



Southwest Metro – Hurlstone Park, Belmore and Wiley Park Station Upgrades Noise and Vibration Management Plan

Sydney Metro Integrated Management System (IMS)

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01	22 December 2020	Revised in response to ER comments and external consultation feedback. Revised for ER endorsement and issue to DPE
02	8 February 2021	Revised in response to DPE comments
03	12 March 2021	Integrate Downer EMS
04	2 August 2021	Address ER comments
05	12 October 2021	Revised with minor changes in response to SM comments
06	13 December 2021	Revised to incorporate updated OOHW periods and forms
07	09 June 2022	Six-monthly review
08	17 November 2022	Revised to incorporate minor modification to emergency works notification requirements of the City & Southwest Out of Hours Work Strategy/ Protocol

Terms and Definitions

Terms	Definitions
AMM	Additional Mitigation Measures
AS	Australian Standard
AVTG	NSW EPA Assessing Vibration – a Technical Guideline
CoCB	City of Canterbury-Bankstown
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CNVIS	Construction Noise and Vibration Impact Statement
CNVS	Sydney Metro Construction Noise and Vibration Strategy (2016)
CoA	Conditions of Approval
CSSI	Critical State Significant Infrastructure
CTMP	Construction Traffic Management Plan
dB	Decibels, used to express sound power or pressure level and vibration velocity or acceleration
dB(A)	A-weighted decibel (sound or vibration)
DECC	NSW Department of Environment and Climate Change (now OEH)
DPE	Department of Planning and Environment (formerly DPIE)
DPIE	Department of Planning and Environment (now DPE)
ECM	Environmental Control Map
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence under the POEO Act
ER	Environmental Representative
Frequency	Repetition of a sound or vibration wave, measured in Hertz (Hz), or cycles per second
HMP	Heritage Management Plan
HNA	Highly Noise Affected
ICNG	NSW EPA Interim Construction Noise Guideline
IMS	Sydney Metro Integrated Management System
ISO	International Standardization Organisation
I&S	TfNSW Infrastructure and Services
LA₁(period)	A-weighted sound pressure level that is exceeded 1% of the measurement period
LA₉₀(period)	A-weighted sound pressure level that is exceeded 90% of the measurement period, used to derive background noise levels
LA_{eq}(period)	A-weighted sound pressure level, energy average over the measurement period
Minister, the	The Minister of New South Wales (NSW) Planning
NML	Noise Management Level
NPfI	Noise Policy for Industry (NSW EPA, 2017)
NSW	New South Wales

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Terms	Definitions
NVMP	Noise and Vibration Management Plan
OOHW	Out-of-Hour Works
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
PPV	Peak Particle Velocity (vibration)
Proponent	The person or organisation identified as the proponent in Schedule 1 of the planning approval. In this case Transport for NSW
RBL	Rating Background Level
REMM	Revised Environmental Mitigation Measure
RMS	Roads and Maritime Services
r.m.s.	Root Mean Square (acoustics, noise and vibration)
RNP	NSW EPA Road Noise Policy
Secretary	The Secretary of the Department of Planning and Environment
SEP	Site Environmental Plan
SMA	Sydney Metro Authority (the proponent)
SPIR	Submissions and Preferred Infrastructure Report
SPL	Sound Pressure Level
SLR	SLR Consulting Australia
SWL	Sound Power Level
TfNSW	Transport for New South Wales
VC	Vibration Criteria
VDV	Vibration Dose Value
VML	Vibration Management Level

1. Introduction

1.1. Context and scope of this Sub-plan

This Noise and Vibration Management Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for Southwest Metro – Hurlstone Park, Belmore and Wiley Park Station Upgrades (the Project).

This NVMP has been prepared to address requirements of the Critical State Significant Infrastructure (CSSI) 8256 including Modification 1 determined 22 October 2020, Conditions of Approval (CoA), the Revised Environmental Mitigation Measures (REMM), the Project's Submissions and Preferred Infrastructure Report (SPIR) and the Sydney Metro Construction Environmental Management Framework (CEMF).

This NVMP describes how Sydney Metro's Principal Contractor (Downer) proposes to manage noise and vibration during the construction of the Project. Operational management measures do not fall within the scope of this Plan and therefore are not included.

This NVMP forms part of the suite of construction noise and vibration documents aiming to achieve the above objectives. The NVMP:

- Applies the Sydney Metro Construction Noise and Vibration Strategy (CNVS, 2016) during the construction phase of the Project;
- Applies the CSSI 8256 CoA for the Project;
- Applies the principles of the NSW EPA Interim Construction Noise Guideline (ICNG, 2009); and
- Considers the interaction of known Conditions of Approval; and
- Applies Downer's Environmental Noise and Vibration Standard (DG-ZH-ST069).

This NVMP summarises the requirements from the documents listed above and explains how they are to be applied in practice for the proposed station works.

This NVMP is supplemented by a Construction Noise and Vibration Impact Statement (CNVIS), which provides a detailed description of the proposed works and the predicted noise and vibration impacts for each site.

The NVMP and the associated CNVIS share the main objectives of the ICNG Section 1.3, a portion of which is presented below:

"The main objectives of the Guideline are to:

- *promote a clear understanding of ways to identify and minimise noise from construction works*
- *focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts*
- *encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours*
- *streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage*

- *provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.”*

The NVMP and CNVIS:

- Identify sensitive receivers and noise and vibration management levels applying at each potentially affected receiver;
- Identify and clarify applicable project-specific construction noise and vibration management requirements under the CoA, Sydney Metro’s CNVS and any EPL which may apply;
- Identify the key noise and / or vibration generating construction activities;
- Identify and recommend feasible and reasonable construction noise and vibration mitigation measures (both engineering and management controls);
- Clarify the requirements of Sydney Metro’s City and Southwest Out of Hours Works Strategy/Protocol;
- Clarify the requirements for all necessary noise and vibration monitoring;
- Reference applicable Sydney Metro communications strategies and requirements for responding to and effectively addressing any community noise complaints relating to construction noise and / or vibration;
- Outline the requirements for maintaining records for noise and vibration monitoring and for community enquiries and complaints.

In accordance with Downer’s Environmental Noise and Vibration Standard (DG-ZH-ST069), the NVMP must consider:

- Identification of nearby residences and other sensitive land users;
- Measured rating background level (RBL) and legal requirement;
- Distance between the site and the area likely to be affected by the noise or vibration;
- Nature of neighbouring buildings and the activity therein, where the noise is likely to be heard, or vibration perceived (dilapidation report for vibration);
- The likely duration of construction, maintenance and demolition operations and the hours during which the above operations will be carried out;
- Undertaking modelling to understand the predicted nature and levels of the noise or vibration; and
- Any initiatives to reduce the impact of noise and vibration.

The Sydney Metro City and Southwest Out of Hours Works Strategy/Protocol (SM-17-00005396) must be followed for any outside of approved hours.

Noise reduction measures must be taken for all equipment or activities identified as potentially impacting noise sensitive receivers. Noise reduction measures should be aligned with the relevant Noise Hierarchy of Control categories:

- Avoid/ Reduce;
- Manage;

- Engineer.

Noise reduction (management and mitigation) measures are discussed in Section 7.

1.2. Project background

The Sydney Metro City and Southwest - Sydenham to Bankstown Upgrade Environmental Impact Statement (EIS) (GHD/AECOM September 2017) assessed the noise and vibration impacts of construction within Chapter 12 (Construction noise and vibration). The Sydney Metro City and Southwest - Sydenham to Bankstown Upgrade Submissions and Preferred Infrastructure Report (SPIR) (GHD/AECOM June 2018) was prepared in response to the submissions received during the EIS exhibition period. The SPIR revised the scope of the Sydenham to Bankstown Upgrade project and updated construction noise and vibration assessment was included in SPIR Appendix E.

This CEMP and Sub-plan suite addresses the upgrade of Hurlstone Park, Belmore and Wiley Park Stations only. Please refer to Section 1 of the CEMP for the Project Description.

1.3. Objectives and targets

This NVMP provides the basis for the management of construction noise and vibration in order to minimise the risk of impact during works. The objectives and targets of noise and vibration management and mitigation are outlined in Table 1.

Table 1: Noise and vibration objectives and targets

Objective	Target
Minimise unreasonable noise and vibration impacts on residents and businesses	Mitigation and management measures adopted in accordance with Section 7. Aim is to achieve Noise and Vibration Management Levels where feasible and reasonable, and apply Additional Mitigation Measures for residual excess noise in accordance with Section 7.11
Avoid structural damage to buildings or heritage items as a result of construction vibration	Measured vibration levels from construction activities all meet agreed vibration criteria (refer Section 5.7)
Undertake active community consultation	Community notification and management provided in accordance with the Sydney Metro Overarching Community Consultation Strategy (OCCS) and with notification provided in accordance with Section 7.5 and the Additional Mitigation Measures Matrix (Section 7.12)
Maintain positive, cooperative relationships with schools, childcare centres, local residents and building owners	Community notification and management provided in accordance with the Sydney Metro Community Consultation Strategy (CCS) and in accordance with Section 7.5

These objectives conform to Sydney Metro objectives as described in the Construction Environmental Management Framework.

1.4. NVMP and supporting documents

This NVMP and the associated CNVIS (Hurlstone Park, Belmore and Wiley Park Station Upgrades draft Construction Noise and Vibration Impact Statement Rev00 21 December 2020) have been developed to assess works to be carried out by Downer. Sydney Metro has provided indicative works stages, locations, and plant for assessment.

The CNVIS and NVMP, with appropriate mitigation measures, can be updated at any time to reflect the detailed design, development of construction methods, and coordination with other contractors / projects in the areas to manage cumulative impacts.

If Downer proposes to carry out any works activity which is not covered in the CNVIS, and if that activity is predicted to exceed CNVIS noise predictions, be in a different location, or be noticeably different in noise character to the assumed activities for the associated works stage, then the CNVIS must be updated and approved prior to commencement of those different works.

Downer can refer to the NVMP and CNVIS to consider ways to mitigate impacts from their proposed works, through plant selection and / or screening, and scheduling of noisy activities to less noise-sensitive periods when possible.

It is expected that Downer will also prepare works plans and out of hours works (OOHW) applications in accordance with the Sydney Metro City and Southwest Out of Hours Works Strategy/Protocol (SM-17-00005396) which has been prepared to satisfy CoA E25 and REMM NVC16, which describe in more detail the plant and activities to be scheduled. These will build on the findings of the CNVIS but be broken down further when plant selection is confirmed and sequencing and location of activities is clear, allowing impacts to be managed appropriately.

The NVMP and CNVIS are part of a suite of construction noise and vibration management documents and have an interrelationship with other documents, as outlined below:

- The CEMP prepared for the Project;
- Site Environment Plans (SEPs) or Environmental Control Maps (ECMs) identify nearby residential and other noise-sensitive receivers and Noise Catchment Areas. These are progressively updated to incorporate physical noise management measures identified in the CNVIS, such as solid hoarding;
- The Heritage Management Plan (HMP) prepared for the Project, given the potential for vibration intensive works to be carried out at heritage-listed railway stations;
- The Construction Traffic Management Plan (CTMP) prepared for the Project; and
- The Sydney Metro City and Southwest Overarching Community Communications Strategy (OCCS) (SM-17-00083972). The OCCS describes the procedures and processes for community notification, consultation and complaints management.

1.5. Consultation

CoA C3(a) and CoA C8(a) require that the NVMP and Noise and Vibration Monitoring Program be prepared in consultation with the relevant Council. As such the following stakeholders have been consulted in developing this Plan:

- City of Canterbury Bankstown Council (CoCB).

A summary of the consultation is provided in Table 2 and in Appendix E.

Table 2: Consultation carried out in the development of this Plan

No.	Agency Consultation	Requirements and date submitted	Key issues raised	NVMP Section Reference
Conditions of Approval				
C6	Department of Planning, Industry and Environment (DPIE) {now DPE}	Issued for review and approval Re-issued in response to DPIE comments	Various comments	Section 1.5 Table 8 Section 5 Section 7 Section 8 Appendix A Appendix B Appendix E
C3(a)	CoCB	Issued for consultation 6/11/20 Invited to consultation workshop held 16/11/20. Response received 16/11/20	Nil	N/A
C8(a)	CoCB	Issued for consultation 6/11/20 Invited to consultation workshop held 16/11/20. Response received 16/11/20	Nil	N/A

2. Legal and other requirements

This Plan addresses applicable requirements within the following documents:

- The Sydney Metro *City and Southwest - Sydenham to Bankstown Upgrade Conditions of Approval CSSI-8256*, determined 12 December 2018 and Modification 1 determined 22 October 2020.
- The Sydney Metro *City and Southwest - Sydenham to Bankstown Upgrade Environmental Impact Statement*, September 2017.
- The Sydney Metro *City and Southwest - Sydenham to Bankstown Upgrade Submissions and Preferred Infrastructure Report*, June 2018.
- The Sydney Metro *City and Southwest - Sydenham to Bankstown Upgrade Bankstown Modification Report*, May 2020
- The Sydney Metro *Sydenham to Bankstown Staging Report (2020)*
- Sydney Metro *City and Southwest Construction Noise and Vibration Strategy (2016)*
- Sydney Metro *City and Southwest Out-of-Hours Works Strategy/Protocol* version 5.3 (2023)
- Sydney Metro *Construction Environmental Management Framework v3.2 (2017)*;
- Sydney Trains Environment Protection Licence 12208; and
- Downer Environmental Noise and Vibration Standard (DG-ZH-ST069).

The Compliance Matrix in Section 2.2 provides a comprehensive list of compliance requirements, environmental documents and the contract documents.

Table 3 details the legislation and planning instruments considered during development of this Plan.

Table 3: Legislation and Planning Instruments

Legislation	Description	Relevance to this Plan
Environmental Planning and Assessment Act 1979	This Act establishes a system of environmental planning and assessment of development proposals for the State.	The approval conditions and obligations are incorporated into this NVMP.
Protection of the Environment Operations Act 1997 (POEO Act)	This Act includes all the controls necessary to regulate pollution and reduce degradation of the environment, provides for licensing of scheduled development work, scheduled activities and for offences and prosecution under this Act.	This Plan defines how the Project will manage works to comply with this Act. Downer does not intend to use an EPL including Sydney Train's EPL 12208.

2.1. Policies, Standards and Guidelines

Additional guidelines and standards to the management of noise and vibration include:

- NSW EPA *Noise Policy for Industry* (NPfI, 2017);
- NSW EPA *Interim Construction Noise Guideline* (2009);
- NSW EPA *Assessing Vibration – a Technical Guideline* (AVTG, 2006 – for human exposure);
- NSW EPA *Road Noise Policy* (2011);
- Transport for NSW (TfNSW) *Infrastructure and Services Construction Noise and Vibration Strategy* (I&S CNVS, 2018, for supplementary information not provided in the Sydney Metro CNVS);
- TfNSW Roads and Maritime Services *Construction Noise and Vibration Strategy* (RMS CNVS, 2016, for supplementary information not provided in the Sydney Metro CNVS);
- Australian Standard AS 2017-2016 *Acoustics – Recommended design sound levels and reverberation times for building interiors*;
- Australian Standard AS 3671-1989 *Acoustics – Road traffic noise intrusion – Building Siting and Construction (for guidance only; applies to siting of the receiver buildings)*;
- Australian Standard AS/NZS 2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors*;
- Australian Standard AS 2187:2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives*;
- Australian Standard AS/NZS ISO 3100:2009 *Risk Management – Principals and Guidelines*;
- British Standard BS 6472-1992 *Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*;
- British Standard BS 7385:2-1993 *Evaluation and measurement for vibration in buildings Part 2*; and
- German Standard DIN 4150: Part 3-1999 *Structural Vibration Part 3: Effects of Vibration on Structures*.

The primary reference for managing noise and vibration from construction and maintenance is the Environment Protection Authority (EPA) *Interim Construction Noise Guideline* (“ICNG”, 2009).

2.2. Conditions of Approval

The CoA and REMM relevant to this NVMP are listed in Table 4. In accordance with CoA C4, the relevant requirements of the CEMF have also been included in Table 4.

Table 4 also provides a cross reference to demonstrate where the CoA, REMM or CEMF requirement is addressed in this NVMP or other management documents.

Please refer to Appendix A for all other CoA, REMM and CEMF requirements relevant to the development of this Plan.

Table 4: NVMP Compliance Matrix

No.	Requirement	Reference	How addressed?			
Conditions of Approval						
C3	<p>The CEMP Sub-plans must be prepared in consultation with the relevant government agencies identified for each CEMP Sub-plan and be consistent with the CEMF and CEMP referred to in Condition C1:</p> <table border="1"> <tr> <td>(a)</td> <td>Noise and vibration</td> <td>Relevant council(s)</td> </tr> </table>	(a)	Noise and vibration	Relevant council(s)	Section 1.5 Appendix E	This Plan has been prepared in accordance with this condition and describes how Downer proposes to manage noise and vibration during construction of the Project. This plan has been provided to CoCB for consultation.
(a)	Noise and vibration	Relevant council(s)				
C4	The CEMP Sub-plans must be prepared in accordance with the CEMF	This Table	Table 4 demonstrates how this Plan has been prepared in accordance with the relevant requirements of the CEMF.			
C5	Details of all information requested by an agency to be included in a CEMP Sub-plan as a result of consultation, including copies of all correspondence from those agencies, must be provided with the relevant CEMP Sub-Plan.	Section 1.5 Appendix E	This Plan has been provided to CoCB for consultation. Refer to Section 1.5 and Appendix E of this Plan for a summary of consultation.			
C6	Any of the CEMP Sub-plans may be submitted along with, or subsequent to, the submission of the CEMP but in any event, no later than one (1) month before Construction.	Refer to section 1.2 of the CEMP	This Plan was submitted to DPIE (now DPE) for approval prior to submission of the CEMP for approval.			
C7	Construction must not commence until the CEMP and all CEMP Sub-plans have been approved by the Planning Secretary. The CEMP and CEMP Sub-plans, as approved by the Planning Secretary, including any minor amendments approved by the ER must be implemented for the duration of Construction. Where Construction of the CSSI is staged, Construction of a stage must not commence until the CEMP and CEMP Sub-plans for that stage have been approved by the Planning Secretary.	Refer to section 1.2 of the CEMP	Construction has not commenced until the CEMP and all CEMP Sub-plans have been approved by DPE. The CEMP and Sub-plans are being implemented for the duration of construction.			
C8	<p>The following Construction Monitoring Programs must be prepared in consultation with the relevant government agencies identified for each to compare actual performance of Construction of the CSSI against the predicted performance.</p> <table border="1"> <tr> <td>(a)</td> <td>Noise and Vibration</td> <td>Relevant council(s)</td> </tr> </table>	(a)	Noise and Vibration	Relevant council(s)	Section 1.5 Section 8 Appendix E	The Noise and Vibration Monitoring Program has been provided to CoCB for consultation, as part of the NVMP. Refer to Section 1.5 and Appendix E of this Plan for a summary of consultation.
(a)	Noise and Vibration	Relevant council(s)				
C9	Each Construction Monitoring Program must provide:					
	<p>(a) details of baseline data available;</p> <p>(b) details of baseline data to be obtained and when;</p>	Section 8.1	Details of baseline noise and vibration data available, and how and when further baseline data is to be obtained is outlined in Section 8.1 of this Plan.			

No.	Requirement	Reference	How addressed?
	(c) details of all monitoring of the project to be undertaken;	Section 8.2	Details of all monitoring of the Project to be undertaken, including the parameters, frequency and location of monitoring is outlined in Section 8.2 of this Plan.
	(d) the parameters of the project to be monitored;	Section 8.2 Section 8.3	Details of the parameters of the project to be monitored are outlined in Section 8.2 and 8.3 of this Plan.
	(e) the frequency of monitoring to be undertaken;	Section 8.4	Details of the frequency of monitoring to be undertaken is outlined in Section 8.4 of this Plan.
	(f) the location of monitoring;	Section 8.2	Details of the location of monitoring to be undertaken is outlined in Section 8.2 of this Plan.
	(g) the reporting of monitoring results;	Section 8.5	The reporting of monitoring results is outlined in Section 8.5 of this Plan.
	(h) procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and	Section 8.6	The procedures to identify and implement additional mitigation measures where results of noise and vibration monitoring are unsatisfactory are outlined in Section 8.6 of this Plan.
	(i) any consultation to be undertaken in relation to the monitoring programs.	Section 1.5 Section 8.7 Appendix E	Consultation undertaken in relation to the monitoring program is detailed in Sections 1.5, 8.7 and Appendix E of this Plan.
C10	The Construction Monitoring Programs must be developed in consultation with relevant government agencies as identified in Condition C8 of this approval and must include reasonable information requested by an agency to be included in a Construction Monitoring Programs during such consultation. Details of all information requested by an agency including copies of all correspondence from those agencies, must be provided with the relevant Construction Monitoring Program.	Section 1.5 Section 8.7 Appendix E	The Noise and Vibration Monitoring Program has been prepared in accordance with this condition and describes how Downer propose to monitor noise and vibration during construction of the Project. The monitoring program has been provided to CoCB for consultation. Refer to Section 1.5 and Appendix E of this Plan for a summary of consultation.
C11	The Construction Monitoring Programs must be endorsed by the ER and then submitted to the Planning Secretary for approval at least one (1) month before the commencement of Construction.	Section 8	The Noise and Vibration Monitoring Program has been endorsed by the ER. The Noise and Vibration Monitoring Program was submitted to DPIE (now DPE) as part of this NVMP, for approval no later than one month prior to the commencement of Construction .

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No.	Requirement	Reference	How addressed?
C12	Construction must not commence until the Planning Secretary has approved all of the required Construction Monitoring Programs.	Section 8	Construction did not commence until the CEMP and Sub-plans, including relevant construction monitoring programs have been approved by DPIE (now DPE).
C13	The Construction Monitoring Programs, as approved by the Planning Secretary including any minor amendments approved by the ER must be implemented for the duration of Construction and for any longer period set out in the monitoring program or specified by the Planning Secretary, whichever is the greater.	Section 8	The Noise and Vibration Monitoring Program is being implemented for the duration of construction as detailed in Section 8 of this Plan.
C14	The results of the Construction Monitoring Programs must be submitted to the Planning Secretary, and relevant regulatory agencies, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	Section 8.5 Section 9.3	Section 8.5 details the reporting requirements and the frequency required for this reporting.
C15	Where a relevant CEMP Sub-plan exists, the relevant Construction Monitoring Program may be incorporated into that CEMP Sub-plan.	Section 8	The Noise and Vibration Monitoring Program is incorporated in Section 8 of this this Plan.
Construction Environmental Management Framework			
9.2(a)	Principal Contractors will develop and implement a Construction Noise and Vibration Management Plan for their scope of works consistent with the Interim Construction Noise Guidelines (Department of Environment and Climate Change, 2009). The Construction Noise and Vibration Management Plan will include as a minimum:	This NVMP	The NVMP addresses the key requirements of 9.2(a) as follows:
	i. Identification of work areas, site compounds and access points,	Section 3.3	Work areas, site compounds and access points described in this NVMP and presented in the CNVIS Appendix B – Worksite Maps
	ii. Identification of sensitive receivers and relevant construction noise and vibration goals,	Section 3.1 Section 4.1 Section 5	Sensitive receiver types are described in Section 3.1 and are identified individually in the NVMP Appendix B (Land Use Map) and in CNVIS Appendices D, E and F (noise prediction tables). Receiver sensitivity is described in Section 4.1. Construction noise and vibration goals are presented in Section 5 for different receiver types. These are also presented in the CNVIS Appendices D, E and F (noise prediction tables).

