling activities, except between the hours of 10:00pm and 7:00am to and from the Five Dock construction site; and c) Haulage of spoil, and delivery of material that is required to be delivered outside of standard construction hours to directly support tunnelling activities, except between the hours 10:00pm and 7:00am to and from the Burwood North construction site using any roads or streets other than directly from Parramatta Road; and d) work within an acoustic shed where there is no exceedance of noise levels under Low impact circumstances identified in condition L5.3, Note: Tunnelling does not include station box excavation
EPL L5.7	**Works outside of standard construction hours (out-of-hours works)** Under this condition, works and activities may be undertaken outside of standard construction hours specified in condition L5.1 and L5.2 until 23 December 2022, and if they are required in relation to one or more of the following: a) carrying on those works and activities during standard construction hours would 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"; b) the relevant road network operator has advised the licensee in writing that carrying out the works an activities during standard construction hours would result in a high risk to road network operational performance; c) a relevant utility service operator has advised the licensee in writing that carrying out the works and activities during standard construction hours would result in a high risk to the operation and integrity of the utility network; d) the TfNSW Transport Management Centre (or other road authority) have refused to issue a road occupancy licence during standard construction hours; or e) Sydney Trains (or other rail authority) requires a rail possession for the activities to be performed outside of standard construction hours.
EPL L5.8	**Works outside of standard construction hours - Regulatory Requirements** In undertaking any out-of-hours works or activities under condition L5.7, the licensee must comply with the following: a) Prepare a construction noise and vibration impact assessment in accordance with the Interim Construction Noise Guideline (DEC, 2009) that is to include: i. a description of the proposed out-of-hours works; ii. predictions of LAeq (15 minute) dB noise levels at noise sensitive receivers from these works and activities, where noise levels are predicted to be greater than those permitted under condition L5.3; and

Condition	Description of works permitted outside Approved Working Hours
	iii. a monitoring plan to validate the noise predictions, based on monitoring at the iv. boundary of representative sensitive receivers during noise generating activities that are representative of the out-of-hours works, including during the period/s predicted to have the highest noise level impacts. b) Undertake noise monitoring in accordance with the monitoring plan required by c) condition L5.8(a)(iii). d) Only undertake activities between the hours of 6:00pm on Mondays, Tuesdays, Wednesdays, Thursdays, Fridays and 7:00am the following day (unless permitted by another condition of this licence). e) Activities are not to be undertaken between the hours of 6:00pm on Saturdays, Sundays or Public Holidays and 7:00am the following day (unless permitted by another condition of this licence). f) Ensure that out-of-hours works do not result in noise levels exceeding those specified in condition L5.3 at the same noise sensitive receivers (unless specified in another condition of this licence) on more than: i. 2 consecutive evenings and/or nights at any time; and ii. 3 evenings and/or nights per week; and iii. 10 evenings and/or nights per month. g) Undertake any high noise impact works before 12:00 am (midnight) where reasonable and feasible. h) Where high noise impact activities are undertaken, the respite provisions as per the requirements of condition L5.2(c) do not apply provided that all high noise impact activities are undertaken prior to 12:00 am (midnight). i) Where high noise impact activities are undertaken after 12:00 am (midnight), the licensee is required to submit a written report to the EPA within 2 business days of the activity outlining the justification for continuing high noise impact works after midnight and the reasonable and feasible noise mitigation measures that were implemented to address these night time impacts. j) Upon request of an authorised officer, the licensee must provide within 5 business days: i. the construction noise and vibration impact assessment required by condition L5.8(a); ii. noise monitoring results required by condition L5.8(b); iii. written evidence demonstrating the works are necessary and permitted under condition L5.7; and/or iv. any other relevant information or records requested by the EPA.

In accordance with CoA D38 and as referenced within CoA D37 (c) (ii), an Out-of-Hours Work Protocol (OOWP) must be prepared to identify a process for the consideration, management and approval of works which are outside the approved construction hours, where those works are not subject to an EPL. The Protocol must be prepared in consultation with Sydney Metro, the ER, AA and the EPA and approved by the Planning Secretary prior to commencement of the out of hours works. The OOWP is discussed in Section 9.3.

In accordance with CoA D50, OOHW undertaken by third parties (such as utility relocations), must be coordinated to the greatest extent possible to ensure respite periods are provided, this includes:

a) reschedule any work to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with CoA D51 (refer to Section 9.3.1); or

b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers.

In such cases, evidence will be provided to the AA in support of any decision made in relation to the management and implementation of respite or mitigation.

The consideration of respite must also include all other approved Critical SSI and SSI and SSD projects which may cause cumulative and / or consecutive impacts at receivers affected by the delivery of Stage 1 of the CSSI. This is discussed further in Section 9.6.

6 NOISE AND VIBRATION MANAGEMENT LEVELS

6.1 AIRBORNE NOISE MANAGEMENT LEVELS

Noise Management Levels (NML) are developed using the approach in the Interim Construction Noise Guideline (DECC 2009) (ICNG), as required under the CNVS and as shown in Table 6-1.

Refer to Table 6- for a summary of NMLs for the CTP works area calculated from the RBL provided in Table 4-4.

TABLE 6-1: ICNG NOISE MANAGEMENT LEVEL – RESIDENTIAL RECEIVERS

Time of Day	Noise Management Level $L_{Aeq\ (15\ min)}$ *	Application
Standard hours: Monday to Friday 7:00am to 6:00pm Saturday 8:00am to 1:00pm No work on Sundays or public holidays	Noise affected RBL + 10dB	Where the predicted or measured LAeq (15 min) is greater than the noise affected level, AFJV will apply all feasible and reasonable work practices to meet the noise affected level
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise
Outside recommended standard hours	Noise affected RBL + 5dB	A strong justification would typically be required for works outside the recommended standard hours AFJV will apply all feasible and reasonable work practices to meet the noise affected level

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

TABLE 6-2: RESIDENTIAL RECEIVER - CONSTRUCTION NOISE MANAGEMENT LEVELS

NCA	Standard hours	Out of hours				
	Day	Day	Evening	Night	Sleep Disturbance screening, L_{Amax}, dBA	Awakening criterion, L_{Amax}, dBA
NCA07	56	51	49	46	56	65
NCA08	58	53	53	51	61	
NCA09	58	53	51	46	56	
NCA10	57	52	52	49	59	
NCA11	61	56	52	44	54	
NCA12	53	48	48	47	57	
NCA13	58	53	53	49	59	
NCA14	52	47	46	38	52	
NCA15	53	48	48	43	53	
NCA16	58	53	50	42	52	
NCA17	58	53	50	42	52	
NCA18	53	48	48	42	52	
NCA19	46	41	41	38	52	
NCA20	61	56	56	50	60	
NCA21	53	48	48	40	52	
NCA22	58	53	52	44	54	

6.1.1 SLEEP DISTURBANCE

Noise generated by construction activities during the night-time period can trigger awakenings and disturbance to sleep stages. In line with the Construction Noise and Vibration Standard (CNVS), the approach to managing events that cause sleep disturbance shall be consistent with the Noise Policy for Industry (EPA, 2017).

A detailed 'maximum noise event' assessment is required to be undertaken where predicted night-time noise levels for surface works construction activities exceed the following triggers (as defined in the Project Approval) at an occupied residential location:

- LAeq,15min 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or the
- LAFmax 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater

The maximum noise will be described as part of the OOHW Permit (refer to Section 8.3) and will define the predicted maximum noise level and the extent to which the maximum noise level exceeds the triggers. A component of understanding sleep disturbance is consideration of the number of times or duration that this exceedance may occur during the night-time period. This information however is not able to be determined as part of the OOHW Permit, and as such the assessments solely will be based on the LAFmax descriptor on an event basis under 'fast' time response.

There are two categories available for classifying sleep disturbance; Audible (maximum noise exceeds background noise + 15 dBA) or High Impact (maximum noise exceeds 65dBA). These classifications are quite conservative, and it is noted they do not align with the CNVS categories of noise impact.

As no assessment of frequency of exceedance is available, a worst case scenario will be presented. Given the nature of construction, it is common that works will exceed 65dBA and as such most works will trigger the 'High Impact' classification, and as such should be considered in light of the following:

- Duration of proposed works
- Time period of the proposed works (it is understood that the period between midnight and 6:00 am is considered to be the most sensitive)
- Sensitivity of receivers (it is noted that receivers adjacent to major roads or rail infrastructure may have more tolerance of night time disturbance)
- History of complaints associated with the proposed areas of works or type of activities proposed.

In consideration of the above, the OOHW Permit will identify feasible and reasonable noise mitigation measures with a goal of reducing the maximum noise levels for all OOHW works.

As per CoA A36, the AA will review proposed night-time works (with the exception of low risk activities) undertaken in accordance with CoA D38 to determine if sleep disturbance would occur and recommend measures to avoid sleep disturbance or appropriate additional alternative mitigation measures.

6.1.2 OTHER SENSITIVE RECEIVERS

NMLs adopted for sensitive receivers other than residential land uses are presented in Table 6-3. These NMLs are based on the criteria provided in the ICNG and AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building. NMLs for industrial, offices and rental space are for external areas.

TABLE 6-3: CONSTRUCTION NOISE MANAGEMENT LEVELS AT OTHER SENSITIVE RECEIVERS (NON-RESIDENTIAL)

Land Use	**NML (when in use) $L_{Aeq(15\ mins)}$**
Classrooms at schools and other education institutions **Hospital wards** and operating theatres **Places of worship**	45dB(A) (internal) 55dB(A) (external)
Childcare centres	
Internal play area (windows closed)	55dB(A)
Internal play area (windows open)	65dB(A)
Internal sleep area (windows closed)	40dB(A)
Internal sleep area (windows open)	50dB(A)
External play areas	65dB(A)
Active recreational areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	65dB(A) (external)

Land Use	NML (when in use) $L_{Aeq(15\ mins)}$
Passive recreational areas (which are spaces used for contemplative activities that generate little noise and where benefits are compromised by external noise intrusion)	60dB(A) (external)
Community centres	Maximum internal levels recommended in AS2107 for specific use
Industrial premises	75dB(A)
Office, retail outlets, small commercial premises	70dB(A)
Hotels	
Bars and lounges (day and evening)[1]	50dB(A)
Sleeping areas: Hotels near major roads (night)[1]	40 dB(A)

Notes:
AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors

- Where no external seating has been identified, minimum outside-to-inside attenuation of 20 dBA is assumed. The internal ICNG noise goal then corresponds to a facade level of 70 dBA.
- Where an open frontage or outdoor seating area has been identified, the external noise goal is taken as 60 dBA.

In accordance with CoA D41, noise generating work in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs will be timetabled so as to avoid sensitive periods, unless other reasonable arrangements have been made with the affected institutions.

6.2 GROUND BORNE NOISE CRITERIA

Ground-borne noise NMLs for residences are nominated in the ICNG and CNVS and indicate when management actions will be implemented. Mitigation measures will be applied when residential ground-borne noise NMLs are exceeded in accordance with CoA D40. This is typically where noise sensitive receivers are located close to construction activities involving work below ground level (e.g. rock breaking in station boxes).

Table 6-4 sets out the ground-borne noise management levels for residential receivers. These levels are applicable when ground-borne noise levels are higher than airborne noise levels during the evening and night periods.

TABLE 6-4: GROUND-BORNE NML - RESIDENTIAL

Period	Time of day	Ground-borne Noise Management Level, $L_{Aeq(15minute)}$
Evening	6:00pm to 10:00pm	40 dB(A) internal
Night	10:00pm to 7:00am	35 dB(A) internal

For other sensitive receivers, including commercial receivers such as offices and retail areas, the ICNG does not provide guidance in relation to acceptable ground-borne noise levels. This NVMP however, has adopted an internal level derived from the airborne NML presented in the ICNG for commercial premises and assuming a minimum 20dB(A) noise reduction from outside to inside with closed windows, consistent with the Project EIS.

For other noise sensitive receivers, guidance is taken from the recommended 'maximum' internal noise levels in AS/NZS 2107:2000 'Acoustics – Recommended design sound levels and reverberation times for building interiors' to determine suitable noise management levels. The ground-borne noise objectives for ‘other’ noise sensitive land uses are identified in Table 6-5.

TABLE 6-5: GROUND-BORNE NML – OTHER SENSITIVE RECEIVERS

Land Use	NML (dB(A)	Application	Reference
Classrooms at schools and other educational institutions	45	Internal	ICNG
Places of worship	45	Internal	ICNG
Commercial premises (including offices)	50	Internal	ICNG
Commercial premises (including retail outlets)	55	Internal	AS/NZS 2107:2000
Industrial premises	55–60	Internal	ICNG/AS/NZS 2107:2000

6.3 ROAD TRAFFIC NOISE CRITERIA

When trucks and other vehicles are operating within the CTP works area, vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions described in the DNVIS. When construction-related traffic moves onto the public road network it is regarded as 'additional road traffic'.

Construction road traffic noise criteria are provided in the CNVS and are based on the Road Noise Policy (EPA 2011) (RNP). An objective of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity as the result of a project. An increase of up to 2dBA in road traffic noise levels represents a minor impact that is generally considered to be indiscernible to the average person. Therefore, construction traffic NMLs set at 2dBA above the existing road traffic noise levels during the daytime and night-time periods have been adopted to identify the onset of potential noise impacts.

Where road traffic noise levels increase by more than 2dBA because of construction traffic, consideration will be given to the actual noise levels associated and whether these levels comply with the following road traffic noise criteria in the RNP:

- Existing freeway/arterial/sub-arterial roads: 60dBA $L_{Aeq(15hour)}$ day and 55dBA $L_{Aeq(9hour)}$ night
- Existing local road: 55dBA $L_{Aeq(1hour)}$ day and 50dBA $L_{Aeq(1hour)}$ night.

Where the construction traffic contribution is >2dBA and results in an exceedance with the road traffic noise criteria, consideration will be given to applying feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

6.4 VIBRATION OBJECTIVE

Approval condition MCoA D39 requires that the project be constructed with the aim of achieving the following vibration goals:

- For structural damage, the vibration limits set out in the German Standard *DIN 4150-3: Structural Vibration – effects of vibration on structures*;
- The vibration limits set out in the British Standard BS 7385-2:1993 – Evaluation and measurement for vibration in buildings Part 2 – Guide for measurement of vibration and evaluation of their effects on buildings (as they are "applicable to Australian conditions");
- For human exposure, the acceptable vibration values set out in *Environmental Noise Management Assessing Vibration: A Technical Guideline* (Department of Environment and Conservation, 2006);

Further details of each of these references are provided below.

6.4.1 BUILDING AND STRUCTURES

Potential building damage from construction vibration requires the application of values set out in BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2. These values are presented in Table 6-6 and relate to transient vibration, which does not give rise to resonant responses in structures, and to low-rise buildings.

TABLE 6-6: GUIDELINE VALUES FOR VIBRATION VELOCITY FOR THE EFFECTS OF SHORT-TERM VIBRATION STRUCTUES (BS 7385)

		Peak component particle velocity in frequency range of predominant pulse	
Line	**Type of Building**	4Hz to 15Hz	15Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	-
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

Where vibration may give rise to magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values may need to be reduced by up to 50%. Rock breaking/hammering and sheet piling have potential to cause dynamic loading in some structures (e.g. residences).

