Appendix B2

Noise and Vibration Management Sub-plan

M4-M5 Link Mainline Tunnels

August 2020

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Contents

Tables

Appendices

Document control

Approval and authorisation

Title	M4-M5 Link Mainline Tunnels Noise and Vibration Management Sub-plan
Document No/Ref	M4M5-LSBJ-PRW-EN-MP01-PLN-0002-21
Document Path	

Version control

Revision	Date	Description
01	18 September 2018	For DPE review
02	24 September 2018	For DPE review
03	16 October 2018	For DPE review
04	7 November 2018	For DPE review
05	15 November 2018	For DPE review
06	19 November 2018	For DPE review
07	22 November 2018	For DPE approval
08	04 February 2019	Updated for DPE tunnelling approval – internal review
09	07 February 2019	Updated for DPE tunnelling approval
10	08 February 2019	Updated post Project Modification
11	15 February 2019	Further update post Project Modification
12	27 February 2019	Update post Project Modification for DPE review
13	7 March 2019	For DPE approval
14	19 March 2019	For DPE review – new NCA and vibration screening criteria drawings
15	18 April 2019	For DPE approval – new NCA and vibration screening criteria drawings
16	13 May 2019	Update for Consistency Assessment 04 and updated Appendix E2
17	4 September 2019	Minor update for WestConnex Transurban review
18	25 September 2019	Minor update – for ER approval
19	28 October 2019	Further update – for ER/AA approval
20	12 June 2020	Minor update - for ER approval
21	6 August 2020	Update to provide detail on management of Sydney Water assets

Note: Revision 07 Document Number has changed from M4M5-LSBJ-PRW-GEN-EV01-PLN-0003 (previous revisions) to M4M5-LSBJ-PRW-EN-MP01-PLN-0002.

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline
CCS	Community Communications Strategy
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CNVIS	Construction Noise and Vibration Impact Statement
CNS	Construction Noise Strategy (Transport for NSW, 2012)
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now OEH)
DECC	Department of Environment and Climate Change (now OEH)
DECCW	Department of Environment, Climate Change and Water (now OEH)
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.

Abbreviations	Expanded Text
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
ENMM	Environmental Noise Management Manual (RTA 2001)
EPA	NSW Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPL	Environment Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
KPI	Key Performance Indicator
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
$L_{A\ (max)}$	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LGA	Local Government Area
LSBJV	Lendlease Samsung Bouygues Joint Venture
NCA	Noise Catchment Area
NML	Noise Management Level
NVMP	Noise and Vibration Management Plan

Abbreviations	Expanded Text
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works
PPV	Peak Particle Velocity
RBL	The Rating Background Level for each period is the medium value of the Assessment Background Level values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
REMM	Revised Environmental Management Measures
RNP	NSW Road Noise Policy (DECCW 2011)
Roads and Maritime	Roads and Maritime Services
SMC	Sydney Motorway Corporation
SPIR	Submissions and Preferred Infrastructure Report
SSI	State Significant Infrastructure

1 Introduction

1.1 Context

This Noise and Vibration Management Sub-plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for the M4-M5 Link Mainline Tunnels (the Project).

This NVMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), the WestConnex M4-M5 Link Environmental Impact Statement (EIS), and the revised environmental management measures (REMM) listed in the WestConnex M4-M5 Link Submissions and Preferred Infrastructure Report (SPIR), the WestConnex M4-M5 Link Mainline Tunnel Modification report (September 2018) and all applicable guidance and legislation.

1.2 Project background

The M4-M5 Link EIS (AECOM 2017) assessed noise and vibration impacts on sensitive receivers and structures during construction and operation of the Project, within Chapter 10 and the Noise and Vibration Technical Working Paper (Appendix J of the EIS).

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

Please refer to Section 1.3 of the CEMP for Project Description.

1.3 Scope of the Sub-plan

The scope of this Plan is to describe how Lendlease Samsung Bouygues Joint Venture (LSBJV) propose to manage potential noise and vibration impacts during construction of the Project. Operational noise and vibration impacts and operation measures do not fall within the scope of this Plan and therefore are not included within the processes contained within this Plan.

1.4 Environmental management systems overview

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

2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how the LSBJV proposes to manage potential noise and vibration impacts during construction of the Project.

2.2 Objectives

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

- The EIS prepared for WestConnex M4-M5 Link
- The SPIR prepared for WestConnex M4-M5 Link
- The Modification report for WestConnex M4-M5 Link Mainline Tunnel (September 2018)
- Conditions of Approval granted to the Project on 17 April 2018 and as modified on 25 February 2019
- Roads and Maritime specification G36
- The Project's Environment Protection Licence (EPL)
- All relevant legislation and other requirements described in Section 3.1 of this Plan.

2.3 Environmental performance outcomes and targets

The following targets, presented in Table 2-1 have been established for the management of potential noise and vibration impacts during construction of the Project. The Project has also established key performance indicators (KPIs) for these targets. These have been derived from the following sources:

- EIS Appendix A
- Conditions of Approval granted to the project on 17 April 2018
- NSW Interim Construction Noise Guideline (ICNG) (DECC, 2009).

Table 2-1 KPIs for noise and vibration

Target / KPI number	Target	KPI	Records	Source
1	Ensure full compliance with the relevant legislative requirements, CoA and REMM	No repeat non-conformances	LLE703A Environmental Inspection Checklist / Audits (internal document)	CoA A1

Target / KPI number	Target	KPI	Records	Source
2	Implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009)	Demonstrable implementation of noise mitigation measures	LLE703A Environmental Inspection Checklist / Audits (internal document)	ICNG
3	Potential construction impacts are minimised for construction-fatigued community and stakeholders.	Implementation of NIP in accordance with CoA	At receiver treatment records	CoA E88 CoA C11(b)
4	Ensure prediction tools are accurate as possible through feedback between monitoring and predictions	Ongoing refinement of noise and vibration prediction tools	Noise monitoring records Update of prediction tool	LSBJV Practice
5	Implementation of continual improvement and corrective action where monitored levels are above predictions	Demonstrable implementation of continual improvement and corrective actions	Noise monitoring records	LSBJV Practice
6	Effective management of construction noise and vibration in accordance with relevant guidelines.	Demonstrable implementation of effective management of construction noise and vibration	LLE703A Environmental Inspection Checklist / Audits (internal document)	EIS Appendix A
7	No damage to features of heritage conservation significance from vibration as a result of the Project.	Demonstrable implementation of effective management of construction vibration to avoid damage	LLE703A Environmental Inspection Checklist / Audits (internal document)	EIS Appendix A

3 Environmental requirements

3.1 Relevant legislation

3.1.1 Legislation

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

3.1.2 Guidelines

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

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System)
- Roads and Maritime Construction Noise and Vibration Guidelines (CNVG) (Roads and Maritime 2016)
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- Road and Traffic Authority Environmental Noise Management Manual (ENMM) (Roads and Traffic Authority 2001)
- NSW Road Noise Policy (RNP), Dept. of Environment, Climate Change and Water 2011
- NSW Industrial Noise Policy (INP), NSW Environment Protection Authority 2000
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006
- Australian Standard AS/NZS 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-1999 Structural vibration Part 3: Effects of vibration on Structures,
- Construction Noise Strategy 7TP-ST-157/2.0 (CNS), Transport for NSW 2012

3.2 Minister's Conditions of Approval

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

Refer to **Appendix A** for all other CoA relevant to the development of this Plan.

Table 3-1 Minister's Conditions of Approval

<table>
<tr><th>CoA No.</th><th>Condition Requirements</th><th>Document Reference</th><th>How Addressed</th></tr>
<tr><td>C4</td><td>The following CEMP Sub-plans must be prepared in consultation with the relevant authorities identified for each CEMP Sub-plan and be consistent with the CEMP referred to in the EIS.
<table>
<tr><th></th><th>Required CEMP Sub-plan</th><th>Relevant authority(s) and council(s) to be consulted for each CEMP and Sub-plan</th></tr>
<tr><td>(b)</td><td>Noise and Vibration</td><td>EPA and relevant council(s)</td></tr>
</table></td><td>This NVMP
Section 3.5</td><td>This Noise and Vibration Management Sub-plan has been prepared in accordance with this condition and describes how LSBJV propose to manage noise and vibration during construction of the Project.</td></tr>
<tr><td rowspan="4">C5</td><td>The CEMP Sub-plans must state how:</td><td></td><td></td></tr>
<tr><td>(a) The environmental performance outcomes identified in the EIS and SPIR as modified by these conditions will be achieved</td><td>Section 2.3</td><td>This Sub-plan was prepared in accordance with the environmental performance outcomes identified in the EIS and SPIR and is evidenced primarily in Section 2.3 and Table 2-1.</td></tr>
<tr><td>(b) The mitigation measures identified in the EIS and SPIR as modified by these conditions will be implemented</td><td>Table 8-1</td><td>The implementation of noise and vibration management and mitigation measures identified in the EIS and SPIR are listed in Table 8-1.</td></tr>
<tr><td>(c) The relevant terms of this approval will be complied with; and</td><td>Section 3.2
Appendix A – Other conditions of Approval and Revised</td><td>Details regarding how LSBJV propose to comply with the relevant terms of approval are listed in this Table and in Appendix A.</td></tr>
</table>

CoA No.	Condition Requirements	Document Reference	How Addressed
		Environmental Management Measures relevant to this Plan.	
	(d) Issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed.	Section 6.2 Table 8-1 Environmental Risk Assessment Workshop (Section 3.2.1 of CEMP)	Noise and vibration issues requiring management during construction of the Project have been identified through the EIS, SPIR and Environmental Risk Assessment Workshop. These issues including cumulative impacts have been detailed in Section 6.2 of this Sub-plan and Appendix A2 of the CEMP. Environmental risk analysis will be ongoing and regularly reviewed in accordance with Section 3.9 to Section 3.13 of the CEMP to ensure effective management of noise and vibration impacts. Mitigation and management measures for these issues are listed in Table 8-1, Appendix A and Appendix A2 of the CEMP.
C6	The CEMP Sub-plans must be endorsed by the ER and then submitted to the Secretary for approval no later than one (1) month prior to the commencement of the construction activities to which they apply.	Refer to Section 2.2 of the CEMP	This NVMP has been endorsed by the ER. The NVMP will be submitted to DPIE for approval no later than one month prior to the commencement of the construction activities.

<table>
<tr><th>CoA No.</th><th>Condition Requirements</th><th>Document Reference</th><th>How Addressed</th></tr>
<tr><td>C7</td><td>Any of the CEMP Sub-plans may be submitted to the Secretary along with, or subsequent to, the submission of the CEMP.</td><td>Refer to Section 2.2 of the CEMP</td><td>This Sub-plan has been submitted for approval to DPIE prior to the final submission of the CEMP for DPIE approval.</td></tr>
<tr><td>C8</td><td>Construction must not commence until the CEMP and all CEMP Sub-plans have been approved by the Secretary. The CEMP and CEMP Sub-plans, as approved by the Secretary, including any minor amendments approved by the ER, must be implemented for the duration of construction. Where the CSSI is being staged, construction of that stage is not to commence until the relevant CEMP and CEMP Sub-plans have been endorsed by the ER and approved by the Secretary.</td><td>Refer to Section 2.2 of the CEMP</td><td>Construction will not commence until the CEMP and all CEMP Sub-plans have been approved by DPIE. The CEMP and CEMP Sub-plans will be implemented for the duration of construction.</td></tr>
<tr><td>C9</td><td>The following Construction Monitoring Programs must be prepared in consultation with the relevant authorities identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance.
<table>
<tr><th></th><th>Required Construction Monitoring Programs</th><th>Relevant authority(s) and council(s) to be consulted for each Construction Monitoring Program</th></tr>
<tr><td>(c)</td><td>Noise and Vibration Monitoring Program</td><td>Relevant council(s), NSW Health</td></tr>
</table></td><td>Section 3.2 of the Noise and Vibration Monitoring Program (Appendix B)</td><td>The Noise and Vibration Monitoring Program has been prepared in accordance with this condition and describes how LSBJV propose to undertake noise and vibration monitoring during construction of the Project.</td></tr>
<tr><td>C10</td><td>Each Construction Monitoring Program must provide:</td><td></td><td></td></tr>
</table>

CoA No.	Condition Requirements	Document Reference	How Addressed
	(a) Details of baseline data available	Section 4 of the Noise and Vibration Monitoring Program (Appendix B)	Details of baseline noise and vibration data available is outlined in Section 4 of the Noise and Vibration Monitoring Program.
	(b) Details of baseline data to be obtained and when	Section 4 of the Noise and Vibration Monitoring Program (Appendix B)	Details of baseline noise and vibration data to be obtained and when is outlined in Section 4 of the Noise and Vibration Monitoring Program.
	(c) Details of all monitoring of the Project to be undertaken	Section 5 and 6 of the Noise and Vibration Monitoring Program (Appendix B)	Details of all monitoring of the Project to be to be undertaken is outlined in Sections 5 and 6 of the Noise and Vibration Monitoring Program.
	(d) The parameters of the Project to be monitored	Sections 5.1.1, 5.2.1, 5.3.1, 6.1.1 and 6.2.1 of the Noise and Vibration Monitoring Program (Appendix B)	The parameters of the Project to be monitored are outlined in Sections 5.1.1, 5.2.1, 6.1.1 and 6.2.1 of the Noise and Vibration Monitoring Program.
	(e) The frequency of monitoring to be undertaken	Section 5 and 6 of the Noise and Vibration Monitoring Program (Appendix B)	The frequency of monitoring to be undertaken is outlined in Sections 5 and 6 of the Noise and Vibration Monitoring Program.
	(f) The location of monitoring	Section 5 and 6 of the Noise and Vibration Monitoring Program (Appendix B)	The noise and vibration monitoring locations are outlined in Sections 5 and 6 of the Noise and Vibration Monitoring Program.

CoA No.	Condition Requirements	Document Reference	How Addressed
	(g) The reporting of monitoring and analysis results against relevant criteria	Section 10 of the Noise and Vibration Monitoring Program (Appendix B)	The reporting of monitoring and analysis results against relevant criteria is outlined in Section 10 of the Noise and Vibration Monitoring Program.
	(h) Details of the methods that will be used to analyse the monitoring data	Section 9 of the Noise and Vibration Monitoring Program (Appendix B)	Details of the methods that will be used to analyse are outlined in Section 9 of the Noise and Vibration Monitoring Program.
	(i) Procedures to identify and implement additional mitigation measures where results of monitoring are unsatisfactory; and	Section 9 of the Noise and Vibration Monitoring Program (Appendix B)	The procedures to identify and implement additional mitigation measures where results of noise and vibration monitoring are unsatisfactory are outlined in Section 9 of the Noise and Vibration Monitoring Program.
	(j) Any consultation to be undertaken in relation to the monitoring programs.	Section 3.2 of the Noise and Vibration Monitoring Program (Appendix B)	Consultation undertaken in relation to the monitoring program is detailed in Section 3.2 of the Noise and Vibration Monitoring Program.
C11	The Noise and Vibration Monitoring Program must include:		
	(a) noise monitoring at agreed representative sensitive residential receiver locations adjacent to the Parramatta Road East and West construction ancillary facilities in Bland and Alt Streets to confirm that construction noise levels do not exceed the 'Noise affected' Noise Management Levels as identified in the ICNG;	Section 5.1 of the Noise and Vibration Monitoring Program (Appendix B)	Noise monitoring to satisfy Condition C11(a), is detailed in Section 5.1 of the Noise and Vibration Monitoring Program.

CoA No.	Condition Requirements	Document Reference	How Addressed
	(b) noise monitoring associated with condition E88 and Appendix E at agreed representative sensitive residential receiver locations alongside those properties bordering the Northcote Street construction ancillary facility that have been identified as eligible for construction noise treatment in Appendix E and in Paige Avenue and/or Earle Avenue located immediately outside, and to the east and west of the nominated boundary in Appendix E;	Section 5.1 of the Noise and Vibration Monitoring Program (Appendix B)	Noise monitoring to satisfy Condition C11(b), is detailed in Section 5.1 of the Noise and Vibration Monitoring Program.
	(c) for the purposes of (a) and (b), noise monitoring during the day, evening and night-time periods must be undertaken within the first month of operation of the construction ancillary facilities and must cover the range of activities (excluding activities associated with site establishment) being undertaken at the sites; and	Section 5.1 of the Noise and Vibration Monitoring Program (Appendix B)	Noise monitoring to satisfy Condition C11(c), is detailed in Section 5.1 of the Noise and Vibration Monitoring Program.
	(d) provision of real time noise and vibration monitoring data. The data must be readily available to the construction team, Proponent, ER and AA. The Department and EPA must be provided with access to the real-time monitoring data, on request.	Section 5.3 and 6.2 of the Noise and Vibration Monitoring Program (Appendix B)	Real time noise monitoring undertaken to satisfy Condition C11(d), is detailed in Section 5.3 of the Noise and Vibration Monitoring Program. Real time vibration monitoring undertaken to satisfy Condition C11(d), is detailed in Section 6.2 of the Noise and Vibration Monitoring Program.
C13	The Construction Monitoring Programs must be developed in consultation with the relevant authorities as identified in Condition C9.	Section 3.4 of the Noise and Vibration Monitoring Program (Appendix B)	This Noise and Vibration Monitoring Program has been developed in consultation with Inner West Council, City of Sydney Council and NSW Health. Consultation is outlined in Section 3.4 of

CoA No.	Condition Requirements	Document Reference	How Addressed
			the Noise and Vibration Monitoring Program.
C14	The Construction Monitoring Program must be endorsed by the ER and then submitted to the Secretary for approval at least one (1) month prior to commencement of construction.	Refer to Section 2.2 of the CEMP	The Noise and Vibration Monitoring Program has been endorsed by the ER. The Noise and Vibration Monitoring Program will be submitted to DPIE for approval no later than one month prior to the commencement of the construction activities.
C15	Construction must not commence until the Secretary has approved all of the required Construction Monitoring Programs relevant to that activity and all the necessary baseline data for the required monitoring programs has been collected, to which the CEMP relates.	Noise and Vibration Monitoring Program (Appendix B)	Construction will not commence until the CEMP and all CEMP Sub-plans, including any relevant Construction Monitoring Programs, have been approved by DPIE. The CEMP and CEMP Sub-plans, including any relevant Construction Monitoring Programs will be implemented for the duration of construction.
C16	The Construction Monitoring Programs, as approved by the 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 Secretary, whichever is greater.	Appendix B – Noise and Vibration Monitoring Program	This Noise and Vibration Monitoring Program will be implemented for the duration of construction.
C17	The results of the Construction Monitoring Programs must be submitted to the Secretary, and relevant regulatory authorities, for information in the form of a Construction Monitoring Report at the frequency identified in the relevant Construction Monitoring Program.	Section 10 of the Noise and Vibration Monitoring Program (Appendix B)	The results of the Noise and Vibration Monitoring Program will be submitted to the Secretary and relevant regulatory authorities for information in the form of a Construction Monitoring Report as

CoA No.	Condition Requirements	Document Reference	How Addressed
			outlined in Section 10 of the Noise and Vibration Monitoring Program.

3.3 Revised Environmental Management Measures

Refer to Appendix A for all REMMs relevant to the development of this Plan.

3.4 Acoustics Advisor

As required by CoA A24 through A26, a suitably qualified and experienced Acoustics Advisor (AA), who is independent of the design and construction personnel, has been nominated by the Proponent and engaged for the duration of construction of the Project and for no less than six (6) months following the completion of the construction of the Project. The nominated AA has been approved by the Secretary.

The Project will cooperate with the AA by:

- Providing access to noise and vibration monitoring activities as they take place
- Providing for review of noise and vibration plans, assessments, monitoring reports, data and analyses carried out
- Considering any recommendations to improve practices and demonstrating, to the satisfaction of the AA, why any recommendation is not adopted.

The role of the AA will be to:

- Receive and respond to communication from the Secretary in relation to the performance of the Project in relation to noise and vibration
- Consider and inform the Secretary on matters specified in the terms of the approval relating to noise and vibration
- Consider and recommend, to the Project, improvements that may be made to avoid or minimise adverse noise and vibration impacts
- Review all noise and vibration documents required to be repaired under the relevant CoAs and, should they be consistent with the terms of this approval, endorse them before submission to the Secretary (if required to be submitted to the Secretary), or before implementation (if not required to be submitted to the Secretary)
- Regularly monitor the implementation of all noise and vibration documents required to be prepared under the terms of this approval to ensure implementation is in accordance with what is stated in the document and relevant CoAs
- Notify the Secretary of noise and vibration incidents in accordance with Condition A40
- In conjunction with the ER, the AA will
    - As may be requested by the Secretary or Community Complaints Mediator (required by CoA B13), help plan, attend or carry out audits of noise and vibration management of the Critical State Significant Infrastructure (CSSI) including briefings, and site visits
    - In the event that conflict arises between the Proponent and the community in relation to the noise and vibration performance of the CSSI, follow the procedure in the approved Communication Strategy to attempt to resolve the conflict, and if it cannot be resolved, notify the Secretary
    - Consider relevant minor amendments made to the CEMP, relevant Sub-plans and noise and vibration monitoring programs that require updating or are of an administrative nature, and are consistent with the terms of this approval and the management plans and monitoring programs approved by the Secretary and, if satisfied such amendment is

necessary, endorse the amendment. This does not include any modifications to the terms of this approval

- Review the noise impacts of minor construction ancillary facilities
- Prepare and submit to the Secretary and other relevant regulatory agencies, for information, a Monthly Noise and Vibration Report detailing the AAs actions and decisions on matters for which the AA was responsible in the preceding month. The Monthly Noise and Vibration Report must be submitted within seven (7) days following the end of each month for the duration of the AA's engagement for the Project, or as otherwise agreed by the Secretary.

The Acoustics Advisor will also be responsible for:

- Reviewing management plans related to noise and vibration and endorsing that they address all relevant conditions of approval and requirements of all applicable guidelines
- Reviewing location and activity specific noise and vibration impact assessments prepared during the Project and endorsing the assessments and proposed mitigation measures
- Reviewing proposals regarding works outside standard construction hours, confirming that the works are appropriate and endorsing the proposed mitigation measures
- Monitoring noise and vibration from construction generally and
  - Confirming that actual noise and vibration levels and impacts are consistent with predictions
  - Confirming that reasonable and feasible noise and vibration mitigation measures are being implemented
  - Suggesting additional reasonable measures to further reduce impacts
- Monitoring and providing advice in relation to compliance with conditions of approval and Project commitments related to noise and vibration
- Providing advice in relation to complaints regarding noise and vibration impacts that cannot be resolved between the complainant and the Project
- Reviewing and endorsing the proposed operational noise controls, the associated noise model and the proposed implementation program.

3.5 Consultation

This plan was provided to NSW Environment Protection Authority (EPA), City of Sydney Council and Inner West Council in accordance with CoA C4 (b). Refer to Section 2 of the CEMP for consultation requirements relating to the CEMP and all Sub-plans.

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

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

4 Existing environment

4.1 Sensitive receivers

The Project is located within the Inner West and City of Sydney local government areas (LGAs) and traverses the suburbs of Ashfield, Haberfield, Leichhardt, Annandale, Stanmore, Camperdown, Newtown and St Peters. In order to comply with CoA E66, a land use survey has been completed in areas where works could impact on sensitive receivers (refer to Appendix C) Physical ground truthing of sensitive receivers was completed as part of the development of the land use survey and will continue to be undertaken throughout the delivery of Project. Where other sensitive receivers are identified throughout the delivery of the Project, the land use survey will be revised. Noise and vibration modelling will then account for these additional sensitive receivers, and appropriate mitigation measures will be implemented.

The land use survey required by CoA E66 noted that the existing land use and development within and around the Project contains a mix of residential, commercial, industrial and open space uses including:

- Primarily low and medium density, with limited areas of high density residential land uses around Haberfield, Annandale, St Peters and areas close to public transport.
- Open space as well as active and passive recreational uses, located around the Project footprint.
- This includes areas of open space such as Reg Coady Reserve, Algie Park, Blackmore Park, Pioneers Memorial Park, Camperdown Park, O'Dea Reserve and Sydney Park. Continuous open space corridors, consisting of a series of smaller open spaces, are located along Whites Creek, Johnstons Creek and the Hawthorne Canal.
- Industrial and commercial land concentrated in the suburbs of Ashfield, Camperdown and St Peters. Commercial uses are typically concentrated along arterial roads (such as Parramatta Road, Pyrmont Bridge Road, King Street, and the Princes Highway), some non-arterial roads, at railway stations, and around medium and high density residential areas.
- Community facilities such as churches, schools, medical and veterinary centres, child care centres and aged persons homes surrounding the Project footprint. These include Haberfield Public School, the University of Sydney Camperdown Campus and the Royal Prince Alfred Hospital and supporting educational and medical facilities at Camperdown.

There are several major transport corridors and other infrastructure located in or adjacent to the Project footprint, including City West Link, Parramatta Road, the Princes Highway, Sydney Trains' suburban railway network, and the Inner West Light Rail line corridor.

A noise assessment was conducted as part of the development of the EIS and forms Appendix J of the EIS: Technical Working Paper – Noise and Vibration. The EIS noted that the noise environment in the study area is typically dominated by traffic on major roads adjacent to the study area with existing noise levels typically above the RNP's operational road traffic goals.

As the Project is being constructed within a developed urban area, the Project is surrounded by sensitive receivers. In addition to the residential, commercial and industrial receivers, a number of other sensitive receivers (including educational facilities, child care centres, recording studios and medical facilities) were identified as being potentially impacted by the Project (refer to Appendix G). The mapping of this land use survey is attached in Appendix C.

4.2 Noise Catchment Areas

To facilitate the assessment of noise impacts from the project, receivers along the route have been divided into Noise Catchment Areas (NCAs). NCAs group individual sensitive receivers by common traits such as existing noise environment and location in relation to the Project. The EIS assessment process identified a total of 56 NCAs between the WestConnex M4-M5 Link Tunnels and Rozelle Interchange project. Review of the EIS assessment process determined that NCAs 09-21 and 23-38 (excluding 25, 26 and 29) were specific to the Rozelle Interchange project and therefore not applicable to the WestConnex M4-M5 Link Tunnels project.

The NCAs for the WestConnex M4-M5 Link Tunnels are presented in Table 4-1 with a description of the noise characteristics of each area. NCAs are also presented in the Land Use Survey (refer to Appendix C). LSBJV have developed a new NCA56 at the Pyrmont Bridge Road ancillary facility. This is also presented in Table 4-1 below, the Land Use Survey and also Appendix I of this NVMP.

Table 4-1 NCAs relevant to the WestConnex M4-M5 Link Mainline Tunnels Project

NCA Reference	Description	Main sources of background noise
NCA00	South of Parramatta Road between Bland Street and Orpington Street. Land use consists of residential receivers, an aged care facility and a hotel.	The noise environment is largely influenced by road traffic noise on Parramatta Road.
NCA01	South of Parramatta Road between Iron Cove Creek and Bland Street. Land use comprises a mix of residential receivers, special use facilities, active and passive recreation areas and commercial receivers fronting Parramatta Road.	The noise environment is largely influenced by road traffic noise on Parramatta Road, Wattle Street and Frederick Street.
NCA02	North of Parramatta Road between Henley Marine Drive and Walker Avenue. Land use comprises of a mix of residential and commercial receivers, a place of worship and a childcare centre.	The noise environment is largely influenced by road traffic noise on Parramatta Road and Wattle Street.
NCA03	Catchment adjoins either side of Wattle Street between Ash Lane and Ramsay Street. Land use consists of residential receivers.	The noise environment is influenced by road traffic noise on Wattle Street.
NCA04	Catchment area adjoins Ramsay Street and the western side of Wattle Street. Land use consists of residential receivers, isolated commercial receivers, a veterinary hospital and a passive recreational area.	The noise environment is influenced by road traffic noise on Wattle Street, Dobroyd Parade and City West Link.
NCA05	South of Dobroyd Parade between Hawthorne Parade and Martin Street. Land use consists of residential receivers with isolated commercial receivers and educational facilities.	The noise environment is influenced by road traffic noise on Wattle Street, Dobroyd Parade and City West Link.

NCA Reference	Description	Main sources of background noise
NCA06	North of Parramatta Road between Walker Avenue and Alt Street residences. Land use consists of residential and commercial receivers and an educational facility on Ramsay Street.	The noise environment is influenced by road traffic noise on Parramatta Road, Ramsay Street and Wattle Street.
NCA07	North of Parramatta Road between Dalhousie Street and Bland Street residences. Land use comprises a mix of residential and commercial facilities, other sensitive receivers and active and passive recreation areas.	The noise environment is influenced by road traffic noise on Parramatta Road and Ramsay Street.
NCA08	South of City West Link between Hawthorne Parade and Darley Road. Land use comprises of commercial receivers and active and passive recreation areas.	The noise environment is influenced by road traffic noise on City West Link and local streets in and around the NCA.
NCA 13	South of Darley Road. Land use comprises of residential and commercial receivers.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA 14	East of Darley Road. Land use comprises of a mix of residential and commercial receivers and an educational facility.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA22	Catchment area adjoins either side of Johnston Street, between Piper Street, Booth Street, Whites Creek Valley Park and Johnstons Creek. Land use comprises of a mix of residential receivers, isolated commercial receivers and passive recreation areas.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA39	South of Moore Street/Booth Street between Norton Street and Johnston Street. Land use comprises of a mix of residential receivers and commercial receivers, special use facilities and a passive recreation area.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA40	East of Johnston Street between Booth Street, Johnstons Creek and Parramatta Road. Land use comprises of a mix of residential and commercial receivers and special use facilities.	The noise environment is influenced by road traffic noise on Parramatta Road.
NCA41	North of Parramatta Road between Booth Street/Mallett Street and Johnstons Creek. Land use comprises of a mix of residential and commercial receivers and a place of worship.	The noise environment is influenced by road traffic noise on Parramatta Road and Pyrmont Bridge Road.