No.	Requirement	Reference	How addressed?
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 Strategy (CNVS).	Section 7	CNVS noise and vibration mitigation measures relevant to the scope of works are presented in Section 7 of this Plan.
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 3.3	Section 3.3 of this Plan includes a description of the main phases of work and the main works scenarios expected to generate noise and / or vibration with potential to impact on surrounding receivers.
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 7.4 Section 8.2.2 Section 8.2.3	Section 7.4 describes vibration controls to minimise vibration impacts, and Section 8.2.2 and Section 8.2.3 describe vibration monitoring and building condition survey requirements. Blast program is not applicable to the proposed works.
vi.	Community notification provisions specifically in relation to blasting	Section 7.5	Community notification requirements are covered in Section 7.5 (Community Consultation and Management) and 7.11 of this Plan (Additional Mitigation Measures which include community notification requirements based on predicted noise levels). Blast program is not applicable to the proposed works.
vii.	The requirements of any applicable EPL conditions.	Section 2.3 Section 5.1	Not applicable. Refer to Section 2.3.
viii.	Additional requirements in relation to activities undertaken 24 hours of the day, 7 days per week.	Section 5.1	Section 5.1 of this Plan describes permissible hours of work under the Conditions of Approval (for works carried out under a rail possession). 24-hours a day, 7-days a week work is not anticipated for the proposed Station upgrade works.

No.	Requirement	Reference	How addressed?
ix.	Pre-construction compliance requirements and hold points.	Section 1.5 Section 9.1 Section 8.2.3 Section 8.2.2	Section 1.5 and Section 9.1 of this Plan describe hold points for NVMP and Noise and Vibration Monitoring Plan approvals which are required prior to carrying out the works covered by the NVMP. Section 8.2.3 requires that Condition or Dilapidation surveys are required in any building or structure which is inside the recommended Minimum Working Distance for vibration-generating activities. These surveys must be carried out prior to commencement of the vibration-generating works. Section 8.2.2 requires that “site-law” vibration propagation measurements are carried out at the commencement of vibration-generating works, to ensure that the Minimum Working Distances applied in the vibration assessment are suitable.
x.	The responsibilities of key project personnel with respect to the implementation of the plan.	Section 2.4	Roles and responsibilities are listed in Section 2.4 of this Plan.
xi.	Noise monitoring requirements.	Section 8 Section 7.12	Section 8 of this Plan presents noise monitoring requirements for obtaining additional baseline noise data (if required), plant noise audits (as required or requested during the project), and general environmental noise monitoring in accordance with the CNVS Additional Mitigation Measures Matrix (Section 7.12).
xii.	Compliance record generation and management.	Section 9.3 Section 7.5 Section 8.5	Section 9.3 describes requirements for record-keeping. Section 7.5 also describes requirements for keeping records of complaints and community consultation. Section 8.5 describes requirements for noise and vibration monitoring reports.
xiii.	Community consultation requirements.	Section 7.5 Section 7.11	Section 7.5 describes community consultation requirements Section 7.11 includes Additional Mitigation Measures which include community notification requirements based on predicted noise levels.

No.	Requirement	Reference	How addressed?
	xiv. An Out of Hours Works Protocol applicable to all construction methods and sites.	Section 7.6 Appendix D	Section 7.6 refers to the approved Sydney Metro City and Southwest Out of Hours Works Strategy/Protocol. A copy of Sydney Metro's Out of Hours Works Application (to be utilised in accordance with the Strategy/Protocol) is provided in the Appendix D.

2.3. Environment Protection Licence

At this stage, Downer has not sought an Environment Protection Licence (EPL) from NSW Environment Protection Authority (EPA).

If Downer applies for an EPL for the Project, then this is administered by the EPA and may have different or additional noise and vibration management conditions to the CoAs. In this case, the Project’s NVMP and CNVIS will be updated to incorporate the requirements of the EPL.

The works will be managed in accordance with the railway track maintenance clauses presented in the table in Appendix A.

2.4. Roles and responsibilities

The roles and responsibilities of key Downer personnel (and the ER) with respect to noise and vibration management are as shown in Table 5.

Table 5: Roles and Responsibilities

Roles	Responsibilities
Project Director (Project Leader)	<ul style="list-style-type: none"> Ensure that sufficient resources are allocated for the implementation of this NVMP; Ensure all appropriate noise and vibration mitigation measures are implemented; Authorise cessation of Construction activities on-site if exceedances are identified, in accordance with this NVMP; and Authorise all monitoring reports and any revisions to this NVMP.
Site Foreman (Site Superintendent)	<ul style="list-style-type: none"> Oversee the overall implementation of this NVMP; Ensure all appropriate noise and vibration mitigation measures are implemented; Ensure works occur within standard construction hours unless the appropriate out of hours works approval is in place; and Manage deliveries to mitigate noise impacts.
Project Environment Manager	<ul style="list-style-type: none"> Oversee the implementation of this NVMP; Consider and advise senior management on compliance obligations; Ensure that the outcomes of compliance monitoring / incident reporting are systematically evaluated as part of ongoing management of construction activities; Ensure all appropriate noise and vibration mitigation measures are implemented; Where standard mitigation measures are deemed insufficient, undertake reasonable steps to manage adverse impacts and implement all additional measures; Authorise cessation of Construction activities on-site if exceedances are identified, in accordance with this NVMP; and Ensure Construction activity records/ monitoring records/incident reports are kept and maintained on-site.
Communication and Stakeholder Relations Manager	<ul style="list-style-type: none"> Leadership and management of the Communications, Stakeholder and Community Relations Team; Build and maintain effective working relationship with Sydney Metro’s representative and Stakeholder and Community Liaison team; Develops and oversees the implementation of the Contract Specific Community Communication Strategy and Sub-plans; Responsible for a stakeholder and community relations induction and training program for all personnel involved in the performance of the Project;

Roles	Responsibilities
	<ul style="list-style-type: none"> • Approves the Communications, Stakeholder and Community Relations team roles, role descriptions and responsibilities; • Ensures the Contract Specific Community Communications Strategy and key activities are integrated into the project schedule; • Attends the Sydney Metro led Communications Management Control Group and reports on activities, strategies and issues; • Attends the monthly Project Management Review Group meeting to discuss project status and issues; • Issues and crisis management; • Manages media issues and acts as media spokesperson for the Project (subject to media protocols); • Required to be on call 24 hours based on the team rotation; and • Liaise directly with the Independent Environment Representative as required and where appropriate to facilitate any environmental management requirements, including those identified within the Planning Approvals.
<p>Community Place Manager</p>	<ul style="list-style-type: none"> • Build and maintain effective working relationship with community, businesses, and stakeholders; • Support the successful delivery of the Contract Specific Community Communication’s Strategy and requirements; • Implementation of the Contract Specific Community Communications Strategy and any relevant Sub-plans. • Establish effective working relationships with local stakeholder to support the effective delivery of the Project; • Required to be on call 24 hours based on the team rotation to respond to enquiries and complaints; • Review, approve and oversee the development and distribution of all notification, newsletter, social media, photography, and other communication material; and • Maintain the Consultation Manager database and generate reports as required.
<p>Site personnel and Subcontractors</p>	<ul style="list-style-type: none"> • Understand and implement mitigation as required in the NVMP and any additional required measures identified during Construction; and • Participate in (or conduct if authorised) relevant training to implement the requirements of this NVMP.
<p>Downer’s Noise and Vibration Monitoring Personnel (incl. Acoustic Consultants)</p>	<ul style="list-style-type: none"> • Responsible for carrying out noise and vibration monitoring to support the contractor and in accordance with the construction noise and vibration monitoring plan. Also responsible for updating the CNVIS and NVMP including updated noise predictions as required; • Undertake relevant training where required, to implement this NVMP; • Ensure regular maintenance and calibration of monitoring equipment; and • Ensure all relevant monitoring quality/control assurance procedures are effectively implemented.
<p>Independent Environmental Representative</p>	<ul style="list-style-type: none"> • Receive and respond to communication from the Planning Secretary in relation to the environmental performance of the CSSI; • Consider and inform the Planning Secretary on matters specified in the terms of this approval; • Consider and recommend to the Proponent any improvements that may be made to work practices to avoid or minimise adverse impact to the environment and to the community; • Review documents identified in Conditions C1, C3 and C8 and any other documents that are identified by the Planning Secretary, to ensure they are consistent with requirements in or under this approval and if so:

Roles	Responsibilities
	<p>(i) make a written statement to this effect before submission of such documents to the Planning Secretary (if those documents are required to be approved by the Planning Secretary), or</p> <p>(ii) make a written statement to this effect before the implementation of such documents (if those documents are required to be submitted to the Planning Secretary for information or are not required to be submitted to the Secretary);</p> <ul style="list-style-type: none"> • Regularly monitor the implementation of the documents listed in Conditions C1, C3 and C8 to ensure implementation is being carried out in accordance with the document and the terms of this approval; • As may be requested by the Planning Secretary, assist the Department in the resolution of community complaints; • Consider any minor amendments to be made to the documents listed in Conditions C1, C3 and C8 and any document that requires the approval of the Planning Secretary that comprise updating or are of an administrative or minor nature and are consistent with the terms of this approval and the documents listed in Conditions C1, C3 and C8 or other documents approved by the Planning Secretary and, if satisfied such amendment is necessary, approve the amendment. This does not include any modifications to the terms of this approval; and • Prepare and submit to the Planning Secretary and other relevant regulatory agencies, for information, an Environmental Representative Monthly Report detailing the ER’s actions and decisions on matters for which the ER was responsible in the preceding month. The Environmental Representative Monthly Report must be submitted within seven (7) days following the end of each month for the duration of the ER’s engagement for the CSSI.

It is noted that the site team, including Downer’s Environment Manager, Environmental Coordinator, Construction Manager and Site Foreman/Site Superintendent (roles outlined in Section 3.3 of the CEMP) will attend site inspections with the ER upon request.

The ER may request information relating to noise and vibration management from Downer, the primary contact being the Environment Manager.

3. Existing environment and proposed works

3.1. Existing environment

The proposed station upgrade works are to be carried out at Hurlstone Park, Belmore, and Wiley Park Stations. The three stations are located in predominantly suburban residential areas with mixed use near the stations, including commercial, residential, childcare and medical consulting rooms.

For residential receivers, construction noise targets are set relative to existing background noise levels in the local area.

For other receiver types, noise and vibration targets are often set at absolute levels, without reference to the existing environment.

Nearby sensitive receivers have been divided into 3 different noise catchment areas (NCA). The defined noise catchment areas are consistent with those defined in the EIS for the Sydney Metro City & Southwest Sydenham to Bankstown project.

More detailed maps of each NCA can be found in Appendix B of this NVMP.

The Land Use Survey, as required by CoA E18, has identified some buildings with multiple uses such as shop-top residences. No operating theatres or other vibration-sensitive facilities have been identified in the Medical Centres at Wiley Park. The Land Use Survey is being updated as the Project progresses, also in accordance with E18. Any updates to the receiver list including adding new receivers and changing classification types (including presence of vibration-sensitive facilities) are to be included in updates to the CNVIS.

Most commercial receivers in the vicinity of these works are located along the roads surrounding the stations.

Wiley Park Station is near school premises with several buildings classified as educational receivers, and outdoor sports areas classified as active recreation areas.

A large number of the commercial properties are mixed use with residential or other uses above. The CNVS requires that premises with different uses or receiver types should be classified separately. The other sensitive receivers, as defined in the CNVS, that have been identified are presented in Appendix B, and listed in the Project's OCCS.

In order to understand the potential for construction activities to affect structures, the type of structure needs to be identified. All stations between Sydenham to Bankstown are heritage-listed, with either local or state significance. The EIS identifies heritage-listed buildings along the Sydenham to Bankstown route. The locations of heritage-listed buildings and the EIS assessment of vibration impacts are summarised in Table 6. Refer to the Project's Heritage Management Plan (HMP) for further information about these items.

Notwithstanding the EIS assessment of vibration impacts summarised in Table 6 below and in the NVMP assessment in Section 6.4, it is the Contractor's responsibility to re-assess potential impacts on any heritage receiver and determine whether the proposed vibration-generating works have the potential to cause damage to heritage structures or building fabric.

Table 6: List of heritage receivers near the proposed station works

Station area	Location with respect to the project area	Assessed vibration impacts in EIS
NCA 03 – Hurlstone Park Railway Station Group	Within the station project area	Minor potential impacts, closest elements to works may exceed vibration screening levels
NCA 03 – Hurlstone Park Railway Underbridge	> 200m from station project area	Negligible potential impacts
NCA07 – Belmore Railway Station Group	Within the station project area	Minor potential impacts, closest elements to works may exceed vibration screening levels
NCA07 – Post-war bus shelter and lavatories Belmore	Within the station project area	Negligible potential impacts
NCA07 – Federation House (former Station Master's Cottage) Belmore	Within the station project area	Minor potential impacts, closest elements to works may exceed vibration screening levels
NCA 09 – Wiley Park Railway Station Group	Within the station project area	Minor potential impacts, closest elements to works may exceed vibration screening levels
NCA 09 – Inter-war Water Pumping Station, Wiley Park	Adjacent to station project area	Negligible potential impacts

In accordance with REMM NVC4 where vibration screening levels are predicted to be exceeded at heritage items, condition assessments which consider the specific heritage values of the structure will be undertaken by Downer in consultation with a heritage specialist (refer Section 8.2.3). This assessment is to ensure heritage fabric is monitored and managed during vibration intensive activities.

3.2. Existing noise levels

Construction noise management levels (NML) at residential receivers are set relative to existing background noise levels, measured in the absence of construction activities.

Non-residential NML are absolute levels, but it can be informative to understand the existing ambient noise conditions at both residential and non-residential receivers, when assessing construction noise impacts.

For example, receivers in areas with high ambient noise levels may have well-designed windows, doors and roofing to control noise intrusion. This is particularly true of buildings affected by aircraft noise and new residential buildings which have been built near major road or rail corridors in accordance with Infrastructure State Environment Planning Policy (2007) requirements.

Building envelope acoustic performance may be considered for receiver-specific impact assessments to determine suitable additional mitigation measures for high-noise works. It is the responsibility of the Contractor to ascertain whether residential or non-residential noise-sensitive receivers have high performance building envelope attenuation. Sydney Metro and

the Contractor are to review and agree on any adjustments to be made to Additional Mitigation Measures which are offered to any receivers with high performance building envelope (refer to Section 7.12).

The background noise levels along the Sydenham to Bankstown route have been measured by SLR Consulting Australia (SLR) to support the EIS noise impact assessment. The NCA described in the EIS report have been adopted for this NVMP and the associated CNVIS for consistency.

In some cases, this NVMP and the associated CNVIS have broken down an NCA into two locations, based on unattended measurement locations presented in the EIS which better represent areas near stations. The ambient and background noise levels are all taken from SLR's noise logger locations used for the EIS.

Measured RBL and ambient noise levels (L_{Aeq}) are presented as dB(A) values in Table 7.

Table 7: Measured ambient and background noise levels

	Day 7am – 6pm		Evening 6pm – 10pm		Night 10pm – 7am	
	RBL	L _{Aeq}	RBL	L _{Aeq}	RBL	L _{Aeq}
NCA 03 – Hurlstone Park (3 Commons Street Hurlstone Park, Hurlstone Park Station)	38	56	38	53	34	49
NCA 07 – Belmore (10 Acacia Street Belmore, Belmore Station)	41	49	41	47	35	46
NCA 09 – Wiley Park (5 Shadforth Street Wiley Park, Wiley Park Station)	44	52	44	51	36	49

3.3. Proposed construction works

The likely works scenarios, locations, plant and duration are presented in the detailed works plan tables in the CNVIS associated with this NVMP.

The tables also provide the sound power level in dB(A) assumed for each plant item, and the % on time for the plant during the assessment interval of 15 minutes.

Construction works associated with the proposed station upgrades are expected to run from March 2021 to April 2023. As construction works will occur in the Sydney Trains operational rail corridor or station precincts, they will mostly take place during rail possessions overnight, on weekends, and in some cases over extended periods of more than one week.

A detailed description of the works has been provided in Section 1 of the CEMP.

The main plant and equipment expected to be used for construction include bobcats, compressors, concrete pumps, concrete trucks / agitators, diamond saws, excavators, franna crane, generators, hand tools, mobile cranes (50 tonnes), piling rigs (bored), rollers (non-vibratory), scissor lifts, semi-trailers, trucks, water tankers and welding equipment.

The Project’s proposed work areas as modelled in SoundPlan are shown in Appendix C.

Access gates to the rail corridor are located at:

- Hurlstone Park Station:
 - Off Railway St – Main access point; and
 - Off Floss St Carpark – Secondary access (Only available in ARTC Possessions).
- Belmore Station:
 - Off Tobruk Ave Carpark – City-end Down-side access;
 - Off Redman Pde – City-end Up-side access;
 - Off Bridge Rd Compound – Country-end Down-side access; and
 - Off Railway Pde – Country-end Up-side access.

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- Wiley Park Station:
 - Off The Boulevarde – Down-side access;
 - Off Shadforth St – Up-side access; and
 - Off Cornelia St – Country-end Up-side access.

Table 8: Proposed Construction Works with typical worst-case Sound Power Levels (SWL, dBL_{Aeq,15min})

Activity and location / NCA / indicative Stage of works	Details	OOH	SWL (dBL _{Aeq,15min})
	Main Plant		
Hurlstone Park NCA 03 Scenario 1 Early Works	Chainsaw , mulcher / chipper, bobcat, 13T excavator, 2T dump truck / tipper, Core drill , borehole kit	OOH+std Core drill & borehole kit std hours	110-118dB(A) SWL With chainsaw and mulcher: 118+5dB(A) With core drill / demo saw: 115+5dB(A)
Hurlstone Park NCA 03 Scenario 2 Main Works	5-13T excavator, power tools, 2T dump truck / tipper, road / demo saw , vacuum truck, concrete agitator + pump, smooth drum / pad foot roller	Std hours	104-115dB(A) SWL
Hurlstone Park NCA 03 Scenario 3 Main Works	HIAB truck, power tools, 5-13T excavator, concrete truck, 2T bobcat, 6T dump truck, Franna, 80-250T mobile crane, EWP, forklift	Std hours	104-115dB(A) SWL
Hurlstone Park NCA 03 Scenario 4 Main Works	5-13T excavator, 2T bobcat, dump truck, HIAB truck, power tools, hydrema, jackhammer , EWP, crane, road / demo saw	OOH + Std	104-118dB(A) SWL With jackhammer: 115+5dB(A) With road saw: 118+5dB(A)
Hurlstone Park NCA 03 Scenario 5 Main Works	5-13T excavator, dump truck, small bored piling rig, concrete pump + agitator, jackhammer , daymaker, hydrema, road / demo saw , vacuum truck	OOH + Std	111-120dB(A) SWL With road saw: 12+5dB(A) With jackhammer: 117+5dB(A)
Hurlstone Park NCA 03 Scenario 6 Main Works	EWP, power tools, jackhammer , crane, concrete pump + agitator	Std hours	104-115dB(A) SWL With jackhammer: 115+5dB(A)
Hurlstone Park NCA 03 Scenario 7	HIAB truck, 13T excavator with bucket/ hammer / auger, dump truck, concrete	OOH+std	114-118dB(A) SWL With excavator hammer: 118+5dB(A)

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Activity and location / NCA / indicative Stage of works	Details	OOH	SWL (dBL _{Aeq15min})
	Main Plant		
Main Works	truck, concrete boom / pump, shotcrete machine, EWP, hydrema, soil nail drill, grouting machine		
Hurlstone Park NCA 03 Scenario 8 Main Works	Franna, 350T crane, EWP, power tools, Franna, concrete agitator + pump, generator	OOH + Std hours	105-113dB(A) SWL
Hurlstone Park NCA 03 Scenario 9 Main Works	2T bobcat with profiler, dump truck, 13T excavator, smooth drum / rubber wheel roller, concrete truck, concrete boom/line pump	OOH + Std hours	105-114dB(A) SWL
Hurlstone Park NCA 03 Scenario 10 Main Works	2.5-8T excavator, dump truck, power tools, 80T crane, concrete agitator + pump	Std hours	104-112dB(A) SWL
Hurlstone Park NCA 03 Scenario 11 Main Works	13T excavator flatbed truck, dump truck, power tools, HIAB truck	Std hours	107-110dB(A) SWL
Belmore NCA 07 Scenario 1 Early Works	Chainsaw , mulcher / chipper, bobcat, 13T excavator, 2Tdump truck / tipper, Core drill / demo saw , borehole kit	OOH+std	110-118dB(A) SWL With chainsaw and mulcher: 118+5dB(A) With core drill / demo saw: 115+5dB(A)
Belmore NCA 07 Scenario 2 Main Works	5-13T excavator, power tools, 2T dump truck / tipper, road / demo saw , vacuum truck, concrete agitator + pump, smooth drum / pad foot roller	Std hours	111-118dB(A) SWL With road saw: 115+5dB(A)
Belmore NCA 07 Scenario 3 Main Works	HIAB truck, power tools, 5-13T excavator, concrete truck, 2T bobcat, 6T dump truck, Franna, 80-250T mobile crane, EWP, forklift	OOH + std hours Vacuum truck std hours	104-115dB(A) SWL
Belmore NCA 07 Scenario 4 Main Works	5-13T excavator, 2T bobcat, dump truck, HIAB truck, power tools, hydrema, jackhammer , EWP,	Std hours	104-118dB(A) SWL With jackhammer: 115+5dB(A) With road saw: 118+5dB(A)

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Activity and location / NCA / indicative Stage of works	Details	OOH	SWL (dBL _{Aeq15min})
	Main Plant		
	crane, road / demo saw		
NCA 07 – Belmore Scenario 5 Main Works	5-13T excavator, dump truck, small bored piling rig, concrete pump + agitator, jackhammer , daymaker, hydrema, road / demo saw , vacuum truck	OOH + Std	111-120dB(A) SWL With road saw: 12+5dB(A) With jackhammer: 117+5dB(A)
NCA 07 – Belmore Scenario 6 Main Works	EWP, power tools, jackhammer , crane, concrete pump + agitator	OOH + Std	104-115dB(A) SWL With jackhammer: 115+5dB(A)
NCA 07 – Belmore Scenario 7 Main Works	HIAB truck, 13T excavator with bucket/ hammer /auger, dump truck, concrete truck, concrete boom / pump, shotcrete machine, EWP, hydrema, soil nail drill, grouting machine	OOH + std hours	114-118dB(A) SWL With excavator hammer: 118+5dB(A)
NCA 07 – Belmore Scenario 8 Main Works	Franna, 350T crane, EWP, power tools, Franna, concrete agitator + pump, generator	Std hours	105-113dB(A) SWL
NCA 07 – Belmore Scenario 9 Main Works	2.5-8T excavator, dump truck, power tools, 80T crane, concrete agitator + pump	OOH + Std hours	104-112dB(A) SWL
NCA 07 – Belmore Scenario 10 Main Works	13T excavator flatbed truck, dump truck, power tools, HIAB truck	Std hours	110dB(A) SWL
NCA 07 – Belmore Scenario 11	13T excavator flatbed truck, dump truck, power tools, HIAB truck	Std hours	107-110dB(A) SWL
Wiley Park NCA 09 Scenario 1 Early Works	Chainsaw , mulcher / chipper, bobcat, 13T excavator, 2T dump truck / tipper, Core drill / demo saw , borehole kit	OOH+std Core drill & bore hole kit in std hours	110-118dB(A) SWL With chainsaw: 118+5dB(A) With core drill: 115+5dB(A)
Wiley Park NCA 09 Scenario 2 Main Works	5-13T excavator, power tools, 2T dump truck / tipper, road / demo saw , vacuum truck, concrete agitator +	OOH + std hours Vacuum truck std hours	104-118dB(A) SWL With road saw: 118+5dB(A)

(Uncontrolled when printed)

Activity and location / NCA / indicative Stage of works	Details	OOH	SWL (dBL _{Aeq15min})
	Main Plant		
	pump, smooth drum / pad foot roller		
Wiley Park NCA 09 Scenario 3 Main Works	HIAB truck, power tools, 5-13T excavator, concrete truck, 2T bobcat, 6T dump truck, Franna, 80-250T mobile crane, EWP, forklift	Std hours	104-115dB(A) SWL
Wiley Park NCA 09 Scenario 4 Main Works	5-13T excavator, 2T bobcat, dump truck, HIAB truck, power tools, hydrema, jackhammer , EWP, crane, road / demo saw , 5-13T excavator, 2T bobcat, dump truck, HIAB truck, power tools, hydrema	OOH + Std	104-118dB(A) SWL With jackhammer: 115+5dB(A) With road saw: 118+5dB(A)104-113dB(A) SWL
Wiley Park NCA 09 Scenario 5 Main Works	HIAB truck, 5-13T excavator with bucket/ hammer / auger, dump truck, concrete truck, concrete boom / pump, shotcrete machine, EWP, hydrema, soil nail drill, grouting machine, trench roller, plate compactor	OOH + Std	111-118dB(A) SWL With excavator hammer: 118+5dB(A)
Wiley Park NCA 09 Scenario 6 Main Works	HIAB truck, 13T excavator with bucket/ hammer / auger, dump truck, concrete truck, concrete boom / pump, EWP, shotcrete machine, soil nail	OOH + std hours	114-118dB(A) SWL With excavator hammer: 118+5dB(A)
Wiley Park NCA 09 Scenario 7 Main Works	2T bobcat with profiler, dump truck, 1.5-13T excavator, smooth drum / rubber wheel roller, concrete truck + pump, dump truck, soil nail, hydrema	OOH + Std hours	105-114dB(A) SWL
Wiley Park NCA 09 Scenario 8 Main Works	2.5-13T excavator, dump truck, power tools, HIAB truck, EWP, Franna, 80-220T crane	Std hours	104-110dB(A) SWL
Wiley Park NCA 09 Scenario 9	5-13T excavator flatbed truck, dump truck, power tools, HIAB truck	Std hours	107-110dB(A) SWL

(Uncontrolled when printed)

Activity and location / NCA / indicative Stage of works	Details	OOH	SWL (dBL _{Aeq15min})
	Main Plant		
Main Works			

4. Aspects and potential impacts

Refer to Appendix C of the CEMP for the risk assessment prepared for this Project.