For most construction activities involving rock breakers, piling rigs, vibratory rollers, excavators, vibration predominantly occurs at frequencies in the 10Hz to 100Hz range. On this basis, a conservative vibration damage screening level has been adopted in line with the CNVS and is:

- Reinforced or framed structures: 25.0mm/s
- Unreinforced or light framed structures: 7.5mm/s.

In the lower frequency region below 4Hz the guide values for building types are reduced as a high displacement is associated with relatively low peak component particle velocity. To minimise risk of structural damage a guide value of 3.7mm/s has been adopted.

For heritage structures, BS7385-2:1993 does not provide numerical vibration levels to prevent structural damage, however, notes that ‘a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive’.

DIN4150 is commonly applied to assess potential impacts on heritage and fragile type buildings/structures. To evaluate the effects of long-term (or harmonic) vibration on structures, the lowest criterion of 2.5mm/s (PPV) in DIN4150 is often referred to.

Consistent with BS7385-2:1993, Section 2.5.1 of the Sydney Metro CNVS and Technical Paper 2 of the EIS; heritage buildings and structures would not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. This would be confirmed via the Condition Surveys required by CoA D60. If a heritage building or structure is found to be structurally unsound, the 2.5mm/s criteria would apply. Otherwise, the standard 7.5mm/s criteria will apply. This is consistent with the CTP Heritage Management Plan. Further discussion on the management of heritage items is provided in Section 9.2.3.

6.4.2 HUMAN COMFORT

AFJV will take care to minimise impacts on residents’ comfort. For most construction activities that generate perceptible vibration in nearby buildings, the character of the vibration is intermittent.

AFJV will implement measures to control vibration at the source, and will use the guideline, 'Assessing Vibration: A Technical Guideline (DEC 2006) (Guideline)', which indicates preferred and maximum vibration goals for building areas as shown in Table 6-7.

The Guideline acknowledges that situations exist where vibration above the preferred values may be acceptable, particularly for temporary disturbances and infrequent events of short-term duration. The Guideline also advises that where all feasible and reasonable measures have been applied to control potential ground vibration levels the maximum values may be used. For values above the maximum value AFJV will negotiate directly with the affected community.

TABLE 6-7: VIBRATION DOSE VALUE FOR INTERMITTENT VIBRATION

Building Type	Preferred VDV ($m/s^{1.75}$)	Maximum VDV ($m/s^{1.75}$)
Critical working areas (e.g. laboratories or dental surgeries)	0.10	0.20
Residential daytime (7:00am–6:00pm)	0.20	0.40
Residential night-time (10:00pm–7:00am)	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80
Workshops	0.80	1.60

The Guideline advises a low probability of adverse comment or disturbance to building occupants would be expected at or below the preferred values.

To assess the potential for vibration impact on human comfort, AFJV will undertake a screening test based on peak velocity, as this metric is also used for the cosmetic building damage assessment. The screening test is conservative being based on continuous vibration criteria while construction works are mostly intermittent. The initial screening test for vibration disturbance to building occupants is based on the maximum peak particle velocity (ppv, mm/s) and is summarised in Table 6-8. If the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (eVDV) will be determined based on the level and duration of the event causing exceedance.

TABLE 6-8: SCREENING TEST PEAK VELOCITY CRITERIA

Building Type	Preferred VDV ($m/s^{1.75}$)	Maximum VDV ($m/s^{1.75}$)
Critical working areas (e.g. laboratories or dental surgeries)	0.14	0.28
Residential daytime (7:00am–6:00pm)	0.28	0.56
Residential night-time (10:00pm–7:00am)	0.20	0.40
Offices, schools, educational institutions and places of worship	0.56	1.10
Workshops	1.10	2.20

AFJV will undertake attended vibration measurements at the commencement of vibration generating activities to confirm that vibration levels satisfy the criteria for that vibration generating activity.

6.4.3 VIBRATION SENSITIVE STRUCTURES

In accordance with CoA D58, the CTP must be designed and constructed with the objective of minimising impacts to, and interference with, third party property and infrastructure, and that such infrastructure and property is protected during construction.

Gas pipelines, sewer pipes, and fibre optic cables close to the CTP may be sensitive to vibration. However, structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition – as indicated in British Standard BS 7385-2:1993 Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground-borne Vibration.

Further guidance is taken from the German Standard DIN 4150-3:2016 Vibration in Buildings – Part 3: Effects on Structures, which sets vibration velocity values for evaluating effects of vibration on buried pipework. Table 6-9 presents guideline values to evaluate the effects of short-term vibration.

TABLE 6-9: SCREENING TEST PEAK VELOCITY CRITERIA

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

These specific vibration goals will be used as part of vibration assessment of each work site as part of DNVIS.

In accordance with CoA D59, the services potentially affected by construction must be identified to determine requirements for diversion, protection and / or support. In consideration of proposed civils activities works are likely to be required in close proximity to existing utilities and services. In all cases, protection requirements or alterations to services will be determined by negotiation with the service providers. This will be managed in accordance with the specific process of the asset owner, and as identified in the Project Interface Management Plan. Disruption to services resulting from construction will be avoided, wherever possible, and advised to customers where it is not possible.

Monitoring of at-risk structures is discussed in Section 9.2.2.

6.4.4 SAFE WORKING DISTANCES

The propagation of vibration emitted from a source is site-specific with the level of vibration potentially experienced at a receiver dependent on the vibration energy generated by the source, the main frequencies of vibration, the localised geotechnical conditions and the interaction of structures and features which can dampen vibration.

The recommended safe working distances for construction plant provided in Table 6-10are referenced from TfNSW's *Construction Noise Strategy.* Consistent with the British Standard and the Assessing Vibration guideline, the recommendations are for the practical management of potential vibration to minimise the likelihood of cosmetic damage to buildings and disturbance or annoyance in humans. The human comfort safe working distances are conservative, developed with reference to the more stringent objectives for continuous vibration for typical residential building constructions.

TABLE 6-10: RECOMMENDED SAFE WORKING DISTANCES FOR VIBRATION INTENSIVE PLANT

		Safe Working Distances	
Plant Item	**Rating / Description**	**Cosmetic damage[1]**	**Human response[2]**
Vibratory roller	<50kN (typically 1–2t)	5m	15−20m

Plant Item	Rating / Description	Safe Working Distances	
		Cosmetic damage[1]	Human response[2]
	<50kN (typically 2–4t)	6m	20m
	<50kN (typically 4–6t)	12m	40m
	<50kN (typically 7–13t)	15m	100m
	<50kN (typically 13–18t)	20m	100m
	<50kN (typically >18t)	25m	100m
Small hydraulic hammer	300 kg–5–12t excavator	7m	23m
Medium hydraulic hammer	1600kg–12–18t excavator	22m	73m
Large hydraulic hammer	1600kg–18–34t excavator	2m	7m
Vibratory pile driver	Sheet piles	2–20m	20m
Pile boring	≤ 800mm	2m (nominal)	N/A
Jackhammer	Handheld	1m (nominal)	Avoid contact with structure

Notes

1. Referenced from British Standard BS 7385 Part 2-1993.
2. Referenced from DECCW *Assessing Vibration: a technical guideline.*

6.5 BLAST CRITERIA

Blasting is not currently proposed to be undertaken for the CTP.

In the event there is a change of construction methodology and blasting is required, the blasting criteria will be outlined in a Blast Management Strategy required under CoA D54.

7 ENVIRONMENTAL ASPECTS AND IMPACTS

7.1 NOISE AND VIBRATION ASPECTS

The general categories of construction activity likely to interact with nearby sensitive receivers are described in Table 7-1. An indicative construction program identifying start and end dates at each construction site is provided in Figure 2. The description of the general construction activities and the construction program are indicative and the various DNVISs will include detailed descriptions of the activities that apply to that DNVIS and a more detailed program of the activities that are discussed.

TABLE 7-1:GENERAL CONSTRUCTION CATEGORIES

Site establishment of construction sites and enabling works	This involves demolition of existing buildings, vegetation clearing, erection of hoarding and relocation, adjustment and protection of utilities and would involve the operation of supporting equipment such as generators, cranes, compressors, etc, and loading of heavy vehicles with equipment such as excavators. This category would include the use of noise intensive equipment such as rockbreakers and concrete saws at times, especially during demolition of existing structures. The North Strathfield construction site has been cleared by previous activities and would not require site clearing works. At these sites the enabling and site establishment works would involve the following less noise intensive activities including delivery of equipment and facilities to the site and the assembly of site facilities including perimeter hoarding and amenities buildings.
Piling	Piling is required at all Construction Sites for foundations of future structures and as linings of station and shaft excavations. Bored piling will be used rather than impact piling. This activity would include operation of supporting equipment such as excavators and cranes, as well as concreting equipment such as concrete mixer heavy vehicles and concrete pumps
Surface construction	Civil works and surface structures include roads, hardstand areas, water treatment facilities and site offices. At all sites excluding The Bays (currently) acoustic sheds will be constructed over excavation and spoil handling areas. This activity would involve the use of general construction equipment such as cranes, generators and hand tools. In addition, noise intensive equipment such as grinders would be used for some activities.
Excavation	Stations and tunnel service/access shafts will be excavated from the surface, commencing once piling is complete. Excavation will initially be performed through soft soil material and then through rock. Equipment may vary from site to site but may include excavators and dozers 'ripping' the material and excavators with rock breaker attachments to penetrate harder rock. Spoil will be removed from site by truck and dog. Once sufficient depth is created, acoustic sheds or panels will be installed to reduce noise impacts on receivers. Fresiney cutters and clam shell excavators may be utilised for D-wall construction.
Spoil and materials transport	Heavy vehicles will be required to transport non-tunnel spoil, tunnel spoil and other materials to and from each Construction Site or to the relevant waste facility.

Tunnelling	Tunnelling will involve the use of two tunnel boring machines to excavate twin tunnels between The Bays and Sydney Olympic Park. The tunnel boring machines would be launched from the station box excavation at The Bays and retrieved and dismantled at the Sydney Olympic Park metro station construction site. Irregular shaped tunnels such as stub tunnels, cross passages, crossover and turnback caverns and niches would be excavated via the use of roadheaders and rockhammers. Cross passages would be excavated at regular intervals (about 500m) across the project alignment, with the final position being considered as part of the Tunnelling DNVIS.

	2021				**2022**				**2023**				**2024**	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Construction Sites (Civil Works)														
Sydney Olympic Park														
Enabling and Demolition				X	X									
Station Box Excavation						X	X	X	X	X	X	X		
North Strathfield														
Enabling and Demolition					X									
Station Box Excavation						X	X	X	X	X				
Burwood North														
Enabling and Demolition				X	X									
Station Box Excavation						X	X	X	X	X				
Five Dock														
Enabling and Demolition				X	X									
Cut and Cover shaft excavation						X	X							
Station Box Excavation							X	X	X	X	X	X		
The Bays														
Enabling and Demolition			X											
Cut and Cover shaft excavation			X	X	X	X	X	X	X	X				
Tunnelling														
Tunnelling								X	X	X	X	X	X	

FIGURE 2: INDICATIVE CONSTRUCTION PROGRAM

7.2 NOISE AND VIBRATION IMPACTS

The potential for noise and vibration impacts upon sensitive receivers as a result of the CTP civils construction works is dependent on several factors including:

- Type and number of plant and machinery being used
- The duration of works
- The distance of the works to the nearest sensitive receiver
- Topography and barriers
- Ground condition
- Condition of receiver building/structure

- Existing background noise

Noise and vibration impacts during the tunnelling phase of the project would include potential ground-borne noise and vibration from the tunnel boring machines as they progress along the alignment and the excavation of cross passages, cross over caverns and the like. Potential ground-borne noise and vibration impacts would be greatest when the tunnelling works are directly below individual receivers. Additional noise impacts during tunnelling would be related to potential road traffic noise as a result of spoil truck movements.

Noise and vibration is initially assessed within the Project EIS, as discussed in Section 8.1

On approval of the Project, assessment of noise and vibration impacts is undertaken at three key stages, which are discussed in the following chapters:

1. Risk assessment as part of a CTP wide risk assessment workshop – high level assessment for establishing appropriate control measures (refer to Section 8.1) and identifying any project-specific or site specific controls which should be applied.
2. Where works may exceed the noise management levels, vibration criteria and/or ground-borne noise levels at any residence outside approved construction hours or where receivers will be highly noise affected, detailed noise and vibration impact statements (DNVIS) would be prepared prior to commencement of those works (refer to Section 8.2).
3. During planning for out-of-hours works not included in the DNVIS (eg utilities relocations or similar), impacts will be assessed as part of the OOHW Permit (refer to Section 8.3) using a project-specific noise and vibration assessment tool, which have been developed by the project acoustic consultant and utilised by the project team (refer to Section 8.4).

7.3 HERITAGE IMPACTS

The potential for impacts on non-Aboriginal heritage and Aboriginal Cultural heritage has been assessed as part of the Project EIS. The Non-Aboriginal heritage impacts were assessed in Chapter 12 and Technical Paper 3. Aboriginal Cultural heritage impacts were assessed in Chapter 13 and Technical Paper 4 of the Project EIS, and revised for the Submissions Report.

The CTP construction activities that have the potential to impact on Aboriginal and Non-Aboriginal heritage are:

- Enabling works including demolition of existing structures, vegetation clearing, site levelling and grading, establishment of site access/internal haul routes, and
- Station excavation at Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays construction sites.

As Aboriginal Cultural Heritage items are generally archaeological in nature it is unlikely that any noise and vibration impacts would affect these types of items.

The Non-Aboriginal Heritage Assessment (Technical Paper 3) prepared by Artefact (2020), also defined the construction sites as the study area and applied a 50m buffer around each of the construction sites (refer to Table 7-2)

The EIS (Technical Paper 2, Section 6) identified that the CTP works area has the potential to impact on several listed heritage items as described in Table 7-2. A full description of the heritage items and assessment of significance can be found in in the EIS (Technical Paper 3). It should be noted that the EIS anticipated that the vibration associated with tunnelling would be much lower than the vibration screening level. As such, vibration impacts from tunnelling are not expected to impact upon heritage items.

TABLE 7-2 NON-ABORIGINAL HERITAGE ITEMS WITHIN THE STUDY AREA POTENTIALLY VIBRATION AFFECTED

Heritage Item	Construction Site	Significance	Potential impact
State Abattoirs	Sydney Olympic Park	State Environmental Planning Policy (State Significant Precincts) 2005 Listing No. A; Sydney Regional Environmental Plan No 24 – Homebush Bay Area Item No. 1	Potential direct impact - vibration
North Strathfield Railway Station Group	North Strathfield	Railcorp's Section 170 4801029	Direct impact – partial demolition
St Alban's Anglican Church	Five Dock	Canada Bay LEP Item No. I226	Potential direct impact – vibration
White Bay Power Station	The Bays	SHR Listing No. 01015	Direct impact – partial demolition
		Urban Growth NSW Development Corporation S170 4500460	Potential direct impact – vibration
White Bay Power Station (inlet) canal	The Bays	Port Authority of NSW s170 4560062	Potential direct impact – vibration

8 NOISE AND VIBRATION ASSESSMENT

8.1 RISK ASSESSMENT

Aspects and the potential for impacts have been considered in a high-level CTP wide risk assessment which is included as Appendix C of the CEMP. All activities with a residual risk ranking of 'high' or greater require an Environmental Work Method Statement (EWMS) which considers in greater detail the potential risks and appropriate management for that activity, unless another risk assessment process is in place.