NCA Reference	Description	Main sources of background noise
NCA42	South of Parramatta Road between Mallett Street and Salisbury Road. Land use comprises of a mix of residential and commercial receivers, special use facilities and active and passive recreation areas.	The noise environment is influenced by road traffic noise on Parramatta Road and local traffic within and surrounding this NCA.
NCA43	South of Parramatta Road, east of Mallett Street. Land use comprises of a mix of residential and commercial receivers and special use facilities.	The noise environment is influenced by road traffic noise on Parramatta Road, Mallet Street and Missenden Road.
NCA44	North of Parramatta Road, east of Booth Street. Land use comprises of a mix of residential and commercial receivers and an educational facility.	The noise environment is influenced by road traffic noise on Parramatta Road and Pyrmont Bridge Road..
NCA45	Catchment area extends from Salisbury Road in the north to the Illawarra Rail Line/St Peters Rail Station in the south. Land use comprises of a mix of residential and commercial receivers and special use facilities.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA46	North of Sydney Park Road between Concord Street, Coulson Street and Maddox Street. Land use comprises of a mix of residential receivers, a childcare facility and isolated commercial receivers.	The noise environment is influenced by road traffic noise on Sydney Park Road.
NCA47	East of Euston Road, between Maddox Street and Campbell Road. Land use consists of commercial receivers and special use facilities.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA48	South of Sydney Park Road between Barwon Park Road, Campbell Road and Euston Road. Land use comprises of a passive recreation area and commercial receivers.	The noise environment is influenced by road traffic noise on Sydney Park Road and local traffic within and surrounding this NCA.
NCA49	Catchment area adjoins either side of Barwon Park Road, between Campbell Road and Crown Street. Land use comprises of a mix of residential and commercial receivers.	The noise environment is influenced by road traffic noise on the Princes Highway.
NCA50	Catchment area adjoins either side of Princes Highway, between Mary Street, Church Street/Applebee Street and May Street. Land use comprises of a mix of residential and commercial receivers, an educational facility and an active recreation area.	The noise environment is influenced by road traffic noise on the Princes Highway.

NCA Reference	Description	Main sources of background noise
NCA51	North of Campbell Street between Applebee Street and the Illawarra Rail Line/St Peters Rail Station. Land use comprises of a mix of residential and commercial receivers and active and passive recreation areas.	The noise environment is influenced by road traffic noise on the Princes Highway.
NCA52	South of the Illawarra Rail Line between Campbell Street, Sutherland Street and Princes Highway premises. Land use comprises of a mix of residential and commercial receivers, an educational facility and active and passive recreation areas.	The noise environment is influenced by road traffic noise on the Princes Highway and local traffic within and surrounding this NCA.
NCA53	West of Princes Highway, south of Sutherland Street. Land use comprises of a mix of residential and commercial receivers.	The noise environment is influenced by road traffic noise on the Princes Highway and local traffic within and surrounding this NCA.
NCA54	East of Princes Highway, between Canal Street and Alexandra Canal. Land use comprises a mix of residential and commercial receivers.	The noise environment is influenced by road traffic noise on the Princes Highway, M5 motorway/Southern Cross Drive and local industry.
NCA55	East of Burrows Road. Land use comprises a mix of residential and commercial receivers, as well as several special use facilities.	The noise environment is influenced by local traffic within and surrounding this NCA.
NCA56	A strip centring on Parramatta Road near Pyrmont Bridge Road ancillary facility one block wide either side of Parramatta Road. Stretching from Cardigan Street to the west to near Missenden Road to the east.	The noise environment is influenced predominantly by road traffic noise on Parramatta Road.

4.3 Ambient noise

4.3.1 Overview

As part of the EIS process and prior to construction, noise monitoring was conducted between July 2016 and November 2016 at a total of 23 locations. This monitoring was supplemented with results at a further 11 locations which had been monitored during 2014 and 2015 for previous stages of the WestConnex project.

This noise monitoring was utilised to determine appropriate Rating Background Levels (RBLs) and Noise Management Levels (NMLs) for each NCA. The RBLs for each area were determined for each of the day, evening and night periods as per the Industrial Noise Policy (INP) and defined below:

- **Day** is defined as 7:00am to 6:00pm
- **Evening** is defined as 6:00pm to 10:00pm
- **Night** is defined as 10:00pm to 7:00am

The locations were selected and considered to be representative of the appropriate NCA and a combination of attended and unattended monitoring was conducted to determine appropriate NMLs. In order to comply with CoA E67, ambient and background noise levels obtained as part of the EIS process have been used for this Project, as they do not include other WestConnex M4 East and New M5 projects. The full details of the monitoring results are presented in Appendix J of the EIS.

4.3.2 Shoulder period analysis

The majority of the NCAs surrounding the project are heavily influenced by road traffic noise levels from major roads as described in Table 4-1. In accordance with prescribed methods in the NSW Industrial Noise Policy (Section 3.3) and the NSW Road Noise Policy (Section 2.5.5), the background noise logging data for the Project, was reviewed in greater detail to identify potential shoulder periods.

This review identified background noise levels in the night period between 10pm and 12am and 5am to 7am that were elevated in comparison to the total night-time RBL. This is most likely caused by the presence of higher road traffic volumes during these times. This trend can be seen for the majority of noise monitoring locations as presented in Appendix H.

It is proposed to adopt the INP mid-point approach for RBLs and NMLs during the shoulder periods of 5am to 7am and 10pm to midnight in order to manage noise according to the noise characteristics of the catchments. For the morning shoulder 5am to 7am, this involves taking the mid-point of the night and day RBL. For the evening shoulder, this involves taking the mid-point of the evening and night RBL.

It is noted that the Interim Construction Noise Guideline (ICNG) relies on methodologies contained within NSW Industrial Noise Policy for the establishment of RBLs. Hence, this approach is deemed consistent with the guidance provided by the ICNG.

4.3.3 INP short-term method for determining RBL during compliance

The short-term background noise method is a more appropriate technique for establishing the difference between the background noise level and the source being measured, checking the noise compliance of a development at a given time and/or determining the effect of background noise on a source-noise measurement. This is particularly true for construction activities where noise impacts are generally short-term (if any). Hence, the short-term method (15-minute measurement) for determining RBL during compliance is deemed to be appropriate for the Project where activities are short term (e.g. utilities works which occur over several days). Where works are longer term (e.g. greater than 1 week) the long-term RBLs in Table 4-2 will be adopted.

Measurements will be undertaken during the period when the noise source is expected to operate and when the greatest impact is likely to occur (i.e. when the difference between the measured background noise level and construction noise level is the greatest). Background noise measurements (15-minute) should be taken at the most affected noise-sensitive location and in the absence of both the noise under investigation and any extraneous noise not typical of the area. If this not possible, then the background noise should be measured at a remote location judged to have a similar noise environment to the assessment location.

Measurements should not be taken when average wind speed is greater than 5 m/s at microphone height or during rainfall. It is noted that where the measured background level is measured to be less than 30 dB(A), the RBL is considered to be 30 dB(A) in accordance with the INP.

4.3.4 RBL summary

A summary of the noise monitoring results relevant to the Project is provided in Table 4-2.

Table 4-2 Ambient noise monitoring results (dB(A))

Location	Rating Background Level (RBL) dB(A)				
	Day	Evening	Night	Morning shoulder (5 am to 7 am)[3]	Evening shoulder (10pm to 12am)[3]
R.02	51	51	45	48	48
R.03	61	60	44	53	52
R.04	65	63	51	58	57
L.01	51	47	40	46	44
L.02	51	49	42	47	46
P.01	51	49	41	46	45
H.01[1]	58	58	52	55	55
H.02[1]	46	46	43	45	45
H.03[1]	46	46	38	42	42
H.04[1]	58	55	44	51	50
H.06[1]	56	53	43	50	48
S.01[2]	57	51	40	49	46
S.02[2]	50	46	39	45	43
S.03[2]	54	45	40	47	43
S.04[2]	52	50	44	48	47
S.05[2]	58	56	49	54	53
EMM.01[4]	62	59	51	57	55

Notes

1: Noise monitoring data for these locations are taken from the M4 East EIS assessment

2: Noise monitoring data for these locations are taken from the New M5 EIS assessment

3: Applies Monday to Saturday

4. Undertaken by LSBJV post-EIS

5 Noise and vibration criteria for NSW

The EPA recommends management levels and goals when assessing construction noise and vibration. These are outlined in:

- ICNG
- Assessing Vibration: a technical guideline (for human exposure)
- German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage).

Relevant elements of these documents are summaries and discussed in this Chapter.

5.1 Construction noise and assessment objectives

The ICNG provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

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

5.2 Quantitative noise assessment criteria

5.2.1 Interim Construction Noise Guideline (DECC, 2009)

Table 2 of the ICNG (reproduced in Table 5-1 below) shows how NMLs at residences are determined and how they are to be applied.

Table 5-1 Noise Management Levels at Residential Receivers

Time of Day	Noise Management Level $L_{Aeq\ (15min)}$	How to Apply
Standard hours: Monday to Friday 7 am to 6 pm	RBL + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise.
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level.

The RBL is used when determining the NML and is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term and methodology to obtain RBLs is described in detail within the NSW Industrial Noise Policy (EPA, 2000).

The difference between the internal noise level and the external noise level is typically 10 dB with windows open for adequate ventilation, as detailed within the ICNG. This figure has been adopted by the EIS and this plan. NMLs apply at the property boundary that is most exposed to construction noise, at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

Other sensitive land uses, such as schools, typically find noise from construction to be disruptive when the properties are being used (such as during school times). Consultation will be carried out, as per the CCS, with occupants likely to be affected by noise from the works.

Internal noise levels are assessed at the centre of the occupied habitable room. As described within the ICNG for residential properties, noise levels will be measured at the most noise affected point within 30 m of the property boundary, while for other sensitive land uses this is assessed at the most affected point within 50 m of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences, with some buildings achieving greater performance, such as where windows are fixed (that is, cannot be opened). The

management levels in Table 3 on page 13 of the ICNG are 5 dB above the corresponding road traffic noise levels in the Environmental Criteria for Road Traffic Noise (EPA 1999) (and the 'maximum' levels in the NSW Industrial Noise Policy (EPA 2000) for commercial and industrial uses) to account for the variable and short-term nature of construction noise.

The noise management levels for commercial and industrial premises are defined by three categories and are assessed at the most affected point of the premises. Table 5-2 outlines the management levels for other sensitive land uses as per the ICNG.

Table 5-2 Noise at sensitive land uses (non-residential) using quantitative assessment

Land use	Noise assessment location	Noise management level ($L_{Aeq\ (15\ min)}$)
Classrooms at schools and other educational institutions	Internal	45
Hospitals and operating theatres		
Places of worship		
Active recreation areas[1]	External	65
Passive recreation areas[2]	External	60
Community centres	Dependent on intended use	Maximum internal levels recommended in AS2107 for specific use
Industrial premises	External	75
Office, retail outlets	External	70
Other noise sensitive businesses	Suitable noise levels to be determined in accordance with AS2107, where required.	

Notes:

1. Active recreation areas are characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.
2. Passive recreation areas are characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg. reading, meditation).

5.2.2 Sleep disturbance

The INP guideline suggests that a $L_{A\ (max)}$ level of RBL plus 15 dB is a suitable screening criteria for sleep disturbance for the night-time period.

A detailed maximum noise level event assessment is required if the screening criteria is exceeded. Further guidance with regards to potential impact on sleep is provided in the NSW Road Noise Policy (RNP) (DECCW 2011). The RNP calls upon a number of studies that have been conducted into the effect of maximum noise levels on sleep, and provides the following factors that are key in assessing the extent of impacts on sleep:

- How often high noise events would occur;
- The distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the project

- Whether there are times of day when there is a clear change in the noise environment (such as during early-morning shoulder periods)
- Current scientific literature available at the time of the assessment regarding the impact of maximum noise level events at night.

The RNP also quotes the following internal noise levels with respect to potential sleep disturbance:

- Maximum internal noise levels ($L_{A\ (Max)}$) below 50 to 55 dB(A) are unlikely to awaken people from sleep; and
- One or two noise events per night, with maximum internal noise levels ($L_{A\ (Max)}$) of 65 to 70 dB(A), are not likely to affect health and wellbeing significantly.

The Roads and Maritime ENMM identifies that the facade of a residential building of standard construction including a partially open window will reduce external noise levels by 10 dB. Therefore, external noise levels in the order of 60 to 65 dB $L_{A\ (Max)}$ calculated at the facade of a residence are unlikely to cause sleep disturbance affects.

5.3 Construction hours, limitations and approach to works

5.3.1 Approved construction hours

Working hours for the Project are set by the CoA in Conditions E68 to E72.

Specifically, standard construction working hours are defined in CoA E68 and E69 as being:

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

5.3.2 Approved 24-hour works

In accordance with CoA E70, the following works are permitted to be carried out 24 hours a day, seven days a week:

- Tunnelling activities excluding cut and cover tunnelling
- Haulage of spoil and delivery of material
- Works within an acoustic shed
- Tunnel fit out works.

Other works associated with the Project may also be carried out in accordance with the requirements of Condition E73.

5.3.3 Highly noise intensive works

Construction activities which are defined as annoying under the ICNG are defined as ‘highly noise intensive works’. These include;

- Using power saws (for cutting timber, masonry, road pavement or steel work)
- Grinding metal, concrete or masonry
- Rock drilling
- Line drilling
- Vibratory rolling
- Bitumen milling and profiling
- Jackhammering

- Rock-hammering or rock-breaking
- Impact piling.

In accordance with CoA E72, except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be carried out:

- Between the hours of 8:00 am to 6:00 pm Monday to Friday
- Between the hours of 8:00 am to 1:00 pm Saturday
- In continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.

'Continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work that are the subject of this condition.

Where monitoring has confirmed that activities described above do not possess annoying characteristics in accordance with the ICNG (i.e. tonality or impulsive etc), the above restrictions will not apply. Such monitoring will be provided to the AA for endorsement for activities outside of the EPL, otherwise for approval by the EPA.

5.4 Out-of-Hours Works

In accordance with CoA E73, works may be undertaken outside the hours specified in Section 5.3 in the following circumstances:

- For the delivery of materials required by the NSW Police Force or other authority for safety reasons
- 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
- Where different construction hours are permitted or required under an EPL in force in respect of the Project
- Works approved under an OOHW Protocol for works not subject to an EPL (refer to Section 5.4.2)
- Construction that generate $L_{Aeq\ (15min)}$ noise levels
    - No more than 5 dB(A) above rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC 2009)
    - No more than that the noise management levels specified in Table 5-2 at other sensitive land uses
- Construction works that causes
    - 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 5-5 and Table 5-6
    - Intermittent vibration values measures at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 5-7.

In accordance with CoA E74, on becoming aware of the need for emergency works to avoid the loss of life, damage of property or environmental harm, LSBJV will notify the AA, the ER and the EPA of the need for that work. In these circumstances, LSBJV will use best endeavours to notify all noise and/or vibration affected sensitive receivers of the likely impact and duration of the works.

5.4.1 Out-of-Hours Work scheduling and respite

Excluding tunnelling and its related activities undertaken in accordance with CoA E70, in order to undertake OOHW that are regulated by an EPL or approved through the Project's OOHW Protocol (Appendix D), LSBJV will identify appropriate respite periods for these works in consultation with the community at each affected location as identified by CNVIS (refer to Section 7.1) or the Project's noise and vibration prediction tool (refer to Section 7.2). This consultation will be conducted in accordance with the CCS and include the provision of following to affected receivers:

- An indicative three-month construction lookahead for OOHW
- A description of the potential works, location and duration
- The noise characteristics and likely noise levels of the proposed works
- Proposed mitigation and management measures.

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

5.4.2 Out-of-Hours Work Protocol – Works not subject to an EPL

In order to manage out-of-hours works that are not subject to an EPL, an OOHW Protocol has been developed in accordance with CoA E77, and is included in Appendix D of this NVMP. The aim of the OOHW Protocol is to ensure that OOHW not subject to an EPL follow a rigorous process to ensure the following outcomes:

- Potential OOHW are identified as early as possible
- Justification is provided for each OOHW proposed
- Appropriate levels of consultation and mitigation measures are carried out for all the OOHW activities
- Environmental impacts from the OOHW are managed/mitigated in line with the approved CEMP documents to minimise impact on the surrounding environment and community.

5.4.3 Out-of-Hours Works – Utility coordination and respite

All out-of-hours utility works carried out during the delivery of the Project, (including those undertaken by third parties), will be coordinated to ensure respite periods are provided at noise affected locations, in accordance with the additional mitigation measures outlined in the CNVG (refer to Section 8.6). To this end, LSBJV will:

- Reschedule any works to provide respite to impacted noise sensitive receivers so that respite is achieved
- Consider the provision of alternative respite or mitigation to impacted noise sensitive receivers
- Provide documentary evidence to the AA in support of any decision made by LSBJV in relation to respite or mitigation.

5.5 Adopted Project Noise Management Levels

Based on measured noise levels described in Section 4.3, the Project-specific construction NML for each NCA was determined based on a representative monitoring location and these NMLs are presented in Table 5-3. The NMLs are derived from the RBLs in accordance with Table 2 of the ICNG.

Table 5-3 Project-specific construction noise objectives

NCA	EIS Monitoring Location	Noise Management Level dB(A)				
		Day	Evening	Night	Morning shoulder (5am to 7am)[1]	Evening / NIght shoulder (10pm to 12am)[1]
00	H.03	56	51	43	47	47
01	H.03	56	51	43	47	47
02	H.01	68	63	57	60	60
03	H.04	68	60	49	56	55
04	H.06	66	58	48	55	53
05	L.02	61	54	47	52	51
06	H.02	56	51	48	50	50
07	H.02	56	51	48	50	50
08	*Monitoring not conducted and no RBL/NML identified during EIS process*[2]					
13	L.01	61	52	45	53	49
14	L.03	61	52	45	53	49
22	*Monitoring not conducted and no RBL/NML identified during EIS process*[2]					
25	R.02	61	56	50	53	53
26	R.04	75	68	56	63	62
29	R.03	71	65	49	58	57
39	*Monitoring not conducted and no RBL/NML identified during EIS process*[2]					
40	P.01	61	54	46	51	50
41	P.01	61	54	46	51	50
42	P.01	61	54	46	51	50

NCA	EIS Monitoring Location	Noise Management Level dB(A)				
		Day	Evening	Night	Morning shoulder (5am to 7am)[1]	Evening / Night shoulder (10pm to 12am)[1]
43	P.01	61	54	46	51	50
44	P.01	61	54	46	51	50
45	*Monitoring not conducted and no RBL/NML identified during EIS process*[2]					
46	S.01	67	56	45	54	51
47	S.01	67	56	45	54	51
48	S.01	67	56	45	54	51
49	S.03	64	50	45	52	48
50	S.04	62	55	49	53	52
51	S.02	60	51	44	50	48
52	S.02	60	51	44	50	48
53	*Monitoring not conducted and no RBL/NML identified during EIS process*[2]					
54	S.05	68	61	54	59	58
55	S.05	68	61	54	59	58
56	EMM.01[3]	72	64	56	62	60

Notes:

1. Applies Monday to Saturday

2. These NCA are unlikely to be impacted by the Project's surface works and as such an RBL/NML were not assigned to these areas during the EIS phase. Tunnelling is the only activity that is proposed within these NCA, as such the ICNG Ground Borne Noise NML (which does not require an RBL) will be applied to receivers in these NCA, during tunnelling works. If necessary to obtain RBL (and NML) for these NCA, noise monitoring will be conducted in accordance with Section 4 of the Construction Noise and Vibration Monitoring Program (refer to Appendix B).

3. Undertaken by LSBJV post-EIS.

5.6 Ground-borne noise

Ground-borne noise is caused when vibration is retransmitted within a structure and is typically low frequency dominant which may be audible to receivers. Ground-borne noise is vibration commonly generated by activities such as vibratory rollers, large hammers or tunnelling machines which may enter buildings via the ground and may cause vibration and noise radiation through the floors, walls, ceilings or via small objects in a room.

The amount of ground-borne noise experienced by receivers in proximity to works is influenced by several factors including; construction technique, depth of work, geological conditions, condition and age of the receiver structure, foundation material, floor the receiver is based on and the timing and duration of construction activities. Receivers will generally experience ground-borne noise when it is louder than the air-borne noise from the surrounding construction activities. Ground-borne noise would typically be masked by air-borne noise, especially during the day, where receivers are in proximity of above ground works.

The ground-borne noise objectives outlined in the ICNG will be adopted and are presented in Table 5-4. There is no daytime objective for ground-borne noise described within the ICNG as the objective is to protect the amenity and sleep of receivers when they are typically at home. These objectives are therefore only applicable during the evening and night time periods.

There is no guidance in the ICNG for acceptable ground-borne noise levels in commercial and other potentially sensitive receivers. However, the following has been applied as an initial screening approach for commercial and potentially sensitive other receivers in use outside daytime hours:

- Where an external ICNG NML applies, a level of 10 dB(A) below the NML has been adopted. This is based on the assumption that a 10 dB(A) noise reduction typically applies from external to internal for partially open windows as described in the NSW Road Noise Policy; or
- Where an internal ICNG NML applies, the objective for ground borne noise has also been set at this internal NML level.

These objectives are summarised in Table 5-4

Table 5-4 Ground-borne noise objectives

Time	Ground-borne noise objectives
Residential Receiver	
Evening (6 pm to 10 pm)	40 dB(A) $L_{Aeq\ (15\ min)}$
Night-time (10 pm to 7 am)	35 dB(A) $L_{Aeq\ (15\ min)}$
Commercial and other receivers	
Evening and Night (when in use)	10 dB(A) below ICNG external target or ICNG/AS2107 internal target

5.7 Vibration criteria

Effects of ground vibration on buildings resulting from construction may be segregated into the following three categories:

- Human comfort – disturbance to building occupants: vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building contents – vibration where the building contents may be affected.
- Effects on building structures – vibration in which the integrity of the building or structure itself may be prejudiced.

Vibration criteria relating to human comfort that are applicable to this Project are taken from the DEC (2006) document Assessing Vibration – A Technical Guideline and include the following:

- Continuous vibration – from uninterrupted sources (see Table 5-5)
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (see Table 5-6)
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (see Table 5-7).

Two standards by which building damage from construction-induced vibration are commonly assessed include:

- British Standard 7385: Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (BSI 1993)
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).

The German standard provides the most stringent criteria and will be used in this NVMP. The DIN guideline values for peak particle velocity (PPV) (mm/s) measured at the foundation of the building are summarised in Table 5-8. The criteria are frequency dependent and specific to particular categories of structure. Subject to inspection, where a historic building is deemed to be more sensitive to cosmetic damage from vibration, the more conservative screening criterion of 3 mm/s will be considered. Otherwise the 20 mm/s and 5 mm/s screening criteria will apply, as applicable to the building. Where the monitored vibration results are greater than the 1 Hz to 10 Hz screening criteria, LSBJV will review the vibration frequency and amplitude of the vibration intensive plant through monitoring, and will apply the most appropriate DIN criteria.

Vibration criteria for utilities will be assigned in accordance with standards referenced in the CoA and will be done so in consultation with relevant operators where utilities are in proximity to works and as guided by the nominated safe working distances.

Table 5-5 Continuous vibration acceleration criteria (m/s^2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night time	0.04	0.029	0.080	0.058

Table 5-6 Impulsive vibration acceleration criteria (m/s^2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night time	0.64	0.46	1.28	0.92
Workshops	Day or night time	0.64	0.46	1.28	0.92

Table 5-7 Intermittent vibration impacts criteria ($m/s^{1.75}$) 1-80Hz

Location	Daytime		Night-time	
	Preferred values	Maximum values	Preferred values	Maximum values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Table 5-8 DIN 4150 Part 3 structural damage criteria for buildings

Type of structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

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

Note: These guide values should be halved if vibration is continuous.

Table 5-9 DIN 4150 Part 3 – structural damage criteria for buried pipework

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

Notes:

The values given in Table 5-8 for foundations also apply to the first two metres (nearest the building) of gas and water service pipes.
These guide values should be halved if vibration is long-term.

6 Environmental aspects and impacts

6.1 Construction activities

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

- Site establishment and enabling works
  - Installation of environmental controls
  - Demolition of existing buildings
  - Site clearing
  - Utility works
  - Pavement and infrastructure works
  - Establishment of construction facilities
- Tunnel excavation and supporting works
  - Onsite car parking
  - Workshop, deliveries, maintenance and storage
    - Receiving deliveries
    - Assembly of tunnelling plant and equipment
    - Maintenance of tunnelling plant and equipment
    - General laydown and storage of construction material
    - Refuelling of plant and equipment
  - Construction of tunnel dives
    - Excavation of material
    - Piling of support walls
    - Establishment of access for tunnelling plant and equipment
    - Installation of ground support
  - General activities within an acoustic shed
    - Spoil stockpiling
    - Loading out of spoil
    - Refuelling of plant and equipment
  - Onsite truck movements
  - Tunnelling support activities
    - Operating water treatment plants
    - Operation of ventilation into tunnel
    - Compressed air and water supply into tunnel
    - Workshop, deliveries, maintenance and storage activities

- Spoil haulage
- Mechanical and electrical fit out
- Construction
  - Line marking
  - Ventilation building construction
  - Lane configuration changes
  - Construction of tunnel cut and cover
  - Pavement construction
- Site rehabilitation and landscaping

6.2 Impacts

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

- The type of equipment in use
- The number of equipment simultaneously in use
- Proximity to sensitive receivers
- Topography and other physical barriers
- Hours/duration of construction works
- Ground conditions
- The physical condition of the structure the receiver is in
- Presence of existing background noise (e.g. from heavy traffic areas).

Relevant aspects and the potential for related impacts have been considered in an Aspects and Impacts Register in Appendix A2 of the CEMP. Potential noise and vibration impacts identified in the Aspects and Impacts Register, and their associated risk levels prior to and following mitigation are summarised in Table 6-1. Throughout the delivery of the Project, the environmental risk assessment will be regularly reviewed and an ongoing risk analysis for the Project will be conducted as detailed in Section 3.13 of the CEMP.

Table 6-1 Noise and vibration summaries from the Project's Aspect and Impact register

Issue	NCAs most affected	Potential impact	Risk level prior to mitigation	Risk level following mitigation[1]
Site establishment including vegetation clearing and demolition	00, 01, 02, 03, 06, 07, 41, 42, 43, 44, 48, 49, 50, 56	Noise and vibration impacts to sensitive receivers adjoining the compounds	Significant	Moderate
	00, 01, 02, 03, 06, 07, 41, 42, 43, 44, 48, 49, 50, 56	Construction fatigue impacting sensitive receivers and broader community	Significant	Moderate

Issue	NCAs most affected	Potential impact	Risk level prior to mitigation	Risk level following mitigation[1]
Ancillary facility establishment and operation	00, 01, 02, 03, 06, 07, 25, 29, 41, 42, 43, 44, 48, 49, 50, 56	Noise and vibration impacts on nearby receivers including out-of-hours impacts	Significant	Moderate
Excavation and earthworks	00, 01, 02, 03, 06, 07, 41, 42, 43, 44, 48, 49, 50, 56	Noise and vibration impacts on nearby receivers including out of hours impacts	Significant	Minor
	00, 01, 02, 03, 06, 07, 41, 42, 43, 44, 48, 49, 50, 56	Disturbance or damage of non-Aboriginal heritage item, including Sydney Water	Moderate	Minor
General construction activities	00, 01, 02, 03, 06, 07, 41, 42, 43, 44, 48, 49, 50, 56	Noise and vibration impacts on nearby receivers, including out-of-hours impacts resulting in structural damage or community complaints	Significant	Moderate
Tunnelling	02, 03, 05, 06, 07, 08, 13, 14, 39, 40, 42, 45, 49, 50, 51, 52, 56	Vibration impacts leading to structural damage or cosmetic damage	Moderate	Minor
	02, 03, 05, 06, 07, 08, 13, 14, 39, 40, 42, 45, 49, 50, 51, 52, 56	Vibration impacts leading to human discomfort criteria exceedance	Significant	Moderate
	02, 03, 05, 06, 07, 08, 13, 14, 39, 40, 42, 45, 49, 50, 51, 52, 56	Regenerated noise impacts on nearby receivers, including out-of-hours impacts, resulting in sleep disturbance or community complaints	Significant	Moderate
	06, 40, 42, 45, 56	Vibration leading to damage of heritage items	Moderate	Minor
Spoil transport, deliveries, other plant on public roads	00, 01, 02, 03, 04, 05, 06, 07, 41, 42, 43, 44, 48, 49, 50, 56	Noise and vibration impacts on receivers near construction site or along haul roads (during standard hours)	Minor	Minor

Issue	NCAs most affected	Potential impact	Risk level prior to mitigation	Risk level following mitigation[1]
Utility works	00, 01, 02, 03, 06, 07, 41, 42, 43, 44, 56	Noise and vibration impacts on nearby receivers, including out-of-hours impacts resulting in structural damage or community complaints	Significant	Moderate

Note:

1 – Application of mitigation measures outlined in the NVMP and/or relevant CNVIS

Chapter 8 of this plan provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment.

7 Construction noise and vibration assessment

7.1 Construction Noise and Vibration Impact Statements

In accordance with CoA E79, Construction Noise and Vibration Impact Statements (CNVIS) will be progressively prepared to supplement the NVMP and refine impact predictions presented in the EIS for ancillary facilities. All CNVIS will be prepared by an appropriately qualified and experienced acoustic consultant. All CNVIS will be reviewed and endorsed by the AA.