When assessing and managing noise and vibration due to construction activities, the following general considerations apply:

- Airborne noise levels generated by the works, and how audible or intrusive they are at noise-sensitive receivers (both internal and external noise level may need to be assessed);
- Ground-borne or structure-borne noise, which is related to vibration energy being transferred through the ground and / or structures and being re-radiated as audible sound. Typically ground-borne noise is assessed inside buildings, while structure-borne noise may be a consideration inside buildings as well as externally (for example, if a structure radiates sound which is audible in the open environment, such as structure-radiated noise from a bridge or viaduct); and
- Ground borne or structural vibration, which is transmitted through the ground and / or structures. Humans can feel vibration at relatively low levels, and human comfort is an important consideration for the management of ground-borne vibration. At much higher levels, vibration can be associated with damage to structures, and even minor cosmetic damage such as development of cracks is to be avoided where possible. Other potentially vibration-sensitive items include highly vibration-sensitive equipment such as medical imaging equipment, or underground services such as buried pipes.

4.1. Receiver sensitivity

The sensitivity of the receiver to noise and vibration depends on the receiver type. This means that the identification of the receiver type is important to any noise and vibration assessment.

Each receiver in the NCA is identified as falling into one of the following categories:

- Commercial
- Educational
- Industrial
- Mixed residential/commercial
- Residential
- Place of Worship
- Medical facilities
- Other sensitive receivers such as Public Buildings

These receivers are identified on Environmental Control Maps and are included in the SoundPlan model which has been used for construction noise predictions.

Note that noise and vibration management levels assigned to receiver types are based on statistical research, however there is a range in noise and vibration sensitivity between individuals.

Furthermore, in 2020 there has been an increased number of people working from home, which may mean that general assumptions about day-time use of homes no longer apply.

During construction phase, active community engagement will assist in understanding local sensitivities to noise and vibration. Community engagement will be undertaken during the construction phase of the Project, in accordance with the OCCS.

For the vibration assessment, heritage-listed buildings and structures within the proximity of the Project have been identified, so that they can be inspected to understand if they are structurally unsound. This affects the vibration management level which applies to the heritage-listed buildings or structures.

5. Construction noise and vibration criteria

5.1. Construction hours

The CoAs acknowledge the need to carry out works outside standard construction hours.

CoA E19 defines standard Sydenham to Bankstown hours of work as:

- Monday to Friday 7am to 6pm and Saturdays 8am to 6pm;

Exceptions for highly noise intensive work (refer Section 5.4) are in accordance with E24:

- 8am to 6pm Monday to Friday and 8am to 1pm Saturday.

In accordance with CoA E20, notwithstanding CoA E19 and E24, work may be undertaken outside the hours specified in the following circumstances:

- For the delivery of materials required by the NSW Police Force or other authority for safety reasons; or
- 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; or
- Where different construction hours are permitted or required under an EPL in force in respect of the Project; or
- Work approved under an Out of Hours Works Protocol for work not subject to an EPL as required by CoA E25; or
- Construction that causes $L_{Aeq(15\text{minute})}$ noise levels:
 - No more than 5dB(A) above the rating background level at any residence in accordance with the ICNG, and
 - No more than the 'Noise affected' noise management levels specified in Table 3 of the ICNG at other sensitive land uses, and
 - Continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of AVTG, and
 - Intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of AVTG.
- Where a negotiated agreement has been reached with a substantial majority of sensitive receivers who are within the vicinity of and may be potential affected by the particular Construction, and the NML and/or limit for ground-borne noise and vibration (human comfort) cannot be achieved. All agreements must be in writing and a copy forwarded to the Planning Secretary at least one week before the commencement of activities.

In accordance with CoA E21, on becoming aware of the need for emergency work in accordance with Condition E20(b), Downer must notify the ER and the EPA (if a EPL applies) of the need for that work. Downer will provide the notification in the form of a written email or text message to Sydney Metro, the ER and the EPA (if an EPL applies). Downer will notify all noise and/or vibration affected sensitive receivers of the likely impact and duration of those works within two hours of the commencement of emergency works.

Within 24 hours of completion of any emergency works, Downer will provide a written emergency work report to Sydney Metro. The emergency work report will include but not limited to:

- Date, time, duration and cause of the emergency,
- Description of emergency work undertaken,
- Mitigation measures implemented to address the impacts of the emergency work, and
- Actions/Measures taken or to be taken to prevent or mitigate recurrence of the emergency. If there are no appropriate actions/measures to be taken, explanation is to be provided as to why.

This project does require evening and night work throughout the construction program, particularly to reduce impacts on the operational Sydney Trains railway along the Sydenham to Bankstown route. The CSSI 8256 applies to works carried out under a rail possession.

To comply with applicable OOH CoA and REMMs, any works planned to occur outside standard work hours must be assessed and approved in advance in accordance with Sydney Metro’s approved City and Southwest Out of Hours Works Strategy/Protocol.

For works conducted outside standard construction hours, the following time periods are considered in order of least noise-sensitive to most noise-sensitive for typical residential receivers:

- Sunday day 8am to 6pm
- Monday to Sunday evening 6pm to 10pm
- Monday to Sunday night before midnight 10pm to midnight
- Monday to Friday early morning “shoulder period” 6am to 7am
- Monday to Sunday night after midnight 10pm to 6am Monday to Friday, or 10pm to 8am Saturday and Sunday – most noise sensitive

These priorities are generally represented in the CoAs clauses which relate to restrictions on high impact works.

The break-down of noise-sensitive periods is a useful tool for planning out of hours works using Sydney Metro’s City and Southwest Out of Hours Works Strategy/Protocol. Noise impacts can be effectively managed by determining the most practical sequence of events which can also limit noisier activities to less noise-sensitive times.

5.2. General construction noise and vibration criteria

The Sydney Metro CNVS is applied for deriving construction noise and vibration management levels for Sydney Metro projects.

The primary reference for managing noise and vibration from construction and maintenance is the ICNG. Where specific receiver types are not explicitly assigned an NML in the ICNG, Sydney Metro has derived NMLs with reference to Australian Standard AS/NZS 2107:2016 *Acoustics - Recommended design sound levels and reverberation times for building interiors* and Vibration Management Levels (VMLs) in accordance with relevant guidelines and standards. Refer to Section 2.1 for a list of guidelines and standards referenced in the CNVS.

5.3. Airborne construction noise

The three primary noise metrics used to describe construction noise emissions in the modelling and assessments are:

- L_{A1(1minute)}** The typical ‘maximum noise level for an event’, used in the assessment of potential sleep disturbance during night-time periods. Alternatively, assessment may be conducted using the L_{Amax} or maximum noise level
- L_{Aeq(15minute)}** The ‘energy average noise level’ evaluated over a 15-minute period. This parameter is used to assess the potential construction noise impacts.
- L_{Aeq(15/9hr)}** The ‘energy average noise level’ evaluated over a 15-hour Day (7am to 10pm) or 9-hour Night (10pm to 7am) period. This parameter is used to assess the potential construction noise impacts from road traffic noise.
- L_{A90(11/4/9hr)}** The ‘background noise level’ in the absence of construction activities. This parameter represents the average minimum noise level during the 11-hour 7am to 6pm daytime, 4-hour 6pm to 10pm evening and 9-hour 10pm to 7am night-time periods respectively. The L_{Aeq(15minute)} construction noise management levels are based on the L_{A90} background noise levels.

The subscript ‘A’ indicates that the noise levels are filtered to approximate normal human hearing characteristics (A weighted).

Table 9 sets out the ICNG airborne NML for residential receivers and how they are to be applied. The noise management levels are based on the RBL in each relevant assessment period. RBL is the overall single-figure background noise level derived from measurements in each relevant assessment period (as defined in the EPA “Noise Policy for Industry” dated October 2017).

Sydney Metro recognises that there are periods during the night (10pm to 7am) when ambient noise is elevated, such as from traffic during the 10pm to midnight and 6am to 7am shoulder periods. Residents may be less sensitive to noise at these times due to the ambient noise providing more effective masking than during the quietest; midnight to 6am night-time period.

Noise management levels are external noise levels from construction activity and apply at the property boundary that is most exposed to construction noise. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

Table 9: How noise management levels at residences are derived (external)

Time of Day	Management Level L _{Aeq(15minute)}	How to Apply
Recommended standard hours: Monday to Friday 7.00 am to 6.00 pm Saturday 8.00 am to 6.00 pm	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L _{Aeq(15minute)} is greater than the noise affected level, the proponent would apply all feasible and reasonable work practices to minimise noise.
No work on Sundays or public holidays	Highly noise affected 75 dB	The highly noise affected level represents the point above which there may be strong community reaction to noise. It is not considered a Noise Management Level.

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Time of Day	Management Level $L_{Aeq(15\text{minute})}$	How to Apply
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent would apply all feasible and reasonable work practices to meet the noise affected level.

Table 10 presents airborne NML for non-residential noise-sensitive land uses. The NML apply only when the property is being used, for example classrooms during school hours (including before- and after school activities). Internal noise levels are to be assessed at the centre of the occupied room. External noise levels are to be assessed at the most-affected point within 50 m of the area boundary.

Table 10: NMLs at non-residential sensitive land uses

Land Use	Management Level, $L_{Aeq(15\text{minute})}$ (Applies When Land Use is being Utilised)
Classrooms at schools and other educational institutions, when in use Places of worship, when in use Library, opening hours <i>Hospital wards and operating theatres</i>	Internal noise level 45 dB Equivalent external noise level 55 dB (windows open), or 65 dB (windows closed)
Childcare Centre, when in use	Outside play area External noise level 60 dB Inside play area Internal noise level 45 dB Equivalent external noise level 55 dB (windows open), or 65 dB (windows closed) Inside sleeping area Internal noise level 40 dB Equivalent external noise level 50 dB (windows open), or 60 dB (windows closed)
Active recreation areas (parks, sports grounds or playgrounds)	External noise level 65 dB
Passive recreation areas (such as outdoor grounds used for teaching, outdoor cafes or restaurants)	External noise level 60 dB
Café, Bar, Restaurant, opening hours <i>Hotel Bars and Lounges, Day and Evening</i>	Internal noise level 50 dB Equivalent external noise level 60 dB, windows open, or 70 dB, windows closed
Offices, retail outlets (commercial), when in use	External noise level 70 dB
<i>Hotel Sleeping areas, Night time</i>	<i>Internal noise level 40 dB</i>
<i>Recording Studio, when in use</i>	<i>Internal noise level 25 dB</i>
<i>Theatre / Auditorium, when in use</i>	<i>Internal noise level 30 dB</i>
<i>Industrial premises</i>	<i>External noise level 75 dB</i>

There have been no hospitals, industrial premises, hotels, bars, lounges, recording studios or theatres identified in the vicinity of the proposed station upgrade works. They are listed for

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completeness, but in *italic* font to denote that they are not applicable to this NVMP or the associated CNVIS.

Where internal noise management levels apply, the external equivalent has been derived assuming a 10dB noise reduction is used as a default assumption through a window opened sufficiently to allow natural ventilation through the window.

However, depending on observed and repeatable specific receiver characteristics, alternative external noise management equivalents can be revised as follows:

- Where a building has been constructed or modified to meet the Infrastructure SEPP, and it can be demonstrated or reasonably assumed that the windows are fixed or kept closed, a 20dB noise reduction may be considered. The assessment can be adjusted by decreasing the predicted noise level by 10dB or increasing the NML by 10dB . Sydney Metro and the ER must endorse the application of this revision prior to implementation.
- Higher levels of attenuation may be adopted, if agreed with Sydney Metro and the ER, if site inspections by a qualified acoustic consultant have determined that windows and facades of individual buildings provide a higher level of sound attenuation than 20dB and if it can be demonstrated or reasonably assumed that the windows are fixed or kept closed. In that case, the external noise level presented in the table above can be increased by 15dB or more, depending on the acoustic consultant’s receiver-specific building envelope attenuation advice.
- Residential receivers may have been provided with property treatment, for example, as part of the NSW government roll out of aircraft, road noise or freight rail noise abatement programs, or as a result of pro-active construction noise management (including as a consequence of Condition E32 for this project). In these cases, the noise benefit achieved by the property treatment can be considered in the assessment of construction airborne noise impacts at these individual receivers. It is the Contractor’s responsibility to determine if specific receivers have benefitted from property treatments. Sydney Metro must approve of any modifications to the external residential noise trigger levels for considering Additional Mitigation Measures (refer to Section 7.12).

Based on the background noise levels measured by SLR for the EIS, the applicable airborne NMLs are as presented in Table 11.

Table 11: Project specific residential NML

	Day 7am – 6pm		Evening 6pm – 10pm		Night 10pm – 7am	
	RBL, dBL _{A90} (Day)	NML, dBL _{Aeq} (15min)	RBL, dBL _{A90} (Day)	NML, dBL _{Aeq} (15min)	RBL, dBL _{A90} (Day)	NML, dBL _{Aeq} (15min)
NCA 03 – Hurlstone Park (3 Commons Street Hurlstone Park, Hurlstone Park Station)	38	48 std 43 Sat 1-6pm	38	43*	34	39*
NCA 07 – Belmore (10 Acacia Street Belmore, Belmore Station)	41	51 std 46 Sat 1-6pm	41	46	35	40*

	Day 7am – 6pm		Evening 6pm – 10pm		Night 10pm – 7am	
	RBL, dBL _{A90} (Day)	NML, dBL _{Aeq} (15min)	RBL, dBL _{A90} (Day)	NML, dBL _{Aeq} (15min)	RBL, dBL _{A90} (Day)	NML, dBL _{Aeq} (15min)
NCA 09 – Wiley Park (5 Shadforth Street Wiley Park, Wiley Park Station)	44	54 std 49 Sat 1-6pm	44	49	36	41*

It is noted that the daytime and evening NML is less than, or similar to, the existing ambient noise level in many of the receiver locations near the station worksites. This is not unexpected, but it does mean that any noise monitoring method would need to consider whether the construction noise can be measured above the ambient noise.

In some areas, the existing ambient evening or night-time level is more than 5dB above the NML. These locations are marked with an asterisk (*), as this is relevant to the noise monitoring plan (Section 8).

5.4. High impact noise

High impact noise can be defined in two ways in the context of Sydenham to Bankstown works.

The ICNG defines “highly noise affected” (HNA) levels as exceeding 75dB(A) at residential receivers during daytime hours. It is common practice to adjust the HNA levels for evening and night-time, by 5 and 10dB respectively. Where predicted noise levels exceed the HNA level, all reasonable and feasible mitigation measures are to be applied to the works.

In practice, this already occurs as Sydney Metro aims to meet the lower NML where reasonable and feasible. Residual impacts that cannot be eliminated through engineering controls are managed through timing of works and application of Additional Mitigation Measures (refer Section 7.11).

REMM NVC10 requires high noise and vibration generating activities including ballast tamping may only be carried out in continuous blocks, not exceeding 3 hours each, with minimum respite periods of one hour between each block and these works. CoA E24 also imposes additional restrictions on the timing of “Highly Noise Intensive Works”.

There is no definition in the CoA CSSI 8256 for “Highly Noise Intensive Works” mentioned in Condition E24. Sydney Metro has adopted the following definition for “Highly Noise Intensive Works”, based upon definitions within CoA issued by NSW Department of Planning, Industry and Environment (now DPE) for other CSSI projects. For the purpose of this NVMP, Highly Noise Intensive Works are construction activities which are defined as annoying under the ICNG, these include:

- Use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work;
- Grinding metal, concrete or masonry;
- Rock drilling
- Line drilling;

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- Vibratory rolling;
- Rail tamping and regulating;
- Bitumen milling or profiling;
- Jackhammering, rock hammering or rock breaking; and
- Impact piling.

For the station works, the following plant and activities have therefore been identified as being potentially used and therefore subject to timing restrictions in accordance with CoA E24:

- Jackhammering, rock hammering or rock breaking;
- Road or concrete / diamond saw; and
- Vibratory rolling – note that vibratory rolling is not currently proposed. Smooth drum rollers and pad foot rollers are listed in the preferred list of plant provided by Sydney Metro.

Restrictions on timing of highly noise intensive or high noise impact generating works are summarised in Table 12.

Table 12: Restrictions on highly noise intensive works

	Conditions apply if the predicted noise exceeds the NML		
	CoA E24	EPL 12208	REMM NVC6
Precedence	Except as permitted by circumstances listed in CoA E20	Using CSSI not EPL 12208	CoA override REMM if they are more onerous
Timing – general restrictions	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	O13.2 The licensee may undertake maintenance activities outside of the hours specified in Condition O13.1: a) to provide safe and reliable train services or a safe working environment; [...] c) for the delivery of oversized plant or structures that require special arrangements or authorisation to be lawfully transported along public roads.	Noise intensive plant would not be used during the night-time period (10pm to 7am) unless: <ul style="list-style-type: none"> • during a weekend rail possession or shut down • a requirement of a road authority, emergency services or Sydney Coordination Office requires works to be undertaken during this period. <i>Interpretation:</i> CoA E24 restrictions on Saturday and Sunday works must be observed, unless there is a weekend rail possession or shutdown applies.
Respite	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. For the purposes of this condition, ‘continuous’ includes any period during which there is less than a one (1) hour respite between ceasing and recommencing any of the work that are the subject of this condition. <i>Interpretation:</i> other works can take place during the 1-hour “respite” time.	No specific requirements.	
Assessment and Notification	Assessment and notification in accordance with Sydney Metro’s CNVS and CCS.	O13.4 Where maintenance activities are undertaken, including outside of the hours specified in Condition O13.1, noise impacts must be managed in accordance with the recommendations in the Interim Construction Noise Guideline (DECCW, 2009), as updated from time to time. The licensee is required to: a) identify noise sensitive receivers that may be affected; b) identify hours of work for the proposed activities;	

	Conditions apply if the predicted noise exceeds the NML		
	CoA E24	EPL 12208	REMM NVC6
		c) identify noise impacts at noise sensitive receivers; d) select and apply reasonable and feasible work practices to minimise noise impacts; and <i>Interpretation:</i> Assessment requirements are in line with the CNVS and this NVMP / CNVIS.	
Notification	Assessment and notification in accordance with Sydney Metro’s CNVS and CCS.	O13.4 e) notify the identified noise sensitive receivers at least 5 days prior to the commencement of maintenance activities undertaken outside of the hours specified in Condition O13.1, except where the licensee first becomes aware of the need to undertake those maintenance activities less than 5 days prior to the proposed commencement date, in which case the notification must be provided as soon as practicable after becoming aware of the need to undertake the maintenance activities. <i>Interpretation:</i> Notification requirements similar to CNVS apart from timing – assume that 7 days’ notice is required per the CNVS to be consistent with other Sydney Metro works.	

5.5. Sleep disturbance

At residential receivers, the ICNG and the RNP require an assessment of sleep disturbance for noise occurring at night (10pm to 7am). Sydney Metro’s CNVS adopts the following approach for assessing sleep disturbance:

- External sleep disturbance screening level of $L_{Amax} > RBL + 15 \text{ dB}$
- External sleep awakening level of 65 dB L_{Amax} (assuming open windows).

If the Sleep Disturbance screening level is not exceeded, then no further review of sleep disturbance is required. If the screening level is exceeded, then the L_{Amax} level is to be compared with the external equivalent Sleep Awakening Level (65dB L_{Amax}).

The Sydney Metro Out-of-hours Works Strategy/Protocol and Out-of-Hours Works Application form consider night-time noise levels in terms of $L_{Aeq(15min)}$ predictions.

While OOHW Application does incorporate sleep disturbance considerations in terms of the emergence of the predicted construction noise above background, additional sleep

disturbance assessments will be made on a case-by-case basis where night-time noise construction levels ($dBL_{Aeq(15min)}$) exceed:

- RBL + 10dB, as this is roughly equivalent to $L_{Amax} > RBL + 15$ for many types of plant / activity; and
- 60 dB(A), as this is roughly equivalent to $L_{Amax} > 65$ dB(A) for many types of plant / activity.

If the Sleep Awakening Level is exceeded, then sleep disturbance is to be reviewed in more detail. This may include consideration of whether windows are open or can be kept closed. If windows can be kept closed, then the External sleep awakening criterion is 75 dBL_{Amax} because it is based on an internal Sleep Awakening noise level.

The aim of sleep disturbance assessments is to determine appropriate mitigation measures. Mitigation measures may involve the use of quieter equipment, relocating equipment, using screens, or changing the timing of the work to a less noise-sensitive time. Refer to Section 7.

5.6. Construction traffic noise

When trucks and other vehicles are operating within the boundaries of the various construction sites, road vehicle noise contributions are included in the overall predicted $L_{Aeq(15minute)}$ construction site noise emissions.

When construction related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site. More detail is provided in the Sydney Metro CNVS.

In addition to the Sleep Disturbance criteria provided in Section 5.5, the RNP refers to Practice Note 3 of the Environment Noise Management Manual (ENMM) for specific impacts from road traffic. The ENMM recommends an evaluation of the number and distribution of night-time pass by events where:

- Construction-related truck event $L_{Amax} - \text{General ambient } L_{Aeq(1hour)} > 15$ dB, and
- Construction-related truck event $L_{Amax} > 65$ dB L_{Amax} .

The ICNG does not provide specific guidance in relation to acceptable noise levels associated with construction traffic. For assessment purposes, guidance is taken from the RNP, which suggests feasible and reasonable noise mitigation measures should be considered where:

- The road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, and
- The resultant road traffic noise level, including construction traffic, exceeds the following road traffic noise criteria in the RNP:
 - 60 dB $L_{Aeq(15hour)}$ day and 55 dB $L_{Aeq(9hour)}$ night for existing sub-arterial roads.
 - 55 dB $L_{Aeq(1hour)}$ day and 50 dB $L_{Aeq(1hour)}$ night for existing local roads.

In addition, night-time road traffic noise due to intermittent maximum noise events, such as truck pass by events, should be assessed against the sleep assessment criteria summarised above.

5.7. Building damage vibration goals

Most commonly specified ‘safe’ structural vibration limits are designed to minimise the risk of threshold or cosmetic surface cracks and are set well below the levels that have potential to cause damage to the main structure.

Sources of vibration that are considered include demolition, excavation, piling, ground treatments (e.g. compaction), construction equipment and road traffic.

Details about the derivation and application of Sydney Metro construction vibration criteria to protect structures are presented in the Sydney Metro CNVS.