The outcomes of the CTP wide risk assessment found that construction activities at construction sites would have a high impact on surrounding residential and other sensitive receivers, however this would be managed through the DNVIS and OOHW Permit process, and as such no EWMS is required. Similarly, the risk assessment found that tunnelling activities may have a high ground-borne noise and vibration impact on surrounding residential and other sensitive receivers. This would also be managed via the DNVIS and OOHW Permit process.

8.2 DETAILED NOISE AND VIBRATION IMPACT ASSESSMENT

In accordance with CoA D44, a DNVIS will be prepared for each Construction Site (i.e. five in total) plus one for all Tunnelling (including cross passages) along the alignment length. Additional DNVIS will be prepared as required in the case of OOHW and for works outside the project boundary of the construction sites. The DNVIS will be prepared to supplement this NVMP and refine impact predictions presented in the Project EIS. The DNVIS will use the Projects predictive modelling tool (refer to Section 8.4) and will consider actual construction methodologies, plant and equipment, location and duration. The DNVIS will be prepared by an appropriately qualified and experienced acoustic consultant prior to exceeding:

- the noise management levels at any residence outside the approved construction hours,
- vibration criteria any residence outside the approved construction hours, and/or
- ground-borne noise levels at any residence outside the approved construction hours; or
- where receivers will be highly noise affected (at any time).
- in accordance with REMM NV11, an activity specific DNVIS (in accordance with the requirements of the Construction Noise and Vibration Standard) would be developed for rockbreaking in the tunnel and at cross passages, specifically addressing the activity where it is required between 10pm-7am.

The intention of the DNVIS is to capture the conceivable and realistic worst-case scenario of the major phases of works for the Project at each location. This is to inform the mitigations to be implemented to ensure minimisation of noise and vibration impacts.

Each DNVIS will be prepared in consideration of the:

- ICNG
- Assessing Vibration: A Technical Guideline
- German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures
- EPL conditions (if applicable)
- Sydney Metro CNVS
- Project requirements, including CoA D44.

The Tunnelling and five Construction Sites DNVIS will include specific mitigation measures identified through engagement with affected sensitive receivers, to be implemented for the duration of the activity. DNVIS prepared for OOHW will inform the consultation process required for the works, which will in turn identify any specific issues to be considered as part of the implementation of the works.

AFJV will progressively complete DNVIS for each Construction Site to provide site-specific and detailed noise predictions. With detailed knowledge of the potential impacts on sensitive receivers,

appropriate reasonable and feasible mitigation measures and consultation will be implemented. Each DNVIS will meet the requirements of the CNVS and include as a minimum:

- Acoustic Terminology/Glossary
- Overview of the Works including realistic assessment scenarios, and timing/duration of impacts
- Secretary's Environmental Assessment Requirements
- Site Plan and identification of all noise and vibration sensitive receivers which may be affected by the Project
- Ambient Noise Monitoring: methodology, locations, analysis and results, including the Rating background Levels (RBL)
- Construction Noise and Vibration Criteria for each sensitive receiver:
  - Airborne Noise Criteria
  - Ground-borne Noise Criteria
  - Vibration Criteria
- Construction Noise and Vibration Assessment:
  - Airborne Noise Methodology/Predictions – including LAeq noise level with noise contour maps as appropriate and sleep disturbance assessment
  - Ground-borne Noise Methodology/Predictions – including internal LAeq noise level where appropriate
  - Vibration Methodology/Predictions – including estimated levels of vibration and vibration contour maps as appropriate
- Cumulative impacts from adjacent projects identified as occurring concurrently with the CTP activities
- Summary of Noise and Vibration Impacts with comparison against the noise and vibration goals
- Subjective classification of noise impacts as being low, moderate or high based on
  - predicted levels of noise and vibration,
  - sensitivity of the receiver(s);
  - exceedance of NMLs
  - existing noise mitigation under a noise abatement program
  - sleep disturbance likelihood
  - type and intensity of noise from the works (e.g. highly noise or vibration intensive works)
  - Duration of OOHW and timeframes of these works
- Summary of all Standard and Additional Mitigation Measures based on risk classification
- Nomination of verification monitoring locations

As required by the CNVS, the DNVIS will be provided to the ER for review and to the AA for review and endorsement prior to the commencement of associated works. Where a DNVIS has been prepared for an OOHW Permit for works applicable to the Project EPL, these will be provided to the ER and AA in accordance with CoA D43, but do not require approval or endorsement.

In accordance with the CoA A36(e), works that require AA endorsement of the DNVIS cannot proceed until this has been received.

The DNVIS will be a key site management tool to provide clear instructions for managing noise and vibration by providing activity specific noise and vibration predictions and specific mitigation measures identified through consultation with affected sensitive land user(s) to be implemented for the duration of the works. The DNVIS will also provide data for the OOHW Permit which will demonstrate compliance regarding the assessment of OOHW activities. Further detail is provided in the OOHW Protocol, attached as **Appendix C** and OOHW Permit described in Section 9.3.

Monitored noise and vibration levels will be analysed against the predictions made in the relevant DNVIS or using the Project's predictive tools, incorporating standard project mitigation measures as described in Section 9. This will allow a like-for-like comparison of actual and predicted noise levels

(incorporating relevant mitigation measures) and will allow for ongoing review, verification and, where required, amendment of the predictive model.

Monitoring will be compared against the predictive modelling rather than the EIS to ensure relevant reasonable and feasible mitigation measures are included consistently within the model and on the ground.

8.3 OOHW PERMIT

As per CoA D38(a) approval of OOHW is dependent upon the types of activity proposed. The works must be categorised by risk and the approved framework as follows:

- the ER and AA review all proposed out-of-hours activities not permitted under an EPL and confirm their risk levels;
- low risk activities can be approved by the ER in consultation with the AA; and
- high risk activities are approved by the Planning Secretary;

To facilitate this process, the AFJV OOHW Permit will be utilised for all OOHW applications to ensure due diligence is undertaken by requiring the applicant to:

- Provide justification for the works to be undertaken outside of approved hours;
- Adequately assess the noise impacts at nearest receivers;
- Demonstrate mitigation measures being implemented; and
- Request formal review and approval by TfNSW prior to commencement.

The OOHW Permit ensures that a quantitative noise assessment is undertaken for every Application. Refer to the OOHW Protocol (**Appendix D**) for more detail in the implementation of the OOHW Permit.

8.4 PROJECT SPECIFIC NOISE AND VIBRATION TOOL

KNOWnoise™, a project specific noise prediction tool will be used to prepare site-specific or activity-specific noise assessments where any new activities and/or variations to the activities or locations are proposed during delivery, such as out-of-hours work (as per out-of-hours protocol in Appendix D).

The three-dimensional noise prediction tool uses SoundPlan, considers topography at a 1m digital elevation and has been developed to predict noise in accordance with ISO 9613-2:1996. The noise prediction tool would:

- Populate sensitive receivers as identified in accordance with Section 4.3
- Plant and machinery to be used and Sound Power Level (SWL)
- Specific CTP work area

The noise prediction tool would model nose level predictions at sensitive receivers and the assessment can be viewed in various formats including maps, tables and excel spreadsheets.

Verification 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 Construction Monitoring Program and compared to the outcomes of the model (in cases where model descriptors, such as plant numbers, type and proximity, have been accurately met during the model). Where there are notable inconsistencies between noise model predictions and monitoring results further investigation will be undertaken to understand the cause. This may include additional site specific background monitoring and plant noise output spot checks. This feedback will ensure the prediction tool is suitably accurate across various sections of CTP.

More information about KNOWnoise™ can be accessed at https://hutchisonweller.com/knownoise/.

9 ENVIRONMENTAL CONTROLS

9.1 OVERVIEW

In accordance with MCoA D39, reasonable and feasible noise mitigation measures (such as those listed within Chapter 6 of the ICNG and Section 4 and 5 of the CNVS) will be implemented with the aim of achieving the noise and vibration criteria specified in Section 6 of this plan. The proposed reasonable and feasible noise mitigations are included in the following sections. Noise and Vibration Mitigation and Management Measures

A range of standard and specific mitigation and management measures will be implemented for the duration of construction to minimise construction noise and vibration impacts with aim of achieving the NMLs and vibration criteria detailed in Section 6. The mitigation and management measures have been developed in consideration of CoAs, REMMs and Table 11 of the CNVS.

Mitigation measures have been developed considering the SMART principles, being specific with measurable outcomes. They are all achievable (notwithstanding assessment of reasonableness and feasibility) and realistic. Each measure is also time-based, applicable before or during construction as indicated.

TABLE 9-1: NOISE AND VIBRATION MANAGEMENT AND MITIGATION MEASURES

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
MMNV1	Implement community consultation measures (including notification of upcoming works) using the following tools: ▪ Periodic Notification (letterbox drop) ▪ Website ▪ Project information and construction response ▪ Telephone line ▪ Email distribution list ▪ Place Managers	Construction	Best Practice	CCO	Community Communication Plan/s Community notifications
MMNV2	Further engagement and consultation will be carried out with: ▪ affected communities to understand their preferences for mitigation and management measures ▪ 'Other sensitive' receivers such as schools, medical facilities or places of worship to understand periods in which they are more sensitive to impacts. Based on this consultation, appropriate mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.	Construction	REMM NV01 CoA D41	CCO	Community Communication Plan/s Community notifications
MMNV3	Training will be provided to relevant AFJV personnel, including relevant subcontractors on noise and vibration requirements from this NVMP through toolboxes and/or targeted training	Construction	Best Practice	EM/EA	Training material Training records
MMNV4	All employees, contractors and subcontractors will receive an environmental induction, involving at least: ▪ All relevant project-specific and standard noise and vibration mitigation measures ▪ Relevant licence and CoAs ▪ Permissible hours of work ▪ Any limitations on high noise-generating activities	Prior to construction	CNVS	EM/EA	Induction material Induction records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
	▪ Location of nearest sensitive receivers ▪ Construction employee parking areas ▪ Designated loading/unloading areas and procedures ▪ Site opening/closing times (including deliveries) ▪ Environmental incident procedures ▪ Behaviours that workforce can implement to minimise noise generation.				
MMNV5	Construction activities associated with the Project will be carried out in accordance with the hours in Section 5. Work generating high noise and/or vibration levels is scheduled during less sensitive time periods. When working adjacent to schools and childcare centres, consider scheduling particularly noisy activities around school exam times, childcare sleep times where feasible and reasonable	Construction	CoA D35 CNVS	EM, CM	NVMP Inspection records
MMNV6	Out-of-hours deliveries will be minimised where possible and will be carried out in accordance with the OOHW protocol and/or the EPL	Construction	Best Practice	EM, CM	OOHWP Induction records Inspection records
MMNV7	OOHW is to be carried out in accordance with the OOHW protocol and/or the Project EPL.	Construction	CoA D38	EM, CM	OOHW Permits Site inspection records
MMNV8	Except as permitted by an EPL, highly noise intensive works (as defined in Section 5.2 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.	Construction	CoA D36	EM, CM	Induction records Inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
MMNV9	Cumulative noise impacts will be continually reviewed during CTP and coordination will occur between potentially interacting projects to minimise concurrent or consecutive works in the same areas, where possible	Construction	REMM NV18	EM/CM/CCO	Coordination Meeting (minutes)
MMNV10	A noise monitoring program will be carried out for the duration of the Project Works in accordance with this NVMP and any approval and licence conditions	Construction	CoA C14 CoA C16 CNVS	EM, EA	Noise and Vibration Construction Monitoring Program Inspection and monitoring records
MMNV11	Attended vibration measurements will be undertaken at the commencement of vibration generating activities to confirm that vibration levels satisfy the criteria for that vibration generating activity. Where there is potential for exceedances, further vibration site law investigations will be undertaken to determine the site-specific safe working distances for that vibration generating activity. For heritage items, assessment of the heritage values of the structure will be completed in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	Construction	REMM NV16	EM	Noise and Vibration Construction Monitoring Program Inspection and monitoring records
MMNV12	Pre-Construction Condition survey reports of buildings and structures near to excavations and within safe working distance of vibratory works would be undertaken prior to the commencement of works that could impact on the building and/or structure, where appropriate. The survey would be undertaken by a suitably qualified person. For heritage buildings and structures the surveys would consider the heritage values of the structure in consultation with a heritage specialist. The results of the	Prior to construction	REMM NV17	CM	Pre-Construction Condition Survey (report)