The CNVIS will provide detailed construction noise and vibration prediction, assessment, mitigation design outcomes and discussion of management measures to limit impacts to sensitive receivers.

In accordance with CoA E67, CNVIS prepared for the Project will utilise ambient and background noise levels which do not include other WestConnex M4 East and New M5 projects (SSI 6307 and SSI 6788 respectively). This will ensure cumulative noise impacts from the Project are minimised.

The CNVIS will be a key site management tool that will give LSBJV clear instructions for managing noise impacts at each ancillary facility. Each CNVIS will be prepared before construction noise and vibration impacts commence and will set out the mitigation and management measures required for the construction stage, through consultation with affected receivers.

Each CNVIS will address:

- Scope of work covered by CNVIS
- Justification for OOHW (where required)
- Nearest noise and vibration sensitive receivers, based on land use survey
- Construction noise and vibration objectives
- Construction noise and vibration assessment
- Mitigation options and preferred management measures
- Noise and vibration monitoring requirements.

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS or using the Project's predictive tools. This will allow for ongoing review and verification of the predictive model.

Physical noise mitigation measures such as noise barriers, acoustic enclosures around fixed plant and acoustic sheds will be outlined in the CNVIS. Furthermore, specific management measures such as a staging of works, respite periods and community notification will also be summarised, and implemented. In the event the CNVIS and NVMP both propose mitigation measures the most stringent measures would be implemented.

CNVIS's will be prepared in consideration of the ICNG, Assessing Vibration: A Technical Guideline and German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.

During the delivery of the Project works the AA will endorse the verification of the predictive model through the review of the monitoring data against the CNVIS predictive outputs. Noise and vibration monitoring data will be collected throughout the delivery of the Project in accordance with the Construction Noise and Vibration Monitoring Program (refer to Appendix B).

7.2 Tunnel construction noise and vibration prediction tool

CNVIS are static documents which show worst case impacts. Due to the dynamic nature of tunnel excavation; with various pieces of plant operating in close proximity within different areas of the tunnel over time, a tunnel construction noise and vibration prediction tool will be created by LSBJV's noise and vibration specialists to assist in the prediction of cumulative impacts and the

identification of appropriate mitigation measures. This prediction tool will be a live, working component of the CNVIS for tunnel excavation. The initial predictive tool will be reviewed and endorsed by the AA.

The prediction tool enables the assessment of noise and vibration impacts associated with tunnel construction at sensitive receivers, based on the location, separation distance and types of construction machinery in operation within the tunnel. The identified tunnel construction noise and vibration impacts will be used to select the specific management measures to be applied to individual properties during construction.

Verification and adjustment of the prediction tool will occur throughout the delivery phase via monitoring. The AA will endorse the verification of the predictive model through the review of the monitoring data against the predictive tool outputs.

Noise and vibration monitoring data will be collected throughout the delivery of the Project in accordance with the Construction Noise and Vibration Monitoring Program (refer to Appendix B). This feedback loop will ensure the prediction tool is revised to ensure accuracy across the various geological formations through which the tunnel excavation will proceed. In accordance with CoA A26, the AA will regularly monitor the process of noise and vibration impact prediction and the implementation of mitigation measures

8 Environmental control measures

In accordance with CoA E81, reasonable and feasible noise mitigation measures (such as those listed within Chapter 6 of the ICNG and Appendix B of the CNVG) will be implemented with the aim of achieving the noise and vibration criteria specified in Section 5 of this plan. Specific measures and requirements to address contract specifications, CoA and REMM's in relation to impacts from noise and vibration are outlined in Table 8 1.

8.1 Noise Insulation Program

In accordance with CoA E89, LSBJV will prepare and implement a Noise Insulation Program for the duration of the Project's construction period for receivers at which requirements of Condition E88 apply. The Noise Insulation Program is attached in Appendix F.

In accordance with CoA E90, LSBJV will provide treatment to eligible receivers within six months following the commencement of construction which would affect the receiver where reasonable access to the property is provided by the property owner. LSBJV will prioritise the implementation of the Noise Insulation Program based on the degree and duration of the exceedance, with high priority exceedances undertaken within three months of the commencement of construction.

In accordance with CoA E162, where acoustic treatment is required at any heritage item identified in the documents listed in CoA A1, the advice of a suitably qualified and experienced built heritage expert will be obtained and implemented to ensure any such work minimises any adverse impacts on the heritage significance of the item.

8.2 Early implementation of operational noise mitigation measures

In accordance with CoA E93, construction noise impacts will be minimised by implementing operational noise mitigation measures identified in the Project's Operational Noise and Vibration Review (ONVR), within six months of the commencement of construction in the vicinity of the impacted receiver, where operational noise mitigation measures will not be physically affected by works.

Where implementation of operational noise mitigation measures are not proposed early in accordance with CoA E93, LSBJV will prepare a report providing justification as to why, along with details of temporary measures that would be implemented reduce construction noise impacts, until such time that the operational noise mitigation measures identified in the ONVR are implemented. In accordance with CoA E94 this report will be endorsed by the AA and submitted to DPIE prior to the commencement of construction which would affect the identified sensitive receivers.

8.3 Vibration Screening Criteria drawings

In order to identify properties at risk of cosmetic damage, vibration screening criteria drawings have been prepared based on proposed vibration intensive construction activities (refer to Appendix E). The activities modelled in Appendix E have been selected as they are indicative of the most vibration intensive works likely to be undertaken at each of the Ancillary Facilities and for tunnelling activity.

In accordance with CoA E83, owners and occupiers of identified properties will be notified before works that generate vibration commences in the vicinity of these properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.

8.4 Property surveys and issues rectification

LSBJV will offer and undertake pre-dilapidation surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in CoA E101. The pre-dilapidation surveys and reports will be prepared by a suitably qualified and experienced person(s) and the report will be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works.

Where pre-dilapidation surveys have been undertaken in accordance with Condition E105, subsequent post-dilapidation surveys will be offered and undertaken where accepted by the land owner to assess damage to the surface and sub-surface structures that may have resulted from the construction of the CSSI within three months of the completion construction.

The results of the surveys will be documented in a Condition Survey Report for each surface and sub-surface structure surveyed. Copies of the Condition Survey Reports will be provided to the owner(s) of the structures surveyed within three weeks of completing the surveys and no later than four months following the completion of construction.

Where damage has been determined to occur as a result of the Project, rectification would occur at the Project's expense and to the reasonable requirements of the surface and sub-surface structure owner(s) within three months of completion of the post-dilapidation surveys unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.

LSBJV will carry out consultation with identified properties following the process set out in Section 9.1 of the CCS.

8.5 Heavy vehicle transport noise

In accordance with REMM TT17, the LSBJV Project Team will monitor and manage heavy vehicle movements to and from sites with the aim of limiting any associated increases in road traffic noise levels during the night-time period to no more than 2 dB(A). Monitoring will consider the number of heavy vehicles used and the relative increase in noise from those movements. Increases in road traffic noise of more than 2 dB(A) during the night-time period will be managed in accordance with the CNVG.

Table 8-1 Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
GENERAL						
NV1	Training will be provided to relevant Project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolboxes and targeted training.	Training materials	Prior to construction Construction	Environmental Coordinator	LSBJV Practice	Training records
NV2	All employees, contractors and subcontractors are to receive a Project induction. The environmental component may be covered in toolboxes and will include: • Relevant license and approval conditions • Permissible hours of work • Any limitations on high noise generating activities • Location of nearest sensitive receivers • Construction employee parking areas • Relevant site specific mitigation measures • Appropriate behavioural practices	Induction materials	Prior to construction Construction	Environmental Coordinator	LSBJV Practice	Site induction records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
CONSTRUCTION TRAFFIC NOISE						
NV3	Project-related heavy-vehicle movements to and from sites will be monitored and managed with the aim of limiting any associated increases in road traffic noise levels during the night-time period to no more than 2 dB(A).	Noise and Vibration Monitoring Program	Construction	Environment & Sustainability Manager Area Manager	REMM TT17	Monitoring records
NV4	Drivers will be advised of designated vehicle routes, parking locations, acceptable delivery hours specific to the site and other relevant practices (i.e. minimising the use of engine brakes and no extended periods of engine idling).	Traffic and Transport and Access Management Sub-Plan	Construction	Foreman Engineer Operator	REMM TT15	Vehicle movement plans Training records
NV5	LSBJV will toolbox construction vehicle contractors and drivers on noise management measures to minimise any sleep disturbance impacts.	Training materials Traffic and Transport and Access Management Sub-Plan	Construction	Superintendent Foreman Engineer Environment & Sustainability Manager	LSBJV Practice	Training records
NV6	Out-of-hours deliveries will be minimised where possible.		Construction	Foreman Engineer Operator	LSBJV Practice	Vehicle movement plans

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
GENERAL PLANT AND EQUIPMENT						
NV7	All construction plant and equipment used on site will be fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications.		Construction	Foreman	G36	Plant inspection records
NV8	All construction plant and equipment used on the site will be maintained in an efficient condition.		Construction	Foreman	G36	Plant inspection records
NV9	All construction plant and equipment used on the site will be operated in a proper and efficient manner.		Construction	Foreman	G36	Site inspection records Safety observations
NV10	Non-tonal movement alarms will be used in place of tonal reversing alarms		Construction	Engineer	G36	Plant inspection records
NV11	Plant and machinery will be switched off when it is not in use for more than 15 minutes	Training materials	Construction	Operators Foreman Area Manager	LSBJV Practice	Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV12	Where possible, maintenance work on plant and equipment will be undertaken off site. If maintenance is to be onsite the task will be carried out away from noise sensitive receivers where reasonable and feasible.		Construction	Operators Foreman	LSBJV Practice	Plant inspection records
NV13	Consider noise when selecting construction methods and substitute for quieter methods where reasonable and feasible.		Construction	Foreman Area Manager	LSBJV Practice	Plant inspection records
NV14	Use appropriately sized equipment, avoiding over-powered plant.		Construction	Foreman Area Manager	LSBJV Practice	Site inspection records
NV15	Additional temporary screening or enclosures will be considered for equipment where additional measures are required to meet relevant NMLs.		Construction	Foreman	LSBJV Practice	Site inspection records
NV16	Stationary noise sources would be enclosed or shielded where reasonable and feasible.		Construction	Foreman	LSBJV Practice	Site inspection records
GENERAL CONSTRUCTION HOURS						

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV17	Construction activities associated with the Project will be carried out in accordance with the hours in Section 5.3 of the NVMP.		Construction	Area Manager	CoA E68 CoA E69	Site inspection records
NV18	Except as permitted by an EPL, highly noise intensive works (as defined in section 5.3.3) that result in an exceedance of the applicable NML at the same receiver will only be carried out: • Between 8:00 am and 6:00 pm Monday to Friday • Between 8:00 am and 1:00 pm Saturday • In continuous blocks not exceeding three (3) hours each with a minimum respite from those activities and works of not less than one (1) hour between each block.		Construction	Project Manager Project Engineer Foreman Environment & Sustainability Manager	CoA E72 EPL	Site inspection records
NV19	OOHW is to be carried out in accordance with: • The Project's Out-of-Hours-Works Protocol (Appendix D); or • The Project's EPL.	OOHW Protocol Project EPL	Construction	Project Manager Project Engineer Foreman Environment & Sustainability Manager	CoA E73 CoA E77	OOHW Permits Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
SITE SPECIFIC MANAGEMENT MEASURES						
NV20	All acoustic sheds will be erected as soon as site establishment works at the facilities are completed and before any activity occurs inside the shed that would otherwise exceed the NML. The AA will verify adherence to the NML.		Construction	Area Manager Acoustic Advisor	CoA E86	Site inspection records
NV21	Acoustic sheds will be designed with consideration of the activities that will occur within them and the relevant noise management levels in adjacent areas		Construction	Area Manager Noise and Vibration Specialist Acoustic Advisor	REMM NV7	Site inspection records
NV22	Noise barriers (such as site hoardings) will be constructed around permanent facilities as detailed within the CNVIS.		Prior to construction Construction	Area Manager	CoA C26 REMM NV3	Site inspection records
NV23	Structures will be used as noise barriers at compounds where appropriate.		Construction	Area Manager Environment & Sustainability Manager	LSBJV Practice	Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV24	Site access and egress points will be located as far as feasible and reasonable from noise sensitive receivers.		Prior to construction	Area Manager Foreman Environmental Coordinator	LSBJV Practice	Site inspection records
BLAST MANAGEMENT						
NV25	Should blasting be required, a standalone Blast Management Strategy and Blast Monitoring Program will be prepared in consultation with the EPA.		Prior to blasting	Project Manager Project Engineer Foreman Specialist Sub-contractor Environment & Sustainability Manager	G36 CoA E96 to E100 CoA C9(d) REMM NV8	Blast Management Strategy Blast Monitoring Program
CONSULTATION AND COMPLAINTS MANAGEMENT						
NV26	Residences / sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the CCS. Information provided will include: • The types of activities to be undertaken		Prior to construction Construction	Public Liaison Manager	LSBJV Practice EPL	Community notifications

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• The timing of activities including expected start and finish • The location of activities • Details of the community information line and how to make an enquiry and/or complaint.					
NV27	Where CNVIS predict noise levels above the NMLs at community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas, consultation with the potentially-affected receiver will be undertaken to identify sensitive periods and avoid impact, where possible.	CNVIS	Prior to construction Construction	Public Liaison Manager Environmental Coordinator	CoA E80	Consultation records
NV28	All complaints, including those related to property damage, will be managed in accordance with the CCS and EPL.		Construction	Public Liaison Manager	G36	Complaints register

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV29	Owners and occupiers at risk of exceeding the screening criteria for cosmetic damage (refer to Appendix E) will be notified before works that generate vibration commences in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.	Vibration Screening Criteria Drawings CCS	Prior to construction Construction	Public Liaison Manager Environment & Sustainability Manager Area Manager	CoA E83	Consultation records
NV30	Monitoring will be undertaken in response to complaints, as determined on a case by case basis and in accordance with condition M5.5 of the EPL.	Noise and Vibration Monitoring Program	Construction	Environmental Coordinator Noise and Vibration Specialist	LSBJV Practice	Monitoring records
SURVEY, MONITORING AND REPORTING						
NV31	Noise and vibration monitoring will be carried out in accordance with the Project's Noise and Vibration Monitoring Program.	Noise and Vibration Monitoring Program	Construction	Environmental Coordinator Noise and Vibration Specialist	LSBJV Practice	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV32	Monitoring will be carried out during the initial stages of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions and that the management measures that have been implemented are appropriate.	Noise and Vibration Monitoring Program	Construction	Project Manager Project Engineer Foreman Environment & Sustainability Manager	REMM NV6	Monitoring records
NV33	LSBJV will conduct vibration monitoring before and during vibration generating activities that have the potential to impact on heritage items. Monitoring will identify minimum working distances to prevent cosmetic damage. In the event that vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, LSBJV will review the construction methodology and implement additional mitigation measures where necessary.		Construction	Environmental Coordinator Noise and Vibration Specialist	CoA E84	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV34	Prior to the commencement of vibration intensive works at each site, existing condition surveys would be carried out by suitably experienced and qualified personnel on properties (including heritage items) and structures within the preferred Project corridor (the zone on the surface equal to 50 metres from the outer edge of the tunnels) and within 50 metres of surface works		Prior to construction Construction	Area Manager	G36	Monitoring records
NV35	The Building Condition Inspection report will include as a minimum • Photograph of the subject building • Record site details – age, construction, site slope and provision for drainage, presence of trees • Types of defects and their positions and extents on the floor plan • Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks		Prior to construction Construction	Engineer	G36	Monitoring records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	• Details of the inspector's qualification and expertise.					
GROUND-BORNE NOISE MITIGATION MEASURES						
NV36	Provide specific notifications to receivers where the ground-borne noise levels are predicted to exceed the night-time NML.		Construction	Area Manager	LSBJV Practice	
NV37	Select the smallest rock hammers capable of efficiently completing the work, where feasible and reasonable.		Construction	Area Manager	LSBJV Practice	
NV38	Undertake ground-borne noise and vibration monitoring as soon as possible into the tunnelling activities to verify the reference levels used in this study at the prediction methodology.	Noise and Vibration Monitoring Program	Construction	Environmental Coordinator Noise and Vibration Specialist	LSBJV Practice	
NV39	Update the tunnelling ground-borne noise and vibration prediction tool as soon as possible and throughout the tunnelling activity to ensure its site-specific applicability.		Construction	Environmental Coordinator	LSBJV Practice	

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV40	Utilise the tunnelling ground-borne noise and vibration prediction tool to inform programming and equipment use decisions and impact mitigation options.		Construction	Environmental Coordinator	LSBJV Practice	
NV41	Notify and consult with potentially affected receivers where the tunnelling ground-borne noise and vibration prediction tool identifies a risk of adverse impacts to identify suitable feasible and reasonable mitigation measures (including identification of appropriate respite offers if deemed necessary).	CCS	Construction	Environmental Coordinator Public Liaison Manager	LSBJV Practice	
SYDNEY WATER CORPORATION (SYDNEY WATER) CITY TUNNEL AND PRESSURE TUNNEL AND SHAFTS						
NV42	• Sydney Water have provided their pre-condition survey reports from July/August 2013 (City Tunnel) and July 2018 (Pressure Tunnel) to LSBJV. • Consult with Sydney Water and agree on appropriate vibration criteria for the assets. This will be documented in the Sydney Water	Tunnelling CNVIS CNVG	Construction	Environment and Sustainability Manager Interface Manager Area Manager	LSBJV Practice	Consultation records Vibration testing records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	City and Pressure Tunnel Interface Protocols • Prior to works in the vicinity of the asset commencing, confirm compliance with the agreed vibration criteria, for all vibration intensive tunnelling activities, based on known or measured vibration levels. • On approach to the asset, the geotechnical model and its predictions is to be validated against the actual data recorded by the extensometers, inclinometers and geophones attached to and around the asset. • Automated real-time monitoring of the Sydney Water assets will be undertaken and made fully accessible to all interface parties. • If a trigger level is reached the action response protocol is to be followed as per the Sydney Water City and Pressure Tunnel Interface Protocol. • Post-construction monitoring will be undertaken for a period of 3 months after tunnelling excavation has continued past the					

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
	interface zone (150m), or when ground conditions have demonstrated stabilisation. • Prior to the date of completion, a final report detailing the predicted, accepted and actual effects on the ground conditions and Sydney Water Tunnels will be provided to TfNSW, WCX.					
OTHER MITIGATION MEASURES						
NV43	No swearing or unnecessary shouting or loud stereos/radios on site. Dropping of materials from height, throwing of metal items and slamming of doors will also be avoided.	Induction materials	Construction	Foreman	LSBJV Practice	Site inspection records

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
NV44	The safe working distances for vibration intensive plant would be complied with where feasible and reasonable. This would include the consideration of smaller equipment when working in close proximity to existing structures. Where the safe working distance cannot be achieved vibration monitoring will be carried out in accordance with the Noise and Vibration Monitoring Program.	Appendix B - Noise and Vibration Monitoring Program	Construction	Superintendent Foreman Environmental Coordinator Noise and Vibration Specialist	G36	Site inspection records

8.6 Additional noise and vibration mitigation measures

In instances where noise levels are still predicted to exceed the NML at receivers, after the application of standard noise mitigation measures (refer to Table 8-1), the CNVG directs that the Project should consider implementing the additional mitigation measures detailed in Appendix C of the CNVG where feasible and reasonable, and this approach will be implemented. Table 8-2, Table 8-3 and Table 8-4 detail the additional mitigation measures for airborne noise, ground-borne noise and vibration respectively, as recommended in the CNVG and details about when each will be applied. In accordance with CoA A26, the AA will regularly monitor and review the selection and implementation of feasible and reasonable additional mitigation measures. It should be noted that the additional mitigation measures described below do not apply to works carried out under CoA E73(a) or E73(b).

Table 8-2 Triggers for Additional Mitigation Measures – Airborne Noise

Predicted airborne $L_{Aeq(15min)}$ noise level at receiver			**Additional mitigation measures**	
Perception	**dB(A) above RBL**	**dB(A) above NML**	**Type[1]**	**Mitigation Levels**
All hours				
75 dB(A) or greater			N, V, PC, RO	HA NML
Standard Hours: Mon – Fri (7 am to 6 pm), Sat (8 am to 6 pm), Sun/Pub Hol (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly audible	10 to 20	<10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML+10
Highly intrusive	>30	>20	N, V	NML+20
OOHW Period 1: Mon – Fri (6 pm to 10 pm), Sat (7 am to 8 am & 6 pm to 10 pm), Sun/Pub Hol (8 am to 6 pm)				
Noticeable	5 to 10	<5	-	NML
Clearly audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly intrusive	>30	>25	V, N, R1, DR, SN	NML+25
OOHW Period 2: Mon – Fri (10 pm to 7 am), Sat (10 pm to 8 am), Sun/Pub Hol (6 pm to 7 am)				
Noticeable	5 to 10	<5	N	NML
Clearly audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, SN, R2, DR	NML+15
Highly intrusive	>30	>25	AA, V, N, SN, R2, DR	NML+25

Notes: 1

AA = Alternative accommodation

V = Verification

N= Notification (should be issued a minimum of five working days prior to the start of works)

R2 = Respite period 2

DR = Duration respite

R1 = Respite period 1

RO = Respite Offer

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

Table 8-3 Triggers for Additional Mitigation Measures – Ground-borne noise

Predicted ground-borne $L_{Aeq(15min)}$ noise level at receiver		**Additional mitigation measures**	
Perception	**dB(A) above GB NML**	**Type[1]**	**Apply to[2]**
Standard Hours: Mon – Fri (7 am to 6 pm), Sat (8 am to 6 pm), Sun/Pub Hol (Nil)			
N/A	Vibration only applicable during standard hours	-	
OOHW Period 1: Mon – Fri (6 pm to 10 pm), Sat (7 am to 8 am & 6 pm to 10 pm), Sun/Pub Hol (8 am to 6 pm)			
Clearly audible	<10	N	All
Moderately intrusive	10 to 20	V, N, SN	All
Highly intrusive	>20	V, N, SN	All
OOHW Period 2: Mon – Fri (10 pm to 7 am), Sat (10 pm to 8 am), Sun/Pub Hol (6 pm to 7 am)			
Clearly audible	<10	V, N, SN	All
Moderately intrusive	10 to 20	AA, V, N, SN	All
Highly intrusive	>20	AA, V, N, SN	All

Notes 1:

AA = Alternative accommodation

V = Verification

N= Notification (should be issued a minimum of five working days prior to the start of works)

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

2: All affected receivers

Table 8-4 Triggers for Additional Mitigation Measures – Vibration

Predicted vibration level at receiver	Additional mitigation measures	
	Type[1]	Apply to[2]
Standard Hours: Mon – Fri (7 am to 6 pm), Sat (8 am to 6 pm), Sun/Pub Hol (Nil)		
Predicted Vibration Exceeds Maximum Levels	V, N	All
OOHW Period 1: Mon – Fri (6 pm to 10 pm), Sat (7 am to 8 am & 6 pm to 10 pm), Sun/Pub Hol (8 am to 6 pm)		
Predicted Vibration Exceeds Maximum Levels	V, N, RO, SN	All
OOHW Period 2: Mon – Fri (10 pm to 7 am), Sat (10 pm to 8 am), Sun/Pub Hol (6 pm to 7 am)		
Predicted Vibration Exceeds Maximum Levels	AA, V, N, SN	All

Notes 1:

AA = Alternative accommodation

V = Verification

N = Notification (should be issued a minimum of five working days prior to the start of works)

RO = Respite Offer

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

9 Compliance management

9.1 Roles and responsibilities

The LSBJV Project Team's organisational structure and overall roles and responsibilities are outlined in Section 3.3 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Section 8 of this Plan.

9.2 Training

All personnel, including employees, contractors, sub-contractors and utility staff working on site will undergo site induction training relating to construction noise and vibration management issues. The induction training will address elements related to noise and vibration management including:

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

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

9.3 Inspection and monitoring

Inspections of sensitive areas and activities with the potential generate noise and vibration impacts will occur for the duration of the Project.

Requirements and responsibilities in relation to monitoring and inspections are documented in Section 3.9.1 and 3.9.2 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project, in accordance with the Project's Noise and Vibration Monitoring Program (refer to Appendix B).

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

- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm that the modelling reflects the actual activity being undertaken
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory

function of the machine), and utilising alternative construction methodology or a combination of these

- Review work practices to ensure compliance with the ICNG
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning
- Communicate lessons learnt to relevant personnel.

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

9.4 Complaints

Complaints will be recorded and managed as detailed in Section 3.7.3 of the CEMP.

9.5 Auditing

Audits (both internal and external) will be carried out to assess the effectiveness of environmental controls, compliance with this sub plan, CoA and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Section 3.9.3 of the CEMP.

9.6 Reporting

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

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

- Reporting required in accordance with the POEO Act and Regulations
- Monthly Noise and Vibration Reports prepared by the AA and submitted to the Secretary and other relevant regulatory agencies for information.

Detail within the reports will contain the following information at a minimum:

- The locations and descriptions of monitoring carried out
- A tabulation of results (e.g. for noise including $L_{A\ (max)}$ and $L_{A90\ and\ LAeq}$ noise levels) together with notes identifying the principle sources and operations
- Summary of any measurements exceeding the nominated criteria, and descriptions of the plan or operations causing these exceedances
- Detail of any corrective actions and confirmation of the successful implementation.

10 Review and improvement

10.1 Continuous improvement

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

The continuous improvement process will be designed to:

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

10.2 NVMP update and amendment

The processes described in Section 3.9 to Section 3.13 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Any revisions to the NVMP will be in accordance with the process outlined in Section 1.5 of the CEMP.