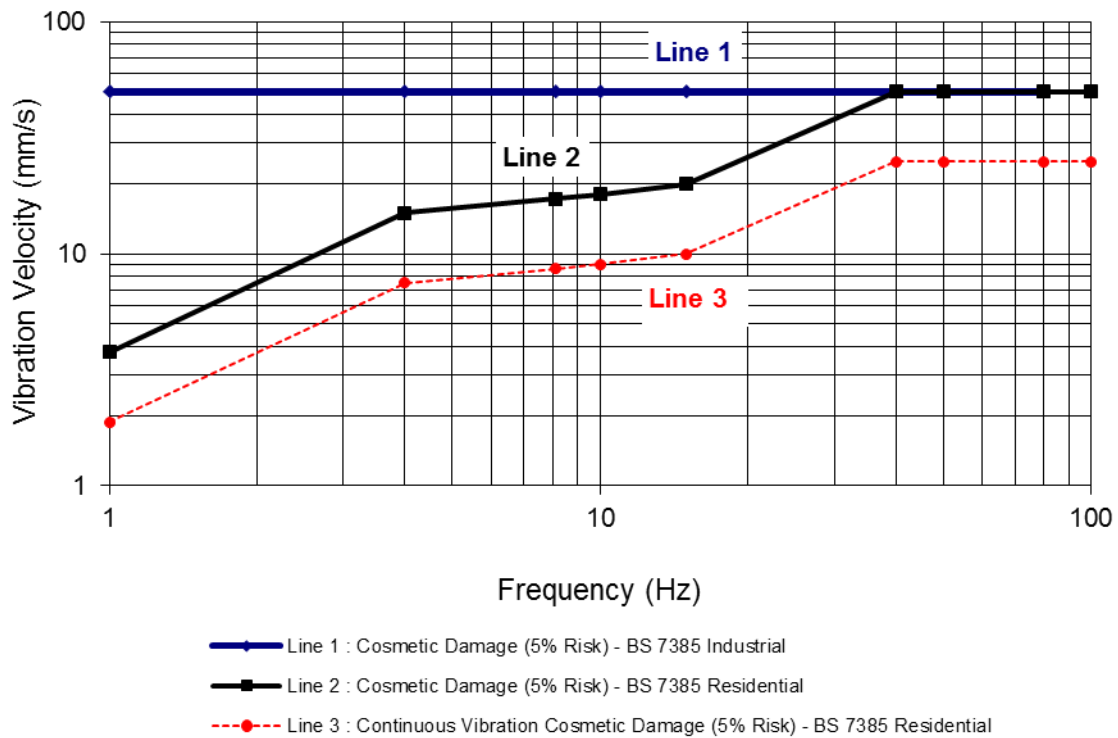
The British Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 13 and graphically in Figure 1. These vibration goals are applicable to relevant structures, building elements or facades with the potential of being affected by vibration impacts.

Table 13: Transient vibration guide values – Minimal risk of cosmetic damage

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

Figure 1: Graph of Transient Vibration Guide Values for Cosmetic Damage



The Standard goes on to state that the vibration values given in Table 13 are less than half of vibration magnitudes at which minor damage is possible, and less than a quarter of the vibration magnitudes at which major damage to a building structure may occur.

It is noteworthy that extra to the guide values nominated in Table 13, the standard states that:

“Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity. This is not inconsistent with an extensive review of the case history information available in the UK.”

Also, that:

“A building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.”

The Standard states that the guide values in Table 13 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings.

Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 13 may need to be reduced by up to 50%.

Most construction activities involving intermittent vibration sources such as rock breakers, vibratory rollers, excavators and the like, produce predominant vibration energy at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range), and have the potential to cause dynamic loading in some structures (e.g. residences). On this basis, a conservative vibration damage screening level per receiver type adopts 50% of the values in Table 13 as listed below:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s
- Heritage structures (structurally sound): 7.5 mm/s
- Heritage structures (structurally unsound): 2.5 mm/s

If a heritage building or structure is found to be structurally unsound (following inspection) a more conservative cosmetic damage criteria (from DIN 4150) would be considered. At construction stage, prior to carrying out works, a structural or condition survey of heritage buildings within 30m of vibration-generating works is required (refer Section 8.2.3).

If the structural or condition survey is not carried out prior to vibration-generating works commencing, then heritage buildings are to be considered “structurally unsound” for the purpose of determining applicable construction-related vibration criteria. This is to adopt a precautionary approach until surveys establish the condition of the building.

At locations where the predicted and/or measured vibration levels are greater than shown above (peak component particle velocity), a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

5.8. Human comfort vibration goals

For vibration, EPA Construction Noise Guideline refers to the EPA Vibration Guideline for assessment of human comfort.

The construction noise and vibration management levels adopted by Sydney Metro represent applicable standards and guidelines. It is important to acknowledge that individual receivers respond to noise and vibration differently. During implementation phase, active community engagement plays a role in understanding individual perception and sensitivity.

The NSW EPA “Assessing Vibration: a technical guideline” dated February 2006 (AVTG) recommends the use of BS 6472-1992 for the purpose of assessing vibration in relation to human comfort.

Vibration dose values are considered appropriate for the assessment of non-continuous vibration sources associated with construction. The vibration dose value depends on both the level and duration of the short-duration vibration event, as well as the number of events occurring during the daytime or night-time period.

The levels highlighted in **bold** in Table 14 are used in Sydney Metro projects as the Vibration Management Level.

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Table 14: Vibration Dose Value (VDV) Ranges which might result in various probabilities of adverse comment within residential buildings, from BS6472-1992

Place and Time	Low Probability of Adverse Comment (m/s ^{1.75})	Adverse Comment Possible (m/s ^{1.75})	Adverse Comment Probable (m/s ^{1.75})
Residential buildings 16 hr day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hr night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Note: For offices / schools and workshops, multiplying factors of 2 and 4 respectively would be applied to the above vibration dose value ranges for a 16 hr day, i.e. 0.8 m/s^{1.75} for offices, educational institutions and places of worship, and 1.6 m/s^{1.75} for workshops.

It is not always practical to measure VDV during construction works, as the calculation relies upon duration, intensity and characteristic frequency of the measured vibration events throughout a workday.

In some cases, it may be necessary to relate to an instantaneous measurement, such as Peak Particle Velocity (PPV). Appendix C of the AVTG provides guidance on relating measurements of continuous and impulsive vibration to PPV. The criteria are included within Table 15.

Table 15: Criteria for exposure to continuous and impulsive vibration – alternative screening level for human comfort measured in real-time

Place and Time	Peak particle velocity (mm/s) – preferred / maximum	
	Continuous vibration	Impulsive vibration ¹
Residential buildings 16 hr day	0.28 – 0.56	8.6 – 17.0
Residential buildings 8 hr night	0.20 – 0.40	2.8 – 5.6
Offices, when in use	0.56 – 1.10	18.0 – 36.0
Workshops, when in use	1.10 – 2.20	18.0 – 36.0

¹ Impulsive vibration must be defined and measured in accordance with the relevant standard. The PPV levels associated with impulsive vibration would be considered to be intolerably high for intermittent and repetitive “impulsive” events, and should be applied to construction works with caution. It is not to be used to set any Alert / Alarm level in a vibration monitoring system used to assess human comfort.

5.9. Vibration affecting sensitive equipment

Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.

No facilities in the vicinity of the proposed station works have been identified as having vibration-sensitive medical or scientific equipment. The following information is provided for reference in case a receiver with vibration-sensitive equipment is identified in future.

Where it has been identified that vibration sensitive scientific and/or medical instruments are likely to be in use inside the premises of an identified vibration sensitive receiver, objectives for the satisfactory operation of the instrument would be sourced from manufacturer’s data. Where manufacturer’s data is not available, generic vibration criterion (VC) curves as published by the Society of Photo-Optical Instrumentation Engineers (Colin G. Gordon – 28 September 1999) may be adopted as vibration goals. These generic VC curves are presented in Sydney Metro’s CNVS.

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The generic VC curves are considered to be conservative. It is beneficial for the project to carry out baseline vibration measurements are carried out at the building where vibration-sensitive equipment is located. If the ambient vibration already exceeds the VC curves, without affecting the equipment operation, then the site-specific sensitive equipment vibration criteria may be reviewed. If the site-specific equipment criteria are reviewed, any changes (i.e. increased levels compared with VC curves) would need to be agreed with the occupant / users of the equipment.

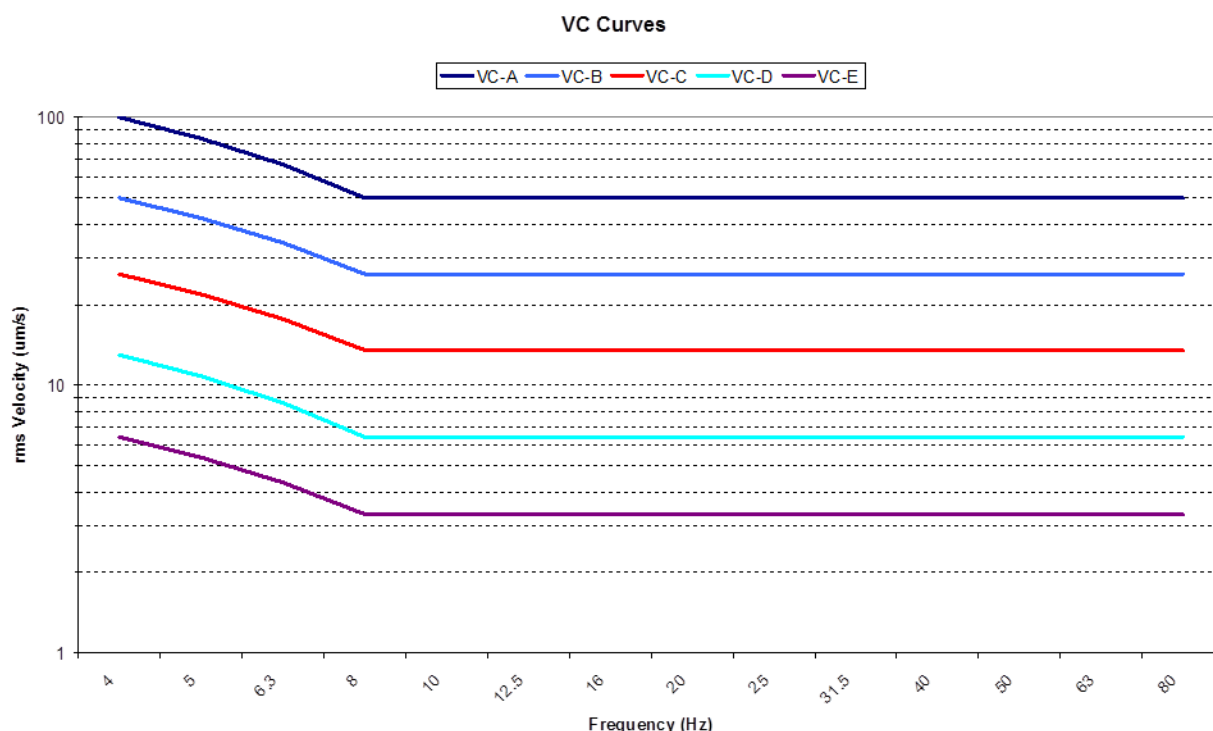
Table 16: Application and Interpretation of generic Vibration Criterion (VC) curves (as shown in Figure 2)

Criterion Curve	Max Level (µm/sec, rms) ¹	Detail Size (microns) ²	Description of Use
VC-A	50	8	Adequate in most instances for optical microscopes to 400X, microbalances, optical balances, proximity and projection aligners, etc.
VC-B	25	3	An appropriate standard for optical microscopes to 1000X, inspection and lithography equipment (including steppers) to 3 micron line widths.
VC-C	12.5	1	A good standard for most lithography and inspection equipment to 1 micron detail size.
VC-D	6	0.3	Suitable in most instances for the most demanding equipment including electron microscopes (TEMs and SEMs) and E-Beam systems, operating to the limits of their capability.
VC-E	3	0.1	A difficult criterion to achieve in most instances. Assumed to be adequate for the most demanding of sensitive systems including long path, laser-based, small target systems and other systems requiring extraordinary dynamic stability.

Note 1: As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz.

Note 2: The detail size refers to the line widths for microelectronics fabrication, the particle (cell) size for medical and pharmaceutical research, etc. The values given take into account the observation requirements of many items depend upon the detail size of the process.

Figure 2: Vibration Criterion (VC) Curves



5.10. Vibration affecting buried utilities and services

Where structures and utilities are encountered which may be considered to be particularly sensitive to vibration, a vibration goal which is more stringent than structural damage goals presented in Section 5.7 may need to be adopted.

Examples of such structures and utilities include:

- Tunnels
- Gas pipelines
- Fibre optic cables

Specific vibration goals would be determined on a case-by-case basis, as the construction of these structures and utilities vary considerably. An acoustic consultant would be engaged by the construction contractor and would liaise with the structure or utility’s owner in order to determine acceptable vibration levels.

The British Standard BS 7385-2:1993 ‘Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from ground-borne vibration’ notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition (British Standard BS 7385-2:1993, p5). Further guidance is taken from the German Standard DIN 4150: Part 3-1999.02 ‘Structural vibration in buildings – Effects on Structures’. Section 5.3 of DIN 4150: Part 3 sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework.

Table 17 presents the initial reference guideline for utilities and other buried pipework to evaluate the effects of short-term vibration impact, for this Sydney Metro NVMP.

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If buried services are encountered for the proposed works, the Contractor must consult with the owner of the services to ensure that they agree with the vibration limit set for the works. An acoustic consultant and structural specialist may need to be involved in the consultation and review process.

Table 17: Transient vibration guide values for buried services – minimal risk of cosmetic damage (BS7385) – peak component particle velocity

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

¹ Rockbreaking / hammering and sheet piling activities have the potential to cause dynamic loading in some structures and it may therefore be appropriate to reduce the transient values by 50%

5.11. Ground-borne noise

Ground-borne (regenerated) noise is noise generated by vibration transmitted through the ground into a structure. Ground-borne noise caused, for example by underground works such as tunnelling, can be more noticeable than airborne noise.

The ground-borne NML adopted by Sydney Metro are provided in the CNVS.

The ICNG nominates ground-borne NML for residences during evening and night only. The internal noise levels are to be assessed at the centre of the most-affected habitable room. Under the ICNG, these ground borne noise management levels only require consideration of mitigation when ground-borne noise levels are higher than airborne noise levels.

Sydney Metro recognises that ground borne noise from some activities, for example by underground works such as tunnelling, can affect residential receivers during the day, and also other sensitive receivers. The following ground-borne noise levels incorporate the ICNG residential evening and night-time noise management levels, and add other receiver types and times for Sydney Metro projects:

- Day (7.00 am to 6.00pm)
Internal Residential: 45 dB $L_{Aeq(15minute)}$
Internal Commercial: 50 dB $L_{Aeq(15minute)}$
- Evening (6.00 pm to 10.00pm)
Internal Residential: 40 dB $L_{Aeq(15minute)}$
Internal Commercial (if in use during Evening hours): 50 dB $L_{Aeq(15minute)}$
- Night-time (10.00 pm to 7.00 am) – typically not occupied, therefore not applicable
Internal Residential: 35 dB $L_{Aeq(15minute)}$

6. Predicted noise and vibration levels

Sydney Metro has provided Sydney Metro's acoustic consultant; Acoustic Studio with:

- Worksite locations for each station included in the Project's works;
- Works scenarios and likely timing of those works scenarios;
- A full list of plant and equipment expected during each works scenario.

Acoustic Studio has reviewed the plant and equipment and made assumptions about likely worst-case scenarios in terms of the number of plant items which might operate at once on the worksite.

It is assumed that works may be carried out at any time of Day / Evening / Night, particularly during rail possessions. Noise predictions are presented in detail in the CNVIS and summarised in this NVMP.

The CNVIS prepared in accordance with CoA E27 and REMM NVC1, predicts noise and vibration levels using more accurate understanding of the works scenarios, duration of each scenario, locations of equipment, timing of the works. These predictions are presented in detail, at each receiver. Where exceedances of management levels are predicted, reasonable and feasible mitigation is recommended for consideration by the contractor (refer Section 7).

On the basis of residual exceedances at individual receivers, the CNVIS determines which Additional Mitigation Measured (AMM) are required in accordance with the Sydney Metro CNVIS (refer Section 7.11).

If Downer determines that the mitigation is practical, then the CNVIS can be updated with a commitment to adopt the mitigation method(s) and any engineering / site planning mitigation method(s) will then be incorporated in revised noise or vibration predictions.

Downer may rely on the predictions from the CNVIS, or if the works scenario is different to the CNVIS scenarios (for example if fewer plant items are on site), then the Sydney Metro Out of Hours Works Application Form may be used as a simple calculation method for the airborne noise levels. Works that are not adequately described in a works scenario assessed in the approved CNVIS are not permitted, unless the activity is predicted to be quieter than the approved works scenarios presented in the CNVIS or the CNVIS is updated to reflect the change in work activity.

6.1. Prediction methodology

Worksite-related noise emissions have been predicted using the SoundPlan noise modelling software. To complete this, a representative 3-D model within the software was constructed of the site and surrounding receivers. The 3-D model with local receivers was provided by Sydney Metro's Acoustic Assurance team for the Sydenham to Bankstown project.

Factors that are included in the modelling are:

- Source sound level emissions and locations;
- Screening effects from buildings
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading; and

- Atmospheric absorption and ground effects.

The results of the airborne noise predictions are presented in the CNVIS associated with this NVMP.

For the CNVIS a number of scenarios have been assessed. It is not clear at this stage whether the proposed activities will occur concurrently. Therefore, the approach for the assessment is to predict noise levels generated from each major work area at each station.

It must be noted that for the purpose of preparing a CNVIS, realistic “worst case” scenarios have been assessed. For example, if the equipment list states that a 5-10T excavator would be used, the CNVIS noise prediction assumes that the noisier 10T excavator will be on site. To comply with this NVMP, it is expected that Downer will make all reasonable and feasible efforts to apply at-source controls to reduce noise impacts and select the 5T excavator which would have a 5dB lower source sound power level.

It is noted also that applying an area noise source, rather than point sources at discrete locations around the work area, is conservative. Downer may choose to use a noise prediction tool which allows them to position plant items around the site and take account of shielding, attenuation due to locating plant farther from receivers, and so on.

Therefore, the CNVIS airborne noise predictions are typically considered to be conservative.

Ground borne noise and vibration prediction is specialist area and will be carried out by an acoustician. Due to the variation in vibration propagation through different ground types and building structures, and the low vibration-risk plant and activities proposed for the station upgrade works, a suitable screening approach for assessing vibration is to review whether vibration-generating plant will be used within “minimum working distances” of sensitive receivers. This is also considered to be conservative for most areas in Sydney; nevertheless it is important to confirm vibration propagation on site where works are within the minimum working distances (refer Section 6.4).

6.2. Predicted construction noise levels

Works for all scenarios are expected to occur outside standard working hours. The OOH works are likely to occur during daytime, evening and night time. Accordingly, the NML for OOH works in Table 18 is for night time, as this assesses the worst potential impact. Predicted L_{Amax} noise levels are also presented for these scenarios.

The SoundPlan model does not incorporate a 5dB penalty in accordance with the ICNG Section 4.5 and also CoA E29, for plant and activities considered to be “annoying”. The table of predicted noise levels in the CNVIS and the summary results presented in this NVMP (below) do include the 5dB penalty where the following plant and equipment are proposed:

- Use of “beeper” style or tonal reversing or movement alarms – it is assumed that non-tonal “broadband” alarms are fitted in accordance with the CNVS;
- Power saws for cutting timber, rail, masonry, road pavement or steel work;
- Grinding metal, concrete or masonry (not proposed);
- Rock drilling (not proposed);
- Line drilling (not proposed);
- Vibratory rolling (not proposed);

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- Rail tamping and regulating (an excavator-mounted tamping attachment is proposed);
- Bitumen milling or profiling;
- Jackhammering (proposed), rock hammering or rock breaking (may be used as an attachment to excavator);
- Impact piling (not proposed; bored piling proposed).

Table 18 summarises the predicted-worst case construction noise levels from Station upgrade works, compared with the night-time NML and sleep disturbance screening level. A typical worst-case sound power level of 120dB(A) has been assumed for each work site. This represents the worst expected impacts from the works, as most scenarios are expected to generate lower noise levels.

Table 18: Summary of worst-case predicted noise levels at residential receivers from the Project’s works, assuming worst-case 120dB(A) worksite SWL

Noise Catchment Area	Night time NML	Predicted worst case excess above NML $L_{Aeq}(15min)$	Sleep disturbance screening level	Predicted worst case excess above sleep disturbance level L_{Amax}
NCA 03 – Hurlstone Park (3 Commons Street Hurlstone Park, Hurlstone Park Station)	39	49	49	47
NCA 07 – Belmore (346 Burwood Road, Belmore, Belmore Station)	40	42	50	40
NCA 09 – Wiley Park (1 Shadforth Street Wiley Park, Wiley Park Station)	41	50	51	48

Predicted noise levels at non-residential noise sensitive receivers are similar, and indicate that there are several non-residential receivers which may be impacted by the works. The CNVIS details the predicted level of noise excess at both residential and non-residential receivers. This provides a reference for determining applicable noise mitigation measures.

Worst case predicted noise levels excess above NML at commercial receivers are:

- Hurlstone Park: 25dB above NML;
- Belmore: 18dB above NML; and
- Wiley Park: 13dB above NML.

Non-residential receivers such as libraries and educational receivers are predicted to experience excesses of 16-29dB.

Worst-case predicted noise levels are due to high impact activities such as road saws and excavator with tamping head. Mitigation measures are described in Section 7.2 and 7.3.

If these high noise works are limited to less sensitive hours (refer Section 5.1 and 5.4), the predicted noise levels for other works may be in the order of 10-15dB quieter and therefore significantly less impactful on residential receivers.

6.3. Construction traffic noise assessment

At this stage detailed construction traffic volumes have not been determined and a detailed construction traffic noise assessment cannot be undertaken.

However, a high-level review has been carried out based on the number of work vehicles and plant arriving by road, as listed in the Sydney Metro works package documents, and comparing the number of vehicles with the road traffic numbers provided in the EIS.

It is noted that a 2dB increase in $L_{Aeq(period)}$ arises from an increase in road traffic numbers by 60%, all other factors being equal (including vehicle type and speed). Even if the construction traffic noise levels are on average significantly louder than general light vehicles, a large increase in numbers is still required to trigger the 2dB increase. It is highly unlikely that the proposed station upgrade works would generate such construction-related traffic increases.

Applying the road type definitions in the RNP, the primary site access roads are classified as either arterial or sub arterial. It is unlikely that construction traffic will be required to use local roads.

Analysis of the measured traffic noise levels at each monitoring location indicates that existing traffic noise in the area is high, and in some locations are above the night-time criteria specified in the RNP.

Based on the high existing traffic noise levels and the access routes being largely restricted to arterial and sub arterial roads, impact from additional construction traffic is expected to be minimal.

However, the Station Upgrade works are just one component of a larger suite of Sydney Metro construction packages.

Downer is responsible for applying all reasonable and feasible mitigation measures to minimise construction-related road traffic noise, in order to contribute the management of Sydney Metro project-wide noise impacts.

Mitigation options are described in Section 7.

6.4. Construction vibration assessment

As required by CoA E18 all vibration sensitive receivers have been identified. There are a number of medical facilities which were identified during the land use survey. There are two medical centres on Redman Road near Belmore Station, and two on Crinan and Floss Streets in Hurlstone Park. These facilities have all been identified as small general practices and dental practices, without highly vibration-sensitive medical equipment. However, there is still potential for them to house medical equipment which is relatively sensitive to vibration.

The vibration-generating works and activities associated with the Project's works are:

- Bored piling rig
- Vibratory roller (assessed for completeness; smooth drum or padfoot rollers are proposed by Sydney Metro)
- Excavator with hammer attachment
- Jackhammer

Safe working distances for these vibration-generating activities are provided in TfNSW I&S CNVS (2018). Extracts of the I&S CNVS table of safe working distances are provided in Table 19 for the works relating to this Project.