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
	survey must be documented in a pre-construction condition survey report and provided to the relevant owner/s of the item no later than one (1) month prior to the commencement of work that could impact the building/structure. For all items in which a condition survey was undertaken and a pre-construction condition survey report produced. The AFJV will undertake a survey upon the completion of works and document the results in a post-construction condition survey report.				
MMNV13	All construction plant and equipment used on Site will be fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications including residential grade mufflers on all mobile plant regularly used at worksites.	Construction	CoA D42 CNVS	CM	Manufacturer's specification Inspection records
MMNV14	All construction plant and equipment used on Site will be maintained in an efficient condition and operated in a proper and efficient manner	Construction	CoA D42 CNVS	CM	Manufacturer's specification Inspection records
MMNV15	Non-tonal movement beepers (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant where this does not compromise WHS requirements. Additionally, where possible, alarm volumes will be adjusted to be appropriate to ambient construction and non-construction noise.	Construction	CNVS Best Practice	SS	Manufacturer's specification Inspection records
MMNV16	When equipment is not in use or not expected to be in use for more than 15 minutes, it will be switched off where appropriate.	Construction	Best Practice	SS	Induction Induction records Inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
MMNV17	Noise will be considered when selecting construction methods and quieter methods substituted where reasonable and feasible. Appropriately sized equipment will be used, avoiding over-powered plant in accordance with Table 12 of the CNVS where appropriate.	Construction	REMM NV02	CM, SS	Manufacturer's specification Inspection records
MMNV18	The use of noise intensive equipment at construction sites with 'moderate' and 'high' out-of-hours noise management level exceedances will be scheduled for standard construction hours, where feasible and reasonable. Where this is not feasible and reasonable, the works will be undertaken as early as possible in each work shift	Construction	REMM NV04	EM/CM	DNVS Monitoring and inspection records
MMNV19	High noise-generating activities near receivers will be carried out in blocks that do not exceed three hours each, with a minimum respite period of one hour between each block. The duration of each block of work and respite will be flexible to accommodate the usage and amenity at nearby receivers temporary noise barriers (including the arrangement of plant and equipment) must be established around noisy equipment and activities such as rock hammering and concrete cutting.	Construction	REMM NV03 CoA D42	EM/CM	DNVS Monitoring and inspection records
MMNV20	Appropriate respite would be provided to affected receivers in accordance with the Sydney Metro Construction Noise and Vibration Standard. This would include consideration of impacts from Stage 1 utility and power supply works when determining appropriate respite periods for affected receivers. When determining appropriate respite, the need to efficiently undertake construction would be balanced	Construction	REMM NV03	EM/CM	DNVS Monitoring and inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
	against the communities' preferred noise and vibration management approach.				
MMNV21	Noise levels of plant and equipment will have operating Sound Power Levels compliant with the maximum noise levels detailed in Table 13 of the Sydney Metro CNVS. This also identifies defective silencing equipment on the items of plant	Construction	CNVS	CM, SS	Manufacturer's specification Monitoring and inspection records
MMNV22	Noise levels of plant and equipment items will be considered in procurement decisions, and in any case cannot be used on Site unless compliant with the maximum noise levels in Table 11 of the Sydney Metro CNVS	Construction	Best Practice	CM, SS	Manufacturer's specification Monitoring and inspection records
MMNV23	Air brake silencers would be used on heavy vehicles that access construction sites multiple times per night or over multiple nights, noting that site speed restrictions are likely to prevent the triggering of air brakes.	Construction	REMM NV05	SS	Induction material Induction records Inspection records
MMNV24	Long term Construction Site support equipment and machinery will be low noise emitting and suitable for use in residential areas, where feasible and reasonable. Examples include: ▪ Low noise water pumps for use in water treatment facilities ▪ Low noise generators and compressors ▪ Low noise air conditioner units for use of amenities buildings	Construction	REMM NV07	SS	Manufacturer's specification Monitoring and inspection records
MMNV25	Quieter and lower noise-emitting construction methods will be used where feasible and reasonable, especially if replacing high noise or vibration impact works. This includes consideration of:	Construction	REMM NV02	EM, CM	DNVS Monitoring and inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
	▪ The use of hydraulic concrete shears in lieu of hammers/rock breakers ▪ Sequencing works to shield noise sensitive receivers by retaining building wall elements ▪ Locating demolition load out areas away from the nearby noise sensitive receivers ▪ Providing respite periods for noise intensive works ▪ Minimising structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using handheld splitters and pulverisers or hand demolition ▪ Installing sound barrier screening to scaffolding facing noise sensitive neighbours ▪ Using portable noise barriers around particularly noisy equipment, such as concrete saws ▪ Use of electric tower cranes where available and feasible ▪ Use of battery powered, solar powered or electric equipment where feasible and available (e.g. battery powered lighting, battery powered plant such as EWPs and small excavators, hydrid powered machines) ▪ Gates and access points designed to minimise unnecessary noise (e.g. pedestrian gates that can open and close quietly; quiet roller doors etc). ▪ Modifying demolition works sequencing/hours to minimise impacts during peak pedestrian times and/or adjoining neighbour outdoor activity periods				
MMNV26	Traffic flow, parking and loading/unloading areas will be planned to minimise reversing within the Site	Construction	Best Practice	SS	Induction material Induction records Inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
MMNV28	Loading and unloading of materials/deliveries will occur in designated locations that are identified as part of site planning an included in site DNVIS.	Construction	Best Practice	EA, SS	DNVS, Induction material Induction records Inspection records
MMNV30	Where possible, structures will shield residential receivers from noise, such as Site shed placement; fencing; quieter equipment; erection of operational stage noise barriers, with consideration of Site topography when situating plant (where practicable), as described in the DNVIS.	Construction	Best Practice	EA, SS	DNVS, Induction material Induction records Inspection records
MMNV31	Design of perimeter Site hoarding will consider achieving optimum noise reductions between Site and the nearest receivers. Temporary noise blankets will be used where the need is identified.	Prior to construction	REMM NV06	EM, CM	DNVS Monitoring and inspection records
MMNV32	All acoustic measures will be implemented as soon as practical on site during establishment works.	Construction	Best Practice	CM	Site layout drawings Inspection records
MMNV33	Acoustic sheds will be designed with consideration of the activities that will occur within them and the relevant noise management levels in adjacent areas.	Prior to construction	REMM NV08	CM	Site layout drawings Inspection records
MMNV34	Noise generating ventilation systems such as fans, compressors, scrubbers, etc, will also be located inside the shed (where applicable), and external air intake/discharge ports will be appropriately acoustically treated. The door of the acoustic shed will be kept closed during the night-time period, where feasible and reasonable. Where night-time vehicle access is required, the doors	Construction	REMM NV08	CM, SS	Site layout drawings Inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
	will be designed and constructed to minimise noise breakout.				
MMNV35	Quieter and less vibration-emitting construction methods will be used where feasible and reasonable	Construction	REMM NV02	EM, CM	DNVS Monitoring and inspection records
MMNV36	Safe working distances identified in each DNVIS for vibration intensive plant will be complied with where feasible and reasonable	Construction	Best Practice	EM, CM	DNVS Monitoring and inspection records
MMNV37	Feasible and reasonable measures will be implemented to minimise avoidable ground-borne noise where exceedances are predicted. This may include implementation of less vibration intensive construction methodologies	Construction	REMM NV09	EM, CM	DNVS Monitoring and inspection records
MMNV38	Specific notifications will be provided to receivers where the ground-borne noise levels are predicted to exceed the night-time NML	Prior to construction	Best Practice	EM, CM	DNVS Monitoring and inspection records
MMNV39	Further assessment of construction traffic will be completed prior to construction commencing. Potential impacts will be managed using the following, where feasible and reasonable: ▪ On-site spoil storage capacity will be maximised to reduce the need for truck movements during sensitive times ▪ Vehicle movements will be redirected away from sensitive receiver areas and scheduled during less sensitive times ▪ The speed of vehicles will be limited and the use of engine compression brakes will be avoided	Prior to construction	REMM NV14	EM, CM	DNVS, Noise and Vibration Construction Monitoring Program Monitoring and inspection records

ID	Requirement	Timing	Source of req.	Responsibility	Action/Evidence
	▪ Heavy vehicles will not be permitted to idle near sensitive receivers.				
MMNV40	Construction site traffic generated at the Five Dock Station construction site would be managed to minimise movements during church service times at St Albans Anglican Church.	Construction	REMM TT22	CM, SS	Monitoring and inspection records
MMNV41	The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation works would be considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts would be considered, where feasible and reasonable.	Prior to construction	REMM NV10	EM	Design package

9.2 VIBRATION

9.2.1 HUMAN COMFORT

Minimum working distances for typical vibration intensive equipment for human comfort are detailed in Section 6.4.4. Monitoring will be undertaken in accordance with the evaluation criteria presented in Assessing Vibration: A Technical Guideline (DECC 2006). Exceedances of the human comfort criteria are predicted in all surface construction areas except for The Bays, as sensitive receivers are relatively close to the boundary of the other construction sites.

9.2.2 COSMETIC DAMAGE

Minimum working distances for typical vibration intensive equipment for buildings and structures is detailed in Section 6.4.4. Vibration monitoring will be carried out in accordance with German Standard DIN 4150 (heritage structures) and BS 7385: Part 2 – 1993 (other structures).

CoA D60 requires a suitably qualified and experienced person to undertake condition surveys of all buildings, structures, utilities and the like identified as being at risk of damage before commencement of any work that could impact on the subject surface / subsurface structure. The results of the surveys must be documented in a Pre-Construction Condition Survey Report for each item surveyed. Copies of Pre-construction Condition Survey Reports must be provided to the relevant owners of the items surveyed in the vicinity of the proposed work, and no later than one (1) month before the commencement of the work that could impact on the subject surface / subsurface structure.

CoA D45 requires owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before the works that generate vibration commences in the vicinity of the 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.

The properties at risk of exceeding the screening criteria will be identified in the DNVIS.

Potential exceedances of the cosmetic damage screening criteria are predicted in Burwood, Five Dock and The Bays due to vibration sensitive structures being adjacent to the boundary of these sites, however more precise understanding of exceedances will be determined and understood as part of the DNVIS. Tunnelling is not expected to cause exceedances of the cosmetic damage screening criteria.

Monitoring is described in the Noise and Vibration Monitoring Protocol, and additional details of the management of heritage items identified are included in the Heritage Management Plan.

9.2.3 HERITAGE ITEMS

Heritage items are considered on a case-by-case basis. It should be noted that 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.

In accordance with CoA D14 before installing protective site boundary hoarding or equipment used for vibration and noise monitoring at any Heritage item the advice of a suitably qualified and experienced built heritage expert must be obtained and implemented to ensure any such work does not have an adverse impact on the heritage significance of the item. The installation must also consider and avoid impacts to potential historical archaeology and seek advice from the Excavation Director. Similarly, in accordance with CoA D48 before installing at property treatment at a Heritage item, the advice of a suitably qualified and experienced built heritage expert would be obtained and implemented to ensure the installation does not have adverse impacts of the heritage significance of the item.

As described above and as per Section 2.5.1 of the Sydney Metro CNVS and Technical Paper 2 of the EIS, heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. In accordance with CoA D49 a conservative vibration damage screening level of 2.5 mm/s will be adopted for heritage structures and other sensitive structures of great intrinsic value where they are found to be structurally unsound. Otherwise, the standard 7.5mm/s criteria will apply (as discussed in Section 6.4).

In line with Condition D46 vibration testing will be undertaken during activities that have the potential to impact heritage items, above the appointed criteria, to identify minimum working distances to prevent cosmetic damage. Vibration monitoring would be undertaken at heritage assets at the request of the asset owners where feasible and reasonable. In the event that the vibration testing and attended monitoring shows that the preferred values for vibration are likely to be exceeded, the construction methodology will be reviewed and, if necessary, implement additional mitigation measures.

Additionally, per CoA D47 advice from a heritage specialist (being the contractors heritage consultant) will be obtained on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures, prior to monitoring commencing. Relevant asset management groups would also be consulted on the placement of vibration monitoring devices within the curtilage of Heritage items.

9.3 OUT OF HOURS WORK PROTOCOL

An Out of hours Work Protocol has been prepared to address CoA D38 to identify the process for the consideration of management and approval of work which are outside the approved working hours (CoA D35 and D36) and that are not subject to an EPL. Refer to **Appendix D**.

9.3.1 COMMUNITY CONSULTATION ON RESPITE

To satisfy CoA D51, consultation with the community to determine appropriate respite periods for OOHW would be undertaken where works are:

- undertaken outside standard construction hours and
- likely to exceed the noise and vibration objectives identified in CoA D39(a) and (b).

The consultation would include, but not be limited to providing the community with:

- a progressive schedule for a period no less than three (3) months of likely out of hours work
- a description of the activity, location and duration of the out of hours work
- the noise characteristics and likely noise levels of the work; and
- likely mitigation and management measures to be implemented to achieve criteria in CoA D39 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers).

Note: Respite periods can be any combination of days or hours where OOHW would not be more than 5 dB(A) above the RBL at any residence.

The outcomes of the community consultation, including the identified respite periods and the scheduling of OOHW would be documented and provided to the AA, EPA, and the Planning Secretary for information within two (2) weeks of undertaking the community consultation.

To satisfy CoA D50, all OOHW, including works undertaken by third parties (such as utility relocations), would be coordinated to ensure respite periods are provided in accordance with CoA D50. The consideration of respite would also include all other approved Critical SSI and SSI projects which may cause cumulative and / or consecutive impacts at receivers affected by the delivery of Stage 1 of the CSSI.

9.4 ADDITIONAL NOISE AND VIBRATION MANAGEMENT MEASURES

After standard noise mitigation measures have been applied noise levels may still exceed noise management levels. Where construction noise and vibration levels are still predicted to exceed the noise or vibration objectives, the Additional Mitigation Measures matrix described in Table 9-2, Table 9-3 and Table 9-4 will be used to determine additional measures and implementation where reasonable and feasible.

Further detail on the definitions and implementation of the Additional Mitigation Measures can be found in the Sydney Metro Construction Noise and Vibration Standard (2019) and the OOHW Protocol (**Appendix D**.).

There may be personal circumstances among the sensitive receivers where the approach to specific additional mitigation measures is not best suited. The Stakeholder and Community Engagement Manager has the authority to amend the below approach taking into account personal circumstances that may apply.

TABLE 9-2: ADDITIONAL MITIGATION MEASURES MATRIX – AIRBORNE NOISE

Construction hours	dB above NML	Additional management measures
Approved hours	0 to 10	-
Monday – Friday: 7am – 6pm	10 to 20	LB
Saturday: 8am to 6pm	20 to 30	LB, M, SN
	>30	LB, M, SN
Evening	0 to 10	LB
Monday – Friday: 6pm – 10pm	10 to 20	LB, M
Saturday: 7am – 8am, 6pm – 10pm	20 to 30	LB, M, SN, RO
Sunday / PH: 8am – 6pm	> 30	LB, M, SN, IB, PC, RO
Night	0 to 10	LB
Monday – Saturday: 10pm – 7am	10 to 20	LB, M, SN, RO
Saturday: 10pm –8am)	20 to 30	LB, M, SN, IB, PC, RO, AA
Sunday / PH: 6pm –7am	> 30	LB, M, SN, IB, PC, RO, AA

Notes:		
	PC = Phone calls	SN = Specific notification
	M = Monitoring	LB = Letterbox drops
	IB = Individual briefings	DR = Duration reduction
	AA = Alternative accommodation	RO = Project specific respite offer

TABLE 9-3: ADDITIONAL MITIGATION MEASURES – GROUND BORNE CONSTRUCTION NOISE (TABLE 17 CNVS)

	Mitigation measures		
	Predicted LAeq (15minute) noise level Above NML		
Construction hours	**0-10dB**	**10-20dB**	**>20dB**
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	No NML for GBN during standard hours		
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	LB	LB, M, SN	LB, M, SN, IB, PC, RO
Night Monday – Saturday: 10pm – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	LB, M, SN	LB, M, SN, IB, PC, RO, AA	LB, M, SN, IB, PC, RO, AA
Notes: PC = Phone calls M = Monitoring IB = Individual briefings AA = Alternative accommodation		SN = Specific notification LB = Letterbox drops DR = Duration reduction RO = Project specific respite offer	

TABLE 9-4: ADDITIONAL MITIGATION MEASURES – GROUND BORNE VIBRATION

Construction hours	**Mitigation measures predicted vibration levels exceed maximum levels**
Approved hours Monday – Friday: 7am – 6pm Saturday: 8am to 6pm	LB, M, RO
Evening Monday – Friday: 6pm – 10pm Saturday: 7am – 8am, 6pm – 10pm Sunday / PH: 8am – 6pm	LB, M, IB, PC, RO, SN
Night Monday – Saturday: 10pm – 7am Saturday: 10pm –8am) Sunday / PH: 6pm –7am	LB, M, IB, PC, RO, SN, AA

Notes:		
	PC = Phone calls	SN = Specific notification
	M = Monitoring	LB = Letterbox drops
	IB = Individual briefings	DR = Duration reduction
	AA = Alternative accommodation	RO = Project specific respite offer

9.5 CONSULTATION AND NOTIFICATION

Throughout construction, AFJV will continue to work with the Project communications team to consult with relevant councils and community stakeholders, including any unique local noise sensitive receivers such as schools, medical facilities and places of worship. Notification providing progress on construction and updates on any out of hours works will be provided to the local community in accordance with the Community Communications Plan/s prepared in accordance with the OCCS and site specific CCS.

Further engagement and consultation led by the AFJV Community Team will be carried out with:

- affected communities to understand their preferences for mitigation and management measures
- 'Other sensitive' receivers such as schools, medical facilities or places of worship to understand periods in which they are more sensitive to impacts.

Based on this consultation, appropriate mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.

In accordance with Condition of Approval D41, noise generating work in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs will be timetabled so as to avoid sensitive periods, unless other reasonable arrangements have been made with the affected institutions.