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

Appendix A Other Conditions of Approval and Revised Environmental Management Measures relevant to this plan

Other Conditions of Approval relevant to the development of this Plan

<table>
<tr><th>CoA No.</th><th>Condition Requirements</th><th>Document Reference</th></tr>
<tr><td>C9</td><td>The following Construction Monitoring Programs must be prepared in consultation with the relevant authorities identified for each Construction Monitoring Program to compare actual performance of construction of the CSSI against predicted performance.
<table>
<tr><th></th><th>Required Construction Monitoring Programs</th><th>Relevant authority(s) and council(s) to be consulted for each Construction Monitoring Program</th></tr>
<tr><td>(d)</td><td>Blast Monitoring Program</td><td>EPA</td></tr>
</table></td><td>Should blasting be proposed, a standalone Blast Monitoring Program will be prepared.</td></tr>
<tr><td>C19</td><td>The Parramatta Road East and Parramatta Road West civil sites are to be used for parking and other works that do not exceed the ‘Noise affected’ Noise Management Levels as identified in the ICNG.</td><td>Parramatta Road East and West Civil Site Construction Noise and Vibration Impact Statement (CNVIS)</td></tr>
<tr><td>C26</td><td>Boundary fencing required under Condition C25 of this approval must minimise visual, noise and air quality impacts on adjacent sensitive receivers.</td><td>Table 8-1 NV22</td></tr>
<tr><td>E66</td><td>A detailed land use survey must be undertaken to confirm sensitive receivers (including critical working areas such as operating theatres and precision laboratories) potentially exposed to construction noise and vibration, construction ground-borne noise and operational noise. The survey may be undertaken on a progressive basis but must be undertaken in any one area prior to the commencement of works 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 Management Sub-plan.</td><td>Section 4.1
Appendix C – Land Use Survey maps
Sensitive Area Plans</td></tr>
<tr><td>E67</td><td>All noise and vibration assessment, management and mitigation required by this approval must consider the cumulative noise impacts of approved CSSI and SSI projects. This includes using ambient and</td><td>Section 7.1</td></tr>
</table>

CoA No.	Condition Requirements	Document Reference
	background levels which do not include other WestConnex M4 East and New M5 (SSI 6307 and SSI 6788) projects. This condition applies to all works and operation.	
E68	Works must be undertaken during the following hours: (a) 7:00 am to 6:00 pm Mondays to Fridays, inclusive; (b) 8:00 am to 1:00 pm Saturdays; and (c) at no time on Sundays or public holidays.	Section 5.3.1 Table 8-1 NV17
E69	Notwithstanding Condition E68, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.	Section 5.3.1 Table 8-1 NV17
E70	Notwithstanding Conditions E68 and E69 the following works are permitted to be undertaken 24 hours a day, seven days a week: (a) tunnelling activities excluding cut and cover tunnelling; (b) haulage of spoil and delivery of material; (c) works within an acoustic shed; and (d) tunnel fit out works. Other surface works associated with tunnelling must only be undertaken in accordance with the requirements of Condition E73.	Section 5.3.2
E72	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and	Section 5.3.3 Table 8-1 NV18

CoA No.	Condition Requirements	Document Reference
	(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. 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.	
E73	Notwithstanding Conditions E68 to E72 works may be undertaken outside the hours specified under those conditions 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) works approved under an Out-of-Hours Work Protocol for works not subject to an EPL as required by Condition E77; or (e) construction that causes $L_{Aeq\ (15\ minute)}$ 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).	Section 5.4 Table 8-1 NV19 Appendix D – Out-of-Hours Works (OOHW) Protocol

CoA No.	Condition Requirements	Document Reference
	Note: Section 5.24(1)(e) of the EP&A Act requires that an EPL be substantially consistent with this approval. Out-of-hours works considered under Conditions E73(c) and (d) must be justified and include an assessment of mitigation measures.	
E74	On becoming aware of the need for emergency works in accordance with Condition E73(b), the Proponent must notify the AA, the ER and the EPA 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 works.	Section 5.4
E75	Out-of-hours works that are regulated by an EPL as per Condition E73(c) or through the Out-of-Hours Work Protocol as per Condition E77 include: (a) works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 “Risk Management – Principles and Guidelines”; or (b) where the relevant road network operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to road network operational performance; or (c) where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network; or (d) where the TfNSW 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 works or activities during the hours specified in Condition E68 and Condition E69; or (e) where Sydney Trains (or other rail authority) has advised the Proponent in writing that a Rail Possession is required. *Note: Other out-of-hours works can be undertaken with the approval of an EPL, or through the project’s Out-of-Hours Work Protocol for works not subject to a EPL.*	Appendix D – OOHW Protocol

CoA No.	Condition Requirements	Document Reference
E76	In order to undertake out-of-hours work described in Condition E75, the Proponent must identify appropriate respite periods for the out-of-hours works in consultation with the community at each affected location. This consultation must include (but not be limited to) providing the community with: (a) a schedule of likely out-of-hours work for a period no less than three (3) months; (b) the potential works, location and duration; (c) the noise characteristics and likely noise levels of the works; and (d) likely mitigation and management measures. The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour works must be provided to the AA, EPA and the Secretary.	Section 5.4.1 Appendix D – OOHW Protocol Community Communications Strategy (CCS)
E77	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of works which are outside the hours defined in Conditions E68 and E69, and that are not subject to an EPL. The Protocol must be approved by the Secretary prior to commencement of the works. The Protocol must be prepared in consultation with the EPA and AA. The Protocol must: (a) provide a process for the consideration of out-of-hours works against the relevant noise and vibration criteria, including the determination of low and high-risk activities; (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 E76; (c) identify procedures to facilitate the coordination of out-of-hours works approved by an EPL to ensure appropriate respite is provided; (d) identify an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where: (i) low risk activities can be approved by the ER in consultation with the AA, and (ii) high risk activities that are approved by the Secretary; and	Section 5.4.2 Table 8-1 NV19 Appendix D – OOHW Protocol

CoA No.	Condition Requirements	Document Reference
	(e) identify Department, EPA and community notification arrangements for approved out of hours works, which maybe detailed in the Communication Strategy.	
E78	All works undertaken for the delivery of the CSSI, including those undertaken by third parties, must be coordinated to ensure respite periods are provided. The Proponent must: (a) reschedule any works to provide respite to impacted noise sensitive receivers so that the respite is achieved in accordance with Condition E76; or (b) consider the provision of alternative respite or mitigation to impacted noise sensitive receivers; and (c) provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation.	Section 5.4.3 CCS
E79	Construction Noise and Vibration Impact Statements must be prepared for construction ancillary facility(s) before any works that result in noise and vibration impacts commence, and include specific mitigation measures identified through consultation with affected sensitive receivers. The Statements must supplement the Construction Noise and Vibration Management Sub-plan or Site Establishment Management Plan(s) and are to be implemented for the duration of the works. The Construction Noise and Vibration Impact Statement for the White Bay Civil Site (C11) must be prepared in consultation with the Port Authority of NSW and NSW Heritage Council.	Section 7.1
E80	Noise generating works in the vicinity of potentially-affected community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (such as theatres, laboratories and operating theatres) resulting in noise levels above the NMLs must not be timetabled within sensitive periods, unless other reasonable arrangements with the affected institutions are made at no cost to the affected institution.	Table 8-1 NV27 CNVIS CCS
E81	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria:	Table 8-1

CoA No.	Condition Requirements	Document Reference
	(a) construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009); (b) vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure); (c) Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives"; (d) BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and (e) the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Any works identified as exceeding the noise management levels and/or vibration criteria must be managed in accordance with the Construction Noise and Vibration Management Sub-plan. *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.*	
E82	Mitigation measures must be applied when the following residential ground-borne noise levels are exceeded: (a) evening (6:00 pm to 10:00 pm) — internal $L_{Aeq\ (15\ minute)}$: 40 dB(A); and (b) night (10:00 pm to 7:00 am) — internal $L_{Aeq\ (15\ minute)}$: 35 dB(A). The mitigation measures must be outlined in the Construction Noise and Vibration Management Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E77.	Table 8-1 NV36 Table 8-1 NV37 Table 8-1 NV38 Table 8-1 NV39 Table 8-1 NV40 Table 8-1 NV41 Section 8.6
E83	Owners and occupiers of properties at risk of exceeding the screening criteria for cosmetic damage must be notified before works that generate vibration commences in the vicinity of those properties. If the	Section 8.3

CoA No.	Condition Requirements	Document Reference
	potential exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers are to be provided a schedule of potential exceedances on a monthly basis for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier. These properties must be identified and considered in the Construction Noise and Vibration Management Sub-plan.	Table 8-1 NV29 Appendix E – Vibration Screening Criteria Drawings CCS
E84	The Proponent must conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage. In the event that the vibration testing and monitoring shows that the preferred values for vibration are likely to be exceeded, the Proponent must review the construction methodology and, if necessary, implement additional mitigation measures.	Appendix B – Noise and Vibration Monitoring Program Section 7 Non-Aboriginal Heritage Management Sub-Plan
E85	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.	Appendix B – Noise and Vibration Monitoring Program Section 7
E86	All acoustic sheds must be erected as soon as site establishment works at the facilities are completed and before undertaking any works which are required to be conducted within the sheds.	Table 8-1 NV20
E88	At receiver noise mitigation in the form of at-property treatment must be offered to the land owner for habitable living spaces, or other mitigation or management measures as agreed by the occupier, to residential properties identified in Appendix E. Mitigation must be offered prior to works commencing. This requirement does not apply if the sensitive receiver has been provided with noise mitigation under the RMS Noise Abatement Program or the *State Environment Planning Policy (Infrastructure) 2007* (clause 102(3)). The adequacy of at-property treatments will be reviewed where previous treatments have been installed as part of other SSI or CSSI projects. *Note: This condition does not preclude the application of other noise and vibration mitigation and management measures.*	Section 8.1 Appendix F – Noise Insulation Program

CoA No.	Condition Requirements	Document Reference
E89	A Noise Insulation Program must be prepared and implemented for the duration of CSSI works for receivers at/to which the requirements of Conditions E87 and E88 apply. The Program must be incorporated into the Construction Noise and Vibration Management Sub-plan. The Noise Insulation Program must detail the following matters: (a) receivers eligible for the scheme; (b) the scope of the insulation package; (c) responsibility for the noise insulation works; (d) procedure and the terms of the noise insulation works; (e) program monitoring; and (f) program review and amendment. The Noise Insulation Program must be endorsed by the AA.	Section 8.1 Appendix F – Noise Insulation Program
E90	Receivers which are eligible for receiving treatment under the Noise Insulation Program required under Condition E89 must have treatment implemented within six (6) months following the commencement of construction which would affect the receiver. The implementation of the Noise Insulation Program must be prioritised based on the degree and duration of exceedance with high priority exceedances undertaken within three (3) months of the commencement of construction.	Section 8.1 Appendix F – Noise Insulation Program
E93	Noise mitigation measures as identified in Condition E92 that will not be physically affected by works, or which have not been implemented in accordance with Conditions E87 and E88 must be implemented within six (6) months of the commencement of construction in the vicinity of the impacted receiver to minimise construction noise impacts, and detailed in the Construction Noise and Vibration Management Sub-plan for the CSSI.	Section 8.2
E94	Where implementation of operational noise mitigation measures are not proposed early in accordance with Condition E93, 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 reduce construction noise impacts, until such time that the operational noise mitigation measures identified in Condition E92 are	Section 8.2

CoA No.	Condition Requirements	Document Reference
	implemented. The report must be endorsed by the AA and submitted to the Secretary prior to the commencement of construction which would affect the identified sensitive receivers.	
E96	If blasting is proposed a Blast Management Strategy must be prepared and must include: (a) sequencing and review of trial blasting to inform blasting; (b) regularity of blasting; (c) intensity of blasting; (d) impact mitigation measures including periods of relief; and (e) blasting program.	Should blasting be proposed, a standalone Blast Management Strategy will be prepared.
E97	The Blast Management Strategy must be endorsed by a suitably qualified and experienced person and reviewed by an independent specialist.	Should blasting be proposed, a standalone Blast Management Strategy will be prepared.
E98	The Blast Management Strategy must be prepared in accordance with relevant guidelines and in consultation with the EPA to ensure that all blasting and associated activities are carried out so as not to generate unacceptable noise and vibration impacts or pose a significant risk to sensitive receivers.	Should blasting be proposed, a standalone Blast Management Strategy will be prepared.
E99	The Blast Management Strategy must be submitted to the Secretary for information no later than one (1) month prior to the commencement of blasting. The Strategy as submitted to the Secretary, must be implemented for all blasting activities.	Should blasting be proposed, a standalone Blast Management Strategy will be prepared.
E100	Blasting associated with the CSSI must only be undertaken during the following hours: (a) 9:00 am to 5:00 pm, Monday to Friday, inclusive; (b) 9:00 am to 1:00 pm, Saturday; and	Should blasting be proposed, a standalone Blast Management Strategy will be prepared.

CoA No.	Condition Requirements	Document Reference
	(c) at no time on Sunday or on a public holiday; or as authorised through an EPL if blasting is proposed outside of these hours. This condition does not apply in the event of a direction from police or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.	
E105	The Proponent must offer pre-dilapidation surveys and must undertake and prepare pre-dilapidation reports where the offer is accepted, on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model described in Condition E101. The pre-dilapidation surveys and reports must be prepared by a suitably qualified and experienced person(s) and must be provided to the owners of the surface and sub-surface structures for review prior to the commencement of potentially impacting works.	Section 8.4 CCS
E106	Where pre-dilapidation surveys have been undertaken in accordance with Condition E105, subsequent post-dilapidation surveys must be undertaken to assess damage to the surface and sub-surface structures that may have resulted from the construction of the CSSI within three (3) months of the completion of construction.	Section 8.4 CCS
E107	The results of the surveys must be documented in a Condition Survey Report for each surface and sub-surface structure surveyed. Copies of the Condition Survey Reports must be provided to the owner(s) of the structures surveyed within three (3) months of completion of the post-dilapidation surveys unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.	Section 8.4 CCS
E108	Where damage has been determined to occur as a result of the project, the Proponent must carry out rectification at its expense and to the reasonable requirements of the surface and sub-surface structure owner within three (3) months of completion of the post-dilapidation surveys unless another timeframe is agreed with the owner of the affected surface or sub-surface structure.	Section 8.4 CCS
E162	Prior to conducting acoustic treatment at any heritage item identified in the documents listed in Condition A1 the advice of a suitably qualified and experienced built heritage expert must be obtained and	Non-Aboriginal Heritage Management Plan Section 8.1

CoA No.	Condition Requirements	Document Reference
	implemented to ensure any such work minimises any adverse impacts on the heritage significance of the item.	Appendix F – Noise Insulation Program

Revised Environmental Mitigation Measures relevant to the development of this Plan

Outcome	Ref #	Commitment	Timing	NVMP
Impacts from the generation of construction noise and vibration	REMM NV1	A suitably qualified and experienced Acoustics Advisor, who is independent of the design and construction personnel, will be engaged for the duration of construction of the project. The Acoustics Advisor will be responsible for: • Reviewing management plans related to noise and vibration and endorsing that they address all relevant conditions of approval and requirements of all applicable guidelines • Reviewing location and activity specific noise and vibration impact assessments prepared during the project and endorsing the assessments and proposed mitigation measures • Reviewing proposals regarding works outside standard construction hours, confirming that the works are appropriate and endorsing the proposed mitigation measures • Monitoring noise and vibration from construction generally and:	Construction	Section 3.4

Outcome	Ref #	Commitment	Timing	NVMP
		◦ Confirming that actual noise and vibration levels and impacts are consistent with predictions ◦ Confirming that reasonable and feasible noise and vibration mitigation measures are being implemented ◦ Suggesting additional reasonable measures to further reduce impacts • Monitoring and providing advice in relation to compliance with conditions of approval and project commitments related to noise and vibration • Providing advice in relation to complaints regarding noise and vibration impacts that cannot be resolved between the complaint and the project • Reviewing and endorsing the proposed operational noise controls, the associated noise model and the proposed implementation program		
Impacts from the generation of construction noise and vibration	REMM NV2	A Construction Noise and Vibration Management Plan (NVMP) will be prepared for the project. The plan will:	Construction	
		• Identify relevant performance criteria in relation to noise and vibration		Section 5
		• Identify noise and vibration sensitive receivers and features in the vicinity of the project		Section 4 Appendix C – Land Use Survey

Outcome	Ref #	Commitment	Timing	NVMP
		• Include standard and additional mitigation measures from the Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime 2016) and details about when each will be applied		Table 8-1
		• Describe the process(es) that will be adopted for carrying out location and activity specific noise and vibration impact assessments to assist with the selection of appropriate mitigation measures		Section 7.1
		• Include protocols that will be adopted to manage works required outside standard construction hours in accordance with relevant guidelines		Section 5.4 Appendix D – OOHW Protocol
		• Detail monitoring that will be carried out to confirm project performance in relation to noise and vibration performance criteria.		Section 9.3 Appendix B – Noise and Vibration Monitoring Program
		The CNVMP will be implemented for the duration of construction of the project.		
Impacts from the generation of construction noise and vibration	REMM NV3	Detailed noise assessments will be carried out for all ancillary facilities required for construction of the project. The assessment will consider the proposed site layouts and noise generating activities that will occur at the facilities and assess predicted noise levels against the relevant noise management levels determined in	Construction	Section 7.1 CNVIS

Outcome	Ref #	Commitment	Timing	NVMP
		accordance with the requirements of the *Interim Construction Noise Guideline* (ICNG) (NSW Department of Environment and Climate Change NSW (DECC) 2009). The assessments will be used to determine the appropriate heights and configurations of noise barriers, and other appropriate noise management measures, consistent with the requirements of the ICNG and the CNVG. Noise barriers, as confirmed through the noise assessments, will be installed as early as possible during site establishment and as a minimum prior to the commencement of excavation associated with tunnel access.		
Impacts from the generation of construction noise and vibration	REMM NV4	Location and activity specific noise and vibration impact assessments will be carried out prior to (as a minimum) activities: • With the potential to result in noise levels above 75 dBA at any receiver • Required outside standard construction hours likely to result in noise levels greater than the relevant noise management levels • With the potential to exceed relevant performance criteria for vibration. The assessments will clarify predicted impacts at relevant receivers in the vicinity of the activities to assist with the selection of appropriate management measures, consistent with the requirements of ICNG and CNVG that will be implemented during the works.	Construction	Section 7.1 CNVIS

Outcome	Ref #	Commitment	Timing	NVMP
Out-of-hours impacts	REMM NV5	An out-of-hours works protocol will be developed for the construction of the project. The protocol will include: • Details of works required outside standard construction hours, including justification of why the activities are required outside standard construction hours • Measures that will be implemented to manage potential impacts associated with works outside standard construction hours • Location and activity specific noise and vibration impact assessment process(es) that will be followed to identify potentially affected receivers, clarify potential impacts and select appropriate management measures • Details of the approval process (internal and external) for works proposed outside standard construction hours. The protocol will be included in the CNVMP, prepared in consultation with NSW Department of Planning and Environment and the NSW EPA, endorsed by the Acoustics Advisor for the project and implemented during construction of the project.	Construction	Section 5.4 Appendix D – OOHW Protocol
Noise monitoring	REMM NV6	Monitoring will be carried out at the commencement of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions	Construction	Table 8-1 NV32 Appendix B –Noise and Vibration Monitoring

Outcome	Ref #	Commitment	Timing	NVMP
		and that the management measures that have been implemented are appropriate.		Program Section 5.1
Noise from acoustic sheds	REMM NV7	Acoustic sheds will be designed with consideration of the activities that will occur within them and the relevant noise management levels in adjacent areas. Monitoring will be carried out to confirm that the actual acoustic performance of each shed is consistent with predicted acoustic performance.	Construction	Table 8-1 NV21 Appendix B –Noise and Vibration Monitoring Program Section 5.1
Blasting impacts	REMM NV8	A Blast Management Strategy will be prepared and implemented for the project if blasting is proposed. The strategy will: • Identify relevant performance criteria in relation to potential noise and vibration impacts due to blasting with reference to (as a minimum) *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (Australian and New Zealand Environment Conservation Council (ANZECC), 1990) and Australian Standard AS 2187.2-2006 Explosives -Environmental management measure Timing Storage, transport and use, Part 2: Use of explosives • Describe trials that will be carried out to confirm vibration levels from blasting and facilitate development of predictive tools to allow potential noise and vibration impacts to be identified	Construction	Should blasting be proposed, a Blast Management Strategy will be prepared.

Outcome	Ref #	Commitment	Timing	NVMP
		• Include details of management measures that will be implemented to ensure compliance with relevant performance criteria • Include details of community consultation requirements prior to commencing blasting. The Blast Management Strategy will be implemented for all blasting carried out as part of the project.		
Long term construction noise impacts	REMM NV9	Receivers that qualify for assessment for at receiver treatment in relation to operational noise that are also predicted to experience significant exceedances of noise management levels due to construction will be given priority preference for assessment for treatment based on the severity and timing of impact. Where the building owner accepts the at receiver treatment proposal, the treatments will be installed as soon as possible.	Construction	Section 8.1 Appendix F – Noise Insulation Program ONVR
	REMM NV10	Where reasonable and feasible, operational noise mitigation such as noise barriers, berms and at-property treatments identified during detailed design should be installed early in the project so as to provide a benefit to receivers during the construction phase of the project.	Construction	Section 8.2 ONVR
Impacts on receivers from spoil transport during night time periods	REMM TT17	Monitor and manage project-related heavy vehicle movements to and from sites with the aim of limiting any associated increases in road traffic noise levels during the night-time period to no more than 2 dBA. Any increases in road traffic noise of more than 2 dBA due to project-related vehicle movements will be managed in accordance with the *Construction Noise and Vibration Guideline* (Roads and Maritime 2016).	Construction	Section 8.5 Table 8-1 NV3

Outcome	Ref #	Commitment	Timing	NVMP
Heritage impacts due to vibration	REMM NAH06	Potential vibration impacts to features of heritage significance will be managed in accordance with the CNVMP prepared for the project.	Construction	This NVMP

Appendix B Noise and Vibration Monitoring Program

Noise and Vibration Monitoring Program

M4-M5 Link Mainline Tunnels

October 2019

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Contents

Appendices

Appendix A Typical Noise and Vibration Levels for Construction Equipment

Document control

Approval and authorisation

Title	M4-M5 Link Mainline Tunnels Noise and Vibration Monitoring Program
Document No/Ref	M4M5-LSBJ-PRW-EN-MP01-PLN-0011-09
Document Path	

Version control

Revision	Date	Description
A	29 June 2018	Draft for Internal Review
B	5 July 2018	Draft for Internal Review
C	6 July 2018	Draft for Agencies Review
D	27 July 2018	Draft for SMC/RMS/AA/ER Review
E	10 August 2018	Revised draft in response to SMC, RMS, AA and ER Review
01	5 September 2018	Draft – close out of SMC, RMS, AA and ER comments
02	18 September 2018	Revised draft in response to AA Review
03	24 October 2018	For DPE Review
04	7 November 2018	For DPE Review
05	15 November 2018	For DPE Approval
06	7 February 2019	Update post Project Modification
07	15 February 2019	Further update post Project Modification
08	27 February 2019	Further update post Project Modification – For DPE Review
09	7 March 2019	For DPE approval
10	31 October 2019	Revise hammering safe working distances

Note:

Revision 05 Document Number has changed from M4M5-LSBJV-PRW-GEN-EV01-PLN-0012 (previous revisions) to M4M5-LSBJ-PRW-EN-MP01-PLN-0011-05.

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustic Advisor
AVTG	Assessing Vibration – A technical guideline (DEC 2006)
CCS	Community Communications Strategy
CEMP	Construction Environmental Management Plan
CNS	Construction Noise Strategy 7TP-ST-157/2.0 (Transport for NSW 2012)
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
dB(A)	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now OEH)
DECC	Department of Environment and Climate Change (now OEH)
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2015 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2015 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2015 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
ENMM	Environmental Noise Management Manual (RTA 2001)
EPA	NSW Environment Protection Authority

Abbreviations	Expanded Text
EPL	Environment Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
KPI	Key Performance Indicator
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
$L_{A\ (max)}$	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LSBJV	Lendlease Samsung Bouygues Joint Venture
NCA	Noise Catchment Area
NML	Noise Management Levels
NVMP	Noise and Vibration Management Plan
OEH	Office of Environment and Heritage
OOHW	Out of Hours Works
PPV	Peak Particle Velocity
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
REMM	Revised Environmental Management Measures
Roads and Maritime	Roads and Maritime Services
SMC	Sydney Motorway Corporation
SWL	Sound Power Level

Abbreviations	Expanded Text
SPL	Sound Pressure Level
SWTC	Scope of Works and Technical Criteria
VDV	Vibration Dose Values

1 Introduction

1.1 Context

This Noise and Vibration Monitoring Program (monitoring program) has been prepared for the M4-M5 Link Mainline Tunnels (the Project).

This monitoring program has been prepared to address the requirements of the Minister's Condition of Approval (CoA) C9(c), the WestConnex M4-M5 Link Environmental Impact Statement (EIS) and the revised environmental management measures (REMM) listed in the WestConnex M4-M5 Link Submissions and Preferred Infrastructure Report (SPIR) and all applicable guidance and legislation.

1.2 Project background

An environmental impact statement (EIS) (AECOM 2017) assessed noise and vibration impacts on sensitive receivers and structures during construction and operation of the Project, within Chapter 10.

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

Please refer to Section 1.3 of the Construction Environmental Management Plan (CEMP) for Project description.

1.3 Scope of the monitoring program

The scope of this monitoring program is to describe how Lendlease Samsung Bouygues Joint Venture (LSBJV) propose to carry out noise and vibration monitoring during the construction of the Project. Monitoring will be undertaken for modelling verification, at sensitive receivers to assess compliance in response to complaints, for equipment spot checks, construction traffic and for the verification of acoustic shed effectiveness. For further information refer to Sections 5 and 6.

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

Operational noise and vibration monitoring do not fall within the scope of this monitoring program and therefore are not included within the processes contained within this monitoring program.

1.4 Environmental management systems overview

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

2 Purpose and objectives

2.1 Purpose

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

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

Construction Noise and Vibration Monitoring reports will be made publicly available, including to NSW Health and relevant councils, via the Project website in line with the requirements of the POEO Act and Regulations.

2.2 Objectives

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

- The EIS prepared for WestConnex M4-M5 Link
- The SPIR prepared for WestConnex M4-M5 Link
- Conditions of Approval granted to the Project on 17 April 2018 and Modified on 25 February 2019
- Roads and Maritime specification G36
- The Project's Environment Protection Licence (EPL) (#21149)
- All relevant legislation and other requirements described in Section 3.1 of this monitoring program.

3 Environmental requirements

3.1 Relevant legislation

3.1.1 Legislation

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

3.1.2 Guidelines

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

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System).
- Roads and Maritime Construction Noise and Vibration Guidelines (CNVG) (Roads and Maritime 2016)
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009
- NSW Road Noise Policy, Dept. of Environment, Climate Change and Water 2011
- NSW Industrial Noise Policy, Environment Protection Authority 2000
- NSW Assessing Vibration – a technical guideline (AVTG), (DEC 2006)
- Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard AS/NZS 2107:2000 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard 1055 Acoustics – Description and Measurement of Environmental Noise
- Australian Standard AS2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites
- British Standard BS 6472-2008, ‘Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-1999 Structural vibration Part 3: Effects of vibration on Structures,

  Construction Noise Strategy 7TP-ST-157/2.0 (CNS), Transport for NSW 2012.

3.2 Consultation

This monitoring program was provided to NSW Health, City of Sydney and Inner West Council in accordance with CoA C9 (c) for review and comment.

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

3.3 Environment Protection Licence monitoring requirements

The Project holds an Environment Protection Licence (EPL) (#21149) granted by the NSW Environment Protection Authority (EPA). Noise monitoring requirements from the EPL have been incorporated into this Monitoring Program.

4 Baseline monitoring data

As part of the EIS process, baseline noise monitoring was conducted between July 2016 and November 2016 at a total of 23 locations. This monitoring was supplemented with results at a further 11 locations which had been monitored during 2014 and 2015 for previous stages of WestConnex. The baseline noise monitoring locations were selected to be representative of the appropriate Noise Catchment Areas (NCAs) within and around the Project, across a mix of existing land uses including residential, commercial, industrial and open space.

For further information regarding baseline noise monitoring refer to Section 4 of the NVMP or Section 10.2 of the EIS.

Where additional baseline data is required to better reflect localised acoustic environments, such monitoring will be undertaken in accordance with the relevant guidance and the NVMP will be updated as necessary, and issued to DPE for approval.

5 Noise monitoring

5.1 Attended and unattended airborne noise monitoring

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

- Monitoring will be carried out at the commencement of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions and that the management measures that have been implemented are appropriate.
- At the commencement of activities within an acoustic shed to confirm the actual acoustic performance of the shed is consistent with the predicted acoustic performance
- Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with EPL Condition M5.5.
- As otherwise required by the CNVIS, Out of Hours Works (OOHW) Protocol or EPL Condition M6
- Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels
- Ongoing spot checks for noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with the maximum noise level goals for construction equipment listed in Appendix A
- In order to satisfy CoA C11(a), unattended noise logging will be installed at representative sensitive residential receiver locations along Bland Street and Alt Street, adjacent to the Parramatta Road East and West sites, to confirm that construction noise levels do not exceed the 'Noise affected' Noise Management Levels identified in the ICNG. The locations of the monitoring loggers will be agreed in consultation with landowners on these streets
- In order to satisfy CoA C11(b), unattended noise monitoring associated with condition E88 and Appendix E at agreed representative sensitive residential receiver locations alongside those properties bordering the Northcote Street construction ancillary facility that have been identified as eligible for construction noise treatment in Appendix E and in Paige Avenue and/or Earle Avenue located immediately outside, and to the east and west of the nominated boundary in Appendix E
- Unattended monitoring in relation to CoA's C11(a) and C11(b) will be undertaken during the day, evening and night-time periods, within the first month of construction at the relevant ancillary facilities and will cover the range of activities being undertaken at the relevant ancillary facility (excluding site establishment activities).

Unattended airborne noise monitoring will also be used where by a noise logger will be deployed to obtain noise results over longer periods. Appropriate locations will be identified through consultation between the Public Liaison Team and affected residents within the areas of interest. In these instances, noise loggers will record audio to allow for the identification construction noise contribution and the presence of any extraneous noise, where privacy concerns can be overcome. The use of unattended airborne noise monitoring will be determined on a case-by-case basis and will be subject to any access approval.

Attended noise and unattended noise monitoring locations will vary and be determined on a case-by-case basis by a CNVIS, the Project's noise predictive noise and vibration tool or where in response to complaints.

In accordance with the ICNG the duration and amount of noise monitoring will depend on the scale of the construction activities and extent of expected noise impacts. Noise monitoring will cover a representative period of the construction activity.

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

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

5.1.1 Parameters to be monitored

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

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

Environmental noise monitoring will be recorded over 15 minute sample intervals, excluding periods of extraneous noise until a representative sample has been obtained. A representative sample will be determined by operator, who will be competent, suitability trained and experienced in undertaking noise measurements and familiar with the relevant Australian Standards (as detailed in Section 5). The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: L_{A90}, L_{Aeq}, L_{A10} and $L_{A\ (max)}$.

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

5.2 Attended and unattended Ground-Borne Noise monitoring

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

- At the first opportunity following the commencement of tunnelling and dive excavation to verify and, if necessary, update the ground-borne noise models
- Where appropriate in response to a noise related complaint(s) (determined on a case-by-case basis) and in accordance with EPL Condition M5.5.
- As otherwise required by the CNVIS, OOHW Protocol or EPL Condition M6.

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

There may be instances where the resident does not allow us to monitor in the most suitable habitable room. In these instances, we will endeavour to monitor at the next most suitable available room or location and note in any monitoring report.

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

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

5.2.1 Parameters to be monitored

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

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

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

In some instances, it may be beneficial to monitor ground-borne noise using $L_{A\ (max)}$ and a slow Time Constant. These parameters may be considered during shorter, more transient ground-borne noise events (such as rock hammering and drilling), in consultation with LSBJV's acoustic specialists.

5.3 Real-time (unattended) noise monitoring

Real-time (unattended) noise monitoring will be undertaken to satisfy CoA C11(d). The real-time noise monitors will be in place at each of the three tunnelling worksites (Northcote, Pyrmont Bridge Road and St Peters Interchange), and installed prior to commencement of bulk excavation at these locations.

The location of the real-time noise monitoring equipment will be determined in consultation with the AA and will be subject to the final layout of each tunnelling site and availability of mains power. It is anticipated that the real-time monitoring equipment will be positioned as close as possible sensitive receivers that are adjacent to the construction site boundary, in a location representative of the worst-case predicted impacts.

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

The real-time monitoring data will be available to LSBJV, Sydney Motorway Corporation (SMC), Roads and Maritime, the Environmental Representative (ER) and Acoustic Advisor (AA) via a web based portal. The real-time monitoring data will be available to DPE and EPA on request following an initial screening review, to identify any anomalies or corruption in the dataset.

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

5.3.1 Parameters to be monitored

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

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

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

5.4 Calibration, QA and competency

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

Noise monitoring equipment used will be at least Type 2 instruments and calibrated in accordance with manufacturer specifications or relevant Australian Standards. The calibration of the monitoring equipment will be checked in the field before the noise measurement period. Records of monitoring equipment calibration will be maintained by LSBJV throughout the delivery of the Project.