Table 19: Typical vibration emission and working distances from vibration-generating plant proposed for the Station upgrade works

Plant	Recommended minimum working distance ²	
	Building damage	Human comfort
Large vibratory roller (not proposed, but presented for information in case it is necessary to carry out the works)	12m	40m
Smooth drum roller	12m	50m
Vibratory piling (not proposed, but presented for information in case it is necessary to carry out the works)	2-20m	20m
Bored piling	2m (nominal)	n/a
Small excavator with hammer, 3-5 T	2m	15m
Small excavator with hammer, 8 T	3m	20m
Medium excavator with hammer, 12-18 T	4m	30m
Jackhammer, handheld	1m (nominal)	Avoid contact with structure

Unless stated otherwise the assessment will be based on the screening criteria of 7.5mm/s for an unreinforced structure, including heritage-listed buildings and structures which have been found to be structurally sound.

The recommendations made in this NVMP are based on the typical Minimum Work Distances presented in the table above.

REMM NVC3 requires a more detailed assessment of the structure if the vibration levels are predicted to exceed the vibration screening level or fall within the recommended Minimum Working Distance. REMM NCV4 further requires that heritage items located within the Safe Working Distance require a more detailed assessment including a condition assessment (refer Section 8.2.3) and specifically consider the heritage values of the structure in consultation with a heritage specialist.

The CNVS requires that attended vibration measurements are carried out before any vibration intensive construction activities commence. Potential mitigation will be reassessed following the attended measurements to determine site-specific safe working distances.

Considering that the station buildings are themselves heritage-listed structures (structurally sound), some of the vibration-generating works are expected to be within the safe work distances.

Where Downer prepares detailed works plans and determines that any vibration-generating works will be carried out within the safe working distances to any affected sensitive receiver, then attended vibration monitoring will be required at the commencement of vibration-generating works in accordance with the CNVS.

CoA E30 also requires that a heritage specialist be consulted when installing equipment used for vibration, movement and noise monitoring around heritage listed structures. More information is provided in Section 8.

Downer must select the plant and equipment which generates the lowest vibration levels while still being capable of effectively carrying out the work (refer Section 7.4). In some cases, this may require longer work durations as a necessary outcome of ensuring that no damage occurs due to the works. Downer is expected to build contingencies for vibration-minimising works methods in the work plans.

6.5. Construction ground-borne noise assessment

Ground-borne or regenerated noise is noise generated by vibration transmitted through the ground into a structure that may lead to noise “regenerated” within a space in the building. The ground-borne noise criteria are presented in Section 5.11.

The CNVS states that the ground borne noise criteria are only applicable when ground-borne noise levels are higher than the airborne noise levels.

All the station works are surface works. Ground-borne noise levels within receiver buildings are predicted to be very low, and below the noise management levels. Importantly, the predicted airborne noise will be higher than ground borne noise. A detailed ground-borne noise assessment is not required.

7. Noise and vibration management and mitigation

7.1. Site noise mitigation measures

This section sets out the standard or minimum construction noise and vibration mitigation measures to be implemented on all Sydney Metro projects.

The standard mitigation measures presented in Section 7 shall be applied by default in order to minimise the potential noise and vibration impacts at the surrounding Noise Sensitive Receivers. The aim is to meet the NML and VML where feasible and reasonable in accordance with CoA E29.

Construction hours would be in accordance with the Project's CoA and the EPL (refer Section 5.1).

Avoiding the coincidence of noisy plant working simultaneously close together and adjacent to sensitive receivers will result in reduced noise emissions. Note that clustering noisy plant can present opportunities for effective implementation noise screening, therefore this control needs to be considered on a case by case basis (refer Section 7.3).

Where feasible and reasonable, locate plant to maximise the offset distance and / or maximise screening between noisy plant items and nearby noise sensitive receivers.

Loading and unloading of materials/deliveries is to occur as far as possible from noise sensitive receivers. Provide shielding if close to noise-sensitive receivers.

Select site access points and roads as far as possible away from noise sensitive receivers. Ensure that construction related road traffic adheres to applicable rules and requirements including speed limits and muffler performance. Staff using access gates are required to adhere to neighbour-friendly practices such as quiet operations of gates and locks, and minimising light.

Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.

In accordance with REMM NVC11, ongoing noise and / or vibration monitoring would be undertaken during construction at sensitive receivers during critical periods (i.e. times when noise emissions are expected to be at their highest) to identify and assist in managing high risk noise events (refer Section 8).

In addition, Downer's Environmental Noise and Vibration Standard (DG-ZH-ST069) specifies:

- Planning and designing the work activities to minimise noise
- Minimising truck movements
- Avoiding portable radios, public address systems or other methods of site communication that may unnecessarily impact on nearby residences.

Furthermore, Managers/Supervisors are responsible

- Maximising the distance between noisy activities and noise sensitive land users
- Scheduling activities at appropriate times of the day
- Avoiding scheduling noise generating works over consecutive nights

- Planning routes for the delivery of materials and parking of vehicles to minimise noise
- Operating plant and equipment in the quietest and most efficient manner
- Regularly inspecting and maintaining plant and equipment to:
- Minimise noise and vibration level increases; and
- Ensure all noise and vibration reduction devices are operating effectively
- Maintaining any pre-existing barriers or walls on a demolition or excavation site as long as possible
- Undertaking noisy fabrication off-site (where possible) so noise can be controlled
- Notifying the community between 5 and 14 days prior to any activity with a high noise or vibration
- Providing notifications on the Sydney Metro website so the community can be informed on work operations; and
- Organising demolition, earthmoving and ground impacting operations so as not to occur in the same time period, where feasible.

7.2. Source noise control strategies

The following source noise control strategies are presented as examples of ways that selecting alternative methods and adapting plant can reduce noise at source.

Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, heavy vehicles, etc. Residential grade mufflers are to be fitted on all mobile plant used on Sydney Metro construction projects.

The noise levels of plant and equipment items are to be considered in Downer's procurement and rental decisions and in any case cannot be used on site unless compliant with the criteria.

Regular inspection and maintenance of all plant and machinery used for the Project by Downer, will assist in minimising noise emissions, including the reporting of the results.

Regular compliance checks on the noise emissions of all plant and machinery used for the Project would indicate whether noise emissions from plant items were higher than predicted. This also identifies defective silencing equipment on the items of plant.

Downer will also ensure that air brake silencers are correctly installed and fully operational for any heavy vehicle that approaches and uses any of the Project's construction or compound sites.

Non-tonal reversing alarms will be used for all permanent mobile plant operating on the Project. Consideration will be given to fitting non-tonal vertical movement alarms for plant such as cherry pickers. It is noted that OH&S requirements must also be fully satisfied.

Downer will minimise the use of high noise activities such as diamond or concrete saws and hydraulic breaker / tamping, and limit to less sensitive times (refer also Section 5.4).

Downer will use bored piling methods where feasible, instead of impact or driven piling methods. Implement low noise methods for removing spoil from the auger, use of spoil removal accessories, or rotating the auger in one direction only to avoid the impact noise due to back-and-forth rotation (if spoil type is suited to this method of removal).

Downer will use electric pumps instead of diaphragm air pumps.

Downer will use electric equipment instead of diesel such as electric chainsaws and generators where possible.

Downer will use “silent” lighting towers to minimise continuous noise from lighting towers / day makers.

Downer will consider off-site mulching instead of using night-time on-site mulching and chipping machines.

Downer will use pulverisers instead of conventional concrete breaking methods for demolition where possible (unlikely to be relevant to the Station Upgrade works).

Delivery vehicles are to be fitted with straps rather than chains for unloading, wherever feasible and reasonable.

Tray-back utility vehicles are to have resilient mat or carpet to minimise impact noise.

Noise curtains are to be used for localised equipment, particularly:

- Generators, whenever used out of standard work hours
- Jackhammers and road / demolition saws, particularly at night.

In addition, Downer’s Environmental Noise and Vibration Standard (DG-ZH-ST069) specifies:

- Selecting demolition methods not involving noise impact where possible (e.g. hydraulic rock splitters rather than rock breakers)
- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks
- Limiting equipment that generates impulsive noise
- Using broadband audible alarms on vehicles and elevating work platforms.

7.3. Noise barrier control strategies

Temporary noise barriers are recommended between the noise sources and nearby potentially affected noise sensitive receivers, wherever feasible. Typically, 5 dB to 15 dB attenuation can be achieved with a well-constructed solid ply hoarding or mass-loaded vinyl noise curtain such as Echo Barrier, Flexshield Sonic Quilt or Acoustica AcoustiFlex SQ products.

Stationary noise sources such as generators will be enclosed or shielded where practicable.

Localised noisy activities such as concrete saws and jackhammers will be used inside temporary noise screens, whilst ensuring that the occupational health and safety of workers is maintained. Note that it may be preferable in some cases to carry out the noisy activities more quickly, without erecting temporary noise curtains, to avoid the activity extending into more noise-sensitive evening or night-time periods. The use of noise curtains for high noise activities will be considered on a case-by-case basis to ensure that the Project requirements for limiting the timing of such works are met (refer to Section 5.4).

Use structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) and consideration of site topography when siting plant.

Solid hoarding for the services building worksites have been considered in accordance with CoA A21. This is unlikely to be necessary as the temporary site buildings themselves provide shielding for adjacent receivers.

Acoustic enclosures or sheds are not considered to be a reasonable option for the Station Upgrade works. However temporary structures can be considered for equipment used regularly on site, such as pumps and generators.

CoA E32 requires that early implementation of any operational noise mitigation measures which can be installed during construction phase. As there are no potential locations of operational noise mitigation measures near the Project's worksites, E32 is not relevant to the works covered by this NVMP.

In addition, Downer's Environmental Noise and Vibration Standard (DG-ZH-ST069) specifies:

- Barriers or other noise limiting devices that are part of the end product design, as mentioned above, to be installed as early as possible.
- Using hammer cushions when driving steel piles that minimise the vibration generated.

7.4. Vibration control strategies

Vibration-minimising methods are to be selected where feasible and reasonable.

Downer must select the plant and equipment which generates the lowest vibration levels while still being capable of effectively carrying out the work. In some cases, this may require longer durations which may be a necessary outcome of ensuring that no damage occurs due to the works.

Examples relevant to the Project's works are:

- Smooth drum roller preferred, or else pad foot roller, instead of vibratory roller
- Diamond / concrete saw to cut platform surface to remove in pieces, instead of jackhammer

Attended vibration measurements are required 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 of the criteria further vibration site law investigations would be undertaken to determine the site-specific safe working distances for that vibration generating activity. Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the calculated safe-working distances.

The pattern of vibration radiation is very different to the pattern of airborne noise radiation and is very site specific. Final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver. Section 6.4 presents the recommended minimum working distances for vibration intensive plant. The minimum working distances for cosmetic damage must be complied with at all times, unless otherwise approved by the relevant authority.

REMMS NVC3 and NVC4 require a more detailed assessment of structures located within the Minimum Working Distances presented in Section 6.4. The purpose of the more detailed assessment is to determine the appropriate vibration limits for the potentially affected structure, and to identify sensitive heritage fabric in any heritage-listed structure. This process is described more fully in Section 8.2.3.

The minimum working distances presented in Section 6.4 are indicative and will vary depending on the plant item and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions. Vibration monitoring can be carried out to confirm the minimum working distances at specific sites (refer Section 8.2.2).

In accordance with REMM NVC13, Downer will implement reasonable and feasible measures in accordance with the CNVS and ICNG to minimise ground-borne noise where exceedances and predicted.

Vibration loggers monitoring potential effects on structures are to be set up with visual and SMS warning systems, applying the following Alert and Alarm levels (set to align with the affected structure type):

- Reinforced or framed structures: Alert Level 15mm/s, Alarm Level 25.0 mm/s (PPV);
- Unreinforced or light framed structures: Alert Level 5mm/s, Alarm Level 7.5 mm/s (PPV); and
- Heritage building or structure which is found to be structurally unsound (following inspection): Alert Level 1.5mm/s, Alarm Level 2.5 mm/s (PPV).

Construction personnel engaged on the site must have been briefed on the procedures including the location and nature of audio and visual alarms. The audio and visual alarms must be arranged to directly alert the equipment operations to any alarm event.

For vibration measurements to monitor risks of damage to structures, in accordance with the CNVS Appendix, the transducer mounting plates would be installed at the base of the building or structure, at the location closest to the construction works. The monitoring locations would be on a stiff part of the building or structure (at the foundations) on the side of the structure adjacent to the subject construction works.

- (a) If the vibration-generating works are to be conducted inside the safe working distances, first establish whether an alternative method can be used to reduce vibration. For example, reducing the size of a vibratory roller will typically reduce the impact zone.
- (b) If the final works method is still within the applicable safe working distance, carry out attended vibration monitoring at the commencement of vibration-generating works to establish the local site law for vibration propagation, and to re-assess whether levels are expected to exceed applicable criteria at heritage structures. Start the vibration-generating works at as large a distance as possible from the sensitive structure, and move closer with caution while taking attended vibration measurements.
- (c) If the attended noise monitoring determines that vibration levels may exceed the site screening level, install a vibration logger which is capable of sending automated SMS messages to the Site Manager when Alert levels are exceeded. The monitoring is to be carried out with appropriate equipment so as to provide results that are readily comparable to the preliminary survey and relevant criteria (i.e. PPV).
- (d) If the Alert level is exceeded, the Site Manager is to monitor the works and vibration levels to ensure that the Alarm level is not exceeded. An exceedance of the “Alert Level” will not require the excavation activities to cease, but rather alert the Construction Manager to proceed with caution at a reduced force or load.

- (e) If the Alarm level is approached or exceeded, the Site Manager is to stop all nearby construction works immediately and reassess methods. Examples of measures to manage vibration on site include using smaller hammer attachments on excavators, or using concrete saws to introduce a structural disconnection and thereby reduce vibration transmission.
- (f) If the Alarm level is exceeded, the frequency content of the measured vibration and peak component particle velocity (pcpv) levels will be assessed by a suitably qualified specialist and compared against the applicable Standards to determine whether the vibration levels comply with the Standard (based on the frequency content of the vibration signal). A suitably qualified specialist must endorse the conclusions of such an investigation.
- (g) If the Alarm level is exceeded, once works are approved to continue, attended structural damage vibration monitoring must be carried out by a suitably qualified specialist. This monitoring would provide direct feedback to the operators and appropriate modification of construction techniques.
- (h) If the Alarm level is exceeded, a condition survey is to be conducted of the structure or item, in consultation with the Structural and Acoustic Engineers (as required).

For vibration monitoring of construction works at heritage listed structures, double-sided sticky tape (compliant with the requirements of ISO 5348-2021) will be used to temporarily attach the vibration monitor (if required) at locations specified by the vibration and acoustic advisor to capture the relevant working plant to verify if established working distances are adequate to avoid cosmetic damage to the heritage-listed structure.

In addition, Downer' Environmental Noise and Vibration Standard (2020) specifies:

- Selecting demolition methods not involving vibration impact where possible (e.g. hydraulic rock splitters rather than rock breakers);
- Choosing plant and equipment with low vibration generation characteristics; and
- Controlling blast vibration by careful attention to blast details and the application of correct techniques.

7.5. Community consultation and management

The benefits of good and clear communications are often under-estimated. In practice it is one of the most important aspects of noise and vibration management.

Pro-active community engagement assists in:

- Building stakeholder support for, and understanding of, the Sydney Metro project;
- Understanding the community and supporting their objectives (be it residential, commercial, education, or other);
- Minimising, where possible, project impacts on stakeholders and the community; and
- Ensuring stakeholders and the community fully understand that activities to be undertaken by the contractors, their objectives, benefits, potential impacts and expected outcomes.

Sydney Metro's Overarching Communications Consultation Strategy (OCCS) describes the requirements for community engagement during various stages of the project. The OCCS includes time frames for responding to complaints, record-keeping, and provision of up-to-date and accurate information.

A Business Management Plan has also been prepared for the Project.

Requirements for community engagement includes, for example:

- Notification (including targeted letterbox drops, doorknocks and email) of any planned works that may disturb local residents and businesses (such as noisy activities, access changes and night work);
- Community signage to advise of work that may affect transport (such as road closures, changes to pedestrian routes and changes to bus stops);
- Community contact facilities including via the Sydney Metro website (sydneymetro.info), community email address and 24-hour toll-free community information line; and
- Regular updates to the Sydney Metro website (sydneymetro.info) including uploading notifications and providing community contact details; and
- Individual briefings as required by the CNVS as part of implementation of Additional Mitigation Measures by Place Managers (refer Section 7.12).

Downer is responsible for providing the Place Manager with as much information as is required to effectively inform the community of upcoming works and potential impacts.

As Downer develops works plans, the timing and duration and location of the works will be known in more detail. This important step of assessing impacts in finer detail enables Downer to better understand what mitigation methods are available, review the works plans, and then update the residual impact predictions after application of mitigation.

Noise predictions, including CNVIS prepared in accordance with CoA E27 are to be as accurate as possible to assist project managers and contractors plan ahead to manage and mitigate the impacts of their activities, and this includes the provision of appropriate community measures.

The residual impact predictions are then provided to the Communications Manager or Place Manager to assist with their role in:

- Preparing works notices or information – such as a description of the works and what to expect, and timing plus location of the works;
- Applying management measures where predicted noise levels exceed trigger levels described in the Sydney Metro CNVS, to provide Specific Notification to affected individuals, and offer Respite, or Alternative Accommodation;
- Engaging with receivers as required to negotiate suitable respite periods, for example rest times in affected Child Care Centres;
- Informing the community of the times of planned high-noise works.

CoA E23 requires that the Proponent identify appropriate respite periods for out-of-hours work in consultation with the community at each affected location on a regular basis. This consultation must include provision of:

- (a) A schedule of likely out-of-hours work for a period no less than two (2) months;
- (b) The potential work / activities proposed and the location and duration of the work;
- (c) The noise characteristics (such as hammering, perceptible vibration), and the likely noise levels of the work; and

- (d) Likely mitigation and management measures to be applied, including the selection of lower-noise and –vibration equipment, use of screening or noise curtains, and timing of noisy works.

If Emergency works are required, Downer must also “use best endeavours to notify all noise and / or vibration affected receivers of the likely impact and duration” of Emergency works in accordance with CoA E20.

A register of noise and vibration sensitive receivers is to be kept on site and in Sydney Metro’s records. The register will include the following details for all known noise and vibration sensitive receivers within 300m of the worksite:

- Address of receiver
- Category of receiver (e.g. residential, childcare, etc.)
- Contact name and number if known

Records of consultation and agreements relating to respite periods will be retained by Downer in the noise and vibration sensitive receiver register. In accordance with CoA E23, records of agreed respite periods, timing restrictions and alternate arrangements will be kept on file by Downer and be provided to the Planning Secretary or the EPA, upon request.

It is noted that the sensitive times for non-residential receivers might not align with typical sensitive periods for residential receivers. In accordance with CoA E28, Downer will carry out community consultation with community, religious or educational institutions to identify their noise sensitive periods, prior to works commencing which generate noise levels above the NMLs at these locations. Works which generate noise levels above the NMLs at these locations will not be programmed within sensitive periods, where feasible. Where it is not feasible to plan works outside noise sensitive periods, Downer will consult with the affected receiver(s) to determine if alternate arrangements can be made, at no cost to the affected institution.

Downer is required to consider the impact of noise and vibration on the amenity of businesses in the preparation of the Business Management Plan. The Business Management Plan will consider the potential noise and vibration impacts on businesses, particularly for works during standard business hours, which typically align with the least noise-sensitive periods for residential receivers.

The Sydney Metro Place Manager is responsible for maintaining updated records of the local community and receiver type. If Downer learns that a receiver is incorrectly or incompletely categorised, then they must inform the Sydney Metro Place Manager to follow up and update the receiver records. For example, if a receiver is categorised as “commercial” but is found to have a shop-top residence, then Sydney Metro will need to update the records to apply both “commercial” and “residential” to the same address.

Complaints and enquiries relating to noise and vibration management will be managed in accordance with the Sydney Metro Overarching Community Communication Strategy (OCCS) and Section 3.7 of the CEMP.

Downer will utilize Sydney Metro’s Overarching Community Consultation Strategy (OCCS) which describes the procedures and processes for community notification, consultation and complaints management.

Downer’s Environmental Noise and Vibration Standard (DG-ZH-ST069) includes a complaints management process to follow. Managers/Supervisors must manage the process and verify that the following takes place or is undertaken:

- Communicate a toll-free hotline or contact phone number to stakeholders being the Sydney Metro Community Contact Number.
- Complaints are given a fair hearing.
- Have a documented complaints process, including an escalation procedure so that if a complainant is not satisfied there is a clear path to follow.
- Call back as soon as possible to keep people informed of action to be taken to address noise problems.
- Call back at night-time only if requested by the complainant to avoid further disturbance.
- Provide a quick response to complaints, with complaint handling staff having both a good knowledge of the project and ready access to information.
- Implement all feasible and reasonable measures to address the source of complaint.

Managers/ Supervisors must keep a record in INX (Downer’s compliance management system) to record any complaints, including the following details:

- date/ time
- person receiving complaint
- complainant’s contact number
- person referred to
- description of the complaint
- work area (for larger projects)
- time of verbal response; and
- timeframe for written response (where appropriate).

Note that INX is a system used at Downer for record keeping, tracking of actions, notifications and reporting purposes. This is an internal system.

7.6. Standard Construction hours and out-of-hours work

As explained in Section 5.1, CoA E19 defines Sydenham to Bankstown standard construction hours as, i.e. 7am to 6pm Monday to Friday, and 8am to 6pm Saturday.

CoA E24 requires that “highly noise intensive works” (refer Section 5.4) are only carried out between 8am and 6pm Monday to Friday and 8am to 1pm Saturday, and with the provision of respite periods such that work must only be undertaken in continuous blocks not exceeding three hours each with a minimum respite period of not less than one hour between each block.

CoA E20 permits works outside the hours specified in E19, in the following circumstances:

- (a) For the delivery of materials required by the NSW Police Force of other authority for safety reasons; or

- (b) Where it is required in an emergency requirements to avoid injury or loss of life, to avoid damage or loss of property or to prevent environmental harm; or
- (c) Where different construction hours are permitted or required under an EPL in force in respect of the CSSI; or
- (d) Work approved under an Out-of-Hours Work Protocol for Work not subject to an EPL as required by Condition E25 (refer Appendix D for a copy of the approved Out-of-Hours Work Application to be used for obtaining approval for out-of-hours work); or
- (e) When applicable NMLs and VMLs are met.
- (f) Where a negotiated agreement has been reached with the substantial majority of nearby sensitive receivers who are within the vicinity of and may be potentially affected by the particular Construction, and the noise management levels and/or limit for ground-borne noise and vibration (human comfort) cannot be achieved. All agreement must be in writing and a copy forwarded to the Planning Secretary at least one (1) week before the commencement of activities.

E22 notes that out of hours work may be required to avoid high safety risk to construction personnel or members of the public, or if the proponent has received advice in writing that:

- Carrying out the activities could result in a high risk to road network / utility operational performance or integrity – written advice from the relevant road authority or utility service operator;
- A road occupancy licence (ROL) is required and the ROL will not be issued for the activities during the standard Sydney to Bankstown approved work hours – written advice from TfNSW Management Centre or other road authority; or
- A rail possession is required – advice from Sydney Trains or ARTC (in locations near the shared freight rail corridor).

Condition E22 states that the conditions listed above are either regulated by an EPL (for example, under Sydney Trains' EPL 12208 during a rail possession), or through Sydney Metro's Out-of-Hours Work Strategy/Protocol. E22 also states that other out-of-hours works can be undertaken with the approval of an EPL (such as EPL 12208 during a rail possession), or through Sydney Metro's Out-of-Hours Works Strategy/Protocol for work not subject to an EPL. Refer to Appendix A for a list of EPL 12208 Clauses that relate to construction noise and vibration for the Project.

Conditions E20, E22, E23 and E25 all refer to Sydney Metro's Out-of-Hours Work Strategy/Protocol.

E25 describes the requirements of the Protocol, including approvals processes. Sydney Metro has prepared a Chatswood to Bankstown document which addresses the requirements of the CNVS and the respective approval conditions for the Chatswood to Sydney and Sydney to Bankstown Sydney Metro projects. Both the Sydney Metro City and Southwest Out-of-Hours Work Strategy/Protocol and the approved OCCS describe Planning Secretary, EPA and community notification requirements for out-of-hours work, in accordance with E25.