Owners and occupiers of properties identified in the DNVIS as 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, owners and 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.

For out-of-hours work, appropriate respite periods would be identified in consultation with the community at each affected location on a regular basis. Consultation would include (but not be limited to) providing the community with:

a) a progressive schedule for periods no less than three (3) 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 NMLs under Condition D39 (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, identified respite periods and scheduling of the likely out-of-hour work will be provided to the AA, EPA and the Planning Secretary.

9.6 CUMULATIVE IMPACT MANAGEMENT

AFJV will undertake efforts in co-ordination and consultation to the extent reasonable and feasible, with the relevant stakeholders. This would occur where required to manage the interface of projects under construction at the same time, that are being undertaken within the same affected area. This may include:

- Port Authority of NSW
- Other parts of Transport for NSW including Transport Coordination (including Western Harbor Tunnel project)
- WestConnex (formerly Sydney Motorway Corporation)
- Sydney Metro projects
- Other SSI and CSSI projects as determined by DPE

This process will be managed in cooperation with the Construction Manager (Project Wide), Utilities Manager, Interface Manager and Environment Manager. The process of consultation would include:

- Provision of regular updates to the detailed construction program, construction sites and haul routes
- Identification of key potential conflict points with other construction projects or maintenance activities
- Identification of opportunities to modify program or scope to minimise conflict points
- Opportunities to retain or maximise respite for potentially affected receivers

The purpose of this coordination will be to ensure appropriate respite is maintained; however, it must be acknowledged that AFJV does not have authority over third parties not associated with the Project.

Records of consultation will be kept as meeting minutes.

10 COMPLIANCE MANAGEMENT

10.1 PEOPLE, RESPONSIBILITIES AND COMMUNICATION

AFJV's organisational structure and overall roles and responsibilities are outlined in Section 3.5 of the CEMP. Responsibilities for implementing the specific mitigation measures are detailed in Section 9.

Of specific relevance is the role of the AA, which has the following responsibilities as defined in MCoA A36:

> (a) receive and respond to communication from the Planning Secretary in relation to the performance of Stage 1 of the CSSI in relation to noise and vibration;
>
> (b) consider and inform the Planning Secretary on matters specified in the conditions of this approval relating to noise and vibration;
>
> (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 (with the exception of low risk activities) 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 conditions of this approval and, should they be consistent with the conditions 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 conditions of this approval to ensure implementation is in accordance with what is stated in the document and the conditions of this approval;
>
> (g) review the Proponent's notification of incidents in accordance with Condition A43 of this schedule;
>
> (h) in conjunction with the ER (where required), the AA must:
>
> (i) as may be requested by the Planning Secretary or Community Complaints Mediator (required by Condition B8 of this schedule), help plan, attend or undertake audits of noise and vibration management of Stage 1 of the CSSI including briefings, and site visits,

(ii) in the event that conflict arises between the Proponent and the community in relation to the noise and vibration performance of Stage 1 of the CSSI, follow the procedure in the Overarching Community Communication Strategy referenced in Condition C-B1 of this schedule to attempt to resolve the conflict, and if it cannot be resolved, notify the Planning Secretary,

(iii) if requested by the ER, consider relevant minor amendments made to the 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 conditions 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 conditions of this approval),

(iv) if requested by the ER, review the noise impacts of minor 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 (7) days following the end of each month for the duration of the AA's engagement for Stage 1 of the CSSI, or as otherwise agreed by the Planning Secretary.

10.2 TRAINING

All employees, Subcontractors and staff working on Site will undergo site induction training that includes construction noise and vibration management issues. The induction training will address elements related to project-specific noise and vibration management including:

- Requirements of this NVMP
- Standard, extended and out of hours construction hours
- The process for seeking approval for out of hours works, including consultation
- Location of noise sensitive areas and receivers
- General noise and vibration management measures
- Complaints reporting
- Specific responsibilities to minimise impacts on the community and built environment

Further details regarding staff induction and training are outlined in Section 3.6 of the CEMP.

10.3 HOLD POINTS

The internal hold points applied to Noise and Vibration Management for the CTP are identified in Table 10-1. The internal verification process will require the approval of the Environmental Manager (or delegate) to proceed.

TABLE 10-1. NOISE AND VIBRATION HOLD POINTS

Hold Point	Activity for Release	Where addressed	Release by	Source of Requirement
Land Use Survey	Progressive completion before the commencement of work in each location which generates construction noise, vibration or ground-borne noise in that area.	**Appendix C**	Environment Manager	CoA D34
Noise and Vibration Monitoring Program	Prior to the commencement of Construction	**Appendix B**	Endorsed by ER, AA Approved by DPE	C14(a) C15 C16
Out of Hours Works Permit	Out of hours work not covered by an EPL.	**Appendix D**	Either AFJV, ER, or DPE Approval authority is determined by proposed works and potential impacts – refer to Out of Hours Works Protocol included in **Appendix D**	D37(c) D38
Pre-Construction Condition Survey Report	Must be provided to the relevant owners of the items (buildings, structures, utilities and the like) surveyed in the vicinity of the proposed work, and no later than one month before the commencement of the work that could impact on the subject surface / subsurface structure	**Appendix B**	Construction Director or nominated representative, as determined by risk assessment on the item of potential impact.	D60

10.4 MONITORING AND INSPECTIONS

Weekly site environmental inspections will be undertaken by our environmental team using a project-specific checklist to assess the ongoing effectiveness and suitability of the project's environmental controls. Refer to Section 3.9.3 of the CEMP for the indicative list of environmental inspections that may be undertaken during the delivery of the CTP.

Noise and vibration monitoring will also occur routinely for the duration of the delivery of the CTP, in accordance with the Noise and Vibration Construction Monitoring Program (**Appendix B**). The noise and vibration monitoring program details when monitoring will be undertaken, as well as the representative locations adjacent to the construction works where noise and vibration monitoring will be undertaken.

10.5 COMPLAINTS

The complaint management process is detailed in Section 3.9.5 of the CEMP and the OCCS.

10.6 AUDITS

Audit requirements are provided in Section 3.9.4 of the CEMP.

10.7 REPORTING AND RECORDS

Reporting requirements relevant to this Plan are detailed in Section 3.10 of the CEMP and in the Noise and Vibration Construction Monitoring Program (Appendix B). In addition, the following records will be retained onsite for the duration of works:

- Records of consultation with other CSSI, SSI and/or SSD Projects with regard to cumulative impacts
- Unattended monitoring reports and records from consultants and AFJV
- Attended noise and vibration monitoring records from consultants and AFJV
- Register of OOH Works and Permits
- Records of environmental inspections undertaken
- Records of consultation with sensitive receivers on mitigation measures
- Records of any community agreements

Refer to Section 3.9.5 of the CEMP for information relating to the complaints management process and records.

As outline in Section 3.10 of the CEMP, records will be retained by the Principal Contractor for a period of no less than 7 years. Records will also be made available in a timely manner to Sydney Metro (or their representative) upon request.

11 REVIEW AND IMPROVEMENT

11.1 CONTINUOUS IMPROVEMENT

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The CEMP, sub-plans and monitoring programs will be updated:

- To take into account changes to the environment or generally accepted environmental management practices, new risks to the environment, any hazardous substances, contamination or changes in law
- In response to internal or external audits that identify matters that require attention
- Following reportable environmental incidents
- Upon identification of new risks, including risks identified during risk register updates
- When non-compliances are identified
- In response to a project change that changes the scope of the CTP works (including modifications).

As outlined in Section 3.11.1 of the CEMP, this sub-plan will be reviewed within 12 months following the commencement of construction (being the approval of the CEMP and all associated sub plans) and every 12 months thereafter, or within two months of an incident triggering notification under CoA A43.

The complete process of review and improvement to be implemented throughout the Project is outlined in section 3.11 of the CEMP.

11.2 SUB-PLAN UPDATE AND AMENDMENT

Revisions to this Plan will be undertaken in accordance with the process outlined in Section 3.11 of the CEMP.

APPENDIX A OTHER CONDITIONS OF APPROVAL AND REMMS RELEVANT TO THIS PLAN

Note: additional CoAs relevant to the preparation and approval of this Plan are included in Table 3-2.

Minister's Conditions of Approval (11 March 2021) (SSI 10038)		
Ref	Requirement	Where addressed
A6	Where the conditions 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 and a summary of the issues raised by them; (c) documentation of the follow-up with the identified party(s) where feedback has not been provided to confirm that the party(s) has none or has failed to provide feedback after repeated requests; (d) outline of the issues raised by the identified party(s) and how they have been addressed; and (e) a description of the outstanding issues raised by the identified party(s) and the reasons why they have not been addressed.	Appendix F
A34	"The Proponent must cooperate with the AA by: (a) providing access to noise and vibration monitoring activities as they take place; (b) providing access to the Complaints Register if requested; (c) providing for review of noise and vibration documents required to be prepared under the conditions of this approval; and (d) considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted."	Section 3.5
D14	Before installing protective site boundary hoarding or equipment used for vibration and noise monitoring at any Heritage item identified in the documents listed in **Condition A1** of this schedule, the advice of a suitably qualified and experienced built heritage expert must be obtained and implemented to ensure any such work does not have an adverse impact on the heritage significance of the item. The installation must also consider and avoid impacts to potential historical archaeology and seek advice from the Excavation Director approved under **Condition D27** below.	Section 9.2.2
D34	A detailed land use survey must be undertaken to confirm sensitive receivers (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 prior to the commencement of works	Section 4.3

Minister's Conditions of Approval (11 March 2021) (SSI 10038)			
	which generate 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 C5.		
D35	Work must only be undertaken during the following hours: (a) 7:00am to 6:00pm Monday to Fridays, inclusive, (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 5	
D36	Except as permitted by an EPL, highly noise intensive work that results in an exceedance of theapplicable 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 (3) hours, with a minimum cessation of work of notless than one (1) hour. For the purposes of this condition, 'continuously' includes any period during which there is less than one (1) hour between ceasing and recommencing any of the work.	Section 5 and MMNV8	
D37	Notwithstanding Conditions D35 and D36 of this schedule work may be undertaken outside the hours specified in 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 (a)(ii) above, the AA, the ER, the Planning Secretary and the EPA must be notified of the reasons for such work. The Proponent must use best endeavours to notify as soon as practicable 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: · no more than 5 dB(A) above the rating background level at any residence in accordance with the ICNG, and · no more than the 'Noise affected' NMLs specified in Table 3 of the ICNG at other sensitive land user(s); and (ii) construction that causes LAFmax(15 minute) noise levels no more than 15 dB(A) above the rating background level at any residence; or (iii) construction that causes:	Section 5	

Minister's Conditions of Approval (11 March 2021) (SSI 10038)		
	· 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 D38 of this schedule; 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) are permitted 24 hours a day, seven days a week; or (ii) concrete batching at the Clyde construction site is permitted 24 hours a day, seven days a week; or (iii) delivery of material that is required to be delivered outside of standard construction hours in Condition D35 of this schedule to directly support tunnelling activities, except between the hours 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or (iv) haulage of spoil except between the hours of 10:00 pm and 7:00 am to / from the Five Dock and Westmead construction sites and to / from Burwood North construction site using any roads / streets other than directly from Parramatta Road; or (v) work within an acoustic shed where there is no exceedance of noise levels under Low impact circumstances identified in (b) above, unless otherwise agreed by the Planning Secretary. Note: Tunnelling does not include station box excavation.	
D38	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of works which are outside the hours defined in Conditions D35 and D36 of this schedule. The Protocol must be approved by the Planning Secretary prior to commencement of the out of hours works. The Protocol must be prepared in consultation with the ER, AA and the 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,	Section 9.3, MMNV7, and Appendix D

Minister's Conditions of Approval (11 March 2021) (SSI 10038)		
	ii. low risk activities can be approved by the ER in consultation with the AA, and iii. high risk activities are approved by the Planning Secretary. (b) a process for the consideration of out-of-hours works 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 requirement of Condition D50. 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 D37(b) of this schedule are met. Note: Out-of-hours work is any work that occurs outside the construction hours identified in Condition D35 and D36 of this schedule.	
D39	All reasonable and feasible mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: a. construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009); b. vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure); c. Australian Standard AS 2187.2 – 2006 "Explosives – Storage and Use – 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 for structurally unsound heritage items). 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 require the addition of 5 dB(A) to the predicted level before comparing to the construction Noise Management Level.	Section 6 (outlines criteria to be achieved)
D40	All reasonable and feasible mitigation measures must be applied when the following residential ground-borne noise levels are exceeded:	Section 6.2 and Appendix D

Minister's Conditions of Approval (11 March 2021) (SSI 10038)		
	(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 D38 of this schedule.	
D41	Noise generating works in the vicinity of potentially affected community, religious, educational institutions and 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 6.1 & Section 9.5 and MMNV2
D42	Industry best practice construction methods must be implemented where reasonably practicable to ensure that noise levels are minimised around sensitive land user(s). Practices must include, but are not limited to: (a) use of regularly serviced low sound power equipment; (b) temporary noise barriers (including the arrangement of plant and equipment) around noisy equipment and activities such as rock hammering and concrete cutting; and (c) use of alternative construction and demolition techniques.	MMNV13, MMNV14 & MMNV19
D43	Detailed Noise and Vibration Impact Statements (DNVIS) must be prepared for any work that may exceed the noise management levels, vibration criteria and/or ground-borne noise levels specified in Condition D39 and D40 of this schedule, or where receivers will be highly noise affected. The DNVIS must include specific mitigation measures identified through consultation with affected sensitive land users and the mitigation measures must be implemented for the duration of the works. A copy of the DNVIS must be provided to the AA and ER before commencement of the associated works. The Planning Secretary and the EPA may request a copy of the DNVIS.	Section 8.2
D44	DNVIS must be prepared for each construction site before construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive land users.	Section 8.2
D45	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate 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.	Section 9.2.2 Overarching Community Consultation Strategy

Minister's Conditions of Approval (11 March 2021) (SSI 10038)		
D46	Vibration testing must be conducted during vibration generating activities that have the potential to impact on Heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures. Such measures must include, but not be limited to, review or modification of excavation techniques.	Section 9.2.2
D47	The Proponent must seek the advice of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at Heritage items.	Section 9.2.2
D49	If a Heritage item is found to be structurally unsound (following inspection) a more conservative cosmetic damage criterion of 2.5 mm/s peak component particle velocity (from DIN 4150) must be applied.	Section 9.2.2
D50	All work undertaken for the delivery of Stage 1 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 works to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with Condition E29; or b. consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; 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 approved Critical SSI, SSI and SSD projects which may cause cumulative and / or consecutive impacts at receivers affected by the delivery of Stage 1 of the CSSI.	Section 5 and Section 9.3.1
D51	In order to undertake out-of-hours work outside the work hours specified under Condition D35 of this schedule, appropriate respite periods for the out-of-hours work must be identified 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 (3) 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 NMLs under Condition D39 (including the circumstances of when respite or relocation offers will be available and details about how the affected community can access these offers).	Section 5 and Section 9.3.1