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

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

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

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

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

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

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

6 Vibration monitoring

6.1 Short term attended and unattended vibration monitoring

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded, as determined by a CNVIS or the tunnel vibration tool.
- At the commencement of vibration generating activities that have the potential to impact on heritage items to confirm/identify the minimum working distances to prevent cosmetic damage
- At the first opportunity following the commencement of tunnelling and dive excavation to verify and, if necessary update the vibration model
- Where vibration sensitive locations are determined to fall within the 'safe working distances' established for each item of plant, so to refine the indicative minimum working distances
- At the properties which fall within the validation monitoring safe working distance as highlighted in Appendix E of the NVMP, note that, where appropriate, vibration monitoring will be undertaken at a representative worse case monitoring point rather than at each individual highlighted property.
- Where deemed to be relevant to construction works in response to a vibration related complaint
- At Royal Prince Alfred Hospital and Australian Nuclear Science and Technology Organisation (ANSTO) Nuclear Cyclotron Facility, at the commencement and during vibration generating activities that could conceivably impact these two receivers. The results of this monitoring will be submitted to Sydney Local Health District Public Health Unit.
- As otherwise required by the CNVIS, OOHW Protocol or EPL Condition M6.

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

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

Where property damage is a concern, vibration monitoring results will be assessed and reported against the German Standard DIN4150-1999 Structural vibration Part 3: Effects of vibration on Structures, as presented in the NVMP.

Vibration monitoring equipment will be mounted directly to the buildings foundation using bees wax or other suitable means, where possible. Selected monitoring location will be solid and rigid to best represent the vibration entering the structure of the building under investigation. Any alternative mounting techniques will be determined by an appropriately experienced person in accordance the relevant standards and guidelines.

Where attended vibration monitoring is not feasible, due to extended periods of vibration intensive civil works, unattended vibration monitoring system could be installed to warn plant operators (via flashing light etc.) that there is potential cosmetic damage to buildings and structures.

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

6.1.1 Parameters to be monitored

The following vibration metrics will be stored in memory and reported:

- Vibration Dose Values (VDVs) – for the assessment of human comfort concerns
- Peak-Particle Velocity (PPV) – for the assessment of cosmetic damage concerns.

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

6.2 Real-time (unattended) vibration monitoring

Real-time (unattended) vibration monitoring will be undertaken to satisfy CoA C11(d). The real-time vibration monitors will be in place at, or adjacent to, each of the three tunnelling worksites (Northcote, Pyrmont Bridge Road and St Peters Interchange) and installed prior to commencement of bulk excavation at these locations.

The location of the real-time vibration monitoring equipment will be determined in consultation with the AA and will be subject to the final layout of each tunnelling site and availability of mains power. It is anticipated that the real-time monitoring equipment will be positioned as close as possible sensitive receivers that are adjacent to the construction site boundary.

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

The real-time monitoring data will be available to LSBJV, SMC, Roads and Maritime, the Environmental Representative (ER) and Acoustic Advisor (AA) via a web based portal. The real-time monitoring data will be available to DPE and EPA on request following an initial screening review, to identify any anomalies or corruption in the dataset.

6.2.1 Parameters to be monitored

Real time vibration monitoring will continuously monitor Peak Particle Velocity (PPV). Where a complaint relating to human comfort is received, LSBJV will undertake additional monitoring following the process defined in Section 6.1.

6.3 Calibration and QA

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

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

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

- Date and time of measurements
- Name of person undertaking the measurements
- Type and model number of instrumentation
- Time of day, length of measurement and measurement time intervals
- Monitoring location (including a sketched map of area)

- Measurement location details and number of measurements at each location
- Operation and load conditions of the vibrating plant under investigation
- Possible vibration influences from other sources (e.g. domestic vibrations, other mechanical plant, traffic etc.).

7 Heritage-listed structures

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

Vibration Screening Criteria drawings have been prepared in accordance with CoA E83 and included in the NVMP to identify the safe working distances for heritage buildings during vibration intensive activities. CNVIS prepared for the Project will also identify where monitoring should be conducted at heritage items.

LSBJV will seek the advice of the Project's heritage specialist, Artefact Heritage Services, on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures.

8 Heavy vehicle transport noise

In accordance with REMM TT17, the LSBJV Project Team will monitor and manage heavy vehicle movements to and from sites with the aim of limiting any associated increases in road traffic noise levels during the night-time period to no more than 2 dB(A). Monitoring will consider the number of heavy vehicles used and the relative increase in noise from those movements. Increases in road traffic noise of more than 2 dB(A) during the night-time period will be managed in accordance with the CNVG.

9 Continual improvement and corrective action

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

- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm that the modelling reflects the actual activity being undertaken
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory

function of the machine), and utilising alternative construction methodology or a combination of these

- Review work practices to ensure compliance with the ICNG
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning. For example, where a prediction was a Category D and the actual monitored was a Category B, OOHW scheduling would be updated accordingly to comply with the numbers of nights permitted to be worked per week etc. The same applies in reverse where the monitored noise levels are in a higher Category than initially predicted.
- Communicate lessons learnt to relevant personnel.

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

In the case of tunnelling noise, where an increased noise level has been obtained through monitoring, a review of the mitigation measures will be undertaken and additional goodwill or alternative accommodation will be offered, in accordance with the Project's NVMP.

10 Reporting of monitoring results

The results of noise and vibration monitoring will be documented and published monthly on the Project website in line with the requirements of the POEO Act and Regulations.

In accordance with CoA C17, the results of the Construction Noise and Vibration Monitoring Program will be reported on a six-monthly basis within a Construction Monitoring Report. The Construction Monitoring Report will be submitted to the Secretary of the DPE and relevant regulatory authorities for information.

Where monitoring reports are generated, these will be supplied to the AA for review and reflect the reporting requirements in Section 11.1.4 of the INP.

Additional records relating to noise and vibration training, toolbox talks, monitoring results and audit results are described in Section 3.11.1 of the CEMP. The complaints management and reporting procedure is described in Section 3.7.4 of the CEMP.

Appendix A Typical Noise and Vibration Levels for Construction Equipment

Table A-1 Typical noise levels for construction equipment

Equipment	Typical Noise Level Goals (dB(A)) - $L_{A\ (max)}$	
	Sound Power Level	Sound Pressure Level at 7m
Excavator with hammer	122	97
Excavator (approx. 3 tonne)	90	65
Excavator (approx. 6 tonne)	95	70
Excavator (approx. 10 tonne)	100	75
Excavator (approx. 20 tonne)	105	80
Excavator (approx. 30 tonne)	110	85
Excavator (approx. 40 tonne)	115	90
Skidsteer loaders (approx. ½ tonne)	107	82
Skidsteer loaders (approx. 1 tonne)	110	85
Dozer (equivalent CAT D8)	118	93
Dozer (equivalent CAT D9)	120	95
Dozer (equivalent CAT D10)	121	96
Backhoe/FE Loader	111	86
Dump truck (approx. 15 tonne)	108	83
Concrete truck	112	87
Concrete pump	109	84
Concrete vibrator	105	80
Bored piling rig	110	85
Scraper	110	85
Grader	110	85
Vibratory roller (approx. 10 tonne)	114	89
Vibratory pile driver	121	96
Impact piling rig	134	109
Compressor (approx. 600 CFM)	100	75
Compressor (approx. 1500 CFM)	105	80

Equipment	Typical Noise Level Goals (dB(A)) - $L_{A\ (max)}$	
	Sound Power Level	Sound Pressure Level at 7m
Concrete saw	118	93
Jackhammer	113	88
Generator	104	79
Lighting tower	80	55
Flood lights	90	65
Cherry picker	102	77
Mobile crane	110	85

Table A-2 Typical vibration levels for construction equipment

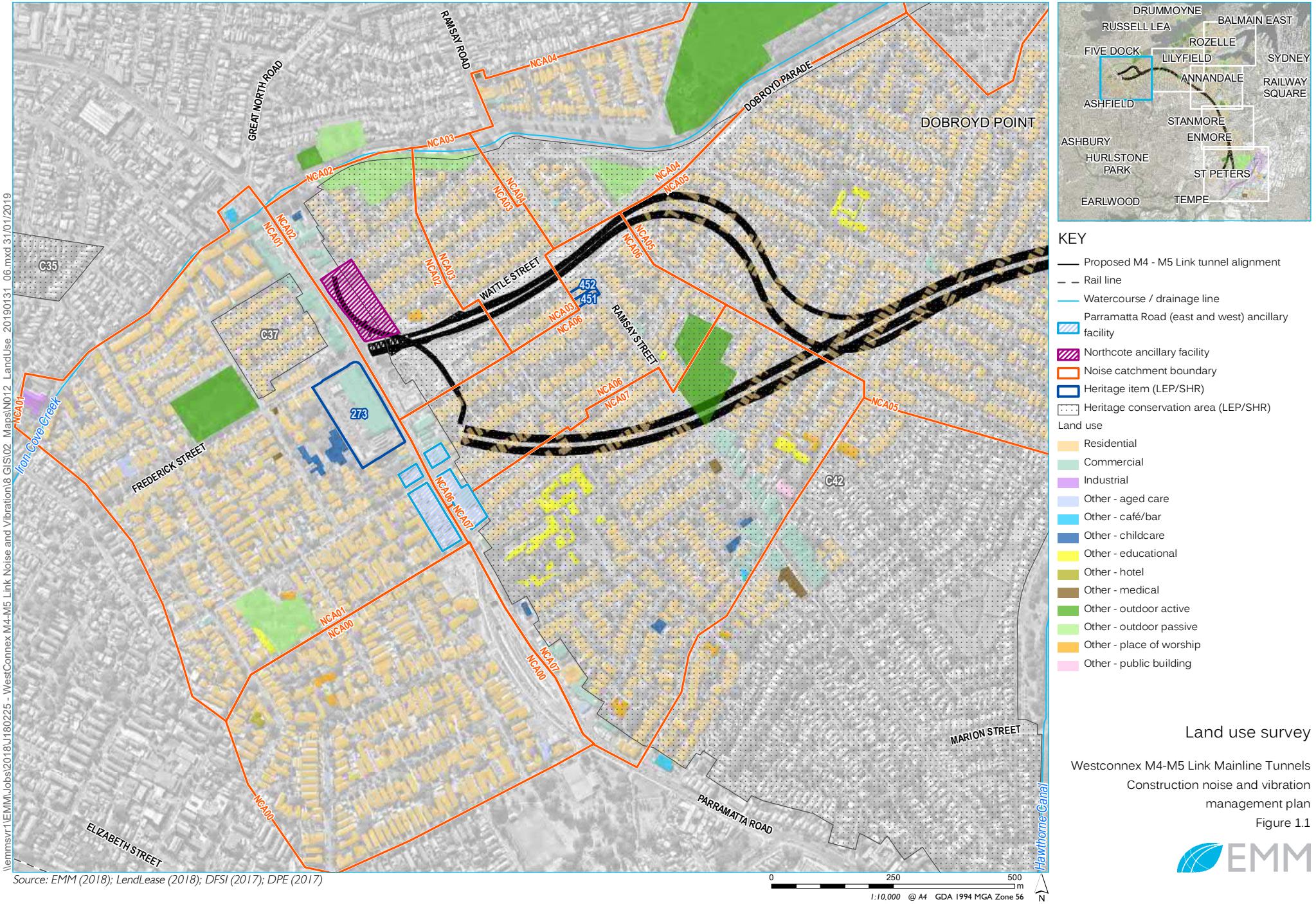
Source	Safe Working Distance				Estimated PPV (mm/s) at Distance					
	Human comfort	Commercial, industrial structures	Dwellings and similar structures	Heritage Structures	5m	10m	20m	30m	40m	50m
Large vibratory roller (20t)	100m	5m	33m	50m	7	4.5	3	2.3	2	1.7
Medium vibratory roller (10t)	100m	5m	20m	31m	-	3.6	2	1.5	1	-
Compactor (7t)	50m	5m	20m	20m	-	6	2.5	0.3	-	-
Hand operated wacka packer on backfill	10m	5m	5m	5m	0.6	0.3	-	-	-	-
Hand operated wacka packer on asphalt	10m	5m	5m	5m	1.2	0.8	-	-	-	-

Source	Safe Working Distance				Estimated PPV (mm/s) at Distance					
	Human comfort	Commercial, industrial structures	Dwellings and similar structures	Heritage Structures	5m	10m	20m	30m	40m	50m
Large hydraulic hammer (approx. 1700kg hammer on 30t excavator) [2]	73m	5m	10m (11-22m)[1]	10m (11-44m) [1]	4.5	2.5	0.5	0.2	0.12	<0.1
Medium hydraulic hammer (approx. 700kg on 18t excavator) [2]	73m	5m	10m	10m (11-15m) [1]	-	-	-	-	-	-
Light hydraulic hammer (300kg on 5t excavator) [2]	10m	5m	5m	5m	1.5	0.3	0.1	<0.1	-	-
Jack hammer	Avoid contact with structure	5m	5m	5m	0.2	0.1	<0.1	-	-	-
Air track drill	20m	5m	5m	10m	4.5	1.5	0.6	-	0.1	<0.1
Small rock drill (estimate)	10m	5m	5m	5m	-	0.5	0.2	0.1	<0.1	-
Down the Hole Hammer	10m	5m	5m	5m	0.9	0.2	<0.1	-	-	-
Ripping (measured in Sydney sandstone)	10m	5m	5m	5m	0.7	0.15	<0.1	-	-	-
Impact piling	30m	5m	10m	20m	11	3.5	1.0	0.5	0.2	<0.1

Source	Safe Working Distance				Estimated PPV (mm/s) at Distance					
	Human comfort	Commercial, industrial structures	Dwellings and similar structures	Heritage Structures	5m	10m	20m	30m	40m	50m
Vibratory piling	30m	5m	26m	100m	10	5	-	0.5	0.2	-
Rock sawing	10m	5m	5m	5m	1.2	0.5	0.3	-	-	-
Bored piling	N/A	5m	10m	10m	-	0.2	<0.1	-	-	-

1. Values in brackets indicate the distance within which verification vibration monitoring will be undertaken only.
2. Where the hammer is being used for tunnelling, the safe working distance should typically be determined to the tunnel floor,

Appendix C Land Use Survey maps



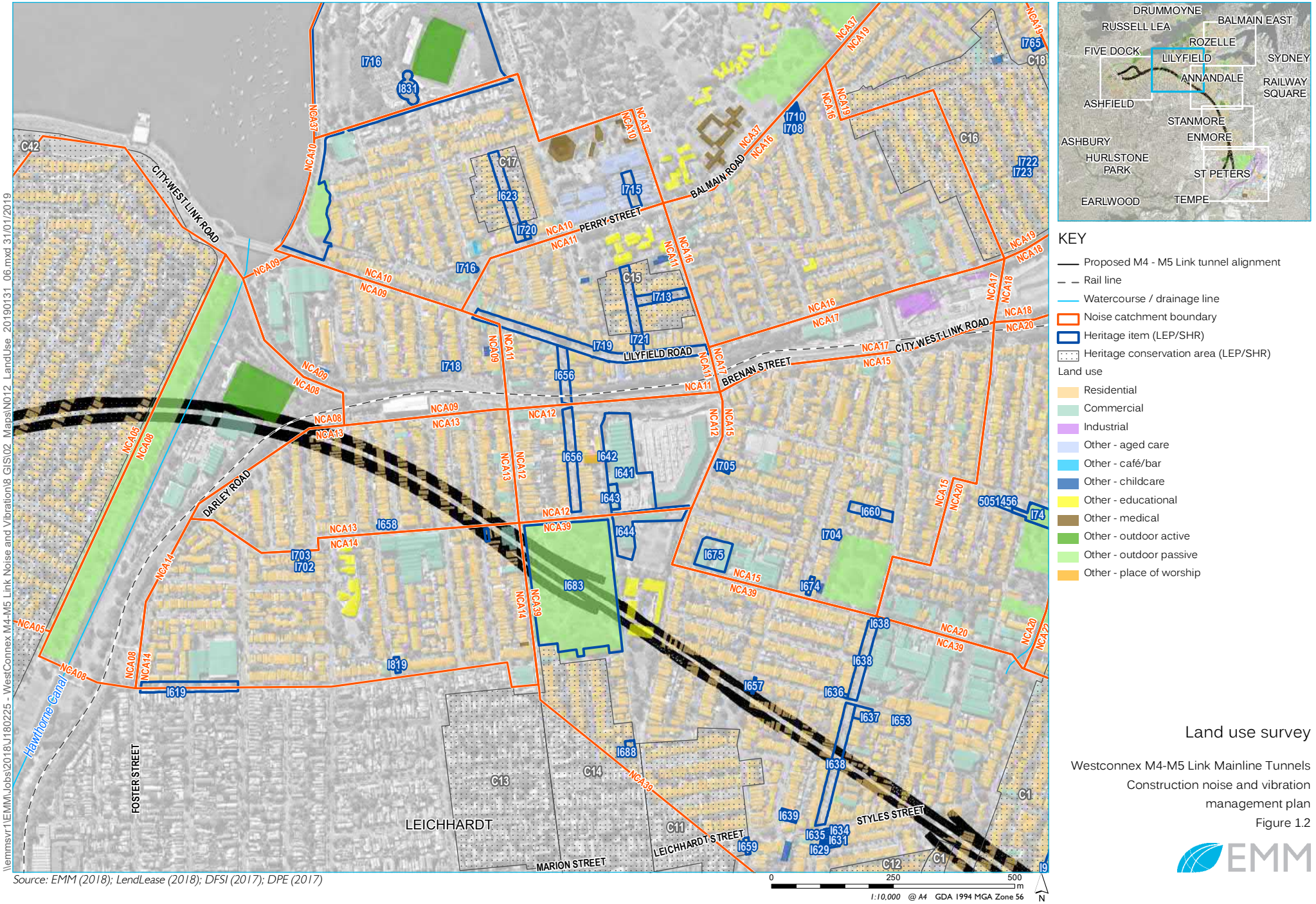
\\emmsvr1\EMM\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\N012 LandUse 20190131 06.mxd 31/01/2019

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

Land use survey

Westconnex M4-M5 Link Mainline Tunnels
Construction noise and vibration management plan
Figure 1.1

EMM



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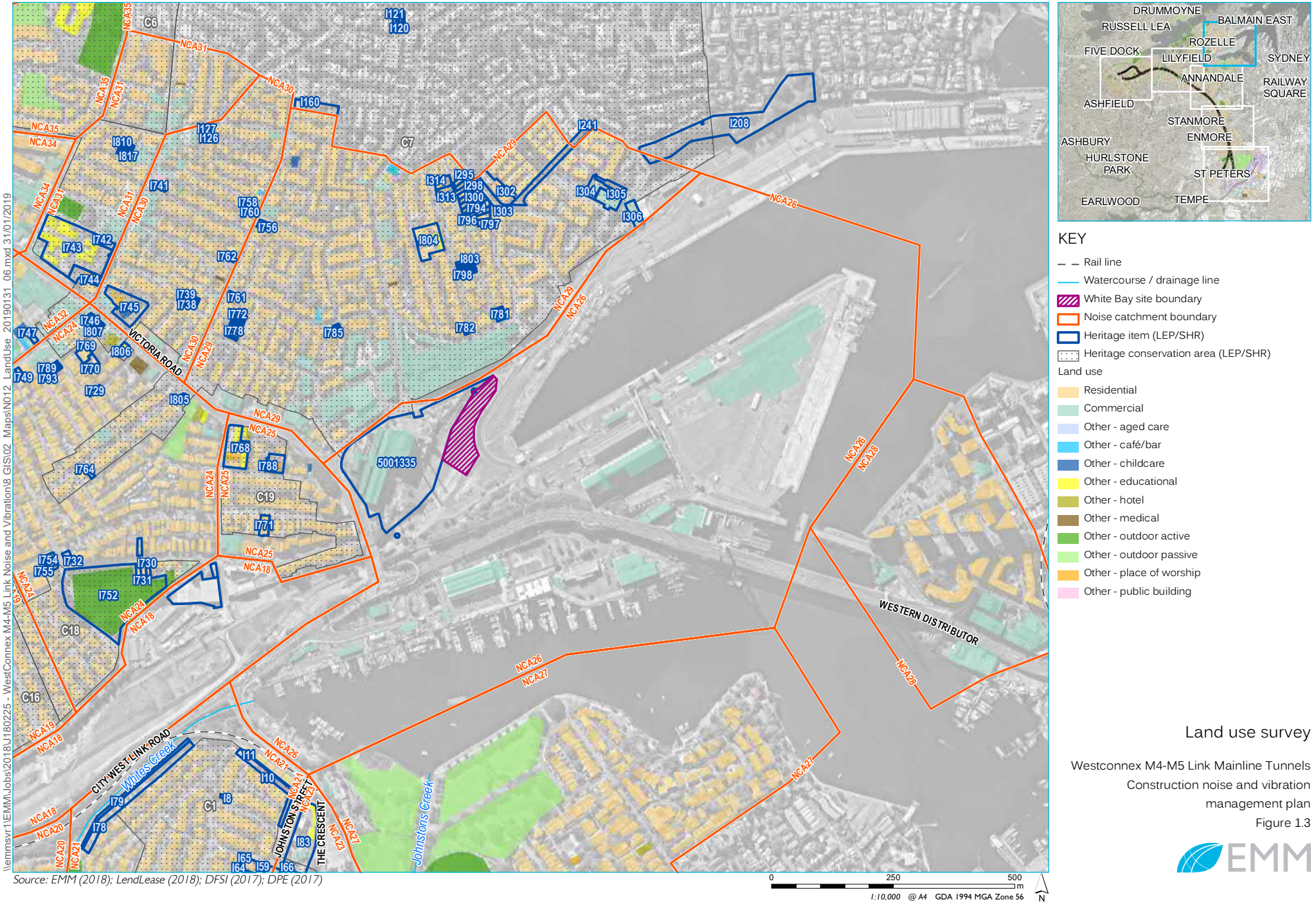
Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

Land use survey

Westconnex M4-M5 Link Mainline Tunnels
Construction noise and vibration management plan
Figure 1.2

EMM



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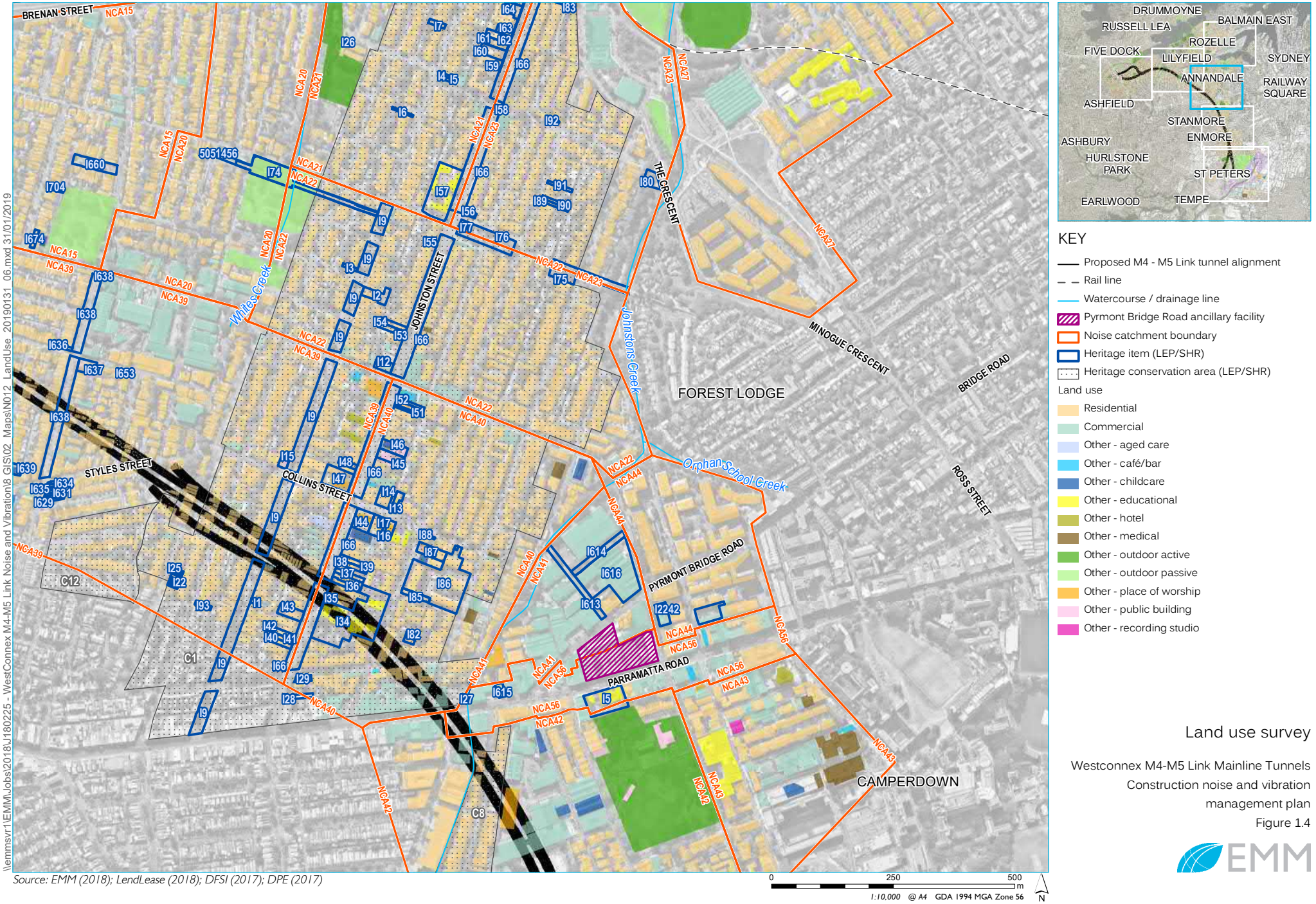
Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

Land use survey

Westconnex M4-M5 Link Mainline Tunnels
Construction noise and vibration management plan
Figure 1.3

EMM



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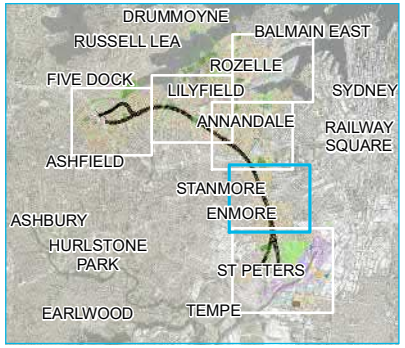
Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

Land use survey

Westconnex M4-M5 Link Mainline Tunnels
Construction noise and vibration management plan
Figure 1.4

EMM



KEY

- Proposed M4 - M5 Link tunnel alignment
- Rail line
- Watercourse / drainage line
- Noise catchment boundary
- Sydney Water s170 - City Tunnel
- Sydney Water s170 - Pressure Tunnel
- Heritage item (LEP/SHR)
- Heritage conservation area (LEP/SHR)

Land use

- Residential
- Commercial
- Other - café/bar
- Other - childcare
- Other - court house
- Other - educational
- Other - medical
- Other - outdoor active
- Other - place of worship
- Other - public building
- Other - theatre/auditorium

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

1:10,000 @ A4 GDA 1994 MGA Zone 56

N

Land use survey

Westconnex M4-M5 Link Mainline Tunnels
Construction noise and vibration management plan
Figure 1.5

EMM

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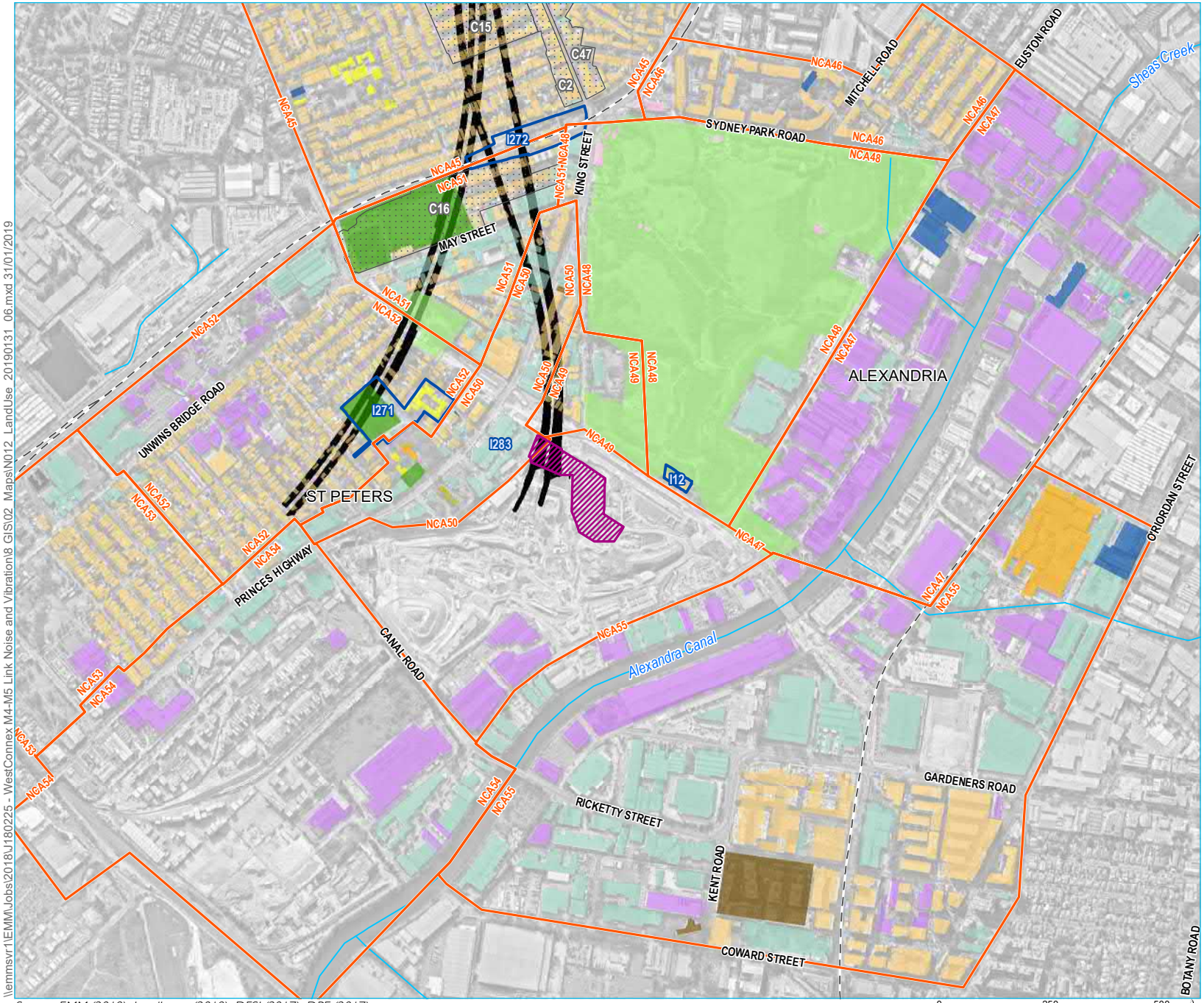

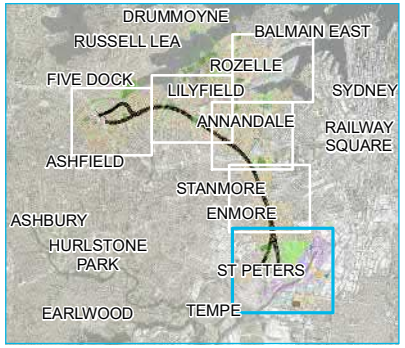

KEY

- Proposed M4 - M5 Link tunnel alignment
- Rail line
- Watercourse / drainage line
- Campbell Road ancillary facility
- Noise catchment boundary
- Heritage item (LEP/SHR)
- Heritage conservation area (LEP/SHR)

Land use

- Residential
- Commercial
- Industrial
- Other - café/bar
- Other - childcare
- Other - educational
- Other - hotel
- Other - medical
- Other - outdoor active
- Other - outdoor passive
- Other - place of worship
- Other - public building
- N/A - acquire by project

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

1:12,500 @ A4 GDA 1994 MGA Zone 56

N

\\emmsvr1\EMM\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\N012 LandUse 20190131 06.mxd 31/01/2019

Land use survey

Westconnex M4-M5 Link Mainline Tunnels
Construction noise and vibration management plan
Figure 1.6

EMM

Appendix D Out-of-Hours Works Protocol

Out-of-Hours Works Protocol

Noise and Vibration Management Sub-plan

M4-M5 Link Mainline Tunnels

November 2018

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Contents

Tables

Appendices

Approval and authorisation

Title	M4-M5 Link Mainline Tunnels Out-of-Hours Works Protocol
Document No/Ref	M4M5-LSBJ-PRW-EN-GE01-PRC-0002-06
Document Path	

Version control

Revision	Date	Description
A	29 June 2018	Draft for internal review
B	20 July 2018	Draft for internal review
C	27 July 2018	Draft for Agency review
D	17 August 2018	Draft for Roads and Maritime, SMC, ER and AA review
E	5 September 2018	Revised draft in response to Roads and Maritime, SMC, ER and AA review
01	18 September 2018	Draft for DPE review
02	24 October 2018	For DPE review
03	7 November 2018	For DPE review
04	16 November 2018	For DPE review
05	19 November 2018	For DPE review
06	22 November 2018	For DPE approval

Note:

Revision 06 Document Number has changed from M4M5-LSBJ-PRW-GEN-EV01-PRC-0003-D (previous revisions) to M4M5-LSBJ-PRW-EN-GE01-PRC-0002-06.