The Out-of-Hours Work Application is a requirement of the Sydney Metro Out-of-Hours Work Strategy/Protocol. A copy of the OOHW Application is provided in Appendix D. This Application includes both qualitative and quantitative construction noise and vibration assessment components, and allows Downer to demonstrate how construction noise and vibration impacts are to be minimised for the proposed out-of-hours work. The mitigation methods include equipment selection and location, and timing of works.

The REMM NVC7 and NVC8 also consider timing of activities to provide respite periods for non-residential sensitive receivers, and management of construction-related traffic as follows:

- When working adjacent to schools, medical facilities and childcare centres, particularly noisy activities would be scheduled outside normal working hours, where feasible and reasonable.
- When working adjacent to churches and places of worship particularly noisy activities would be scheduled outside services, where feasible and reasonable.

This is in line with CoA E23, which requires consultation with affected communities. The specific requirements of E23 are described in Section 7.5.

REMM NVC5 also considers timing of construction-related traffic as follows:

- Where feasible and reasonable heavy vehicle movements would be limited to daytime hours.
- The implementation of procedures to maximise the night-time onsite spoil storage capacity where spoil is produced between the hours of 10.00 pm and 7.00 am.
- The arrival and departure times of construction-related vehicles is to be included in the out-of-hours works applications as part of the assessment of noise impacts from construction-related traffic.

7.7. Site environment induction and training

In accordance with NVC2, all employees, contractors and subcontractors are to receive an environmental induction. The site induction would include the following as a minimum:

- All relevant project specific and standard noise and vibration mitigation measures;
- Relevant licence and approval conditions;
- Permissible hours of work;
- Site opening/closing times (including deliveries);
- Any limitations on high noise generating activities;
- Location of nearest sensitive receivers;
- Construction employee parking areas;
- Designated loading/unloading areas and procedures; and
- Environmental incident reporting and management procedures.

A site plan is required to illustrate the location of sensitive receivers, parking and loading areas, and plant and equipment to be used around the site.

7.8. Neighbour friendly behaviour

All staff and workers associated with Sydney Metro projects must implement neighbour-friendly behaviour.

The site induction will include the following standard requirements for all staff working on Sydney Metro projects:

- No swearing or unnecessary shouting or use of loud stereos/radios;

- No dropping of materials from height, throwing of metal items and slamming of doors;
- No excessive revving of plant and vehicle engines;
- Power down plant when not in use;
- Switch off vehicles when stopped for more than 5 minutes or when parked, including near access gates;
- Controlled release of compressed air in heavy vehicles.

All community engagement would be in accordance with the Sydney Metro OCCS.

If staff are approached by members of the public, they are to engage with courtesy and respect, but direct all queries and complaints to the central Sydney Metro information and complaints website, email address or phone service (refer Section 7.5).

7.9. Cumulative impacts management

The term Cumulative Impacts relates to two or more projects occurring around the same time, affecting the same receivers.

In the context of Sydenham to Bankstown project, this occurs when there is an overlap in time and the works are conducted around the same time. This may result in an overall increase in noise levels when works are carried out close to one another, at the same time. It may also result in a lack of “quiet times” or respite periods, when two project packages carry out work in the same location over the same few months but on different days or nights.

Cumulative impacts may result in receivers requiring additional consideration of mitigation and management than if they had been exposed to a single package of work.

Where projects are expected to be carried out in the same area and within a similar time frame, clustering some construction activities may result in reduced durations of noise exposure and may also allow for effective implementation of mitigation of all the works (e.g. install noise curtains around the shared worksites).

When reviewing out-of-hours works applications for individual works activities, cumulative impact considerations for other projects or contractors working in the area focus on:

- Adding noise levels from concurrent works activities, to ensure that appropriate mitigation measures are in considered and implemented; and
- Coordinating respite periods or “quiet times” to ensure that receivers experience quiet periods, free from audible work (may be one or two hours per night, or three nights per week, for example).

Downer will coordinate their works with other Sydney Metro contractors, as well as external parties such as local Councils, Roads and Maritime Services and Sydney Trains, Utilities services (refer Section 7.10), other infrastructure projects such as WestConnex and also urban renewal projects.

It is useful to understand other contractors’ respite requirements and where feasible adhere to the same respite periods. A common example is where one contractor’s EPL restricts concrete sawing to before midnight, while another has no timing restrictions on concrete saws.

If it is not feasible to adhere to the same restrictions, and if it is not a compliance issue, it may be necessary for the concrete sawing to take place outside of the other contractors’ permitted

hours. In this case it would be essential to inform the local receivers of the planned works and explain why the timing restrictions they may expect does not need to be observed by this particular contractor.

The Out-of-Hours Works Application includes a requirement to identify concurrent works in the area, and to demonstrate efforts to manage cumulative impacts.

It is Downer’s responsibility to determine concurrent works, or works just prior or just after the proposed activities undertaken by Downer. The purpose is to:

- Add noise levels when works occur concurrently, as this may change the additional mitigation measures which are considered (refer Section 7.11 and 7.12);
- Identify other contractors’ agreed hours of respite and make efforts to align the proposed works with the agreed respite hours, or negotiate for changed respite periods, or else provide robust justification for not being able to observe the same respite period;
- Ensure that Evenings / Nights of Respite have been provided by confirming that works are not planned immediately before or after the Project’s planned works.

This coordination also a requirement for CoA E26. Refer to Section 7.10 for provision of respite and coordination with other contractors.

It must be recognised that this Project takes place in the context of other Sydney Metro construction activities. For local receivers, the various works packages are likely to be perceived as one works package, being “Sydney Metro works”. The duration of the Project’s works may be relatively short for a large infrastructure project, but the total duration of Sydney Metro construction activities affect the same receivers for an extended period.

It is important to acknowledge that construction activities carried out over a period of more than a year, affecting the same receivers, is likely to become less tolerable.

For this reason, it is important to understand that the receivers may experience “construction fatigue”. There is no definition for construction fatigue, or when it is likely to occur. As with all noise responses, there is likely to be a significant range among individuals. This may be due to individual noise or vibration sensitivity, and individual circumstances.

Even for seemingly straightforward, relatively low noise activities, all feasible and reasonable efforts to mitigate the noise must be made. For example, noise screening around noise generators will be provided out-of-hours works, not because they are the dominant noise source, but because they are constant noise sources used over long periods.

7.10. Utility coordination and respite

Related to cumulative impacts and provision of aligned respite periods described in Section 7.9 above, CoA E26 states that:

- Work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponent must:*
- (a) reschedule Work to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with **Condition E23**; or*
 - (b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and*
 - (c) provide documentary evidence to the **ER** in support of any decision made by the Proponent in relation to respite or mitigation.*

The Place Manager and Utility Coordination Manager will be able to assist in helping the Downer coordinate works with third parties and understand the various agreed Respite Periods and, where possible, negotiate respite periods which can be effectively implemented by all contractors working in the local area. It is the responsibility of Downer to liaise directly with other Sydney Metro contractors to coordinate works and proposed respite periods.

Interface meetings are regularly facilitated by Sydney Metro to coordinate works including those carried out by local Councils.

If Respite Periods cannot be aligned between Contractors working in the same area, Downer must be able to justify why the proposed Station upgrade works cannot observe the same Respite Periods as other Contractors. Justification may be related to limited access to the worksite for a rail possession, for example. All reasonable and feasible efforts will be made to observe the same respite periods as other works packages. Community information about planned works must provide information about which package of work cannot adhere to Respite Periods which are observed by other Contractors working in the area and provide the reason(s) for not being able to align Respite Periods.

Even if Respite Periods cannot be fully aligned such that the exact same Respite Periods are provided by all contractors working in the same area, they must be coordinated so that there is some overlap in respite periods such that “quiet time” is provided by all contractors working in the area. The minimum duration of the “quiet time” shall be a continuous block of one hour.

In accordance with CoA E23(b), where Respite Periods cannot be aligned, Downer will consider the provision of alternative respite offers or mitigation to the impacted noise sensitive receivers. The types of alternative respite offers or mitigation will be determined by Downer’s Environment Manager, in consultation with their wider Project team.

Documentary evidence of works coordination including copies of written correspondence and meeting minutes with relevant third parties will be retained by Downer and be provided to the ER within one week, should this evidence be requested by the ER.

7.11. Additional mitigation measures

The implementation of the standard management measures, compliance with maximum sound power levels for plant and equipment, construction hour management and standard community engagement measures in this NVMP should significantly reduce the noise and vibration impacts on nearby sensitive receivers.

Nevertheless, due to the highly variable nature of construction activities and the likelihood of work outside the standard construction hours the Project, exceedances of the construction NML and VML are likely to occur, even after application of all feasible and reasonable mitigation.

Where there is a potential exceedance of the construction NML and VML a number of additional measures to mitigate such exceedances – primarily aimed at pro-active engagement with affected sensitive receivers – would be explored and have been included in this Strategy. The Additional Mitigation Measures (AMM) to be applied are outlined in Table 20.

Table 20: Additional Mitigation Measures (AMM)

Measure	Description	Abbreviation
Alternative accommodation	Alternative accommodation options may be provided for residents living in close proximity to construction works that are likely to incur	AA

Measure	Description	Abbreviation
	unreasonably high impacts over an extended period of time. Alternative accommodation will be determined on a case-by-case basis. It is recommended that residential receivers who decline the offer of Alternative Accommodation should still have Respite Offers (such as movie tickets or dinner vouchers) made available to them, although this is not a strict requirement under the CNVS.	
Monitoring	Where it has been identified that specific construction activities are likely to exceed the relevant noise or vibration goals, noise or vibration monitoring may be conducted at the affected receiver(s) or a nominated representative location (typically the nearest receiver where more than one receiver have been identified). Monitoring can be in the form of either unattended logging or operator attended surveys. The purpose of monitoring is to inform the relevant personnel when the noise or vibration goal has been exceeded so that additional management measures may be implemented.	M
Individual briefings	Individual briefings (door knocks) are used to inform neighbouring properties about the impacts of high noise activities and mitigation measures that will be implemented. Place Managers from the contractor would visit identified receivers at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the project.	IB
Letter box drops	For each Sydney Metro project, a newsletter is produced and distributed to the local community via letterbox drop and the project mailing list. These newsletters provide an overview of current and upcoming works across the project and other topics of interest. The objective is to engage and inform and provide project-specific messages. Advanced warning of potential disruptions (e.g. traffic changes or noisy works) can assist in reducing the impact on the community. Content and newsletter length is determined on a project-by-project basis. Most projects distribute notifications on a monthly basis. Each newsletter is graphically designed within a branded template.	LB
Project specific respite offer	The purpose of a project specific respite offer is to provide residents subjected to lengthy periods of noise or vibration respite from an ongoing impact. Respite offers may be in the form of movie tickets or dinner vouchers, to provide residents with opportunities to spend time away from their home during works exceeding the applicable level. Alternative respite offers to movie or dinner vouchers may be considered as the Place Manager is familiar with the local community.	RO
Phone calls and emails	Phone calls and/or emails detailing relevant information would be made to identified/affected stakeholders within 7 days of proposed work.	PC
Specific Notification	Specific notifications will be issued to affected properties 7 days before work starts and may include paper notifications letterbox dropped to affected properties or emailed to registered stakeholders. Phone calls and/or emails provide affected receivers with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs etc. This form of communication is used to support periodic notifications, or to advertise unscheduled works.	SN

7.12. Applying AMM

The Sydney Metro CNVS provides guidance on the application of AMM. In circumstances where - after application of the standard mitigation measures - the $L_{Aeq(15\text{minute})}$ construction

(Uncontrolled when printed)

noise and vibration levels are still predicted to exceed the noise or vibration objectives, the relevant AMM matrix (refer to Table 21 to Table 23) is to be used to determine the AMM to be implemented. This requirement is supplemental to the basic requirements in the ICNG.

Using the relevant AMM matrix, the following steps need to be carried out to determine the additional mitigation measures to be implemented:

- Determine the duration (time period) when the work is to be undertaken.
- Determine the level of exceedance.
- From the relevant AMM matrix, identify the additional mitigation measures to be implemented (using the abbreviations which are expanded in Table 20).

Note that the AMM matrix considers residential impacts and noise sensitivity in terms of the standard construction hours defined in the ICNG, and this concept is to be applied to Sydenham to Bankstown works.

Table 21: AMM matrix – Airborne construction noise

Time Period		Mitigation Measures			
		Predicted $L_{Aeq(15\text{minute})}$ Noise Level Above Background (RBL) for residential receivers, or above NML for non-residential receivers / internal residential receiver locations			
		0 to 10 dB	10 to 20 dB	20 to 30 dB	> 30 dB
Standard	Mon-Fri (7.00 am - 6.00 pm)	-	-	M, LB	M, LB
	Sat (8.00 am - 6.00 pm)				
	Sun/Pub Hol (Nil)				
OOHW 1	Mon-Sat (6.00 pm - 10.00 pm)	-	LB	M, LB	M, IB, LB, RO, SN
	Sun/Pub Hol (8.00 am - 10.00 pm)				
OOHW 2	Mon-Fri (10.00 pm - 7.00 am)	-	M, LB	M, IB, LB, RO, SN	AA, M, IB, LB, RO, SN
	Sat (10.00 pm - 8.00 am)				
	Sun (10.00 pm - 7.00 am) /Pub Hol (10:00 pm – 0800am)				

The AMM for airborne noise is based on external noise levels when applied to residential receivers. If the Contractor confirms that a residential receiver has a high-performance building envelope, for example due to having treated as part of an aircraft sound insulation plan, then the trigger level for AMM may be adjusted to account for reduced internal noise levels. Sydney Metro and the ER must be consulted to approve any adjustments to the external AMM airborne noise trigger level for residential receivers.

Table 22: AMM matrix – Ground borne construction noise

Time Period		Mitigation Measures		
		Predicted $L_{Aeq(15minute)}$ Noise Level Exceedance above NML		
		0 to 10 dB	10 to 20 dB	> 20 dB
Standard	Mon-Fri (7.00 am - 6.00 pm)	LB	LB	M, LB, SN
	Sat (8.00 am - 6.00 pm)			
	Sun/Pub Hol (Nil)			
OOHW 1	Mon-Sat (6.00 pm - 10.00 pm)	LB	M, LB, SN	M, IB, LB, RO, SN
	Sun/Pub Hol (8.00 am - 10.00 pm)			
OOHW 2	Mon-Fri (10.00 pm - 7.00 am)	M, LB, SN	AA, M, IB, LB, RO, SN	AA, M, IB, LB, RO, SN
	Sat (10.00 pm - 8.00 am)			
	Sun (10.00 pm - 7.00 am) /Pub Hol (10:00 pm – 0800am)			

Table 23: AMM matrix – Ground borne construction vibration

Time Period		Mitigation Measures
		Predicted Vibration Levels Exceed Maximum Levels (for human comfort), or the recommended limit (for vibration-sensitive equipment)
Standard	Mon-Fri (7.00 am - 6.00 pm)	M, LB, RP
	Sat (8.00 am - 6.00 pm)	
	Sun/Pub Hol (Nil)	
OOHW 1	Mon-Sat (6.00 pm - 10.00 pm)	M, IB, LB, RO, SN
	Sun/Pub Hol (8.00 am - 10.00 pm)	
OOHW 2	Mon-Fri (10.00 pm - 7.00 am)	AA, M, IB, LB, RO, SN
	Sat (10.00 pm - 8.00 am)	
	Sun (10.00 pm - 7.00 am) /Pub Hol (10:00 pm – 0800am)	

Based on the predicted typical worst case noise levels and the review of minimum work distances for vibration-generating works, AMM are expected to be considered for the Project’s works (refer to Table 24). The requirements for AMM will be refined as Downer prepares more detailed OOHW Applications which delineate when noisy equipment is used, which engineering mitigation measures can be applied, and where and when noise screening is implemented. It is expected that through careful planning of the timing of noise-intensive works, particularly in accordance with the requirements of E24 and as described in Section 5.4, the requirements for AMM can be reduced in most cases.

Table 24: Recommended AMM matrix to be considered for the Project

Scenario	Period	Hurlstone Park, Belmore and Wiley Park Stations
All Scenarios – worst case	Day	LB, M
	OOHW 1	RO, M, IB, SN, LB
	OOHW 2	AA, RO, M, IB, SN, LB

7.13. Construction traffic noise management

Construction-related activities can occur outside the defined worksite or premises. The most far-reaching aspect is construction-related transport - mostly trucks and large equipment arriving on site by road.

REMM NVC15 requires that *“The routes for construction haulage vehicles and bus services associated with the Temporary Transport Strategy would be selected on the basis of compliance with the relevant road noise traffic criteria, where reasonable and feasible. Where compliance with the noise criteria is not possible, reasonable and feasible noise mitigation would be implemented.”*

Mitigation measures that will be implemented where feasible and reasonable include:

- Implementing and monitoring driver behaviour rules, such as smooth braking and accelerating, adhering to truck speed limits;
- Monitoring and enforcing vehicle compliance including ensuring that compliant mufflers are fitted;
- Engineering solutions such as high-grade mufflers.
- Establishing truck routes which avoid noise-sensitive residential receivers as far as practicable. Truck routes would be determined and described in Downer’s CTMP;
- Deliveries to site and removal of material from site is to be restricted to standard construction hours, unless otherwise approved. Access to the site will use the access points specified in Downer’s Construction Traffic Management Plan (CTMP). These will consist of existing Sydney Trains access gates and any new gates that need to be constructed to access the corridor.

8. Construction noise and vibration monitoring program

8.1. Baseline data

Baseline noise data is available from the extensive noise surveys carried out by SLR for the EIS in late 2016. The data is less than five years old and in accordance with the TfNSW I&S CNVS is still applicable.

The results of the surveys are replicated in Section 3.2. As described in Section 3.2, some NCAs have been split into two for the purpose of assessing the Project's works. This is possible without new noise measurements because SLR's EIS Technical Paper includes noise survey results from individual noise loggers along the alignment, some of which are near the Station worksites and more applicable to the proposed works covered by this NVMP and the associated CNVIS.

These SLR baseline noise survey results have been used to set the applicable NMLs for Day, Evening and Night-time works.

No additional baseline noise surveys are considered necessary for the Project at this stage.

8.2. Monitoring

In accordance with CoA C13, a noise and vibration monitoring program is to be carried out for the duration of Construction.

Noise or vibration monitoring is required:

- In response to noise or vibration complaints;
- If requested by Sydney Metro, the ER, DPE or EPA;
- To augment baseline noise levels, if the noise environment at a receiver is considered to be different from the noise logger locations used for the EIS;
- To validate predicted noise levels associated with each works scenario assessed in the CNVIS, at the commencement of works and new construction activities or location;
- To confirm baseline vibration levels currently experienced at heritage-listed structures and at any vibration-sensitive equipment;
- To verify predictions, particularly at the commencement of vibration-generating works;
- Where vibration levels are predicted to exceed the vibration screening level, attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure, in accordance with REMM NVC12;
- As part of a plant noise audit;
- If predicted noise or vibration levels exceed the trigger levels requiring "M" (Monitoring) in accordance with the AMM matrices provided in Section 7.12.

Noise monitoring is required if the predicted airborne noise level is above the applicable AMM trigger level, which is set relative to the NML. Vibration monitoring is required if vibration-generating works are carried out within the Safe Working Distances provided in Section 6.4.

Ground borne noise measurements are not required for the Project, as the review of ground borne noise indicates that it would not be audible above airborne noise and therefore does not require further assessment in accordance with the CNVS (refer Section 6.5).

Attended noise or vibration monitoring during construction is necessary to:

- Observe the character of the existing noise or vibration sources;
- Note the local topography, built environment, and other man-made or natural features which may affect sound or vibration propagation (e.g. existing walls which may act as a noise barrier or sound-reflective surface, or structural breaks on site which reduce vibration propagation);
- Validate the noise or vibration logger data by comparing attended and unattended data, and also by comparing subjective experience of how audible or perceptible the noise and vibration is with the measured levels (particularly when the NML is lower than the prevailing ambient noise level, as noted in Section 5.3);
- Obtain spot measurements at more locations around the area to understand local noise variations and confirm that the noise or vibration logger data is representative of the most-affected receivers;
- Determine whether the noise levels from the works are within the predicted levels presented in the approved works CNVIS;
- Meet the requirements of the CNVS AMM to consider monitoring when predicted levels exceed trigger levels defined in the CNVS (refer Section 7.12).

Downer’s Environmental Noise and Vibration Standard (DG-ZH-ST069) notes that monitoring must be completed using correctly calibrated equipment and include details of:

- The time when measurements are taken – day or night;
- Descriptions of sensitive receiver/s;
- Meteorologic conditions (e.g. prevailing winds, inversion layer); and
- Background noises present at the time of monitoring (e.g. traffic, overhead planes, insects).

Generally, noise and vibration monitoring which is triggered by the CNVS AMM are to be carried out in a location representing the receiver. Downer will be responsible for determining the most appropriate monitoring locations (typically the potentially most exposed receivers), based on the proposed Construction activities and any noise and vibration modelling or assessments carried out, in accordance with the CNVS. The measurements must include a method to derive or directly compare the measured levels with the applicable NML or VML, and the predicted noise level in the CNVIS.

For example, the applicable NML is in terms of $L_{Aeq(15min)}$ which applies outside a residence. The measurement may be carried out on the footpath outside the residence, and the measured level would ideally also be a 15-minute measurement but might need to be a shorter period to exclude other ambient noises such as passing buses. If any post-processing or analysis is required to compare with measurement with the applicable NML or VML, then the adjustment method is to be clearly described in the monitoring report. The raw measured data must be presented in all monitoring reports, and the post-processed data must also be presented if requested by Sydney Metro (or EPA or DPE).

Unattended noise or vibration loggers are suitable for meeting the requirements of the CNVS AMM matrices, particularly if the noise- or vibration-intensive work is localised (for example, at the station platform). Unattended monitoring is useful for works which move to different parts of the worksite (for example, along the rail corridor). Loggers are less labour-intensive, however the value provided by attended monitoring due to the operator's ability to make observations about the audibility of the noise or perceptibility of the vibration, and the changing levels as s/he moves to different receiver locations.

Each Out-of-Hours Works Application must identify whether the proposed monitoring will be attended, unattended or both. The Application requires justification or explanation on the reasons for selecting attended or unattended monitoring, and locations of the proposed monitoring, to provide the Environmental Representative with sufficient information to be able to assess whether the proposed monitoring is suitable for the proposed works.

For monitoring of works around the Stations, CoA E30 requires that a heritage specialist be consulted when installing equipment used for vibration, movement and noise monitoring around heritage listed structures. Generally, noise and vibration monitors do not affect the building fabric in any way. Noise and vibration loggers will be secured such that any chains do not damage the building, and so that they are unlikely to be knocked over and thereby damage surfaces.

8.2.1. Plant noise auditing

The CNVS requires that plant noise auditing is conducted upon arrival on the Project's construction sites and at 6-month intervals thereafter to ensure that they are operating as expected.

Plant noise auditing would preferably be carried out on site, in order to better assess how it operates in the field. Plant noise measurements carried out on site are often affected by other activities, and therefore it is most meaningful for attended measurements to measure event noise levels at a location near to the source. This is a valid method of validating the Sound Pressure Level (SPL) at 10m or the Sound Power Level (SWL) assumed in the CNVS and for the predictions presented in the CNVIS.

However, plant noise auditing can also be carried out in controlled conditions to compare the noise output with applicable standards, including the maximum allowable plant noise levels listed in the CNVS. Off-site plant noise auditing may be requested at any time by Sydney Metro, if inspections indicate that plant used on site is louder than expected.

8.2.2. Vibration monitoring

Attended vibration measurements are required at the commencement of vibration-generating activities listed in Section 6.4 to confirm that vibration levels satisfy the criteria for that vibration generating activity.

If any vibration-generating works take place within the Safe Working Distances of buildings or structures (for both human comfort and building damage), this means that there is the potential for the VML to be exceeded. In these cases, further vibration site law investigations are to be undertaken to determine the site-specific safe working distances for that vibration generating activity. This is in recognition of the fact that vibration propagation is highly variable and site dependent.

Attended vibration monitoring of each specific item of vibration intensive plant is to be conducted before beginning construction works to establish a more accurate minimum working distance.

Generally, the Safe Working Distances are considered to be conservative. If site conditions are atypical and the vibration levels are higher than expected, then the Safe Working Distance is to be extended to reflect the site conditions. Sydney Metro is to be advised of any extended site-specific Safe Working Distances.