Minister's Conditions of Approval (11 March 2021) (SSI 10038)		
	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, 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 RBL at any residence.	
D60	A suitably qualified and experienced person must undertake condition surveys of all buildings, structures, utilities and the like identified in the documents listed in **Condition A1** of this schedule as being at risk of damage before commencement of any work that could impact on the subject surface / subsurface structure. The results of the surveys must be documented in a **Pre- construction Condition Survey Report** for each item surveyed. Copies of **Pre-construction Condition Survey Reports** must be provided to the relevant owners of the items surveyed in the vicinity of the proposed work, and no later than one (1) month before the commencement ofthe work that could impact on the subject surface / subsurface structure.	Section 9.2.2
D101	Utilities, services and other infrastructure potentially affected by construction must be identified before works affecting the item, to determine requirements for access to, diversion protection, and / or support. The relevant owner(s) and / or provider(s) of services must be consulted to make suitable arrangements for access to diversion, protection, and / or support of the affected infrastructure as required. The Proponent must ensure that disruption to any service is minimised and be responsible for advising local residents and businesses affected before any planned disruption of service.	Section 3.6

Revised Environmental Mitigation Measures		
Ref	Requirement	Where addressed
NV01	Further engagement and consultation would be carried out with: • The affected communities to understand their preferences for mitigation and management measures. • 'Other sensitive' receivers such as schools, medical facilities or places of worship to understand periods in which they are more sensitive to impacts. Based on this consultation, appropriate mitigation and management options would be considered and implemented where feasible and reasonable to minimise the impacts.	MMNV2 and Section 9.5
NV02	Alternative construction methodologies and measures that minimise noise and vibration levels during noise intensive works would be investigated and implemented where feasible and reasonable. This would include consideration of: • The use of hydraulic concrete shears in lieu of hammers/rock breakers • Sequencing works to shield noise sensitive receivers by retaining building wall elements • Locating demolition load out areas away from the nearby noise sensitive receivers	MMNV17; MMNV25; MMNV35

Revised Environmental Mitigation Measures		
	• Providing respite periods for noise intensive works • Minimising structural-borne noise to adjacent buildings including separating the structural connection prior to demolition through saw-cutting and propping, using hand held splitters and pulverisers or hand demolition • Installing sound barrier screening to scaffolding facing noise sensitive neighbours • Using portable noise barriers around particularly noisy equipment, such as concrete saws • Modifying demolition works sequencing / hours to minimise impacts during peak pedestrian times and / or adjoining neighbour outdoor activity periods.	
NV03	Appropriate respite would be provided to affected receivers in accordance with the Sydney Metro Construction Noise and Vibration Standard. This would include consideration of impacts from Stage 1 utility and power supply works when determining appropriate respite periods for affected receivers. When determining appropriate respite, the need to efficiently undertake construction would be balanced against the communities' preferred noise and vibration management approach.	Section 5 and MMNV19; MMNV20 and 9.3.1
NV04	The use of noise intensive equipment at construction sites with 'moderate' and 'high' out-of-hours noise management level exceedances would be scheduled for standard construction hours, where feasible and reasonable. Where this is not feasible and reasonable, the works would be undertaken as early as possible in each work shift.	MMNV18
NV05	Air brake silencers would be used on heavy vehicles that access construction sites multiple times per night or over multiple nights.	MMNV23
NV06	Perimeter site hoarding would be designed with consideration of on-site heavy vehicle movements with the aim of minimising sleep disturbance impacts.	MMNV31
NV07	Long term construction site support equipment and machinery would be low noise emitting and suitable for use in residential areas, where feasible and reasonable. Examples include: • Low noise water pumps for use in water treatment facilities • Low noise generators and compressors • Low noise air conditioner units for use of amenities buildings.	MMNV24
NV08	For all sites where acoustic sheds are proposed, the sheds would be designed and constructed to minimise noise emissions. This would likely include the following considerations: • All significant noise producing equipment that would be used during the night-time would be inside the shed, where feasible and reasonable • Noise generating ventilation systems such as compressors, scrubbers, etc, would also be inside the shed and external air intake/discharge ports would be appropriately acoustically treated • The door of the acoustic shed would be kept closed during the night-time period, where feasible and reasonable. Where night-time vehicle	MMNV33; MMNV34

Revised Environmental Mitigation Measures		
	access is required, the doors would be designed and constructed to minimise noise breakout.	
NV09	Feasible and reasonable measures would be implemented to minimise ground-borne noise where exceedances are predicted. This may require implementation of less ground-borne noise and less vibration intensive alternative construction methodologies.	MMNV37
NV10	The proximity of cross passages to nearby receivers and the corresponding construction ground-borne noise and vibration impacts during the excavation works would be considered when determining locations. Relocation of cross passages to be further away from sensitive receivers to mitigate potential construction impacts would be considered, where feasible and reasonable.	MMNV41
NV11	An activity specific Construction Noise and Vibration Impact Statement (in accordance with the requirements of the Construction Noise and Vibration Standard) would be developed for rockbreaking in the tunnel and at cross passages, specifically addressing the activity where it is required between 10pm-7am.	Section 8.2
NV14	Further assessment of construction traffic would be completed during detailed design, including consideration of the potential for exceedances of the NSW Road Noise Policy base criteria (where greater than 2 dB increases are predicted). The potential impacts would be managed using the following approaches, where feasible and reasonable: • On-site spoil storage capacity would be maximised to reduce the need for truck movements during sensitive times • Vehicle movements would be redirected away from sensitive receiver areas and scheduled during less sensitive times • The speed of vehicles would be limited and the use of engine compression brakes would be avoided • Heavy vehicles would not be permitted to idle near sensitive receivers.	MMNV39
NV16	Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure (in consultation with a structural engineer) and vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure. For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	MMNV11 and Section 9.2.2
NV17	Condition surveys of buildings and structures near to the tunnel and excavations would be undertaken prior to the commencement of excavation at each site, where appropriate. For heritage buildings and structures the surveys would consider the heritage values of the structure in consultation with a heritage specialist.	MMNV12
NV18	The likelihood of cumulative construction noise impacts would be reviewed during detailed design when detailed construction schedules are available.	MMNV9

Revised Environmental Mitigation Measures		
	Co-ordination would occur between potentially interacting projects to minimise concurrent or consecutive works in the same areas, where possible. Specific mitigation strategies would be developed to manage impacts. Depending on the nature of the impact, this could involve adjustments to construction program or activities of Sydney Metro West or of other construction projects.	
TT22	Construction site traffic generated at the Five Dock Station construction site would be managed to minimise movements during church service times at St Albans Anglican Church.	MMNV40

Construction Environmental Management Framework		
Ref	Requirement	Where addressed
3.16 a)	Principal Contractors will maintain appropriate records of the following: i. Site inspections, audits, monitoring, reviews or remedial actions; ii. Documentation as required by performance conditions, approvals, licences and legislation; iii. Modifications to site environmental documentation (eg CEMP, sub-plans and procedures); and iv. Other records as required by this Construction Environmental Management Framework.	Section 3.10 of the CEMP Section 10.7
3.16 b)	Records must be accessible onsite for the duration of works	Section 3.10 of the CEMP Section 10.7
3.16 c)	Additionally records will be retained by the Principal Contractor for a period of no less than 7 years. Records will be made available in a timely manner to Sydney Metro (or their representative) upon request.	Section 3.10 of the CEMP Section 10.7
3.17 a)	Principal Contractors will ensure the continual review and improvement of the management systems. This will generally occur in response to: i. Issues raised during environmental surveillance and monitoring; ii. Expanded scope of works; iii. Environmental incidents; and iv. Environmental non-conformances.	Section 3.11 of the CEMP Section 11.1

APPENDIX B NOISE AND VIBRATION MONITORING PROGRAM

Noise and Vibration Monitoring Program

SMWSTCTP-AFJ-1NL-NV-PLN-000001 Revision 3

Sydney Metro West – Central Tunnelling Package

DOCUMENT APPROVAL

	Prepared By	Reviewed By	Approved By
Name:	Gregor Wilson	Erran Woodward	Erran Woodward
Position:	Environmental Advisor	Environment Manager	Environment Manager
Date:	3/6/22	3/6/22	3/6/22

REVISION HISTORY

Rev:	Date:	Pages:	By:	Description:
A	17/08/21	All	AS	For internal review
00	7/10/21	All	AS	For Approval
01	25/10/21	All	AS	Response to comments – for approval
02	29/10/21	All	AS	Response to comments – for approval
03	3/6/22	All	GW	Minor updates to include EPL

CONTENTS

GLOSSARY AND ABBREVIATION

Abbreviation	Description / Definition
AFJV	Acciona Ferrovial Joint Venture (the Contractor)
AS/NZS	Australia/New Zealand Standards
Amendment Report	Sydney Metro West Westmead to The Bays and Sydney CBD Amendment Report Concept and Stage 1 (2020
CEMP	Construction Environmental Management Plan
Construction	Includes all work required to construct Stage 1 of the CSSI as described in the documents listed in Condition A1 of Schedule 3, including commissioning trails of equipment and temporary use of any part of the CSSI, but excluding Low Impact Work. *Note: As defined in Table 1 of SSI 10038 Infrastructure approval for the Project.*
CNVS	Sydney Metro Construction Noise and Vibration Standard Version 4.3 (4/11/2020) (SM-20-00098866)
CoA	Minister's Conditions of Approval (as relevant to Sydney Metro West Concept and Stage 1)
CTP	Central Tunnelling Package
DPE	NSW Department of Planning and Environment
EIS	Sydney Metro West Concept and Stage 1 Environmental Impact Statement (April 2020)
EMS	Environmental Management System
EPA	NSW Environment Protection Authority
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPL	NSW Environment Protection Licence under the *Protection of the Environment Operations Act 1997*.
NVMP	Central Tunnelling Package Noise and Vibration Management Plan (doc number)
OCCS	Overarching Community Communication Strategy
Planning Secretary	The Planning Secretary of the Department of Planning, Industry and Environment
PoEO Act	*NSW Protection of the Environment Operations Act 1997*
Project	Sydney Metro West Concept and Stage 1
Relevant Councils	Any or all local government councils as relevant, Inner West Council, Strathfield Council, Burwood Council, City of Canada Bay, Parramatta City Council
REMM	Revised Environmental Mitigation Measure
Submissions Report	Sydney Metro West Westmead to The Bays and Sydney CBD Submissions Report Concept and Stage 1 (2020)

1. INTRODUCTION

1.1 BACKGROUND

Sydney Metro is Australia's biggest public transport program. Services on the North West Metro Line between Rouse Hill and Chatswood started in May 2019. The Sydney Metro network also includes Sydney Metro City & Southwest, Sydney Metro West and Sydney Metro Western Sydney Airport.

Sydney Metro West is a new 24 kilometre metro line between Westmead and the Sydney CBD. This infrastructure investment will double the rail capacity of the Greater Parramatta to Sydney CBD corridor with a travel time target between the two centres of about 20 minutes.

The planning approvals and environmental impact assessment for Sydney Metro West has been split into a number of stages recognising the size of the project. This includes:

- Stage 1 – Concept and all major civil construction works including station excavation and tunnelling between Westmead and The Bays. Planning approval for this stage was granted in March 2021.
- Stage 2 – All major civil construction works including station excavation and tunnelling from The Bays to Sydney CBD
- Stage 3 – Tunnel fit-out, construction of stations, ancillary facilities and station precincts, and operation and maintenance of the Sydney Metro West line

An Environmental Impact Statement (EIS) (Jacobs/Arcadis, 2020) for the Concept and Stage 1 (herein referred to as the Project) assessed the noise and vibration impacts in response to the Secretary Environmental Assessment Requirements issued by the Department of Planning, Industry and Environment. The Project was approved on 11 March 2021 (SSI 10038).

Sydney Metro is delivering the Project via several different packages, including the Central Tunnelling Package (CTP). This Noise and Vibration Monitoring Program (Program) has been prepared to address the Condition of Approval (CoA) C14(a), C15 and C16. In addition, the Program has been developed in accordance with the Project EIS, the Revised Environmental Mitigation Measures (REMMs) and all applicable for the design and construction of the CTP.

1.2 SCOPE

This Program outlines how Acciona Ferrovial Joint Venture (AFJV) propose to undertake noise and vibration monitoring during construction of the CTP.

This document should be read in conjunction with the AFJV Noise and Vibration Management Plan.

This Program will be appended to the Noise and Vibration Management Plan (NVMP) which forms part of the Project Construction Environmental Management Plan (CEMP).

1.3 OBJECTIVES

This Program is to define, address and implement noise and vibration monitoring requirements and will apply for the duration of construction.

This Program outlines how AFJV will comply with and implement the applicable elements of the following documents, collectively referred to herein as the 'Project requirements' for the CTP:

- The CoA (issued on 11 March 2021 and as modified on 29 July 2021)
- The Project EIS, Submissions Report and Amendment Report
- Sydney Metro Construction Environmental Management Framework (CEMF).

The objectives and targets applicable to the Noise and Vibration Management on the Project are outlined in Section 3.9 of the CEMP and Section 2 of the CNVMP. In addition to these, the following objectives specifically related to the implementation of the monitoring program will be adopted from the CNVS:

- Ongoing noise monitoring during construction at sensitive receivers during critical periods (i.e. times when noise emissions are expected to be at their highest - e.g. piling and hammering) to identify and assist in managing high risk noise events
- Monitoring will be undertaken inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented
- Regular compliance checks on the noise emissions of all plant and machinery used for the project to:
    - indicate whether noise emissions from plant items were higher than predicted
    - identify defective silencing equipment on the items of plant
    - assist in determining where additional management measures should be implemented.

2. ENVIRONMENTAL REQUIREMENTS

2.1 RELEVANT LEGISLATION AND GUIDELINES

Legislation relevant to this Program includes:

- *Protection of the Environment Operations Act 1997* (POEO Act)

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

- Sydney Metro Construction Noise and Vibration Standard (CNVS) 2020 v4.3
- Sydney Metro Construction Environmental Management Framework (CEMF) 2020 v4.1
- 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
- NSW Noise Policy for Industry, 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
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites
- Australian Standard 2659.1 – 1988 Guide to the use of sound measuring equipment – portable sound level meters[1]

[1] AS 2659.1 – 1988 was withdrawn and not replaced in 2017, however is still widely used as a guidance document

- Australian Standard 2775-2004 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 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration German Standard DIN4150-3:2016 Vibration in buildings – Part 3: Effects on structures
- ISO 3744:2010 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 3746:2010 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.

2.2 CONDITIONS OF APPROVAL

CoA relevant to the preparation of this Program are identified in Table 1. A cross reference is also included to indicate where the requirement is addressed in this Program or other documents.