Glossary/ Abbreviations

Abbreviations	Expanded text
AA	Acoustic Advisor
CCS	Community Communications Strategy
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime Services, 2016)
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
CSSI	Critical State Significant Infrastructure
dB(A)	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	Department of Environment and Conservation (now OEH)
DECC	Department of Environment and Climate Change (now OEH)
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
Environmental impact	Defined by AS/NZS ISO 14001:2015 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ER	Environmental Representative
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
$L_{Aeq\ (15min)}$	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.

Abbreviations	Expanded text
$L_{A\ (max)}$	The A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LSBJV	Lendlease Samsung Bouygues Joint Venture
NML	Noise Management Levels
NVMP	Noise and Vibration Management Plan
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
REMM	Revised Environmental Management Measures
Roads and Maritime	Roads and Maritime Services
SMC	Sydney Motorway Corporation
VDV	Vibration Dose Values

1 Introduction

In accordance with Condition of Approval (CoA) E70, tunnelling activities, haulage of spoil, delivery of materials, works within an acoustic shed and tunnel fit out works are permitted to be carried out 24 hours a day, seven days a week and are not subject to this protocol.

However, there will be times that M4-M5 Link Mainline Tunnels (the Project) will require work that is not subject to an Environment Protection Licence (EPL) to be undertaken outside of standard construction hours (such as some utilities works). These Out-of-Hours Works (OOHW) have the potential to exceed relevant noise management levels (NMLs) determined in accordance with the approach outlined in the Interim Construction Noise Guidelines (DECC, 2009) (ICNG).

This protocol applies to works outside of the EPL premise boundary. A copy of the current premise boundary will always be available on the Project Website https://www.westconnex.com.au. Typically, these works will involve service investigations, relocations and other works items that are not scheduled activities under the Protection of the Environment Operations Act 1997 and associated regulations.

As OOHW have the potential to impact on the amenity of adjacent sensitive receivers, these works require assessment and approval prior to commencement.

This protocol defines the process for that assessment and approval for OOHW not subject to an EPL, in accordance with CoA E73(d) and E77.

As required by CoA E77, this Out-of-Hours Work Protocol for works not subject to an EPL will be prepared in consultation with the NSW Environment Protection Authority (EPA) and Acoustics Advisor (AA) and approved by the Secretary prior to commencement of the works.

2 Construction hours, limitations and approach to works

Schedule 2 of the CoA issued for the Project on the 17th April 2018 defines the approved working hours for the Project in CoA E68 through to E72.

Specifically, standard construction working hours for the Project are defined in CoA E68 and E69 as being:

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

This protocol defines the process for that assessment and approval for OOHW not subject to an EPL in accordance with CoA E73(d)(as discussed above), that need to occur outside the time periods stipulated above.

This OOHW Protocol will apply to the two following OOHW periods:

OOHW Period 1:

- Monday to Friday: 6pm to 10pm
- Saturday: 7am to 8am and 6pm to 10pm
- Sunday and Public Holidays: 8am to 6pm

OOH Period 2:

- Monday to Friday: 10pm to 7am

- Saturday: 10pm to 8am
- Sunday and Public Holidays: 6pm to 7am

2.1 Minister's Conditions of Approval

The CoA relevant to this Protocol are listed Table 2-1 below. A cross reference is also included to indicate where the condition is addressed in this Protocol or other Project management documents.

Table 2-1: Minister's Conditions of Approval

CoA No.	Condition Requirements	Document Reference
E73	Notwithstanding Conditions E68 to E72 works may be undertaken outside the hours specified under those conditions in the following circumstances: (d) works approved under an Out-of-Hours Work Protocol for works not subject to an EPL as required by Condition E77;	Section 3
E75	Out-of-hours works that are regulated by an EPL as per Condition E73(c) or through the Out-of-Hours Work Protocol as per Condition E77 include: (a) works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 "Risk Management – Principles and Guidelines"; or (b) where the relevant road network operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to road network operational performance; or (c) where the relevant utility service operator has advised the Proponent in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network; or (d) where the TfNSW 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 works or activities during the hours specified in Condition E68 and Condition E69; or	Section 3

CoA No.	Condition Requirements	Document Reference
	(e) where Sydney Trains (or other rail authority) has advised the Proponent in writing that a Rail Possession is required. *Note: Other out-of-hours works can be undertaken with the approval of an EPL, or through the project's Out-of-Hours Work Protocol for works not subject to a EPL.*	
E76	In order to undertake out-of-hours work described in Condition E75, the Proponent must identify appropriate respite periods for the out-of-hours works in consultation with the community at each affected location. This consultation must include (but not be limited to) providing the community with: (a) a schedule of likely out-of-hours work for a period no less than three (3) months; (b) the potential works, location and duration; (c) the noise characteristics and likely noise levels of the works; and (d) likely mitigation and management measures. The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hour works must be provided to the AA, EPA and the Secretary.	Section 7 Section 8 Community Communications Strategy (CCS) Noise and Vibration Management Sub-plan (NVMP)
E77	An Out-of-Hours Work Protocol must be prepared to identify a process for the consideration, management and approval of works which are outside the hours defined in Conditions E68 and E69, and that are not subject to an EPL. The Protocol must be approved by the Secretary prior to commencement of the works. The Protocol must be prepared in consultation with the EPA and AA. The Protocol must:	This OOHW Protocol
	(a) provide a process for the consideration of out-of-hours works against the relevant noise and vibration criteria, including the determination of low and high-risk activities;	Section 4

CoA No.	Condition Requirements	Document Reference
	(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 E76	Section 5 Section 7 CCS
	(c) identify procedures to facilitate the coordination of out-of-hours works approved by an EPL to ensure appropriate respite is provided;	Section 4.4
	(d) identify an approval process that considers the risk of activities, proposed mitigation, management, and coordination, including where: (i) low risk activities can be approved by the ER in consultation with the AA, and (ii) high risk activities that are approved by the Secretary; and	Section 6 Section 8
	(e) identify Department, EPA and community notification arrangements for approved out of hours works, which maybe detailed in the Communication Strategy.	Section 7 CCS
E82	Mitigation measures must be applied when the following residential ground-borne noise levels are exceeded: (a) evening (6:00 pm to 10:00 pm) — internal $L_{Aeq\ (15\ minute)}$: 40 dB(A); and (b) night (10:00 pm to 7:00 am) — internal $L_{Aeq\ (15\ minute)}$: 35 dB(A). The mitigation measures must be outlined in the Construction Noise and Vibration Management Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E77.	Section 5

2.2 Revised Environmental Management Measures

Relevant Revised Environmental Management Measures (REMM) are listed Table 2-2 below. This includes reference to required outcomes, the timing of when the commitment applies, relevant documents or sections of the environmental assessment influencing the outcome and implementation.

Table 2-2: Revised environmental management measures relevant to this OOHW Protocol

Outcome	Ref #	Commitment	Timing	OOHW Protocol
Out-of-hours impacts	NV5	An out-of-hours works protocol will be developed for the construction of the project. The protocol will include:	Construction	This Protocol
		• Details of works required outside standard construction hours, including justification of why the activities are required outside standard construction hours		Section 3
		• Measures that will be implemented to manage potential impacts associated with works outside standard construction hours		Section 5
		• Location and activity specific noise and vibration impact assessment process(es) that will be followed to identify potentially affected receivers, clarify potential impacts and select appropriate management measures		Section 4
		• Details of the approval process (internal and external) for works proposed outside standard construction hours.		Section 6 Section 8
		The protocol will be included in the CNVMP, prepared in consultation with NSW Department of Planning and Environment and the NSW EPA, endorsed by the Acoustics Advisor for the project and implemented during construction of the project.		Section 8 NVMP

3 OOHW Justification

Construction work associated with the Project will be undertaken in accordance with the assessment and management approach outlined in the ICNG and CNVG. The ICNG outlines recommended standard construction hours and requires that work outside of these hours must be appropriately justified. These requirements are reflected in the CoA for the Project and Project works will be conducted in accordance with the hours in CoA E68 through to E72. In general, OOHW undertaken on public infrastructure projects such as road construction, is necessary to sustain the operational integrity of roads and are considered justified in the ICNG.

As per CoA E75, OOHW not subject to an EPL (outside of the EPL premise boundary) that are regulated through the OOHW Protocol include:

- Works which could result in a high risk to construction personnel or public safety, based on a risk assessment carried out in accordance with AS/NZS ISO 31000:2009 *"Risk Management – Principals and Guidelines"*
- Where the relevant road network operator has advised LSBJV in writing that carrying out the works and activities could result in a high risk to road network operational performance
- Where the relevant utility service operator has advised LSBJV in writing that carrying out the works and activities could result in a high risk to the operation and integrity of the utility network
- Where the Transport for New South Wales (TfNSW) Transport Management Centre (or other road authority) has advised LSBJV in writing that a road occupancy licence is required and will not be issued for the works or activities during the hours specified in CoAs E68 and E69
- Where Sydney Trains (or other rail authority) has advised LSBJV in writing that a Rail Possession is required.

Typically, these works will involve service investigations, relocations and other works items that are not scheduled activities under the Protection of the Environment Operations Act 1997 and associated regulations.

Justification for any activities proposed as OOHW must be established to the satisfaction of the Lendlease Samsung Bouygues Joint Venture (LSBJV) Environment & Sustainability Manager. Once satisfied, the following process is carried out:

- LSBJV Engineers complete an OOHW Permit, summarising the activities, equipment required, location, duration and justification for works
- The OOHW Permit is submitted to the Environmental Team, who will undertake a noise and vibration assessment for the OOHW (refer to Section 4). Predicted noise impacts will be assessed against the impact classification in Section 5 and appropriate mitigation measures (including community consultation) will be determined as per Section 5.
- Approval of the OOHW Permit will follow the process outlined in Section 6
- Community consultation and notification will be undertaken in accordance with the CCS as outlined in Section 7
- Monitoring will be undertaken in accordance with Section 9 and the Project's Construction Noise and Vibration Monitoring Program.

4 OOHW Noise and Vibration Assessment

4.1 Noise

In order to manage potential impacts from noise and vibration during OOHW, LSBJV's noise and vibration specialists engaged by the Project have developed noise and vibration prediction tools that enable the assessment of potential impacts resulting from proposed OOHW.

These prediction tools enable the assessment of surface noise impacts, ground-borne noise impacts and vibration impacts on sensitive receivers based on the location and types of construction machinery operating inside a noise catchment or section of tunnel. The prediction tools will also consider any other OOHW that may be underway during the proposed OOHW, to ensure cumulative noise impacts are minimised at potentially affected sensitive receivers.

The prediction tool will identify the potentially affected sensitive receivers and the predicted impacts allowing additional mitigation measures, as described in Table 5-1 to be applied, in addition to those within the ICNG.

The results of these noise assessment along with the selection of reasonable and feasible management measures both from the ICNG and CNVG will be considered by the LSBJV Environment & Sustainability Manager when determining the approval pathway for OOHW that are subject to this Protocol. Ongoing monitoring and validation of predictive outputs will be undertaken in consultation with the AA as detailed in Section 7 of the NVMP.

Applications for 'high risk' work for approval by the Secretary will include a noise assessment by either a Construction Noise and Vibration Impact Statement (CNVIS) or modelling outputs from noise estimator tool. The decision to use which noise assessment will consider its suitability based upon the nature of the works (type durations etc) in consultation with the AA and DPE.

4.2 Vibration

Where vibration intensive activities with the potential to impact upon sensitive receivers or structures are proposed during OOHW, these shall also be assessed using the Project's prediction tools for compliance with safe working distances for:

- Cosmetic and/or structural impacts (including safe working distances)
- Human comfort impacts due to vibration and ground-borne noise
- In accordance with the safe working distances guide (refer to NVMP).

Ongoing monitoring and validation of predictive outputs will be undertaken in consultation with the AA as detailed in Section 7 of the NVMP.

4.3 Highly Noise Intensive Works

In accordance with CoA E72, except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will only be undertaken:

- Between the hours of 8:00 am and 6:00 pm Monday to Friday

- Between the hours of 8:00 am and 1:00 pm Saturday
- In continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.

'Continuous' includes any period during which there is less than one hour respite between recommencing any of the work that are the subject of the condition.

Where the use of such equipment is proposed during OOHW subject to this Protocol:

- The equipment will be used prior to 10 pm where reasonable and feasible
- Where the above cannot be achieved the equipment will be used prior to midnight where reasonable and feasible
- LSBJV do not propose to apply a three hour on and one hour off respite approach in an effort to ensure that the use of such equipment is completed as early in the night as possible.

Highly noise intensive works will be conducted during standard construction whenever possible. Where highly noise intensive works are proposed under the OOHW Protocol, LSBJV will identify appropriate respite periods for these works in consultation with community at each affected location as identified by the Project's noise prediction tool, in accordance with CoA E76, and with input from the AA.

The Community Team will use the outputs from the predictive tools in order to identify a range of appropriate mitigation measures and respite options to be implemented subject to consultation with the community at each affected location.

4.4 Coordination of OOHW approved by an EPL

As part of the noise and vibration assessment process, LSBJV will consider any other OOHW permitted by the Project's EPL that may be underway during the proposed OOHW, to ensure cumulative noise impacts are minimised and appropriate respite is provided at potentially affected sensitive receivers.

5 OOHW Noise and Vibration Management and Mitigation Measures

Following the noise assessment process as described in Section 4, the most appropriate reasonable and feasible management measures will be determined in accordance with the ICNG, and the standard mitigation measures set out in Appendix B of the Roads and Maritime Services (Roads and Maritime) Construction Noise and Vibration Guideline (CNVG). In addition, the Roads and Maritime CNVG directs that the Project should consider implementing the additional mitigation measures detailed in Appendix C of the CNVG where feasible and reasonable, and this approach will be implemented. Table 5-1 and Table 5-2 detail the relevant additional mitigation measures from the CNVG to be applied during OOHW. In accordance with CoA A26, the AA will regularly monitor and review the selection and implementation of feasible and reasonable additional mitigation measures. As detailed in Section 7 of the NVMP, the AA will also endorse the verification of the predictive model through the review of the monitoring data against the CNVIS and predictive tool outputs. This will ensure that appropriate reasonable and feasible noise and vibration mitigation measures are applied throughout the delivery of the Project. Refer to Section 3.3 of the CEMP for further details on the role and responsibilities of the AA.

Where a receiver falls on a noise catchment boundary, NML applied to that receiver will be the lowest of either noise catchment.

It should be noted that there may be personal circumstances among the sensitive receivers where the below approach to specific additional mitigation measures is not best suited. The Public Liaison Manager has the authority to amend the below approach taking into account due consideration of the personal circumstances that may apply.

Table 5-1 Triggers for Additional Mitigation Measures – Airborne Noise

Predicted airborne $L_{Aeq(15min)}$ noise level at receiver			**Additional mitigation measures**	
Perception	**dB(A) above RBL**	**dB(A) above NML**	**Type[1]**	**Mitigation Levels**
All hours				
75 dB(A) or greater			N, V, RO	HA NML
Standard Hours: Mon – Fri (7 am to 6 pm), Sat (8 am to 6 pm), Sun/Pub Hol (Nil)				
Noticeable	5 to 10	0	-	NML
Clearly audible	10 to 20	<10	-	NML
Moderately intrusive	20 to 30	10 to 20	N, V	NML+10
Highly intrusive	>30	>20	N, V	NML+20

Predicted airborne $L_{Aeq(15min)}$ noise level at receiver			Additional mitigation measures	
OOHW Period 1: Mon – Fri (6 pm to 10 pm), Sat (7 am to 8 am & 6 pm to 10 pm), Sun/Pub Hol (8 am to 6 pm)				
Noticeable	5 to 10	<5	-	NML
Clearly audible	10 to 20	5 to 15	N, R1, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, R1, DR	NML+15
Highly intrusive	>30	>25	V, N, R1, DR, SN	NML+25
OOHW Period 2: Mon – Fri (10 pm to 7 am), Sat (10 pm to 8 am), Sun/Pub Hol (6 pm to 7 am)				
Noticeable	5 to 10	<5	N	NML
Clearly audible	10 to 20	5 to 15	V, N, R2, DR	NML+5
Moderately intrusive	20 to 30	15 to 25	V, N, SN, R2, DR	NML+15
Highly intrusive	>30	>25	AA, V, N, SN, R2, DR	NML+25

Notes: 1

AA = Alternative accommodation

V = Verification

N= Notification (should be issued a minimum of five working days prior to the start of works)

DR = Duration respite

R2 = Respite period 1

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

Table 5-2 Triggers for Additional Mitigation Measures – Vibration

Predicted vibration level at receiver	Additional mitigation measures	
	Type[1]	Apply to[2]
Standard Hours: Mon – Fri (7 am to 6 pm), Sat (8 am to 6 pm), Sun/Pub Hol (Nil)		
Predicted Vibration Exceeds Maximum Levels	V, N, RP	All
OOHW Period 1: Mon – Fri (6 pm to 10 pm), Sat (7 am to 8 am & 6 pm to 10 pm), Sun/Pub Hol (8 am to 6 pm)		
Predicted Vibration Exceeds Maximum Levels	V, N, RO, RP, SN	All

Predicted vibration level at receiver	Additional mitigation measures	
	Type[1]	Apply to[2]
OOHW Period 2: Mon – Fri (10 pm to 7 am), Sat (10 pm to 8 am), Sun/Pub Hol (6 pm to 7 am)		
Predicted Vibration Exceeds Maximum Levels	AA, V, N, RP, SN	All

Notes 1:

AA = Alternative accommodation

RP = Respite Period

V = Verification

N= Notification (should be issued a minimum of five working days prior to the start of works)

SN = Specific notifications (issued no later than seven calendar days ahead of construction activities)

2: All affected receivers

6 Approval of OOHW not subject to an EPL

Refer to Appendix A for the approval process for OOHW not subject to an EPL.

When it is identified that OOHW not subject to an EPL are required, the engineer responsible for the works will submit an internal OOHW Permit, justifying the need to carry out the works, to the LSBJV Environment Team. The noise and vibration assessment process as described in Section 4 will be undertaken by a member of the LSBJV Environment Team and forwarded to the LSBJV Environment & Sustainability Manager and Public Liaison Manager who, in consultation with the AA, will review the level of risk associated with the activity, the predicted impacts and management measures to be implemented.

The Environmental Representative (ER) has the authority to approve low risk OOHW activities in consultation with the AA, following impact assessment described in Section 4 and classification as specified in Section 5 in accordance with the following:

1. OOHW assessed to meet the perception classification of Noticeable.
2. OOHW assessed to meet the perception classification of Clearly Audible and above at any one residential receiver for a maximum of:
    a. Two consecutive evenings or nights, in a calendar week
    b. Three evenings or nights in a calendar week
    c. A maximum of 10 evenings or nights in a calendar month

The effect of the above facilitates two nights in a row and at least one period off before the third period that week.

OOHW are considered to be high risk when the duration limitations outlined above cannot be achieved. In these instance, the OOHW assessment and Permit for high risk OOHW activities, will be issued to the Secretary of the Department of Planning and Environment (DPE) for review and approval.

Following the process described above, the approval to carry out the works will be provided to the construction team by the LSBJV Environment & Sustainability Manager utilising the OOHW Permit, approved either by the ER (in consultation with the AA) or the Secretary of the DPE, following endorsement by the AA.

On receipt of the approval for the OOHW, any standard and additional mitigation measures that relate to the OOHW will be:

- Implemented prior to works (such as specific conditions that relate to the community)
- Toolboxed to relevant workforce and site personnel before each shift to introduce/reinforce work restrictions, management measures and expected workforce behaviour
- Implemented during works and monitored by the Project Environment Team.

During delivery of the works LSBJV will apply the appropriate mitigation measures and undertake monitoring to confirm/validate the predictions. AA to verify that the above approach has been followed and advise opportunities for improvement in accordance with CoA A26(c) and CoA A26(d).

Following the works, LSBJV will feedback into the OOHW Process any lessons learnt and monitoring data to help inform future OOHW activities and application of mitigation measures in order to minimise impacts.

7 OOHW Community Consultation and Communication

A suite of communication tools and activities will be utilised as required to target the predicted impacted receivers based on the nature of works and the potential impacts to provide clear, effective and timely information. The community consultation will be carried out in accordance with the Project CCS.

Where required in the additional mitigation measures outlined in CNVG, LSBJV will notify potentially affected noise sensitive receivers and other affected stakeholders, of works approved outside of standard construction hours not less than 5 calendar days and not more than 14 calendar days before those works are to be carried out.

Where OOHW are proposed over extended periods (e.g. for over 14 days), a monthly notification will be provided in order not to overwhelm the sensitive receivers with constant notification.

In accordance with CoA E76, where OOHWs not subject to an EPL as described in CoA E75 are required, LSBJV will identify appropriate respite periods for the OOHW in consultation with the community at each affected location, as identified by the assessment process outlined in Section 4. This consultation will be conducted in accordance with the CCS and include the provision of the following to affected receivers:

- An indicative three-month construction lookahead for OOHW
- A description of the potential works, location and duration
- The noise characteristics and likely noise levels of the proposed works
- Proposed mitigation and management measures.

The outcomes of the community consultation, the identified respite periods and the scheduling of the likely out-of-hours works will be provided to the AA, EPA and Secretary of DPE.

8 External Approval Authorities

8.1 DPE

In accordance with CoA E77 (d)(ii), where the assessment outlined in Section 4 identifies that proposed OOHW not subject to an EPL include high risk activities, approval of the OOHW will be sought from the Secretary.

8.2 Environmental Representative and Acoustics Advisor

In accordance with CoA E77 (d)(i), where the assessment outlined in Section 4 identifies that proposed OOHW not subject to an EPL include low risk activities, OOHW can be approved by the ER, in consultation with the AA.

9 OOHW Monitoring

9.1 Noise and Vibration Monitoring

Noise and vibration monitoring of OOHW will be conducted and documented in accordance with the Project's Construction Noise and Vibration Monitoring Program.

10 OOHW Exceedances / Non-conformances

10.1 Management response

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

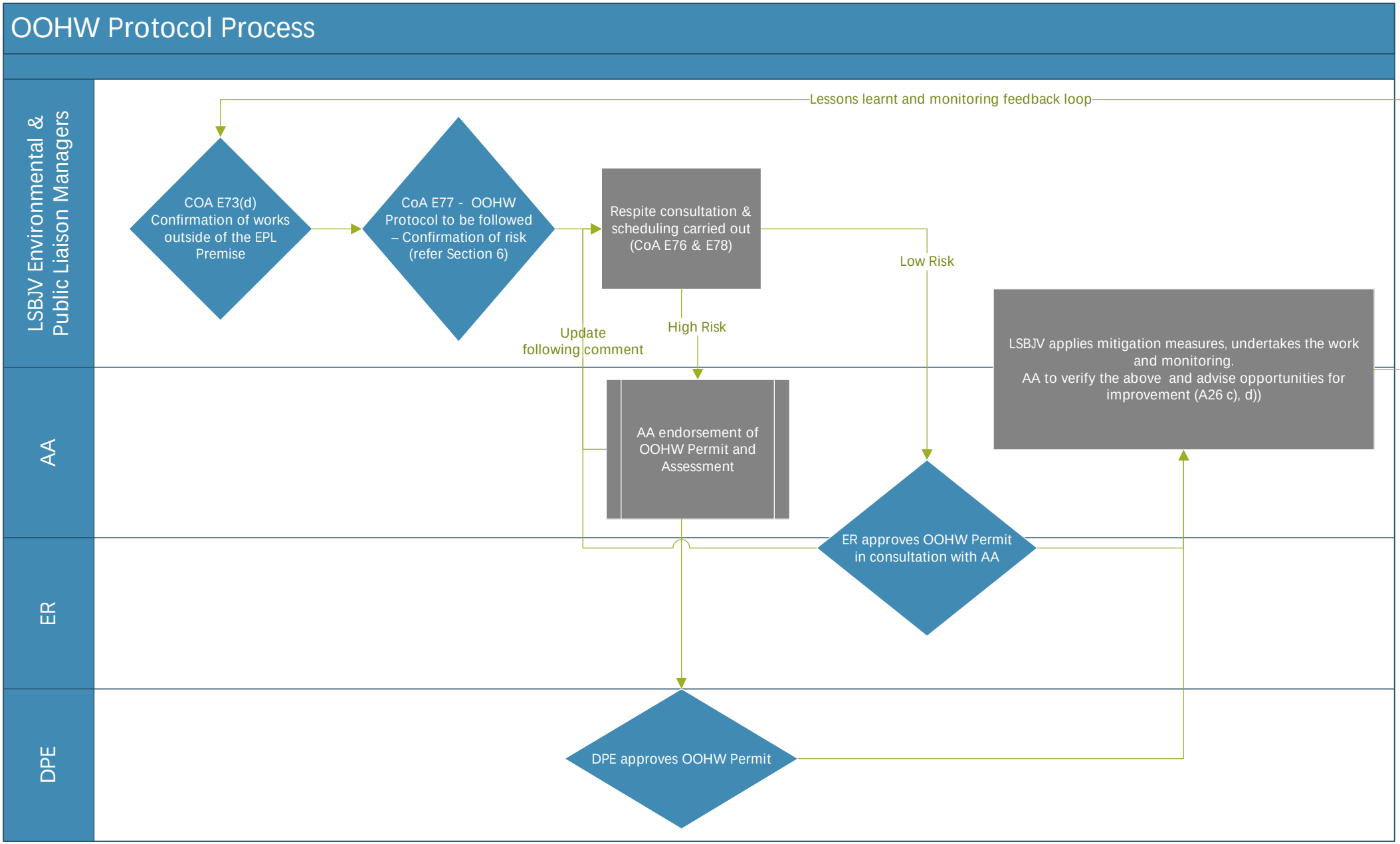
- Confirm the monitored levels are not being impacted by other noise or vibration sources
- Implement other feasible and reasonable measures which may include reducing plant size, modifying time of works, changing operational settings (such as turning off the vibratory function of the machine), and utilising alternative construction methodology or a combination of these
- Review work practices to ensure compliance with the ICNG
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment
- Confirm that the modelling reflects the actual activity being undertaken
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning. For example, where noise or vibration predictions was a Category D and the actual monitored was a Category B, OOHW scheduling would be updated accordingly to comply with the numbers of nights permitted to be worked per week. The same applies in reverse where the monitored noise levels are in a higher Category than initially predicted
- Communicate lessons learnt to relevant personnel.