Vibration monitoring will be carried out by a person with experience and / or qualifications in vibration and acoustics.

Continuous vibration monitoring with audible and visible alarms would be conducted at the nearest sensitive receivers whenever vibration generating activities need to take place inside the applicable safe-working distances. Where more than one building falls within the Safe Working Distance, the continuous vibration monitoring shall be located at the building which is nearest to the works and which is accessible to the Contractor's acoustic consultant.

In order to assess the likelihood of cosmetic damage due to vibration, AS2187 specifies that vibration measurements would be undertaken at the base of the building and the highest of the orthogonal vibration components (transverse, longitudinal and vertical directions) would be compared with the guidance curves presented in BS 7385. This is based on the assumption that the base of the building is most affected by construction-related vibration. Where other parts of the building are more affected than the base, for example if demolition is occurring at higher levels of a building which is structurally connected to an adjacent building, then the measurements and assessment need to apply at the most affected part of the receiver building.

CoA E30 requires that a heritage specialist be consulted when installing equipment used for vibration, movement and noise monitoring around heritage listed structures. Advice received specifies the use of double-sided sticky tape (compliant with the requirements of ISO 5348-2021) to temporarily attach the vibration monitor (if required) at locations specified by the vibration and acoustic advisor to capture the relevant working plant.

Locations of proposed vibration monitoring, both attended and unattended, must be provided to Sydney Metro for review and consultation as required, at least one week prior to the vibration-generating works commencing. This information can be provided in Out-of-Hours Works Applications, or separately if the works are proposed to be carried out during Standard work hours.

8.2.3. Dilapidation or Condition Surveys

If construction activities have the potential to cause damage through vibration to nearby public utilities, structures, buildings and their contents, an Existing Condition Inspection of these items is required to be undertaken in accordance with AS 4349.1 "*Inspection of Buildings*".

A Condition Survey is required for any building or structure which is located within the recommended Safe Working Distances (refer Section 6.4).

The Project REMMs specifically require:

- NVC3 – Where vibration levels are predicted to exceed the vibration screening level, a more detailed assessment of the structure would be carried out to determine the appropriate vibration limits for that structure; and

(Uncontrolled when printed)

- NVC4 – For heritage items where vibration screening levels are predicted to be exceeded, the more detailed assessment would include condition assessment and specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.

Refer Section 6.4 for Minimum Working Distances used to assess whether the vibration screening level may be exceeded.

All stations require a Condition Survey. They are all heritage-listed buildings located within close proximity of vibration-generating works, and a requirement of the CNVS is that they are subject to a Condition Survey to determine whether or not they are structurally sound. Downer is responsible for the Condition Survey, and for providing results of the survey to Sydney Metro for review.

Heritage-listed buildings are to be considered “structurally unsound” until a structural engineering survey is carried out and determines that it is “structurally sound”. In the unlikely event that the structural engineering survey for a station determines that the building is to be considered “structurally unsound”, the relevant criterion will be as stated in Section 5.7. Sydney Metro is to be advised if the station building or other railway structure is considered to be “structurally unsound”, prior to any vibration-generating works commencing.

If any buildings outside the railway premises are located within the Safe Working Distances of vibration-generating works, the potentially affected buildings also require a Condition survey. The Safe Working Distances are based on the assumption that the buildings are structurally sound. Heritage-listed buildings within 30m of vibration-generating works require a Condition Survey prior to works commencing, even if they are outside the Safe Working Distance.

Prior to conducting the Existing Condition Inspections, the property owners will be advised of the inspection scope and methodology and the process for making a property damage claim.

Downer must maintain a register of all properties inspected and of any properties where owners refused the inspection offer. Evidence is required to demonstrate that three attempts have been made to contact the property owner to offer a Condition Survey. If the property owner does not respond to requests for access to the property after three attempts by Sydney Metro contractors, then the offer for a Condition Survey is considered to be refused by the owner.

The findings of all dilapidation surveys conducted for each construction site would be compiled into a report by Downer and provided to Sydney Metro. Follow-up Condition Inspections may be required at the completion of works.

The results of any Condition Surveys are to be documented in CNVIS updates, and a register is to be kept and managed by Downer. The CNVIS and / or site register will be updated to document the vibration criteria which apply at each affected heritage building, to assist with management, monitoring and evidence in case of queries or complaints.

8.3. General monitoring requirements

CoA C13 requires that approved Construction Monitoring Programs must be implemented for the duration of the Construction, and for any longer period set out in the monitoring program or specified by the Planning Secretary (whichever is greater).

Because the proposed Project is a subset of the wider Sydney Metro Sydenham to Bankstown project, the Noise and Vibration Monitoring Program required for this Project will be carried

out as required by the CNVS for these works only. Longer-duration construction noise and vibration monitoring is likely to be carried out by other contractors.

The monitoring requirements are described in detail in the CNVS. The CNVS describes technical requirements for the monitoring equipment, as well as the required content and measurement parameters to be reported. The measurement parameters must be aligned with, or comparable with, the applicable NMLs or VMLs.

If measurements are carried out at alternative locations to the receiver, such as at a publicly accessible location near the site boundary, then adjustments will be presented to be able to compare the measured levels with those predicted in the approved CNVIS and the applicable NML or VML.

Downer’s acoustic consultant or environmental personnel must provide details of their proposed equipment, methodology and reporting format or template to Sydney Metro for review, prior to carrying out any surveys.

Sydney Metro’s acoustic representatives may accompany Downer’s acoustic consultant or environmental personnel and carry out independent monitoring at any time as requested by Sydney Metro or DPE.

As stated in the CNVS, all acoustic instrumentation used in the monitoring programme will be designed to comply with the requirements of AS IEC 61672.1:2004 Electroacoustics – Sound level meters – Specifications and carry current National Association of Testing Authorities (NATA) or manufacturer calibration certificates. The instrumentation must be installed, operated and maintained by suitably qualified or trained personnel. The instruments must be externally calibrated at regular intervals.

Airborne noise measurement metrics and metre settings are as follows:

- As a minimum, $L_{Aeq(15min/event)}$ noise levels should be recorded, to allow direct comparison against NMLs. The measured level may need to be corrected to an equivalent distance to the receiver location in order to compare directly with the NML, which applies at the receiver.
- Attended measurements may also report $L_{Aeq(event)}$ levels to provide useful information about particular activities, or to limit measurements to when construction noise events are clearly audible and measurable above extraneous ambient noise. This also allows direct comparison between measured levels for particular plant and activities against the assumed noise levels used in predictions. The measured levels may need to be corrected by distance to compare with data sheets (e.g. correct to a sound pressure level at 10m). This is a useful measurement to understand whether plant or activities are significantly louder than predicted, and therefore whether actions are required to check the plant.
- In addition, statistical measures may be measured and recorded, such as;
 - L_{Amax} (maximum event level), can be compared against Sleep Disturbance or Sleep Awakening Levels. This needs to be measured at the receiver location, or corrected to an equivalent distance to the receiver location
 - $L_{A10(15min)}$ (highest 10% of noise). The construction LA10 is no longer used in NSW to assess construction noise, but it is a useful indicator of “typical noisiest” event levels.

- $L_{A90(15min)}$ (lowest 10% of noise) should be measured in the absence of construction noise, to verify the background noise levels.
- These A-weighted airborne noise measurements are to be taken using the Fast response setting on the sound level meter or noise logger.

Vibration measurements shall be carried out in accordance with the CNVS Appendix, which describes requirements for construction vibration monitoring instrumentation used for the identification of structural and cosmetic damage. It should be noted that equipment specifications detailed in the Appendix of the CNVS may not be suitable for the measurement of all vibration impacts such as human comfort and or the measurement of vibration impacts to sensitive equipment. Prior to any measurement being conducted the contractor must ensure that the monitoring equipment being proposed is suitable for the type of measurement being conducted.

For Sydney Metro projects, vibration is to be measured using the Fast response setting. Vibration is generally measured using a vibration logger which records Peak Particle Velocity (PPV) levels which can be directly compared with the VMLs for vibration effects on structures.

Attended measurements may also be carried out and this is recommended if there are vibration-sensitive equipment such as medical imaging equipment, in order to measure r.m.s. vibration levels to directly compare with the applicable VMLs for sensitive equipment. If vibration monitoring is conducted for human comfort assessments, then it is typically accepted for PPV vibration loggers to be used as a screening measure, although the VMLs for human comfort are based on a Vibration Dose Value (VDV), rather than a continuous vibration level. It is not always practical to measure VDV during construction works, as the calculation relies upon duration, intensity and characteristic frequency of the measured vibration events throughout a workday. In some cases, it may be necessary to relate to an instantaneous measurement, such as Peak Particle Velocity (PPV). Appendix C of the AVTG provides guidance on relating measurements of continuous and impulsive vibration to PPV.

8.4. Frequency of monitoring

Vibration monitoring is to be conducted whenever vibration-generating works take place within the site-specific Safe Working Distance of sensitive receivers, as described in Section 8.2.2.

Noise monitoring is to be considered whenever the predicted works noise levels exceed the trigger levels listed in the AMM matrices (Section 7.12). If Downer is of the opinion that noise monitoring is not required during out-of-hours works, then justification is to be provided in the OOHW Application or via email and that decision must be endorsed by the Environment Representative. Potential reasons for not carrying out noise monitoring may be that similar works with the same equipment had been carried out on a previous night and found to be compliant with applicable NMLs. In general, noise monitoring would be carried out as specified by the AMM matrices.

Noise or vibration monitoring may also be required:

- In response to noise or vibration complaints;
- To validate predicted noise levels associated with each works scenario assessed in the CNVIS, at the commencement of works and new construction activities or location;

- To confirm vibration “site-law” propagation at commencement of vibration-generating works, to confirm that the Minimum Working Distances are valid for the site (refer Section 6.4);
- To monitor vibration for human comfort and structural effects as required by the CNVS (refer Section 7.12);
- If requested by an authorised officer of the EPA for works undertaken under EPL 12208 (i.e. under a rail possession);
- If requested by Sydney Metro, the ER, or DPE for works undertaken in accordance with the CoAs.

Additional monitoring may be requested by Sydney Metro, DPE or EPA at any time, for example in response to complaints or observations of unexpected sound or vibration generated at worksites during inspections. Additional monitoring may be carried out by Downer, or by Sydney Metro’s acoustic representatives.

8.5. Reporting

In accordance with C9(g), Downer is required to submit noise and vibration monitoring reports to Sydney Metro and the Environment Representative for their review.

The requirements of the reports are described in Appendix A of the CNVS.

CoA C14 requires that the results of the Construction Monitoring Programs must be submitted to the Planning Secretary, and relevant regulatory agencies including councils and the EPA, for information in the form of a Construction Monitoring Report.

The Construction Monitoring Report will encompass other environmental aspect reports and would not be limited to noise and vibration monitoring. Downer’s Construction Monitoring Report would be submitted to City of Canterbury-Bankstown Council, the Planning Secretary and EPA on a six-monthly basis.

The six-monthly Construction Monitoring Reports will include a summary of monitoring undertaken, an overview of the results, analysis of the results and comparison against the nominated noise and vibration management levels, and raw data from monitoring. Once Sydney Metro and the ER have reviewed the reports, the monitoring reports will be provided to DPE, EPA and the City of Bankstown-Canterbury Council.

Reporting associated with incidents, non-conformances and non-compliances are described in the CEMP Section 3.7.2 and 3.10.3. Other noise and vibration-related reporting requirements are as follows:

- Emergency works are to be reported to the Environment Representative and the EPA (if an EPL applies, ie for works under a rail possession), in accordance with CoA E21. The proponent / Contractor must also “*use best endeavours to notify all noise and / or vibration affected receivers of the likely impact and duration*” of Emergency works.
- E23 requires that the outcomes of the community consultation including the agreed appropriate respite periods and works scheduling must be provided to the EPA (for works carried out under Sydney Trains’ EPL 12208 under a rail possession) and the Planning Secretary (for high risk activities after 9pm), upon request. The Environmental Representative will determine whether the noise and / or vibration impacts for any proposed out of hours works are considered to be “high risk” in accordance with Sydney Metro’s approved Out of Hours Work Strategy/Protocol.

- For works carried out under a rail possession under EPL 12208, when requested by an authorised officer of the EPA, O13.6 requires that the Contractor must provide written reasons to demonstrate that works undertaken outside the standard hours specified in EPL12208 O13.1 comply with the licence.
- For works carried out under a rail possession under EPL 12208, when requested by an authorised officer of the EPA, the Contractor must provide information as described in O13.5 to describe any proposed out-of-hours works, including a contact name and number of a responsible person who will be on site during the works.

8.6. Review of monitoring

Survey notes are required for all attended surveys, which provide details of the works taking place, observed mitigation measures on site, how audible the works noise is relative to the ambient conditions at the time of the survey, and any other details as described in the CNVS which are relevant to the assessment of the success or otherwise of the site noise and vibration mitigation methods.

Attended measurements provide the opportunity to identify ways to improve future works noise and vibration management – for example whether:

- There were ways to reduce impact, for example locating fixed plant behind an existing building, or installing noise curtains to break line of sight between source and receiver;
- There were lessons learned about good or bad practice observed on site;
- Adjustments will be made to future predictions, for example if plant was significantly quieter than the CNVS plant SWLs suggest and this make / model is proposed for future works.

Attended surveys may also determine potential non-conformances and/or non-compliances, which are to be reported to Sydney Metro and the ER within one business day of the survey – for example whether:

- Noise curtains or other mitigation commitments made in the approved OOHW Application have been correctly implemented;
- Agreed respite periods have not been observed, including for Highly Noise Intensive Works (Section 5.4);
- Plant used is not among the approved list of plant from the CNVIS or approved OOHW Application;
- Any item of plant is louder than expected and resulting in exceeding the predicted CNVIS noise levels; or
- Vibration levels exceeded the predicted levels, and in particular were high enough to risk damage to structures.

If mitigation has been implemented but incorrectly installed such that they are ineffective, then this is not in itself a non-compliance but a lesson learned, to be passed on to Downer to include in future site-inductions.

If the noise mitigation was ineffective, Downer must investigate and confirm how to correctly install so that it is effective when required in future. Any observations of ineffective noise mitigation and any rectification actions will be recorded by Downer in their site inspection records and training to prevent recurrence will be provided if required.

Effectiveness of noise mitigation is determined by the decibel reduction achieved by the mitigation and is not related to whether complaints have been received or not in relation to the works.

If mitigation has not been implemented, although it was stated as required under an approved OOHW Application, this is a non-compliance. Refer to Section 8.5.

Where the measured noise or vibration exceeds the predicted levels, Downer shall undertake an investigation.

If the investigation finds that the works were not undertaken in accordance with the approved work or this NVMP (for example, plant was different and / or mitigation not implemented), then this is to be recorded as a non-conformance under the CEMP, and may have the potential to be a non-compliance against the Planning Approval.

If the investigation finds that the approved plant and mitigation were implemented, but the predicted levels were lower than measured, Downer's acoustic consultant will investigate the reasons for this and update the noise model as required.

Monitoring results are to be reviewed by Downer's Environment Manager (or delegate) as soon as practicable. Where an opportunity for improvement is identified, mitigation measures will be reviewed. Reviews of monitoring shall occur within a week of any monitoring. If the review must document whether an exceedance of the predicted noise or vibration levels has been recorded, or if a complaint was received related to the works in question.

Downer's Environment Manager will consult with the construction team to determine whether any further mitigation measures will be adopted. This consultation will occur as soon as practicable following the review finding that measured noise or vibration levels exceeded the CNVIS predictions. If the excess is severe, for example vibration levels associated with risks of damage to structures or night-time noise levels associated with sleep awakening, then the consultation will occur formally through a meeting.

Further mitigation measures which may be considered include:

- Changes to construction methodology (change plant);
- Additional or modified respite periods, such as longer continuous breaks for high impact noise, or changing day-time periods of respite to accommodate individual receiver needs);
- Modifying timing of work to less sensitive periods;
- Modifying plant if safe and practicable, for example to install non-tonal vertical movement alarms on EWPs and mobile cranes;
- Any other reasonable and feasible measure.

8.7. Monitoring program consultation

This Noise and Vibration Monitoring Program was prepared in consultation with the local Council(s), in accordance with CoA C8(a), CoA C9(i) and CoA C10. Any feedback from Council has been incorporated into this Noise and Vibration Monitoring Program. See Section 1.5 and Appendix E for consultation carried out in the development of this program.

9. NVMP administration

9.1. Hold points

The delivery of works covered by the NVMP cannot commence until the NVMP and associated CNVIS are approved by relevant authorities or their nominated representatives.

Approval of the NVMP and the associated CNVIS require approval of components as listed in Table 25.

Table 25: NVMP hold points

Item	Process Held	Acceptance Criteria	Approval Authority
CEMP and Sub-plans	Site activities (Prior to construction commencement)	Site specific CEMP and Sub-plans (including this NVMP) have been developed, reviewed, endorsed by the ER and approved by DPE.	ER Endorsement DPE Approval.
CNVIS	Site activities (Prior to construction commencement)	CNVIS to be prepared by Specialist Consultant	ER Endorsement
OOHW Applications – individual works scenarios	Works to be performed outside of approved construction hours (Pre-construction and during construction)	OOHW Strategy/Protocol and Application Form and Community Notification EPL 12208	ER Endorsement and Approval Sydney Metro Approval (if OOHW are occurring under EPL 12208) EPA (Information to be provided on request)
Construction identified as affecting buildings	Site activities	Building Condition Survey conducted by an appropriate professional nominated by Downer	Downer’s Construction Manager

9.2. Review and improvement

The NVMP will be reviewed on a six-monthly basis and earlier if required in response to the relevant findings of any audit, incident report, complaint, monitoring event or inspection.

Other reasons for updating the NVMP and the associated CNVIS are:

- Ongoing of review of construction methodology and project noise and vibration issues, aiming for continuous improvement.
- Re-assess CNVIS and NVMP based on new inputs (if necessary, e.g. if scope, main works scenarios or location of works changes).
- Consistency Assessment (if required).
- Downer’s application for a works specific EPL.
- Amendments to the relevant EPL.

9.3. Records

Records are to be maintained for:

- Records of community enquiries and complaints, and Downer’s response – Sydney Metro central complaints management (refer to OCCS);
- Community Consultation – Sydney Metro Place Manager;
- Offers of Respite and / or Alternative Accommodation – Sydney Metro Place Manager;
- Plant and equipment hire – Downer Site Manager;
- Dilapidation or Condition surveys – Downer Site Manager;
- Works activities including Emergency Works – Downer Site Manager;
- Out of Hours Works Applications reviews, correspondence and approvals – Sydney Metro, Downer, Environment Representative;
- Any works deemed by the Environment Representative to be “High Risk” in accordance with Sydney Metro’s approved Out of Hours Work Strategy/Protocol – Sydney Metro, Environment Representative;
- Noise and vibration surveys – Downer Site Manager;
- Records of noise and vibration monitoring results against appropriate NMLs and vibration criteria, including those published in Construction Monitoring Reports;
- Site audits and inspections – Sydney Metro, Downer, Independent Auditor (where required), Environment Representative; and
- Noise and vibration potential and actual incidents – Sydney Metro, Downer, Independent Auditor, Environment Representative.

Appendix A – Other CoA, REMM and CEMF requirements relevant to this plan

Other relevant Conditions of Approval relevant to the development of this Plan

CoA No.	Condition Requirement	Document Reference
A26	<p>For the duration of the Work until the commencement of Operation, or as agreed with the Planning Secretary, the approved ER must:</p> <ul style="list-style-type: none"> (a) receive and respond to communication from the Planning Secretary in relation to the environmental performance of the CSSI; (b) consider and inform the Planning Secretary on matters specified in the terms of this approval; (c) consider and recommend to the Proponent any improvements that may be made to work practices to avoid or minimise adverse impact to the environment and to the community; (d) review documents identified in Conditions C1, C3 and C8 and any other documents that are identified by the Planning Secretary, to ensure they are consistent with requirements in or under this approval and if so: <ul style="list-style-type: none"> (i) make a written statement to this effect before submission of such documents to the Planning Secretary (if those documents are required to be approved by the Planning Secretary), or (ii) make a written statement to this effect before the implementation of such documents (if those documents are required to be submitted to the Planning Secretary for information or are not required to be submitted to the Secretary); (e) regularly monitor the implementation of the documents listed in Conditions C1, C3 and C8 to ensure implementation is being carried out in accordance with the document and the terms of this approval; (f) as may be requested by the Planning Secretary, help plan, attend or undertake audits of the development commissioned by the Department including scoping audits, programming audits, briefings and site visits, but not independent environmental audits required under Condition A34 of this approval; (g) as may be requested by the Planning Secretary, assist the Department in the resolution of community complaints; (h) assess the impacts of minor ancillary facilities as required by Condition A19 of this approval; (i) consider any minor amendments to be made to the documents listed in Conditions C1, C3 and C8 and any document that requires the approval of the Planning Secretary that comprise updating or are of an administrative or minor nature and are consistent with the terms of this approval and the documents listed in Conditions C1, C3 and C8 or other documents approved by the Planning Secretary and, if satisfied such amendment is necessary, approve the amendment. This does not include any modifications to the terms of this approval; and (j) prepare and submit to the Planning Secretary and other relevant regulatory agencies, for information, an Environmental Representative Monthly Report detailing the ER's actions and decisions on matters for which the ER was responsible in the preceding month. The Environmental Representative Monthly Report must be submitted within seven (7) days following the end of each month for the duration of the ER's engagement for the CSSI. 	<p>The interface between the ER and this Plan are outlined in:</p> <ul style="list-style-type: none"> Section 2.4 Section 7.11 Section 8.4 Section 8.5 Section 8.6 Section 9.1 Section 9.3
A36	<p>The Department must be notified in writing to compliance@planning.nsw.gov.au immediately after the Proponent becomes aware of an incident. The notification must identify the CSSI (including the application number and the name of the CSSI if it has one) and set out the location and nature of the incident.</p>	<p>CEMP Section 3.10.3 Section 8.5</p>

CoA No.	Condition Requirement	Document Reference
A37	Subsequent notification must be given, and reports submitted in accordance with the requirements set out in Appendix A. [Appendix A of CoA SSI 8256 not replicated in this NVMP]	CEMP Section 3.10.3 Section 8.5
E18	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 before the commencement of Work which generate Construction or Operational noise, vibration or ground-borne noise in that area. The results of the survey must be included in the Construction Noise and Vibration Impact Statement(s) or Operational Noise and Vibration Review, where relevant.	Section 3.1 Appendix B
E19	Work must only be undertaken during the following Construction hours: (a) 7:00am to 6:00pm Mondays to Fridays, inclusive; (b) 8:00am to 6:00pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 5.1 Section 7.6
E20	Notwithstanding Conditions E19 and E24 Work may be undertaken outside the hours specified in the following circumstances: (a) for the delivery of materials required by the NSW Police Force or other authority for safety reasons; or (b) 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; or (c) where different Construction hours are permitted or required under an EPL in force in respect of the CSSI; or (d) Work approved under an Out-of-Hours Work Protocol for Work not subject to an EPL as required by Condition E25; or (e) Construction that causes LAeq(15 minute) noise levels: (i) no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and (ii) no more than the 'Noise affected' noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and (iii) continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and (iv) intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006); or (f) where a negotiated agreement has been reached with a substantial majority of sensitive receivers who are within the vicinity of and may be potentially affected by the particular Construction, and the noise management levels and/or limit for ground-borne noise and vibration (human comfort) cannot be achieved. All agreements must be in writing and a copy forwarded to the Planning Secretary at least one (1) week before the commencement of activities.	Section 5.1 Section 7.6