TABLE 1: COMPLIANCE TABLE - REQUIREMENTS FOR PREPARATION OF CNVMP

Ref	Requirement	Document reference
C14	The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of constructionof Stage 1 of the CSSI against the performance predicted in the documents listed in Condition A1 of this schedule or in the CEMP: (a) Noise and vibration – EPA, SOPA (in respect of Sydney Olympic Park), Place Management NSW (in respect of The Bays) and Relevant Council(s)	This Program
C15	Each Construction Monitoring Program must provide:	
	(a) details of baseline data available including the period of baseline monitoring	Section 4
	(b) details of baseline data to be obtained and when	Section 4
	(c) details of all monitoring of the project to be undertaken	Section 5 & Section 6
	(d) the parameters of the project to be monitored	Section 5 & Section 6
	(e) the frequency of monitoring to be undertaken	Section 5 & Section 6
	(f) the location of monitoring	Appendix A
	(g) the reporting of monitoring results and analysis results against relevant criteria	Section10 Section 4 NVMP
	(h) details of methods that will be used to analyse the monitoring data	Section 8
	(i) procedures to identify and implement additional mitigation measures where the results of the monitoring indicated unacceptable project impacts;	Section 9

Ref	Requirement	Document reference
	(j) a consideration of SMART principles; and	Section 9
	(k) any consultation to be undertaken in relation to the monitoring programs; and	Section 3.1
	(l) any specific requirements as required by Conditions C16 to C17 of this schedule.	Noted
C16	The Noise and Vibration Construction Monitoring Program and Blasting Construction Monitoring Program must include:	Note, blasting not currently proposed
	(a) noise and vibration monitoring determined in consultation with the AA to confirm the best- achievable construction noise and vibration levels with consideration of all reasonable and feasible mitigation and management measures that will be implemented;	Section 5 & Section 6
	(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; and	Section 5 & Section 6
	(c) a process to undertake real time noise and vibration monitoring. The results of the monitoringmust be readily available to the construction team, the Proponent, ER and AA. The Planning Secretary and EPA must be provided with access to the results on request.	Section 5 & Section 6

2.3 ENVIRONMENTAL PROTECTION LICENCE

An Environmental Protection Licence (EPL) has been obtained for the Project (EPL 21610). Noise monitoring requirements from the EPL have been incorporated into this Monitoring Program.

2.4 CONSTRUCTION ENVIRONMENTAL MANAGEMENT FRAMEWORK

The CEMF requirements relevant to the preparation of this Program are identified in Table 2. A cross reference is also included to indicate where the requirement is addressed, in this Program or other documents. The CEMF requires this document be prepared consistently with the CNVS, as such this a cross reference demonstrating compliance with the CNVS is also included in Table 2.

TABLE 2: CEMF REQUIREMENTS

CEMF		
Req.	Condition requirements	Document Reference
3.14a)	Issue specific environmental monitoring will be undertaken as required or as additionally required by any approval, permit or licence conditions.	This document
3.14b)	The results of any monitoring undertaken as a requirement of a licence or permit that is required to be published will be published on the Principal Contractor's, or a project specific, website within 14 days of obtaining the results.	Section 10
3.16a)	Principal Contractors will maintain appropriate records of the following:	Section 10

CEMF		
	i. Site inspections, audits, monitoring, reviews or remedial actions; ii. Documentation as required by performance conditions, approvals, licences and legislation; iii. Modifications to site environmental documentation (eg CEMP, sub-plans and procedures); and iv. Other records as required by this Construction Environmental Management Framework.	
3.16b)	Records must be accessible onsite for the duration of works.	Section 10
3.16c)	Additionally records will be retained by the Principal Contractor for a period of no less than 7 years. Records will be made available in a timely manner to Sydney Metro (or their representative) upon request.	Section 10
8.2c)	Noise and vibration monitoring would be undertaken for construction as specified in the CNVS.	This document
8.2d)	The following compliance records would be kept by Principal Contractors: i. Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria; and ii. Records of community enquiries and complaints, and the Contractor's response.	Section 10
CNVS		
6.1	Sound power level comparison against values in Section 4.3 of CNVS	Section 5.1.4
6.2	Noise monitoring where noise goals predicted to be exceeded	Section 5.1.1
6.3	Vibration monitoring where exceedance of cosmetic damage criteria expected, or where human response exceedance is expected and where concerns raised.	Section 6

2.5 REVISED ENVIRONMENTAL MITIGATION MEASURES

There is only one REMM which applies specifically to noise and/or vibration monitoring; REMM NV16 describes the following requirement:

> *Where vibration levels are predicted to exceed the screening criteria, a more detailed assessment of the structure (in consultation with a structural engineer) and vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure.*
>
> *For heritage items, the more detailed assessment would specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.*

This has been addressed in Section 6.4 , and also in the Heritage Management Plan which forms part of the CEMP. The Heritage Management Plan list items/locations of heritage value which will also be reflected in the Environmental Control Maps and identified in the Project DNVIS.

3. DOCUMENT CONSULTATION AND APPROVAL

3.1 DOCUMENT CONSULTATION

This monitoring plan builds on the consultation that had been undertaken by the EIS, and Response to Submissions managed by the project proponent, Sydney Metro.

In accordance with CoA C14(a), this Program will be provided to the following government agencies for review and comment.

- EPA
- SOPA (in respect of Sydney Olympic Park),
- Place Management NSW (in respect of The Bays); and
- Inner West Council
- City of Canada Bay
- Strathfield City Council
- Burwood Council
- City of Paramatta Council.

Details of issues raised by a government agency during consultation will be included as Appendix F of the NVMP, including copies of all correspondence from those agencies, as required under CoA A6.

Ongoing consultation with stakeholders may be undertaken as required during project delivery.

3.2 DOCUMENT APPROVAL

In accordance with CoA C18 this Monitoring Program will be submitted to the Planning Secretary for approval, following ER and AA endorsement.

4. BASELINE MONITORING DATA

Baseline noise levels were established as part of the EIS through background noise monitoring between March and July 2019 at representative locations, with results summarised for each Noise Catchment Area (NCA) in Table 3.

Noise levels in the project area generally display a typical diurnal trend with lower levels during the night-time than the daytime and evening periods (with some exceptions). This is characteristic of urban and suburban areas, where the ambient noise environment is primarily influenced by road traffic.

The baseline information was used to establish the Rating Background Level (RBL), which represents the average minimum background sound level for each measurement period, averaged over the measurement days.

Baseline data from the EIS has been reviewed and is representative of ambient noise in the project area. No further baseline monitoring is proposed prior to commencement of construction of the CTP.

TABLE 3: BACKGROUND NOISE MONITORING RESULTS

Noise Catchment Area (NCA)	Noise level (dBA)		
	Day RBL	Evening RBL	Night RBL2
NCA-8	48	48	46
NCA-9	48	46	41
NCA-10	47	47	44
NCA-11	51	47	39
NCA-12	43	43 (47)[3]	42
NCA-13	48	48	44
NCA-14	42	41	33
NCA-15	43	43 (44)[3]	38
NCA-16	36	36 (39)[3]	33
NCA-17	43	43 (45)[3]	37
NCA-18	48	45	37
NCA-19	43	43	35
NCA-20	51	51	45
NCA-21	48	47	39

Notes:

1. The RBL values have been extracted from the EIS; refer to Table 4 in the EIS Technical Paper 2.
2. Daytime is 7:00am to 6:00pm, evening is 6:00pm to 10:00pm and night-time is 10:00pm to 7:00am.
3. During the EIS noise assessment, the monitoring level was found to be higher than the daytime. In this situation, the NPfI requires that the evening level be reduced to match the daytime.

5. NOISE MONITORING

5.1 AIRBORNE NOISE MONITORING

5.1.1 ATTENDED AIRBORNE NOISE MONITORING

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

- At the commencement of activities (i.e. within the first month) for each location a Detailed Noise and Vibration Impact Statement (DNVIS) has been prepared, to confirm that actual noise and vibration levels are consistent with noise and vibration predictions and the management measures that have been implemented are appropriate
- 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 M7.5
- To consider the actual equipment in use and confirm proposed physical mitigation measures (such as noise shielding and enclosures) are being implemented in accordance with the DNVIS
- To confirm operating sound power level per section 6.1 of the CNVS
- As otherwise required by the DNVIS

- For approved out-of-hours works (see Section 5.3 of this document)
- As required by the EPL Condition M4
- Following the implementation of mitigation measures or noise attenuation due to exceedance of predicted noise levels
- 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
- During daytime, evening and night-time periods to verify predicted noise levels during the different work periods.

5.1.2 UNATTENDED AIRBORNE NOISE MONITORING

5.1.2.1 UNATTENDED REAL TIME MONITORING

Unattended (real time) airborne noise monitoring will also be completed with noise loggers deployed to obtain noise results over longer periods to satisfy CoA C16(c).

To satisfy CoA C16, real time unattended noise monitoring is proposed commence prior to the commencement of construction, for a minimum period of six consecutive months. At this time, the results and validity of the real time unattended monitoring program will be reviewed in consultation with the SM, AA and ER, and any appropriate changes will be made at this time.

Real time monitoring results will be available via a portal to the Environment Manager and relevant personnel of the construction management team. Access to the data set will be provided to Sydney Metro, the ER and AA, which may include a process of annotating irregular results to identify anomalies or corruption in the dataset. Additionally, this data will be provided to the Planning Secretary and EPA upon request.

5.1.2.2 UNATTENDED MONITORING (NOT REAL TIME)

Monitoring will be undertaken for a minimum of 24 hours prior to the activity commencing (to obtain background vibration levels) and will continue for a minimum of 48 hours of the activity commencing and should this not include the peak vibration generating activity, until the completion of the peak vibration generating activity.

5.1.2.3 UNATTENDED MONITORING LOCATIONS

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

- The location of previous monitoring sites
- The proximity of the receiver to a Project worksite
- Availability of power and security
- The sensitivity of the receiver to noise
- Background noise levels
- The expected duration of the impact.

Some locations may be the boundary of construction sites while others may be within the property of sensitive receivers, where access is granted. Indicative monitoring locations are illustrated in Appendix A, however these will be revised on completion of the relevant DNIVS for that location.

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.

During unattended monitoring, noise loggers will record audio (triggered by noisy events) to allow for the identification of construction noise contribution and the presence of any extraneous noise, if privacy concerns can be overcome.

5.1.3 METHODOLOGY

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 the operator, who will be competent, suitability trained and experienced in undertaking noise measurements.

All environmental noise monitoring will be undertaken with a fast time constant (i.e. 125 milliseconds), and A-weighted frequency weighting. The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: LA90, LAeq, LA10, LA (max).

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 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 while using a tripod.

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
- Measure with the source noise off and then on (where possible) and calculate the difference
- Use the ‘pause and back-erase feature on the sound level meter to try to exclude as much of the extraneous noise as possible.

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.

5.1.4 PLANT NOISE AUDITING

Plant or equipment operating on the Project shall have an operating sound power level (SWL) which is no higher than the corresponding SWL presented in Table 13 of the CNVS unless otherwise justified. In line with CNVS Section 4, noise generating items of plant that have a predicted SWL of 105dB(A) or over, operating at the site surface outside the acoustic sheds would have noise audits conducted upon arrival at the Project site and at 6-month intervals thereafter. The purpose of these audits is to verify individual items of plant and equipment fall within the nominated SWL’s.

For all measurements, the plant or equipment under test would be measured while operating under typical operating conditions. If this is not practical, it may be appropriate to conduct a stationary test at high idle.

Monitoring will be undertaken in line with applicable standards described in the CNVS including:

- AS2012–1990 Acoustics – Measurement of Airborne Noise Emitted by Earthmoving Machinery and Agricultural Tractors – Stationary Test Condition Part 1: Determination of Compliance with Limits for Exterior Noise
- International Standard ISO 9614-2 1996 Acoustics – Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning
- Australian Standard AS2012–1977 Method for Measurement of Airborne Noise from Agricultural Tractors and Earthmoving Machinery.

In the case of an exceedance in SWL the item of plant would either be replaced, or the advice of sought to provide suitable mitigation measures, which may include:

- Completing appropriate maintenance
- Implementing additional or upgrading existing muffling devices
- Building enclosures around items of stationary plant (e.g. pumps or generators).

A register of measured sound power levels for each item of plant would be kept for reference where future noise audits are conducted. The register would be reviewed annually in conjunction with this strategy and corresponding revisions made to the Sound Power Levels presented in Section 4.3 of the CNVS to represent contemporary plant noise emission levels.

5.2 GROUNDBORNE NOISE MONITORING

5.2.5 FREQUENCY AND LOCATION OF GROUND BORNE NOISE MONITORING

The need for ground-borne noise monitoring would be determined by a DNVIS, which would identify at which residences the NML may be exceeded and where impacts are likely. The offer of monitoring within the residence may form part of the response to complaints and in accordance with EPL Condition M7.5.

Where monitoring is not triggered by complaint, monitoring would be completed at representative receivers where tunnelling is predicted to exceed the NML and where access is granted. Frequency of GBN monitoring would be dependent on access to affected residences; however, in this way, regular verification of predicted GBN can be completed.

Most ground-borne monitoring will be unattended since monitoring is usually completed within a private residence and typically at night. In these cases, noise loggers may be left in place over night and picked up at a mutually agreed time with the resident.

Attended monitoring of ground-borne construction noise levels may be undertaken, where appropriate, in response to noise-related complaint (determined on a case-by-case basis), where access for unattended monitoring is not granted and the resident would prefer to be present.

5.2.6 GROUND BORNE NOISE MONITORING METHODOLOGY

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.

Ground-borne noise monitoring will be recorded over 15-minute sample intervals, where every 15 minutes 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: LA90, LAeq, LA1 and LA (max).

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.

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, AFJV will endeavour to monitor at the next most suitable available room or location, noting this in the monitoring form.

Noise loggers will record audio to allow for identification of the construction noise contribution and the presence of any extraneous noise provided 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 where appropriate.

Measurements will be carried out by an appropriately trained and competent person in the measurement and assessment of construction noise and vibration.

5.3 OUT OF HOURS WORK

Where out-of-hours works (OOHW) are undertaken, noise monitoring including a visual inspection of the activities may be undertaken as identified by the OOHW Permit, including to:

1. Ensure noise mitigation measures specified in the approved application are appropriately implemented
2. Verify assumptions and model outcomes of the OOHW works (i.e. predicted noise levels)
3. Any necessary additional measures are identified and implemented where reasonable and feasible.

Where OOHW monitoring is required, this will be conducted as soon as practicable (e.g. preferably first night) during the approved works and would involve attended monitoring as described in Section 5.1.1.

Personnel carrying out monitoring will consider the actual vs proposed equipment in use and confirm proposed physical mitigation measures (such as noise shielding and enclosures) are being implemented in accordance with the OOHW Permit.

Monitoring results will be compared with predicted levels to establish the accuracy of predicted noise and inform future predictions. Where the need for additional controls is identified, these will be implemented as soon as possible as actions undertaken in response to monitoring results.

6. VIBRATION MONITORING

6.1 ATTENDED VIBRATION MONITORING

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site for which:
  - Has the potential to generate significant vibration levels
  - Screening criteria is likely to be exceeded
  - 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
- Where vibration sensitive locations are determined to fall within the 'minimum working distances' established for each item of plant, to refine the indicative minimum working distances
- Where appropriate in response to a vibration related complaint(s) (determined on a case-by- case basis)
- As otherwise required by the DNVIS or EPL Condition M4.

Vibration monitoring will be undertaken in accordance with the relevant vibration measurement requirements in the reference standards and documents in Section 1.4. Monitoring results will be assessed against relevant standards as follows:

- Where human comfort is a concern, Tables 2.2 and 2.4 of the EPA's Assessing Vibration – a technical guideline
- Where property damage is a concern, British Standard 7385, as presented in the NVMP
- For heritage structures, BS7385-2:1993 does not provide numerical vibration levels to prevent structural damage; refer to Section 6.4 of this Monitoring Program.

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above, including the following aspects of mounting the device.

- 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
- 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.