Previously recorded non-conformances will also be considered prior to the approval of further OOHW permits. Where noise monitoring indicates that OOHW noise levels are greater or lower than predicted, LSBJV will consider adjusting the nights worked per week, in line with Section 6.

10.2 Reporting

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

Appendix A LSBJV M4-M5 Link Mainline Tunnels OOHW Protocol Approval Process


OOHW Protocol Process
LSBJV Environmental & Public Liaison Managers
AA
ER
DPE
Lessons learnt and monitoring feedback loop
COA E73(d) Confirmation of works outside of the EPL Premise
CoA E77 - OOHW Protocol to be followed – Confirmation of risk (refer Section 6)
Respite consultation & scheduling carried out (CoA E76 & E78)
Low Risk
High Risk
Update following comment
LSBJV applies mitigation measures, undertakes the work and monitoring.
AA to verify the above and advise opportunities for improvement (A26 c), d))
AA endorsement of OOHW Permit and Assessment
ER approves OOHW Permit in consultation with AA
DPE approves OOHW Permit

Appendix E Vibration Screening Criteria Drawings

KEY

- Heritage item (LEP/SHR)
- Approximate works boundary

20 t vibratory roller - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Residential
- Commercial

\\Emmsvr1\emmJobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\VSC001 HO3b20tRoller 20180917 04.mxd 17/09/2018

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

Parramatta Road East and West - 20 t vibratory roller

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.1

EMM

KEY

- Approximate works boundary
- Heritage item (LEP/SHR)

30 t excavator with 1500 kg hammer - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Residential
- Commercial

0 50 100 m

GDA 1994 MGA Zone 56

N

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

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Parramatta Road East and West - 30 t excavator with 1500 kg hammer

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.2

EMM

KEY

- Approximate works boundary
- Approximate noise wall locations
- Heritage item (LEP/SHR)

Noise wall bored piling - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential and heritage

Building within potential exceedance area

- Residential
- Commercial

0 50 100 m

GDA 1994 MGA Zone 56

N

Source: EMM (2018); LendLease (2018); DFSI (2017); DPE (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

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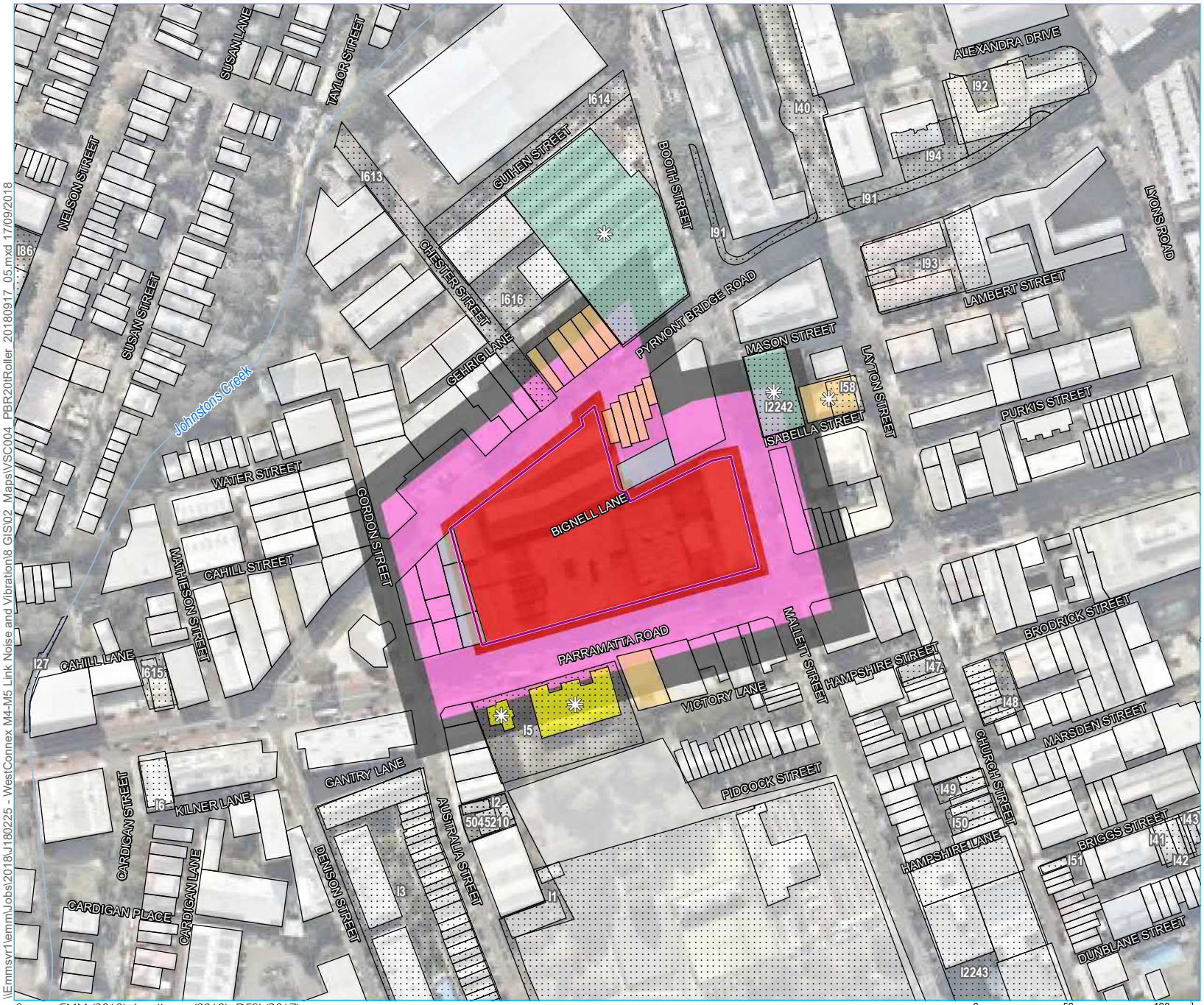
Parramatta Road East and West - noise wall bored piling

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.3

EMM



KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

20 t vibratory roller - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Residential
- Commercial
- Other - educational

Subject to inspection, where a historic building is deemed to be more sensitive to cosmetic damage from vibration, the more conservative screening criterion of 3mm/s will be considered. Otherwise, the 20mm/s and 5mm/s screening criteria will apply, as applicable to the building.

Pyrmont Bridge Road - 20 t vibratory roller

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.4

EMM

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

0 50 100 m
GDA 1994 MGA Zone 56
N

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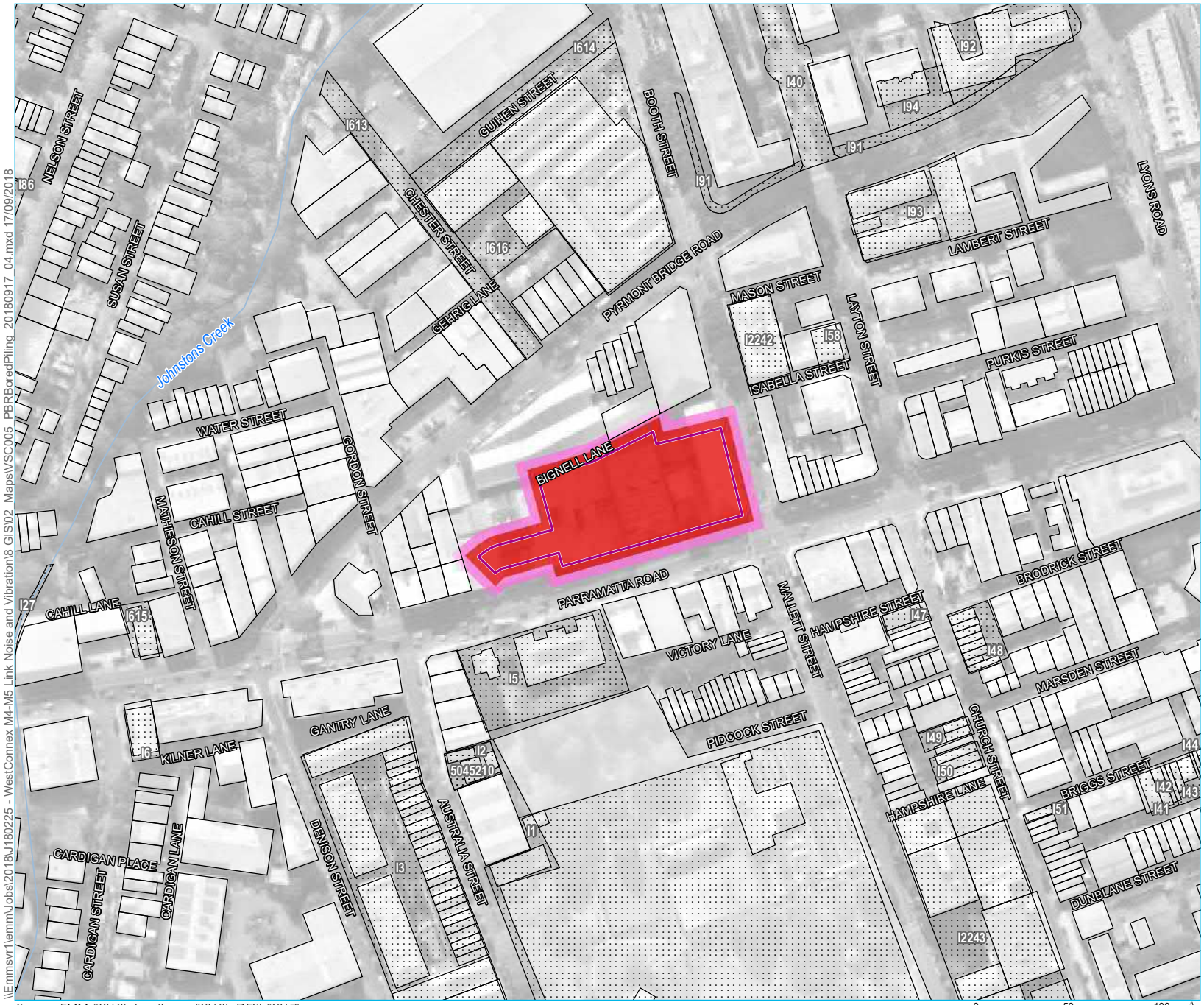


KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

Bored piling - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential and heritage

0 50 100 m

GDA 1994 MGA Zone 56

N

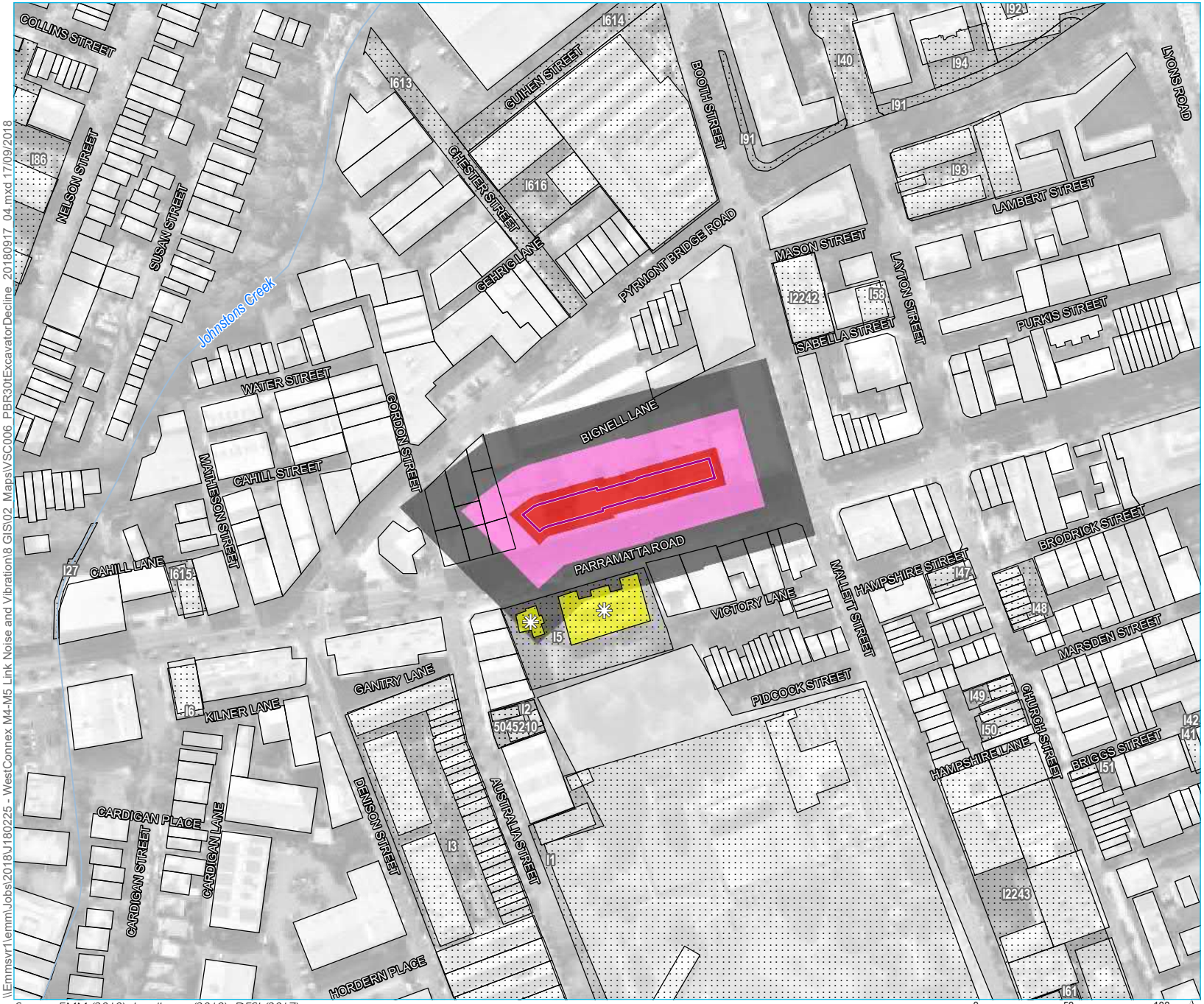
Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

Pyrmont Bridge Road - bored piling

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.5

EMM



KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

30 t excavator with 1500 kg hammer - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Other - educational

Subject to inspection, where a historic building is deemed to be more sensitive to cosmetic damage from vibration, the more conservative screening criterion of 3mm/s will be considered. Otherwise, the 20mm/s and 5mm/s screening criteria will apply, as applicable to the building.

Pyrmont Bridge Road decline - 30 t excavator with 1500 kg hammer

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.6

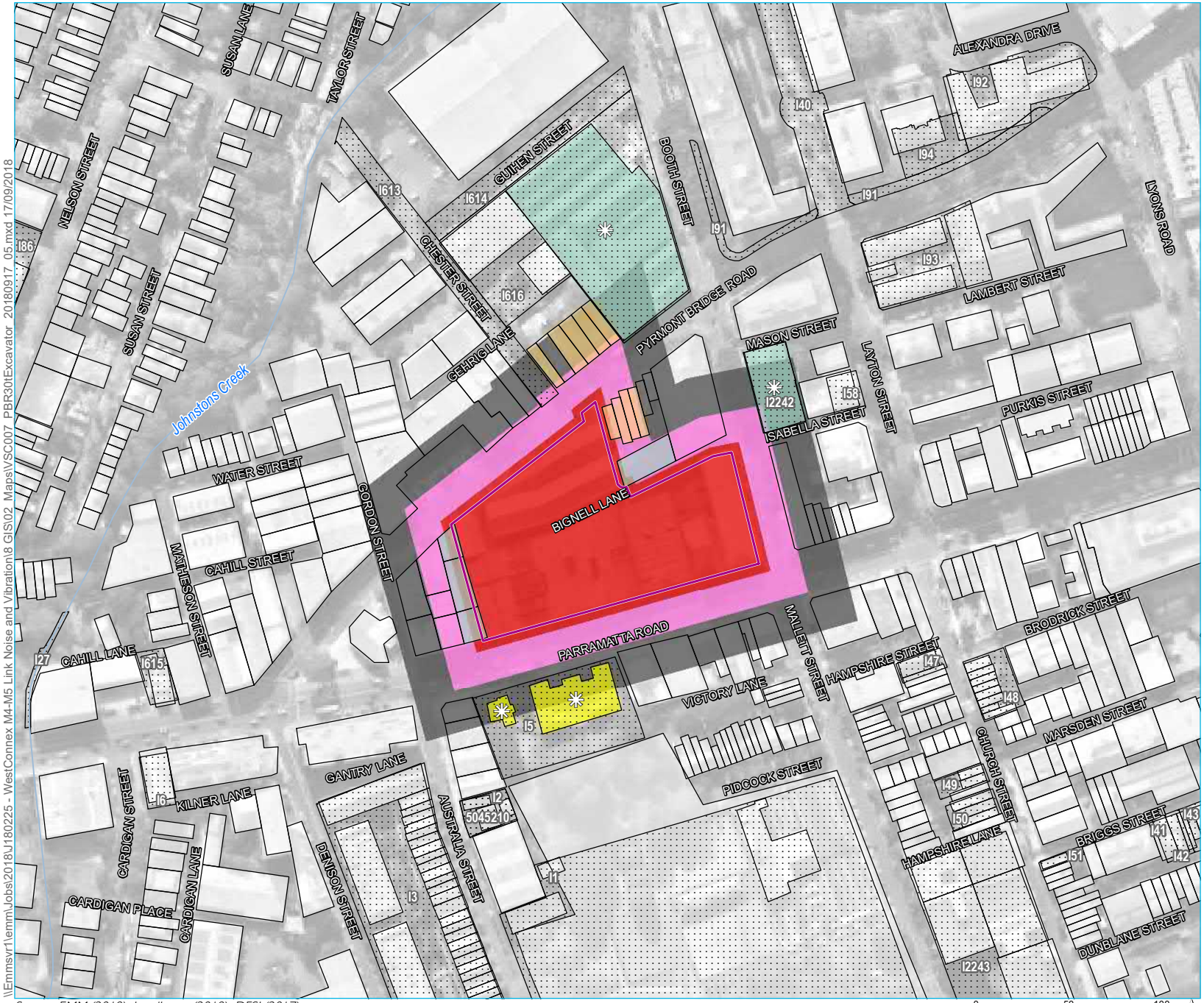
EMM

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

0 50 100 m
GDA 1994 MGA Zone 56
N

\\Emmsvr1\emm\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02_Maps\VSC006_PBR30tExcavatorDecline_20180917_04.mxd 17/09/2018



KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

30 t excavator with 1500 kg hammer - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Residential
- Commercial
- Other - educational

Subject to inspection, where a historic building is deemed to be more sensitive to cosmetic damage from vibration, the more conservative screening criterion of 3mm/s will be considered. Otherwise, the 20mm/s and 5mm/s screening criteria will apply, as applicable to the building.

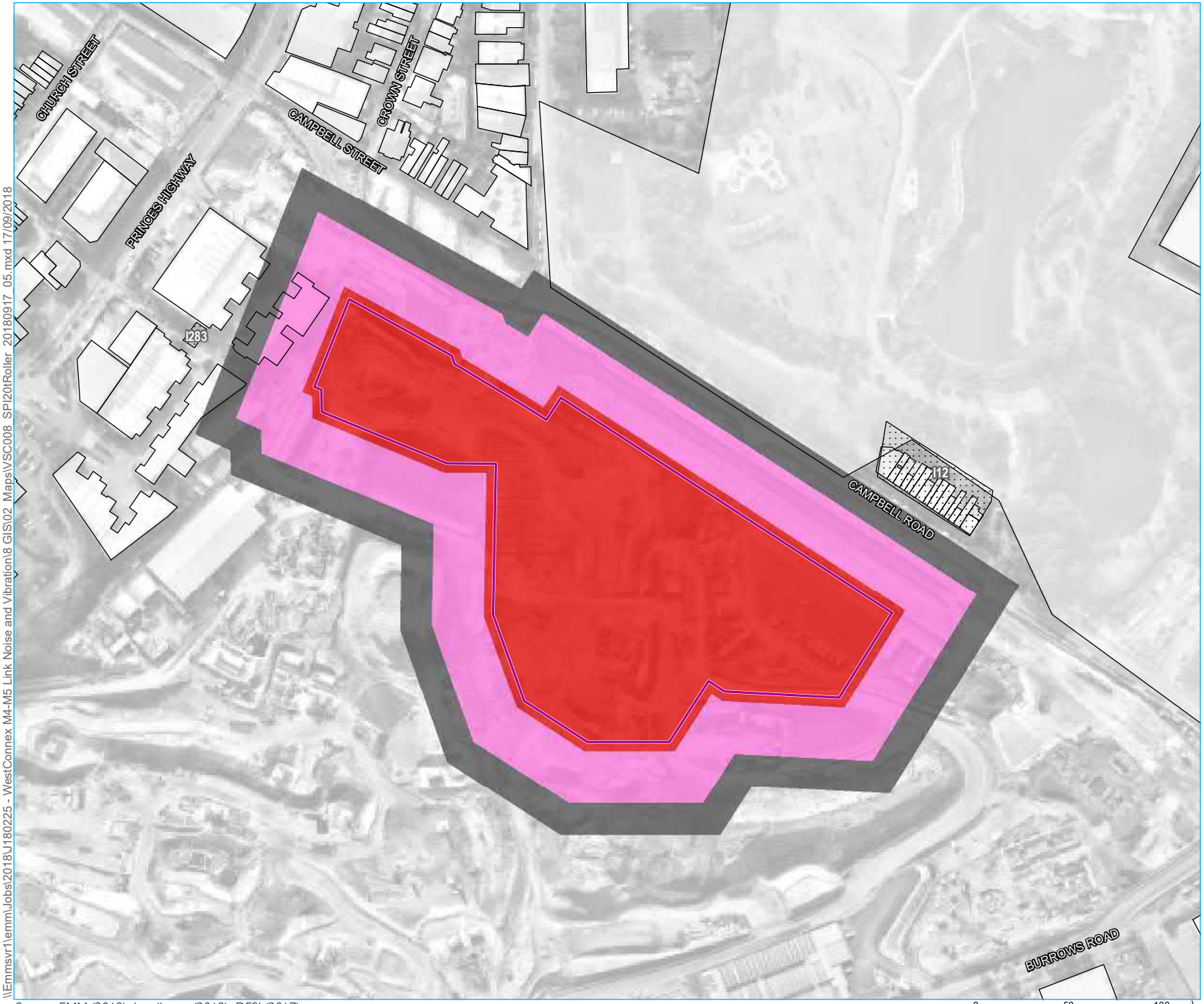
Pyrmont Bridge Road site wide - 30 t excavator with 1500 kg hammer

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.7

EMM

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)



KEY

- Approximate works boundary
- Heritage item (LEP/SHR)

20 t vibratory roller - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

0 50 100 m

GDA 1994 MGA Zone 56

N

\\Emmsvr1\emm\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\VSC008 SPI20tRoller 20180917 05.mxd 17/09/2018

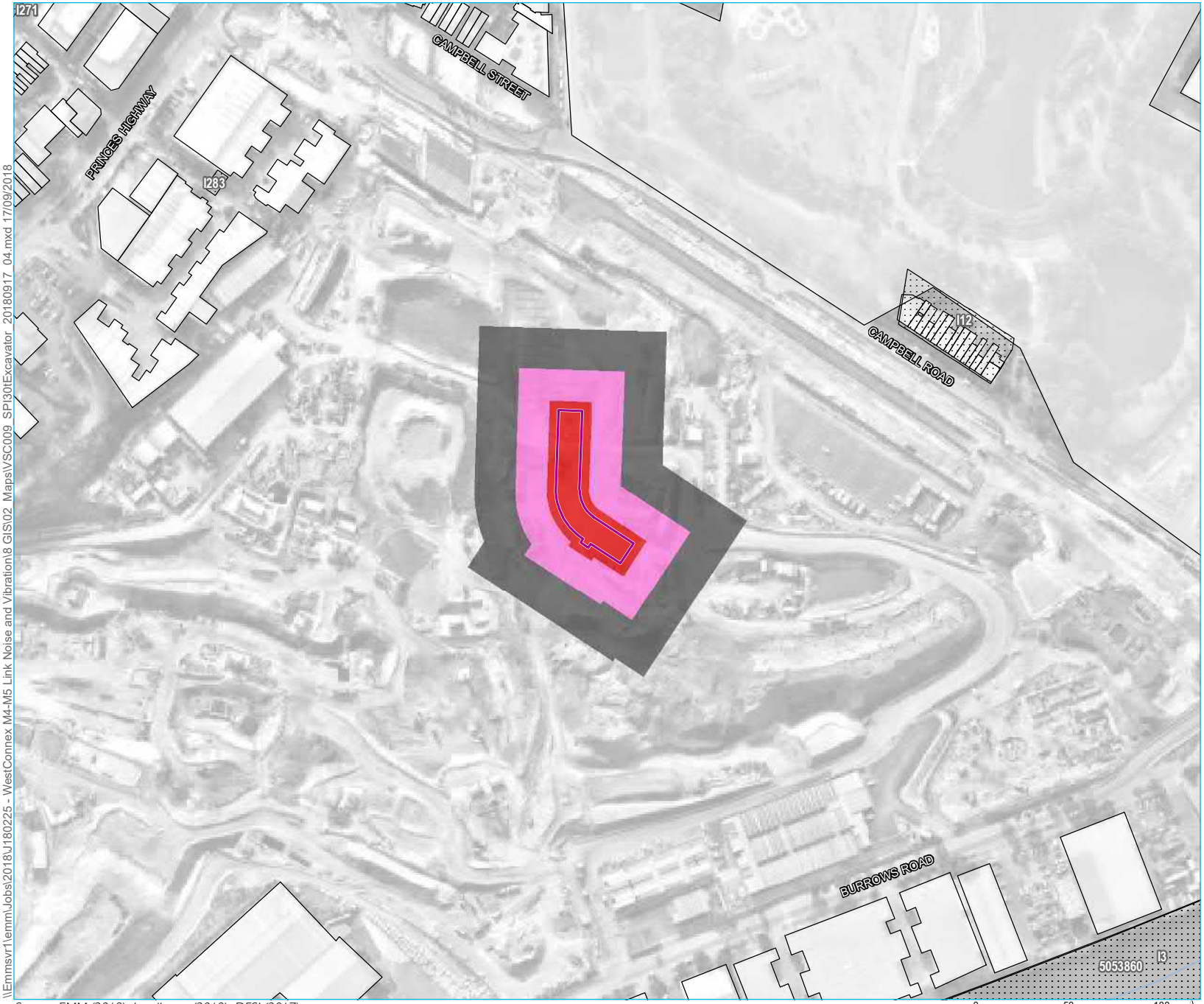
Campbell Road - 20 t vibratory roller

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.8

EMM

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)



KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

30 t excavator with 1500 kg hammer - areas of potential exceedance*

- Cosmetic damage - commerical and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

\\Emmsvr1\emm\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02_Maps\VSC009_SPI30tExcavator_20180917_04.mxd 17/09/2018

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

Campbell Road - 30 t excavator with 1500 kg hammer

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.9

EMM

KEY

- Approximate works boundary
- Heritage item (LEP/SHR)

Bored piling - areas of potential exceedance *

- Cosmetic damage - commercial and industrial
- Cosmetic damage - heritage and residential

0 50 100 m

GDA 1994 MGA Zone 56

N

\\Emmsvr1\emm\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\VSC010 SPIBorePiling 20180917 04.mxd 17/09/2018

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

Campbell Road - Bored piling

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.10

EMM

KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

20 t vibratory roller - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Residential

Subject to inspection, where a historic building is deemed to be more sensitive to cosmetic damage from vibration, the more conservative screening criterion of 3mm/s will be considered. Otherwise, the 20mm/s and 5mm/s screening criteria will apply, as applicable to the building.

Wattle Street Ramps - 20 t vibratory roller

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.11

EMM

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

0 50 100 m
GDA 1994 MGA Zone 56
N

\\Emmsvr1\emm\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\VSC011 WattleSt20tRoller 20180917 08.mxd 17/09/2018

KEY

- Watercourse / drainage line
- Approximate works boundary
- Heritage item (LEP/SHR)

30 t excavator with 1500 kg hammer - areas of potential exceedance*

- Cosmetic damage - commercial and industrial
- Cosmetic damage - residential
- Cosmetic damage - heritage

Building within potential exceedance area

- Residential

Subject to inspection, where a historic building is deemed to be more sensitive to cosmetic damage from vibration, the more conservative screening criterion of 3mm/s will be considered. Otherwise, the 20mm/s and 5mm/s screening criteria will apply, as applicable to the building.