CoA No.	Condition Requirement	Document Reference
	Note: Section 5.24(1)(e) of the EP&A Act requires that an EPL be substantially consistent with this approval.	
E21	On becoming aware of the need for emergency Work in accordance with Condition E20(b), the Proponent must notify the ER and the EPA (if a EPL applies) of the need for that Work. The Proponent must use best endeavours to notify all noise and/or vibration affected sensitive receivers of the likely impact and duration of those Work.	Section 5.1
E22	<p>Out-of-Hours Work that are regulated by an EPL as per Condition E20(c) or through the Out-of-Hours Work Protocol as per Condition E25 include:</p> <p>(a) Work which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 “Risk Management – Principles and Guidelines”; or</p> <p>(b) where the relevant road authority has advised the Proponent in writing that carrying out the activities could result in a high risk to road network operational performance; or</p> <p>(c) where the relevant utility service operator has advised the Proponent in writing that carrying out the activities could result in a high risk to the operation and integrity of the utility network; or</p> <p>(d) where the Transport for NSW Transport Management Centre (or other road authority) has advised the Proponent in writing that a road occupancy licence is required and will not be issued for the activities during the hours specified in Conditions E19 and E20; or</p> <p>(e) where Sydney Trains (or other rail authority) has advised the Proponent in writing that a Rail Possession is required.</p> <p>Note: Other Out-of-Hours Work can be undertaken with the approval of an EPL, or through the project’s Out-of-Hours Work Protocol for Work not subject to an EPL.</p>	<p>Section 5.1</p> <p>Section 7.5</p> <p>Section 7.6</p> <p>Section 7.9</p> <p>Section 7.11</p> <p>Appendix D</p>
E23	<p>In order to undertake Out-of-Hours Work, the Proponent must identify appropriate respite periods for the Out-of-Hours Work in consultation with the community at each affected location on a regular basis. This consultation must include (but not be limited to) providing the community with:</p> <p>(a) a schedule of likely Out-of-Hours Work for a period no less than two (2) months;</p> <p>(b) the potential work, location and duration;</p> <p>(c) the noise characteristics and likely noise levels of the Work; and (d) likely mitigation and management measures.</p> <p>The outcomes of the community consultation, the identified respite periods and the scheduling of the likely Out-of-Hours Work must be provided to the EPA (if an EPL applies) and the Planning Secretary (for high risk activities after 9pm) upon request.</p>	<p>Section 5.1</p> <p>Section 7.5</p> <p>Section 7.6</p> <p>Section 7.9</p> <p>Section 7.11</p> <p>Appendix D</p>
E24	<p>Except as permitted by an EPL, highly noise intensive Work that result in an exceedance of the applicable Noise Management Level at the same receiver must only be undertaken:</p> <p>(a) between the hours of 8:00 am to 6:00 pm Monday to Friday;</p> <p>(b) between the hours of 8:00 am to 1:00 pm Saturday; and</p> <p>(c) 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.</p>	<p>Section 5.4</p> <p>Section 7.6</p>

CoA No.	Condition Requirement	Document Reference
	For the purposes of this condition, 'continuous' includes any period during which there is less than a one (1) hour respite between ceasing and recommencing any of the work that are the subject of this condition.	
E25	<p>An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of Work which are outside the hours defined in Condition E19, and that are not subject to an EPL. The Protocol must be approved by the Planning Secretary before commencement of the Work. The Protocol must:</p> <p>(a) provide a process for the consideration of Out-of-Hours Work against the relevant noise and vibration criteria, including the determination of low and high-risk activities;</p> <p>(b) provide a process for the identification of mitigation measures for residual impacts, including respite periods in consultation with the community at each affected location, consistent with the requirements of Condition E23;</p> <p>(c) identify procedures to facilitate the coordination of Out-of-Hours Work approved by an EPL to ensure appropriate respite is provided;</p> <p>(d) identify an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where:</p> <p>(i) low risk activities and high risk activities that cease by 9pm can be approved by the ER, and</p> <p>(ii) all other high risk activities must be approved by the Planning Secretary; and</p> <p>(e) identify Planning Secretary, EPA and community notification arrangements for approved Out-of-Hours Work, which may be detailed in the Community Communication Strategy.</p>	<p>Sydney Metro Out Of Hours Works Strategy/Protocol</p> <p>Section 5.1</p> <p>Section 7.5</p> <p>Section 7.6</p> <p>Section 7.9</p> <p>Section 7.11</p> <p>Appendix D</p>
E26	<p>Work undertaken for the delivery of the CSSI, including those undertaken by third parties (such as utility relocations), must be coordinated to ensure respite periods are provided. The Proponent must:</p> <p>(a) reschedule Work to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with Condition E23; or</p> <p>(b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and</p> <p>(c) provide documentary evidence to the ER in support of any decision made by the Proponent in relation to respite or mitigation.</p>	Section 7.10
E27	Construction Noise and Vibration Impact Statements must be prepared for Construction sites before Construction noise and vibration impacts commence and include specific mitigation measures identified through consultation with affected sensitive receivers. The Statements must augment the Construction Noise and Vibration Management Sub-plan and must be implemented for the duration of Work. The Statements must be informed by a suite of potential management/mitigation options provided in the Construction Noise and Vibration Sub-plan.	<p>Section 1.4</p> <p>Section 3.3</p> <p>Section 6</p> <p>Section 7.12</p>
E28	Noise generating Work in the vicinity of potentially-affected community, religious, or educational institutions resulting in noise levels above the noise management levels must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution or as otherwise approved by the Planning Secretary.	<p>Section 1.4</p> <p>Section 7.5</p> <p>Section 7.6</p>

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CoA No.	Condition Requirement	Document Reference
E29	<p>Mitigation measures must be implemented with the aim of achieving the following Construction noise management levels and vibration criteria:</p> <ul style="list-style-type: none"> (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) BS 7385 Part 2-1993 “Evaluation and measurement for vibration in buildings Part 2” as they are “applicable to Australian conditions”; and (d) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). <p>Note: The Interim Construction Noise Guideline identifies ‘particularly annoying’ activities that require the addition of 5 dB(A) to the predicted level before comparing to the Construction Noise Management Level.</p>	<p>Section 2 Section 5 Section 7</p>
E30	<p>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-listed structures.</p>	<p>Section 5.7 Section 7.5 Section 7.6</p>
E32	<p>Operational noise mitigation measures as identified in Condition E31 that will not be physically affected by Construction, must commence implementation within six (6) months of the commencement of Construction in the vicinity of the impacted receiver(s) to minimise Construction noise impacts, and detailed in an updated Noise and Vibration CEMP Sub-plan for the CSSI.</p> <p>Note: For the purpose of Conditions E32 and E33, operational noise mitigation measures refer to at property or other identified non-source controls, the detail of which would broadly be included in the Noise and Vibration CEMP Sub-plan. When detail on the specific mitigation measures is known and before the implementation of the mitigation measures, the CEMP sub- plan must be updated.</p>	<p>CoA E32 is not relevant to the Project as station works are not near locations where operational noise mitigation is identified</p>
E33	<p>Where implementation of Operational noise mitigation measures will be physically affected by Construction such that they cannot commence implementation within six (6) months of the commencement of Construction in accordance with Condition E32, the Proponent must submit to the Secretary a report providing justification as to why, along with details of temporary measures that would be implemented to address construction noise impacts until such time that the Operational noise mitigation measures identified in Condition E31 are implemented. The report must be submitted to the ER for review. When the ER is satisfied that the justification and alternative measures are appropriate to address construction noise impacts, and within six (6) months of the commencement of Construction which would affect the identified sensitive receivers, the report must be submitted to the Planning Secretary for information.</p>	<p>CoA E32 is not relevant to the Project as station works are not near locations where operational noise mitigation is identified</p>

Revised Environmental Mitigation Measures relevant to the development of this Plan

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REMM No.	REMM Requirement	Timing	Document Reference
NVC1	In accordance with the Construction Noise and Vibration Strategy, construction noise impact statements would be prepared prior to the commencement of construction components, to consider the scale and duration of construction noise impacts, and identify measures to minimise impacts to sensitive receivers. This would include noise modelling to confirm the results of modelling undertaken as part of the Environmental Impact Statement and Submissions and Preferred Infrastructure Report. Where exceedances of the noise management levels are identified, feasible and reasonable mitigation measures would be identified.	Design/pre-construction	Relevant requirements of the Sydney Metro CNVS form part of this NVMP, as noted in Section 2. Relevant requirements of the Sydney Metro CNVS will be incorporated into the CNVIS prepared for the Station Works outlined in Section 5. Additional mitigation measures, as defined by the Sydney Metro CNVS, are outlined in Section 7.11
NVC2	In accordance with the Construction Noise and Vibration Strategy, all employees, contractors and subcontractors would receive an environmental induction. The induction must at least include: <ul style="list-style-type: none"> i. relevant project specific and standard noise and vibration mitigation measures ii. relevant licence and approval conditions iii. permissible hours of work iv. any limitations on high noise generating activities v. location of nearest sensitive receivers vi. designated loading/unloading areas and procedures vii. site opening/closing times (including deliveries). 	Design/pre-construction	Section 7.7
NVC3	Where vibration levels are predicted to exceed the vibration screening level, a more detailed assessment of the structure would be carried out to determine the appropriate vibration limits for that structure.	Design/pre-construction	Section 5.7 Section 5.8 Section 5.9 Section 5.10 Section 8.2.2
NVC4	For heritage items where vibration screening levels are predicted to be exceeded, the more detailed assessment would include condition assessment and specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is adequately monitored and managed.	Design/pre-construction	Heritage Management Plan Section 5.7 Section 8.2.2
NVC5	The Construction Noise and Vibration Strategy would be implemented with the aim of achieving the noise management levels where feasible and	Construction	Section 7.1 Section 7.2

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REMM No.	REMM Requirement	Timing	Document Reference
	<p>reasonable. This may include the following example mitigation measures alone or in combination, where feasible and reasonable:</p> <ul style="list-style-type: none"> i. The provision of noise barriers around each construction site. ii. The coincidence of noisy plant working simultaneously close together would be avoided. iii. Residential grade mufflers would be fitted to all mobile plant. iv. Non-tonal reversing alarms would be fitted to all permanent mobile plant. v. High noise generating activities would be scheduled for less sensitive periods considering the nearby receivers, where reasonable and feasible. vi. The layout of construction sites would consider opportunities to shield receivers from noise. vii. Stationary noise sources would be enclosed or shielded whilst ensuring that the occupational health and safety of workers is maintained. viii. Loading and unloading of materials/deliveries is to occur as far as possible from noise sensitive receivers. ix. Select site access points and roads as far as possible away from noise sensitive receivers. x. Dedicated loading/unloading areas to be shielded if close to noise sensitive receivers wherever feasible and reasonable. xi. Use quieter and less vibration emitting construction methods where feasible and reasonable. xii. The noise levels of plant and equipment must have operating Sound Power Levels compliant with the criteria in the Construction Noise and Vibration Strategy. xiii. Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. xiv. Where feasible and reasonable, the offset distance between noisy plant items and nearby noise sensitive receivers would be as great as possible. 		<p>Section 7.3 Section 7.4 Section 7.5 Section 7.13 All example NVC5 mitigation measures will be considered in the development of CNVIS assessments associated with this NVMP.</p>



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REMM No.	REMM Requirement	Timing	Document Reference
	<ul style="list-style-type: none"> xv. Where reasonable and feasible heavy vehicle movements would be limited to daytime and evening hours, with night-time movements avoided where possible. xvi. Active community consultation and the maintenance of positive, cooperative relationships with schools, local residents and building owners and occupiers, through: <ul style="list-style-type: none"> o periodic notification or work activities and progress (e.g. regular letterbox drops, e-consult) o specific notification (letter-box drop) prior to especially noisy activities o comprehensive website information o project information and construction response telephone line o email distribution lists. 		
NVC6	<p>Noise intensive plant for, would not be used during the night-time period (10pm to 7am) unless:</p> <ul style="list-style-type: none"> i. during a weekend rail possession or shut down ii. a requirement of a road authority, emergency services or Sydney Coordination Office requires works to be undertaken during this period. 	Construction	<p>Section 5.1 Section 5.4 Section 7.6</p>
NVC7	When working adjacent to schools, medical facilities and child care centres, particularly noisy activities would be scheduled outside normal working hours, where reasonable and feasible.	Construction	This will be addressed in the CNVIS and will incorporate outcomes of consultation in line with Section 7.5
NVC8	When working adjacent to churches and places of worship, particularly noisy activities would be scheduled outside services, where reasonable and feasible.	Construction	This will be addressed in the CNVIS and will incorporate outcomes of consultation in line with Section 7.5
NVC9	Alternative accommodation may be offered to residents living in close proximity to construction works where detailed construction planning identifies unreasonably high noise impacts over a prolonged period. Alternative accommodation arrangements would be offered and discussed with residents on a case-by-case basis.	Construction	Alternative accommodation is to be applied where triggered in accordance with the Sydney Metro City and Southwest Construction Noise and Vibration Strategy, as outlined in: Section 7.11 Section 7.12

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REMM No.	REMM Requirement	Timing	Document Reference
NVC10	High noise and vibration generating activities including ballast tamping, may only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block and these works.	Construction	Section 5.4 Section 7.6 No ballast tamping is proposed as part of this Project's scope.
NVC11	Ongoing noise monitoring would be undertaken during construction at sensitive receivers during critical periods (i.e. times when noise emissions are expected to be at their highest) to identify and assist in managing high risk noise events.	Construction	Section 5.4 Section 7.11 Section 8.2
NVC12	Where vibration levels are predicted to exceed the vibration screening level, attended vibration monitoring would be carried out to ensure vibration levels remain below appropriate limits for that structure.	Construction	Section 5 Section 8.2.2
NVC13	Reasonable and feasible measures would be implemented in accordance with the Construction Noise and Vibration Strategy to minimise ground-borne noise where exceedances are predicted.	Construction	Section 6.5 Section 7.4 Ground borne noise management levels expected to be met
NVC14	Reasonable and feasible mitigation measures would be implemented where power supply works would result in elevated noise levels at receivers. This could include: <ul style="list-style-type: none"> i. carrying out works during the daytime period when in the vicinity of residential receivers ii. where out of hours works are required, scheduling the noisiest activities to occur in the evening period (up to 10pm) iii. use of portable noise barriers around particularly noisy equipment. 	Construction	This NVMP and associated CNVIS Section 7 No power supply works are proposed in this Project's station upgrade scope of this Project.
NVC15	The routes for construction haulage vehicles and bus services associated with the Temporary Transport Strategy would be selected on the basis of compliance with the relevant road traffic noise criteria, where reasonable and feasible. Where compliance with the noise criteria is not possible, reasonable and feasible noise mitigation would be implemented.	Construction	Bus services for the purpose of the Temporary Transport Strategy is outside the scope of this NVMP, and is not the responsibility of Downer. The sections below only address the construction haulage vehicles component of this REMM. Section 5.6 Section 7.13
NVC16	An Out of Hours Work Strategy would be prepared, in consultation with the Environment Protection Authority, to guide the assessment, management, and approval of works outside recommended standard hours.	Construction	Sydney Metro Out of Hours Works Strategy/Protocol Section 1.4

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REMM No.	REMM Requirement	Timing	Document Reference
			Section 5.1 Section 7.5 Section 7.6 Section 7.9 Section 7.11 Appendix D

Construction Environmental Management Framework requirements relevant to the development of this Plan

CEMF Section	CEMF Requirement	Document Reference
3.7(a)	Prior to the commencement of construction Downer will offer Pre-construction Building Condition Surveys, in writing, to the owners of buildings where there is a potential for construction activities to cause cosmetic or structural damage. If accepted, Downer will produce a comprehensive written and photographic condition report produced by an appropriate professional prior to relevant works commencing.	Section 8.2.3 Section 9.1 Table 25
5.1(a)	Standard working hours are between 7am – 6pm on weekdays and 8am – 1pm on Saturdays.	Section 5.1 - Note via the Project CSSI-8256 Standard hours on Saturday is between 0800-1800 and shall apply to the Project.
5.1(b)	Works which can be undertaken outside of standard construction hours without any further approval include: <ul style="list-style-type: none"> i. Those which have been described in respective environmental assessments as being required to take place 24/7. For example, tunnelling and underground excavations and supporting activities will be required 24/7 ii. Works which are determined to comply with the relevant Noise Management Level at sensitive receivers iii. The delivery of materials outside of approved hours as required by the Police or other authorities (including RMS) for safety reasons iv. Where it is required to avoid the loss of lives, property and / or to prevent environmental harm in an emergency v. Where written agreement is reached with all affected receivers. 	Section 5.1



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CEMF Section	CEMF Requirement	Document Reference
5.1(c)	Downer may apply for EPA approval to undertake works outside of normal working hours under their respective Environment Protection Licences	Section 5.1
5.2(a)	Downer will consider the following in the layout of construction sites: i. The location of noise intensive works and 24 hour activities in relation to noise sensitive receivers ii. The location of site access and egress points in relation to noise and light sensitive receivers, especially for sites proposed to be utilised 24 hours per day iii. The use of site buildings to shield noisy activities from receivers iv. The use of noise barriers and / or acoustic sheds where feasible and reasonable for sites proposed to be regularly used outside of daytime hours v. Aim to minimise the requirement for reversing, especially of heavy vehicles.	Section 7.1 Section 7.2 Section 7.3 Section 7.6
9.1(a)	Construction Noise and Vibration Management Objectives The following noise and vibration management objectives will apply to construction: (i) Minimise unreasonable noise and vibration impacts on residents and businesses; (ii) Avoid structural damage to buildings or heritage items as a result of construction vibration; (iii) Undertake active community consultation; and (iv) Maintain positive, cooperative relationships with schools, childcare centres, residents and building owners.	Section 1.3
9.2(b)	Detailed Construction Noise and Vibration Impact Statements will be prepared for noise intensive construction sites and or activities, to ensure the adequacy of the noise and vibration mitigation measures. Specifically, Construction Noise and Vibration Impact Statements will be prepared for EPL variation applications and works proposed to be undertaken outside of standard construction hours.	Section 5.4 Section 7.2 Section 7.3 CNVIS associated with this NVMP (separate document) Separate EPL will not be obtained for these works.
9.2(c)	Noise and vibration monitoring would be undertaken for construction as specified in the CNVS and the EPL.	Section 8
9.2(d)	The following compliance records would be kept by Downer: (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 8.5 Section 9.3

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CEMF Section	CEMF Requirement	Document Reference
9.3(a)	All feasible and reasonable mitigation measures would be implemented in accordance with the CNVS. Examples of noise and vibration mitigation measures include: (i) Construction hours will be in accordance with the working hours specified in Section 5.1; (ii) Hoarding and enclosures will be implemented where required to minimise airborne noise impacts; and The layout of construction sites will aim to minimise airborne noise impacts to surrounding receptors.	Section 5.1 Section 7.6 Section 7.3 Section 7.1 Section 7

The table below presents the compliance matrix for the EPL12208 Clauses relating to construction noise and vibration for the Project. The matrix includes the full text of the Clause and the reference in this NVMP or the associated CNVIS which details how compliance is to be achieved.

EPL Clause	Requirement / Measure	Document Reference
Environmental awareness		
O11.1	All staff, including contractors and subcontractors, involved in the carrying out of the activities authorised by this licence must be aware of their environmental responsibilities relating to the activities regulated by this licence.	Section 7.7 Section 7.8
Other operating conditions – Railway maintenance activities		
O13	Note: The objectives of these conditions are to minimise noise impacts from railway maintenance activities, recognising that operational safety and other factors constrain when these activities can be carried out on the Sydney Trains Network. These factors include avoiding disruptions during peak periods for passenger services and ensuring that programmed track closures facilitate the efficient completion of maintenance activities. Night-time and weekend work will be required for some activities.	Section 7.6
Standard railway maintenance hours		
O13.1	Maintenance activities must be undertaken: a) between the hours of 7:00am and 6:00pm Monday to Friday b) between the hours of 8:00am and 1:00pm Saturday; and c) not on Sunday or public holidays, unless an exception in condition O13.2 or condition O13.3 applies.	Section 5.1 Section 7.6
Exception to standard railway maintenance hours		
O13.2	The licensee may undertake maintenance activities outside of the hours specified in Condition O13.1:	Section 5.1

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EPL Clause	Requirement / Measure	Document Reference
	a) to provide safe and reliable train services or a safe working environment; or b) for emergency works; or c) for the delivery of oversized plant or structures that require special arrangements or authorisation to be lawfully transported along public roads.	Section 7.6 Requirements are aligned with the Sydney Metro CNVS and this NVMP Out of Hours Works Protocol to be applied – refer Section 7.6
Exception to standard railway maintenance hours for low noise impact generating works		
O13.3	(a) The licensee may undertake maintenance activities outside of the hours specified in Condition O13.1, if the activities do not exceed: i. 5dBA (LAeq, 15min) above the relevant rating background levels at day, evening and night, as determined at the nearest noise sensitive receiver as assessed by acoustic investigation, and ii. 15dBA (LA1, 1min or LAm _{ax}) above the relevant rating background level at night, as determined at the nearest noise sensitive receiver as assessed by acoustic investigation. b) The results of any acoustic investigation undertaken in relation to Conditions O13.3(a)(i) and O13.3(a) (ii) must be provided by the licensee when requested by an authorised officer of the EPA. c) An acoustic investigation referred to in Conditions O13.3(a)(i) and O13.3(a)(ii) is not required if there are no noise sensitive receivers impacted by the activities.	Requirements are aligned with the Sydney Metro CNVS and this NVMP Out of Hours Works Protocol to be applied – refer Section 7.6
Management of noise impacts from railway maintenance		
O13.4	Where maintenance activities are undertaken, including outside of the hours specified in Condition O13.1, noise impacts must be managed in accordance with the recommendations in the Interim Construction Noise Guideline (DECCW, 2009), as updated from time to time. The licensee is required to: a) identify noise sensitive receivers that may be affected; b) identify hours of work for the proposed activities; c) identify noise impacts at noise sensitive receivers; d) select and apply reasonable and feasible work practices to minimise noise impacts; and e) notify the identified noise sensitive receivers at least 5 days prior to the commencement of maintenance activities undertaken outside of the hours specified in Condition O13.1, except where the licensee first becomes aware of the need to undertake those maintenance activities less than 5 days prior to the proposed commencement date, in which case the notification must be provided as soon as practicable after becoming aware of the need to undertake the maintenance activities.	Requirements are aligned with the Sydney Metro CNVS and this NVMP Out of Hours Works Protocol to be applied – refer Section 7.6
Management of noise impacts from railway maintenance		



EPL Clause	Requirement / Measure	Document Reference
O13.5	<p>When requested by an authorised officer of the EPA, the licensee must provide the following information regarding any proposed maintenance activities on the Sydney Trains Network:</p> <ul style="list-style-type: none"> a) dates and times of the proposed maintenance activity; b) location of the proposed maintenance activity; c) type(s) of work to be performed in conducting the proposed maintenance activity; d) plant and equipment to be used; and e) contact name and telephone number of a person who will be on site during the activity and who is authorised by the licensee to take action, including the cessation of the activity or any part of it, if so directed by the EPA. A contact person must be contactable 24 hours a day via the supplied telephone number(s) during the whole of the period that the activity takes place outside the hours specified in Condition O13.1. 	<p>Section 8.5 Covered in Sydney Metro procedures for interaction with NSW government agencies.</p>
O13.6	<p>When requested by an authorised officer of the EPA, the licensee must provide written reasons that demonstrate that maintenance activities undertaken outside of the hours specified in Condition O13.1 comply with the licence.</p>	<p>Section 8.5 Covered in Sydney Metro procedures for interaction with NSW government agencies.</p>

Appendix B – Land Use Survey

Map of Receiver Catchment Areas

Appendix C – Indicative work areas

Appendix D – Sydney Metro Out-of-Hours Works Application (SM-17-00000115)

Appendix E – Consultation Records

Agency	Comment	Project Response
CoCB	<p>Email received 16/11/20</p> <p><i>“Thank you for sending Council the three CEMP subplans for these station upgrades. Council has recently provided feedback on the Construction Noise and Vibration Management Plan (NVMP) and Construction Soil and Water Management Plan (SWMP) and is currently reviewing your recently sent Construction Heritage Management Plan (HMP).</i></p> <p><i>I will send you with any feedback on the HMP as soon as it becomes available from the relevant Council officers.</i></p> <p><i>Please contact me should you have any queries.”</i></p> <p>No comments were provided by CoCB in the email issued 16/11/20. A follow up email received 24/11/20 confirmed that CoCB had no comments on the Noise and Vibration Management Plan for the Project.</p>	Noted. No updates to NVMP proposed.