For each monitoring event, the following information shall be recorded:

- Date and time of measurements
- Name of person undertaking the measurements

- Type and model number of instruments
- Sample times, measurement time intervals and time of day
- Map of area showing measurement location, source location and sensitive receivers
- Measurement location details and number of measurements at each location
- Operation and load conditions of the plant under investigation.

Monitoring will be undertaken using tri-axial geophones or accelerometers, which measure vibration as velocity and/or acceleration in three axes.

6.2 UNATTENDED VIBRATION MONITORING

Where monitoring is planned to extend over a longer period than practicable for attended monitoring, such as when works will remain within the safe minimum working distance to prevent cosmetic damage, the monitoring instrumentation will be fitted with the ability to warn plant operators via flashing light, SMS, or email that vibration is approaching levels and 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.

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 the NVMP.

Ideally, vibration would be measured directly on a structure. Where access is not available, vibration will, at times, be monitored in proximity to the equipment and measured levels extrapolated to the nearest structure based on the following equation for geometric damping (conservatively ignoring material damping).

$$PPV_2 = PPV_1 \left(\frac{R_1}{R_2}\right)^n$$

Where:

PPV – Peak Particle Velocity at the source (PPV1) and Receiver (PPV2)

R – distance from source of reference level (R1) and distance from source of receiver (R2)

n – ground factor assumed as 1 for body waves

6.3 REAL-TIME UNATTENDED VIBRATION MONITORING

To satisfy CoA C16(c) real-time unattended vibration monitoring will be established continuously monitor PPV resulting from construction activities. The monitors will be installed following approval of this monitoring program and prior to commencement of vibration intensive works in a potentially affected area.

Real-time noise monitors will be installed as close to sensitive receivers as possible, in consideration of:

- Potential locations of vibration-intensive activities

- Power availability and
- Security
- Access
- Outcomes of the DNVIS.

Some locations may be the boundary of ancillary sites, similar to noise monitoring locations, while others will be within the property of sensitive receivers, where access is granted. Indicative real-time vibration monitoring locations are illustrated in Attachment A and these will be updated once further information is available.

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

Unattended (real time) vibration monitoring will also be completed to satisfy CoA C16(c). Monitoring results will be available via a portal to the Environment Manager and relevant personnel of the construction management team. Following an initial screening review, to identify any anomalies or corruption in the dataset, results of the monitoring will be made readily available to the Sydney Metro, the ER and AA and will be provided to the Planning Secretary and EPA upon request.

For each monitoring event, the following information shall be recorded:

- Date and time of measurements
- Type and model number of instruments
- Sample times, measurement time intervals and time of day
- Map of area showing measurement location, source location and sensitive receivers
- Measurement location details and number of measurements at each location.

6.4 HERITAGE STRUCTURES

Heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound. In accordance with CoA D49 a conservative vibration damage screening level of 2.5 mm/s will be adopted for heritage structures and other sensitive structures of great intrinsic value where they are found to be structurally unsound. Otherwise, the standard 7.5mm/s criteria will apply (as discussed in Section 6.4 of the NVMP). In accordance with CoA D46, AFJV will conduct vibration monitoring during vibration generating activities that have the potential to impact on heritage items that have been identified as structurally unsound, and where preliminary vibration contours indicate that the vibration damage screening level of 2.5 mm/s is likely to be exceeded.

In line with CoA D47, AFJV will seek the advice of the Project's heritage and noise and vibration specialists on methods and locations for installing equipment upon heritage-listed structures.

All heritage items, including heritage structures are included in the Environmental Control Maps (ECMs) for the Project and will be identified in the DNVIS, with the relevant vibration triggers appointed to that location/structure so that potential exceedances can be clearly identified and addressed prior to works commencing.

6.5 OUT OF HOURS WORK

Where out-of-hours works (OOHW) are undertaken, visual and vibration monitoring may be undertaken as identified by the OOHW Permit, including to:

1. Ensure vibration mitigation measures specified in the approved application are appropriately implemented

2. Verify assumptions and model outcomes of the OOHW works (i.e. predicted vibration levels)
3. Any necessary additional measures are identified and implemented where reasonable and feasible.

Where OOHW monitoring is required, this will be conducted as soon as practicable (e.g. preferably first night) during the approved works and would involve attended monitoring as described in Section 6.1.

Personnel carrying out monitoring will consider the actual vs proposed equipment in use and confirm proposed physical mitigation measures (such as noise shielding and enclosures) are being implemented in accordance with the OOHW Permit.

Monitoring results will be compared with predicted levels to establish the accuracy of predicted vibration and inform future predictions. Where the need for additional controls is identified, these will be implemented as soon as possible as actions undertaken in response to monitoring results.

7. MONITORING RECORDS

For each monitoring event, the following information shall be recorded:

- Date and time of measurements
- Name of person undertaking the measurements
- Type and model number of instruments
- Sample times, measurement time intervals and time of day
- Map of area showing measurement location, source location and sensitive receivers
- Measurement location details and number of measurements at each location
- Operation and load conditions of the plant under investigation
- Measured noise parameters including LA90, LAeq, LA10, LA (max)
- Estimated contribution of the Project's activities vs. noise from extraneous and environmental sources (e.g. traffic, aircraft, trains, dogs barking, insects)
- Where possible, describe the frequency of noise events noticeably above the LAeq level, i.e. transient or impulsive events at or around the LAMax value for the monitoring period, either numerically (e.g. up to 5 events in the monitoring period) or subjectively (frequent/single event).

8. CALIBRATION, QUALITY ASSURANCE AND COMPETENCY

All monitoring will be undertaken by competent personnel, suitability trained and experienced in undertaking noise and vibration measurements. Specific targeted training will be developed by the Environmental Manager to ensure that environmental monitoring officers are appropriately trained. Refer to the CEMP for full details on environmental training.

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

Noise monitoring would be completed using at minimum Class 2 instruments, as per Australian Standard IEC 61672.1.

9. CONTINUAL IMPROVEMENT AND CORRECTIVE ACTION

Monitored noise and vibration levels will be analysed against the noise and vibration objectives and predictions made in the relevant DNVIS or using the Project's predictive tools. Results will be utilised to confirm model predictions and confirm vibration minimum working distances (i.e. 'site law').

Where monitored construction levels are found to be above noise or vibration management levels and predicted levels, the following actions will be undertaken:

- Assess the noise/vibration generating sources and activities to identify a potential source of 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 noisy or vibration-intensive piece of equipment
- Confirm that the modelling reflects the actual activity being undertaken
- Implement other feasible and reasonable measures which may include reducing plant type or 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 of these
- 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
- Where noise cannot be reduced for this activity, re-assess the extent of impacts based on new information (e.g. revised equipment sound power level) and implement appropriate mitigation and management measures
- Communicate lessons learnt to relevant personnel
- AFJV will review the activity and where possible, modify the work or activity to prevent any recurrence. Lessons learnt will be communicated to relevant personnel in toolbox talks.

This process follows SMART principles in that the actions are specific and measurable, the outcomes are achievable and realistic, and all steps are time-focussed.

Where monitored construction levels are found to be below predicted noise or vibration levels, there may be an opportunity to highlight a technique or item of equipment that can be used in other situations to reduce noise impacts or amend the noise predictions for improved accuracy. In this situation:

- Assess the noise/vibration generating sources and activities to identify potentially lower noise levels than anticipated
- Confirm if the reduced level is due to equipment sound power or operating variables
- Where sound power is lower, include data in register of plant noise levels for future reference (See Section 5.1.4)
- Where operation is less intense, or other mitigation has been applied to reduce levels, make a note in the register of plant noise levels for future reference and identification of any trends.

10. REPORTING OF MONITORING RESULTS

At the completion of monitoring in line with the methods outlined in the above sections, all data will be downloaded by a suitable competent person to be analysed. These results would then be evaluated in comparison to relevant predictions and criteria. The data along with the information recorded about each event (time, weather, type of work etc.) will help to develop a complete picture of the real time noise and/or vibration environment. This would aid in:

- Validating modelling done as part of the project
- Validating any complaints made by the community
- Improving work methods to minimise impacts.

Data from noise and vibration monitoring will be reported in a Construction Monitoring Report in line with CoA C23. The monitoring report as a minimum will include a description of monitoring parameters, frequency, location and analysis in line with the relevant requirements of CoA C15.

The Monitoring Report will then be provided to the AA and ER for review and endorsement from the AA prior to submission to the Secretary of the DPE and relevant regulatory authorities for information.

Reporting requirements associated with the Program for the construction phase of the Project are presented in Table 10-1.

TABLE 10-1 REPORTING REQUIREMENTS AND SCHEDULE

Schedule (during construction)	Requirements	Submission timeline	Requirement
Noise and Vibration Monitoring Reports (every six months)	AFJV data summary reports presenting tabulated monitoring data collected during the reporting period and highlighting performance criteria exceedances. Applicable management responses will be documented.	The six-monthly monitoring reports will be provided to the relevant authorities within 40 business days of the monitoring period ending.	CNVS S. 6.2 CoA C23
Monitoring reports - Within one week / weekly	Where monitoring is conducted externally, the report would be submitted to the construction contractor Environment Manager within one week or at weekly intervals for continuous monitoring. Information from external consultants will be used to inform the six monthly monitoring reports mentioned above.	These reports provided one week after the monitoring event would be used to inform the 6 monthly monitoring reports. .	CNVS S. 6.3

In line with CoA B11, a copy of the Construction Monitoring Report will be published on the project website 10 days following submission to DPE.

Separate from the Construction Monitoring Report, additional records relating to noise and vibration training, toolbox talks, monitoring results and audit results will be prepared, maintained, and stored in line with the CEMP. The complaints management and reporting procedure is described in the CEMP.

Monitoring records separate to the Six Monthly Monitoring Report can be requested by the ER and AA throughout the project for information.

Where the Project EPL has additional requirements for monitoring or reporting results, these will be added to the Monitoring Program once available, in accordance with the process for updating documents as described in the CEMP.

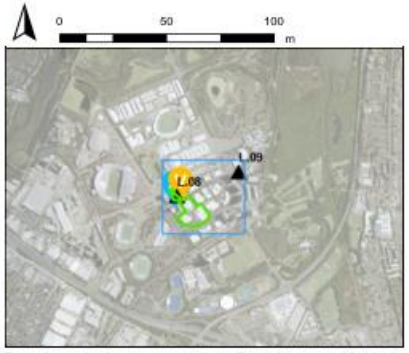
APPENDIX A INDICATIVE REAL-TIME MONITORING LOCATIONS

Sydney Metro West - CTP

Indicative monitoring locations - Sydney Olympic Park

Legend

- North Strathfield
- Baseline noise monitoring locations
- Nominal real-time monitoring - noise
- Nominal real-time monitoring - vibration



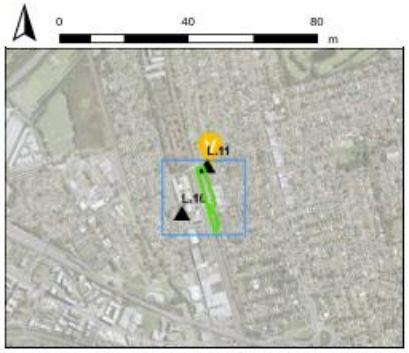
afJV

Sydney Metro West - CTP

Indicative monitoring locations - North Strathfield

Legend

- North Strathfield
- Baseline noise monitoring locations
- Nominal real-time monitoring - noise
- Nominal real-time monitoring - vibration



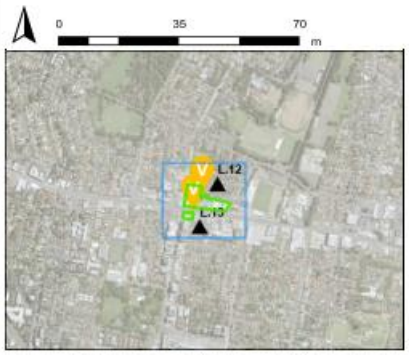
afJV

Sydney Metro West - CTP

Indicative monitoring locations - Burwood North

Legend

- Burwood North
- Baseline noise monitoring locations
- Nominal real-time monitoring - noise
- Nominal real-time monitoring - vibration



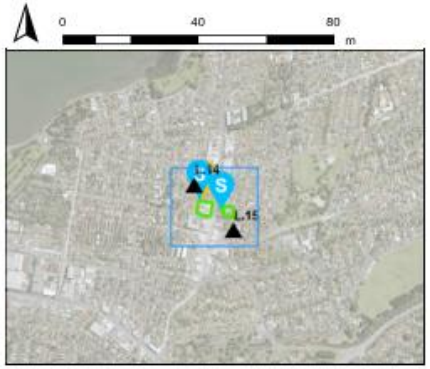
afJV

Sydney Metro West - CTP

Indicative monitoring locations - Five Dock

Legend

- Five Dock
- Baseline noise monitoring locations
- Nominal real-time monitoring - noise
- Nominal real-time monitoring - vibration



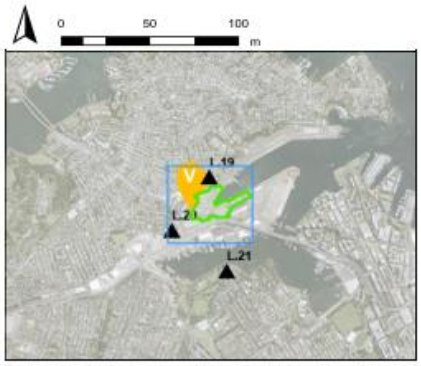
afJV

Sydney Metro West - CTP

Indicative monitoring locations - The Bays

Legend

- The Bays
- Baseline noise monitoring locations
- Nominal real-time monitoring - noise
- Nominal real-time monitoring - vibration



afJV

APPENDIX C LAND USE SURVEY MAPS

Land Use- The Bays

Legend

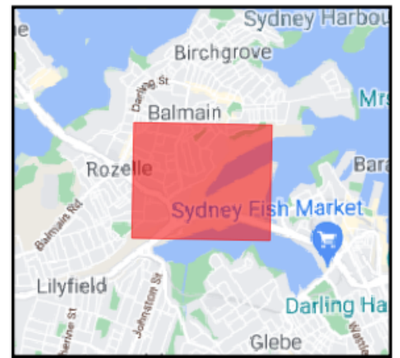
CTP Sites

Receiver Types

- Childcare
- Commercial/Business
- Commercial/Residential
- Community Use
- Community/Residential
- Education
- Garage
- Hotel
- Industrial/Utilities
- Residential
- Medical
- Place of Worship
- None
- Aged Care
- Transport/Infrastructure

The Bays

0 110 220 m



Land Use- Five Dock

Legend

CTP Sites

Receiver Types

- Childcare
- Commercial/Business
- Commercial/Residential
- Community Use
- Community/Residential
- Education
- Garage
- Hotel
- Industrial/Utilities
- Residential
- Medical
- Place of Worship
- None
- Aged Care
- Transport/Infrastructure

0 57 114 m

Land Use- Burwood North

Legend

- CTP Sites

Receiver Types

- Childcare
- Commercial/Business
- Commercial/Residential
- Community Use
- Community/Residential
- Education
- Garage
- Hotel
- Industrial/Utilities
- Residential
- Medical
- Place of Worship
- None
- Aged Care
- Transport/Infrastructure

Burwood North

0 57 114 m