Wattle Street Ramps - 30 t excavator with 1500 kg hammer

M4-M5 Link Mainline Tunnels
Vibration Screening Criteria Drawings
Figure E.12

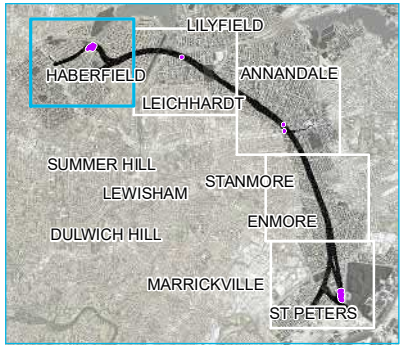
EMM

Source: EMM (2018); LendLease (2018); DFSI (2017)

*NOTE: Vibration screening criteria are based on German Standard DIN 4150-3: Structural Vibration - effects of vibration on structures (for structural damage) (refer to Table 5-8 of the NVMP)

0 50 100 m
GDA 1994 MGA Zone 56
N

\\Emmsvr1\emm\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\VSC012 WattleSt30tExcavator 20180917 08.mxd 17/09/2018



KEY

- Proposed M4 - M5 Link tunnel alignment
- Watercourse / drainage line
- Parramatta Road (east and west) ancillary facility
- Northcote ancillary facility
- Noise catchment boundary
- Heritage item (LEP/SHR/s170)
- Building within safe working distance - trigger for vibration monitoring only*
- Building outside safe working distance (ie unlikely risk of cosmetic damage)

Land use associated with building that falls within safe working distance

- Residential

NOTES:

- The risk of cosmetic damage from the use of road-headers, rock-bolters and small to medium sized rock hammers is negligible

- Safe working distance for rock hammers determined from the tunnel floor

*- *Validation monitoring required only - properties do not fall within safe working distance that triggers consultation in accordance with E83*

Buildings within safe working distances, large rock hammer at tunnel floor

M4-M5 Link Mainline Tunnels

Figure B.1

Source: EMM (2019); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

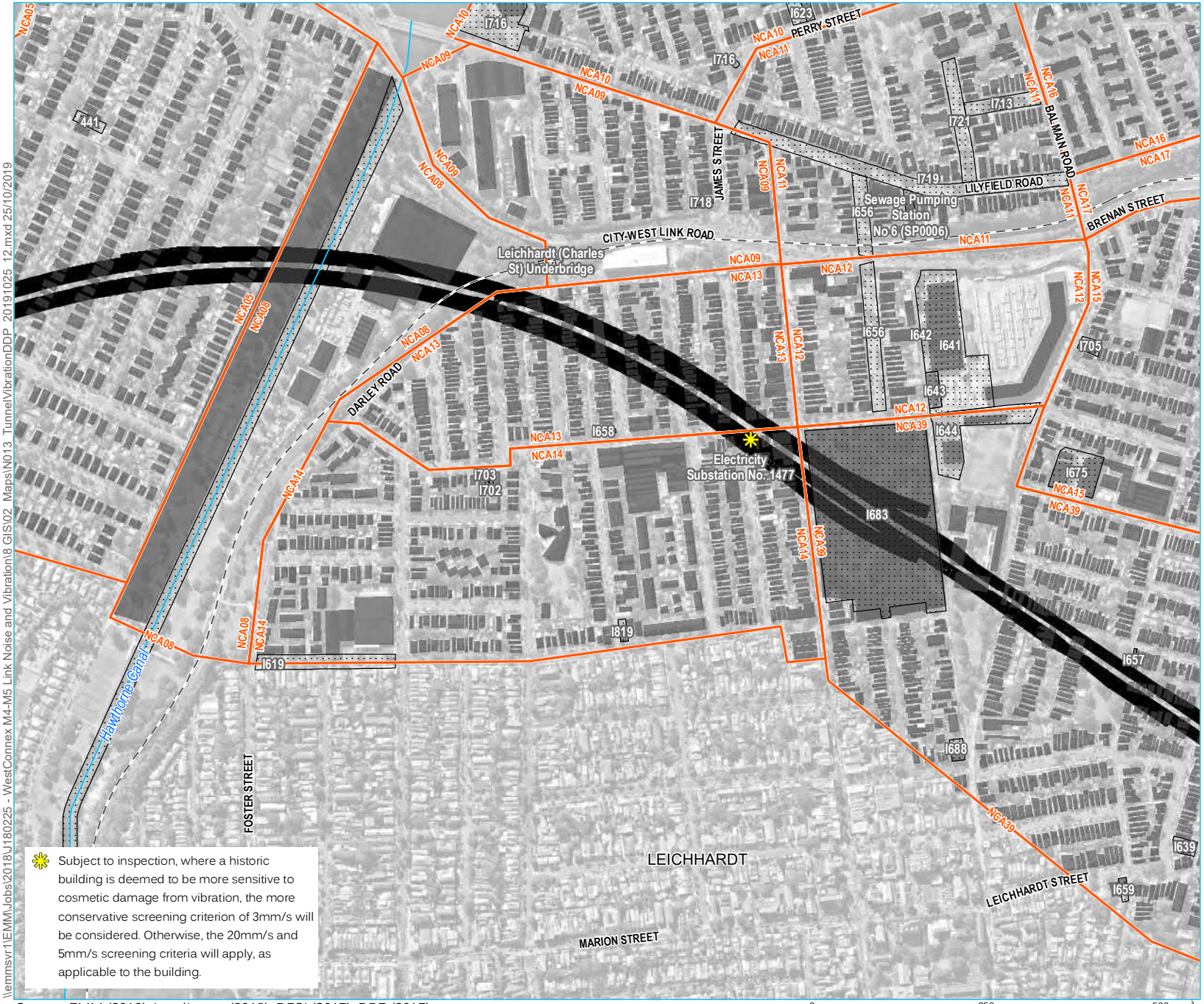
1:8,000 @ A4

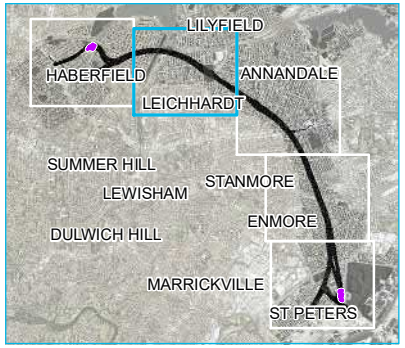
GDA 1994 MGA Zone 56

N

EMM

\\emmsvr1\EMM\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\N013 TunnelVibrationDDP 20191025 12.mxd 25/10/2019





KEY

- Proposed M4 - M5 Link tunnel alignment
- Rail line
- Watercourse / drainage line
- Noise catchment boundary
- Heritage item (LEP/SHR/s170)
- Building outside safe working distance (ie unlikely risk of cosmetic damage)

NOTES:
- The risk of cosmetic damage from the use of road-headers, rock-bolters and small to medium sized rock hammers is negligible
- Safe working distance for rock hammers determined from the tunnel floor
*- *Validation monitoring required only - properties do not fall within safe working distance that triggers consultation in accordance with E83*

Source: EMM (2019); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

1:8,000 @ A4 GDA 1994 MGA Zone 56

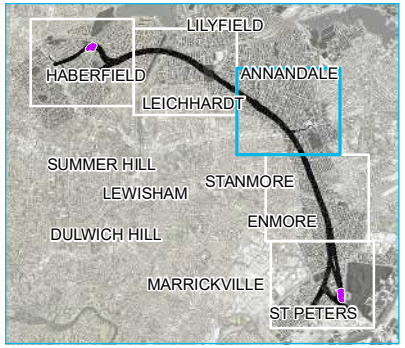
N

Buildings within safe working distances, large rock hammer at tunnel floor

M4-M5 Link Mainline Tunnels

Figure B.2

EMM



KEY

- Proposed M4 - M5 Link tunnel alignment
- Watercourse / drainage line
- Pyrmont Bridge Road ancillary facility
- Noise catchment boundary
- Heritage item (LEP/SHR/s170)
- Building outside safe working distance (ie unlikely risk of cosmetic damage)

NOTES:

- The risk of cosmetic damage from the use of road-headers, rock-bolters and small to medium sized rock hammers is negligible

- Safe working distance for rock hammers determined from the tunnel floor

*- *Validation monitoring required only - properties do not fall within safe working distance that triggers consultation in accordance with E83*

Source: EMM (2019); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

1:8,000 @ A4

GDA 1994 MGA Zone 56

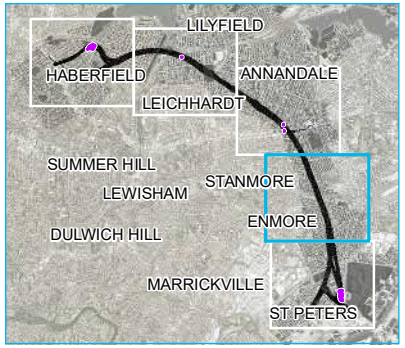
N

Buildings within safe working distances, large rock hammer at tunnel floor

M4-M5 Link Mainline Tunnels

Figure B.3

EMM



KEY

- Proposed M4 - M5 Link tunnel alignment
- Rail line
- Watercourse / drainage line
- Noise catchment boundary
- Heritage item (LEP/SHR/s170)
- Sydney Water s170 - City Tunnel
- Sydney Water s170 - Pressure Tunnel
- Building outside safe working distance (ie unlikely risk of cosmetic damage)

NOTES:
- The risk of cosmetic damage from the use of road-headers, rock-bolters and small to medium sized rock hammers is negligible
- Safe working distance for rock hammers determined from the tunnel floor
*- *Validation monitoring required only - properties do not fall within safe working distance that triggers consultation in accordance with E83*

Source: EMM (2019); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

1:8,000 @ A4

GDA 1994 MGA Zone 56

N

Buildings within safe working distances, large rock hammer at tunnel floor

M4-M5 Link Mainline Tunnels

Figure B.4

EMM

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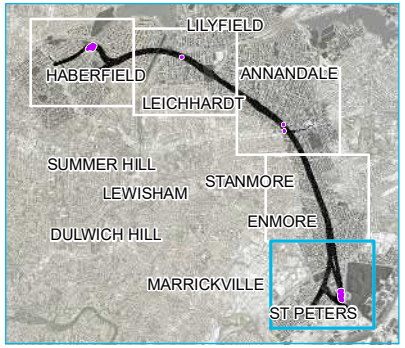

KEY

- Proposed M4 - M5 Link tunnel alignment
- Rail line
- Watercourse / drainage line
- Campbell Road ancillary facility
- Noise catchment boundary
- Heritage item (LEP/SHR/s170)
- Building within safe working distance - trigger for vibration monitoring only*
- Building outside safe working distance (ie unlikely risk of cosmetic damage)

Land use associated with building that falls within safe working distance

- Residential

NOTES:

- The risk of cosmetic damage from the use of road-headers, rock-bolters and small to medium sized rock hammers is negligible

- Safe working distance for rock hammers determined from the tunnel floor

*- *Validation monitoring required only - properties do not fall within safe working distance that triggers consultation in accordance with E83*

Buildings within safe working distances, large rock hammer at tunnel floor

M4-M5 Link Mainline Tunnels

Figure B.5

Source: EMM (2019); LendLease (2018); DFSI (2017); DPE (2017)

0 250 500 m

1:8,000 @ A4

GDA 1994 MGA Zone 56

N

\\emmsvr1\EMM\Jobs\2018\J180225 - WestConnex M4-M5 Link Noise and Vibration\8 GIS\02 Maps\N013_TunnelVibrationDDP_20191025_12.mxd 25/10/2019

Appendix F Noise Insulation Program

Noise Insulation Program

Noise and Vibration Management Sub-plan

M4-M5 Link Mainline Tunnels

February 2018

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Contents

Tables

Figures

Document control

Approval and authorisation

Title	M4-M5 Link Mainline Tunnels Noise Insulation Program
Document No/Ref	M4M5-LSBJ-PRW-EN-MP01-PLN-0012-10
Document Path	

Version Control

Revision	Date	Description
01	16 August 2018	For DPE Review
02	11 September 2018	Updated following DPE comment
03	3 October 2018	Updated following DPE comment
04	4 October 2018	Updated following SMC comment
05	13 November 2018	For DPE review
06	14 December 2018	Internal review
07	19 December 2018	For DPE review
08	22 January 2018	Internal Review
09	24 January 2019	For DPE review
10	15 February 2019	For DPE Approval

[redacted]

Note:
Revision 07 Document Number has changed from M4M5-LSBJ-PRW-GEN-EV01-PLN-0013-01 (previous revision) to M4M5-LSBJ-PRW-EN-MP01-012-09.

Glossary/ Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
AIC	Acoustic Installation Coordinator
Approval, the	Conditions of Approval for WestConnex M4-M5 Link SSI 7485
BCA	Building Code of Australia
CCS	Community Communication Strategy
CEMP	Construction Environmental Management Plan
CoA	Conditions of Approval
CSSI	Critical State Significant Infrastructure
DECC	Department of Environment and Climate Change (now Office of Environment and Heritage)
DP	Deposited Plan
DPE	Department of Planning and Environment
EIS	Environmental Impact Statement
ER	Environmental Representative
ICNG	Interim Construction Noise Guideline (DECC 2009)
LSBJV	Lendlease Samsung Bouygues Joint Venture
NAP	Noise Abatement Program
NML	Noise Management Level
Project, the	M4-M5 Link Mainline Tunnels
Roads and Maritime	Roads and Maritime Services
SMC	Sydney Motorway Corporation
SP	Strata Plan
SSI	State Significant Infrastructure

1 Purpose

This Program is a requirement of Condition E89 of the Ministers Conditions of Approval (CoA) for Infrastructure Approval SSI-7485. The purpose of this program is to describe the scope and process for how Lendlease Samsung Bouygues Joint Venture (LSBJV) proposes to conduct at-property treatment at residential receivers during delivery of the M4-M5 Link Mainline Tunnels (the Project) in accordance with the relevant CoA E88, E89 and E90.

The Noise Insulation Program aims to reduce construction fatigue and improve amenity for residential receivers identified in Appendix E of the Conditions of Approval for WestConnex M4-M5 Link SSI-7485 (the Approval), excluding properties which have already been provided treatment via the Roads and Maritime Services (Roads and Maritime) Noise Abatement Program (NAP), through the installation of at-property treatment.

Pending property owner acceptance and access, at-property treatments are to be implemented in accordance with CoA E90, which requires that treatments at all receivers are to be installed within 6 months following construction that would affect the receiver and the implementation of the Noise Insulation Program (e.g. inspections, agreement of property treatment) for high priority receivers must be undertaken within 3 months from the commencement of construction that would affect the receiver. Refer to Section 3 for identification of high priority and remaining at-property treatments to be implemented.

2 Environmental requirements

2.1 Minister's Conditions of Approval

The CoA relevant to this program are listed Table 2-1 below. A cross reference is also included to indicate where the condition is addressed in this program or other Project management documents.

Table 2-1: Minister's Conditions of Approval

CoA No.	Condition Requirements	Document Reference
E88	At receiver noise mitigation in the form of at-property treatment must be offered to the land owner for habitable living spaces, or other mitigation or management measures as agreed by the occupier, to residential properties identified in Appendix E. Mitigation must be offered prior to works commencing. This requirement does not apply if the sensitive receiver has been provided with noise mitigation under the RMS Noise Abatement Program or the *State Environment Planning Policy (Infrastructure) 2007* (clause 102(3)). The adequacy of at-property treatments will be reviewed where previous treatments have been installed as part of other SSI or CSSI projects. *Note: This condition does not preclude the application of other noise and vibration mitigation and management measures.*	Section 3 Section 3.1 Section 3.2 Section 3.3 Section 3.4
E89	A Noise Insulation Program must be prepared and implemented for the duration of the CSSI works for receivers at/to which the requirements of Conditions E87 and E88 apply. The Program must be incorporated into the Construction Noise and Vibration Management Sub-plan. The Noise Insulation Program must detail the following matters:	This Program
	(a) receivers eligible for the scheme;	Section 3.1 Table 3-1

CoA No.	Condition Requirements	Document Reference
	(b) the scope of the insulation package;	Section 3
	(c) responsibility for the noise insulation works;	Section 6
	(d) procedure and the terms of the noise insulation works;	Section 3
	(e) program monitoring; and	Section 4
	(f) program review and amendment.	Section 8
	The Noise Insulation Program must be endorsed by the AA.	-
E90	Receivers which are eligible for receiving treatment under the Noise Insulation Program required under Condition E89 must have treatment implemented within six (6) months following the commencement of construction which would affect the receiver. The implementation of the Noise Insulation Program must be prioritised based on the degree and duration of exceedance with high priority exceedances undertaken within three (3) months of the commencement of construction.	Section 3.1 Section 3.3

3 Scope of the Noise Insulation Program

3.1 Properties eligible for treatment

In accordance with CoA E88, Appendix E of the Approval identifies the residential properties that will be offered at-property treatment of habitable living spaces, or other mitigation or management measures as agreed by the occupier, by LSBJV during the delivery of the Project (refer to Figure 3-1 below). These properties are focused around Haberfield and Ashfield, where residents are anticipated to experience construction fatigue and reduced amenity due to the concurrent / enduring construction impacts of the M4 East and the Project.

Table 3-1 details the address of each residential property identified to be within the “Mitigation Zone” depicted in Appendix E of the Approval, excluding properties which have already been provided treatment via the Roads and Maritime Services (Roads and Maritime) Noise Abatement Program (NAP), that will be offered at-property treatment by LSBJV.

LSBJV issued a letter advising the properties in Appendix E that they are eligible for consideration in this strategy in 2018. Detailed consultation and appointments with these properties will commence in February 2019 and treatments will be implemented where property owners accept the offer.

Properties located within the boundary of Appendix E that are located along the northside of Wattle Street and immediately adjacent the Northcote Street site are the most at risk of enduring construction fatigue given their location and absence of operational noise walls installed by the M4 East project, such as those along the southern side of Wattle Street. For the purpose of the Noise Insulation Program, these receivers are considered ‘high priority’ and implementation of the program (e.g. inspections, agreement of property treatment) must be undertaken within 3 months of the commencement of construction that would affect the receiver.

Further, receivers located on the upper floors of the apartment buildings at 115 Alt Street, Ashfield and 124 Bland Street, Ashfield are also at risk of enduring construction fatigue as they are located above the height of the proposed temporary noise wall at the Parramatta West civil site. These receivers are also considered high priority.

All property treatments regardless of priority will be implemented within six months of the commencement of construction where these receivers have been affected.

Receivers are considered “affected”, when construction noise levels greater than the ‘noise affected’ NML as defined in the ICNG, as a result of the Project’s construction activities.

All timeframes are dependent upon landowner’s acceptance of the offer for treatment within the timeframe outlined in Section 5.3 and reasonable access being provided in order for LSBJV to implement the treatments within the desired timeframes.

M4-M5 Link Mainline Tunnels

Figure 3-1 Properties to be offered treatment under CoA E88

Legend

- Ancillary Facilities
- CoA Appendix E: Construction Fatigue and Amenity Mitigation
- Properties treated by M4 East (Adequacy Review)
- Properties treated under the RMS NAP (no further treatment)
- High Priority implementation properties
- Remaining Property Treatments
- Properties owned by RMS

Units on Level 2 of 115 Alt Street are considered high priority properties

Units on Level 2 of 124 Bland Street are considered high priority properties

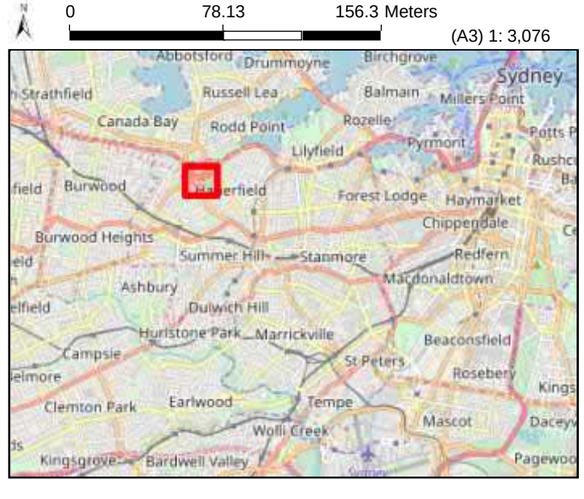

Table 3-1 Properties to be offered treatment under CoA E88

Street	Street number
High priority implementation of at-property treatment	
Wolseley Street, Haberfield	5
Northcote Street, Haberfield	5, 6
Wattle Street, Haberfield	18, 20, 22, 24, 26, 34, 36A, 40, 44
Alt Street, Ashfield	29/115, 30/115, 31/115, 32/115, 33/115, 34/115
Bland Street, Haberfield	6/124, 7/124, 8/124
Remaining property treatments	
Walker Avenue, Haberfield	1, 3, 5, 5A, 7, 7A, 9, 11, 13, 15, 17, 19, 21, 24, 26, 28, 30, 32, 34
Alt Street, Ashfield	5/115, 6/115, 7/115, 8/115, 9/115, 10/115, 17/115, 18/115, 19/115, 20/115, 21/115, 22/115, 117, 119, 126, 128
Alt Street, Haberfield	137, 1/139, 2/139, 3/139, 142
Bland Street, Ashfield	1/124, 2/124, 3/124, 4/124, 5/124,
Bland Street, Haberfield	135, 136, 137, 138
Parramatta Road, Ashfield	300

In accordance with CoA E88, the adequacy of at-property treatments previously installed by other Critical State Significant Infrastructure (CSSI) and State Significant Infrastructure (SSI) projects; such as WestConnex M4 East will be reviewed during implementation of the Project's Noise Insulation Program. This is discussed further in Section 3.4

A number of residential properties within those identified in Appendix E of the Approval have previously been provided with noise mitigation under the Roads and Maritime NAP (refer to Table 3-2). In accordance with CoA E88, the requirement for LSBJV to offer at-property treatment to these properties does not apply and they will not be addressed in this Program.

Table 3-2 Properties identified in Appendix E of the Approval that have been provided treatment under the Roads and Maritime NAP and are not subject of this Program.

Street	Street number
Wattle Street, Haberfield	6-12, 14, 16, 26A, 28, 30, 32, 36, 38, 42, 46, 48, 50, 52, 54, 56, 58
Ramsay Street, Haberfield	1/166, 2/166, 3/166, 4/166

3.2 At-property treatments

Analysis will be undertaken by an acoustician to determine which facades are considered noise affected by construction noise at each property. Noise affected receivers identified in Table 3-1 will be offered at-property treatments. At-property treatments will be installed if, during an inspection, it can be confirmed that there are 'habitable zones' as defined by the BCA along noise affected facades. This will depend on individual building layout, orientation of each residence.

Acoustic treatments are only required for rooms deemed habitable (such as bedrooms and living spaces). Rooms that are not habitable (such as wardrobes, hallways, laundries, bathrooms and kitchens that do not adjoin an open plan living area) are not eligible for acoustic treatment.

A short report will be provided to the owner outlining the inspection outcomes, and a plan of affected rooms and the mitigation measures on offer, including location at-property treatment.

The at-property treatments available are presented in Table 3-3.

Table 3-3 At-property treatments offered by the Noise Insulation Program

At-property treatments
Mechanical ventilation (e.g. 240v Aeropac systems), door, wall vent and windows seals, acoustic curtains and the provision of secondary glazing system (where a second window pane is installed within an existing window frame, providing additional noise attenuation).

Where installation of a treatments requires mechanical ventilation in order to be installed to meet BCA standards this will be offered to property owners.

Where at-property treatment packages cannot be installed at the property, LSBJV will investigate the provision of other treatment options (refer to Section 3.3).

Should owners not accept at-property treatment, LSBJV will continue to consult with the occupier of the property to determine other appropriate mitigation measures that may be suitable, such as noise cancelling headphones.

As outlined in the Roads and Maritime Noise Mitigation Guideline (Roads and Maritime 2015), financial compensation will not be offered in lieu of undertaking treatments.

3.3 Process

1. LSBJV will appoint a suitability qualified person who is experienced in the installation of at-property noise treatments; the Acoustic Installation Coordinator (AIC).
2. The LSBJV Public Liaison Team will attempt to confirm property ownership information from registers such as CoreLogic and from tenants during doorknocks where possible. However, these mechanisms may not result in clear ownership information, as such LSBJV will continue to work in good faith.
3. The LSBJV Interface Manager will liaise with the M4 East project to align treatment approach.
4. The LSBJV Public Liaison Team will make contact with all property owners/occupiers and strata managers (for unit blocks) eligible for treatment from February 2019. Refer to Section 5 for details of the engagement process.
5. Where the property owner/occupiers has indicated they would accept the offer of at-property treatment during the engagement process outlined in Section 5, the AIC will conduct a visual inspection of the property. The inspection would be carried out during daytime hours from Monday to Saturday at a time convenient to the property owner. The property owner will need to arrange LSBJV's access to the property if it is tenanted.

The inspection will focus on the existing features of the property that are relevant to the implementation of at-property treatment, such as:

- Condition of existing windows and doors
- The presence and condition of existing door and window seals
- The presence of fresh air ventilation
- The identification of a suitable location for the installation of mechanical ventilation
- The location of rooms and living areas.

The inspection would also assess the constructability and feasibility of installing the treatment package; including any safety considerations.

6. The AIC will maintain a Noise Insulation Program inspection register. The register will record:
   - Property information including street address, lot and Deposited Plan (DP) / Strata Plan (SP) numbers, project area
   - Property owner details including name, and if possible phone number and email
   - Details of tenant if property is leased
   - Dates, times and methods of contact
   - Any reasons why owner refuses the offer of an inspection or treatment
   - Inspection completion date
   - Details of the property, such as:
     - Condition and description of existing windows/doors/seals
     - List of identified habitable rooms
   - Details of the property inspections findings (including relevant parameters which may prevent implementation of the treatment package)
   - Details of the assessment report discussed with the property owner
   - Date and program details for the treatment to be carried out, if required.
7. Where the AIC identifies that the at-property treatment package cannot be installed at the property, due to safety or constructability constraints (such as poor condition or unsuitable existing windows and doors or no suitable location for mechanical ventilation), LSBJV will investigate the provision of other treatment options.
8. For those owners who accept treatment, and the property inspection confirms that treatments can be implemented, LSBJV will:
   a. Prioritise the implementation of the Noise Insulation Program (e.g. inspections, agreement of property treatment) for high priority receivers within the first 3 months; and
   b. Complete all installations within six months.
9. Should owners not accept at-property treatment, LSBJV will continue to consult with the occupier of the property to determine other appropriate mitigation measures that may be suitable, such as noise cancelling headphones.

3.4 Adequacy review

In accordance with CoA E88, the adequacy of at-property treatments previously installed by other Critical State Significant Infrastructure (CSSI) and State Significant Infrastructure (SSI) projects; such as WestConnex M4 East will be reviewed during implementation of the Project's Noise Insulation Program.

Review of adequacy would involve the identification of at-property treatments previously provided by the M4 East project, and comparison against those offered by the Noise Insulation Program. Where previously provided at-property treatments are determined to offer similar or better insulation treatment than those offered by the Noise Insulation Program, this would be recorded in the property report and no further at-property treatments will be required, otherwise the process detailed within this Program will continue.

Table 3-4 outlines the residential properties within Appendix E of the Approval that have previously been offered treatment by the M4 East project. LSBJV will confirm if the below properties have actually had treatments installed. The adequacy of these treatments will be assessed as detailed above. If no treatments have been installed or the treatments are not adequate then these properties will be offered treatment under this Program.

Table 3-4 Residential properties within Appendix E of the Approval, previously offered treatment by the M4 East project

Street	Street number
Wattle Street, Haberfield	18, 20, 24, 26, 34, 40, 44
Walker Avenue, Haberfield	26, 30

4 Noise Insulation Program monitoring

LSBJV will maintain ongoing monitoring and reporting requirements during the installation process. The installation progress will be provided in updates to the Acoustics Advisor (AA) on a fortnightly basis and will be reported upon by the Environmental Representative (ER) on a monthly basis.

The update to the AA will include the following information relevant to the installation process;

- Doorknock numbers and number of letters issued including:
  - Numbers responded to and accepted
  - Numbers declined and no response.
- Inspections and reports including:
  - Number of inspections carried out and outstanding and where access has been denied despite a confirmed booking
  - Property reports completed including agreed and not agreed
  - Installation of treatments completed, commenced and to be completed
  - Property details such as habitable room list and the condition of existing windows/doors/seals
- Dates for the commencement of high priority at-property treatment implementation
- Trigger dates for commencement of the remaining property treatments
- Locations identified and confirmed as being already treated by alternative methods/requirements
- Safety aspects and other challenges faced which may put the delivery timeframe at risk.

In addition, as part of continuous improvement, the AA and AIC will investigate any Program-related complaints from property owners who have received at-property treatments via the Noise Insulation Program. The investigation will review the implementation of the at-property treatment and identify any opportunities for improvement within the scope of the Noise Insulation Program. Where the investigation finds that the at-property treatment products are faulty or the installation is not satisfactory, rectification works will be carried out within six weeks, subject to property access.

5 Communication strategy

5.1 Communication aims

The main communication aims in this strategy are:

- Raise awareness of the Project and to provide details about the offer of at-receiver treatment to property owners
- Determine what mitigation (if any) have been previously offered and provided by other projects such as M4 East
- Encourage uptake of treatment and inspection
- Explain the process including terms and conditions, obligations and limitations and inspection procedures
- Provide stakeholders with a central point of contact with the LSBJV Project Team.

5.2 Key messages

The key messages in this strategy are:

- All eligible residential properties (refer to Table 3-1) will be offered at-property treatment
- At-property treatment is being offered to minimise the impact of construction noise impacts, construction fatigue and to improve amenity of identified residential receivers, during construction activities
- The property inspection is free, takes around two hours to complete, and is carried out by suitably qualified person who is experienced in the installation of at-property noise treatments
- At-property treatments will be implemented at no cost to the owner and will be installed as soon as practicable at the identified residential properties.

5.3 Communication and engagement tools

A range of communication materials will be used to support stakeholder engagement in this strategy. Stakeholders will be given information packs – comprising materials developed by LSBJV and pre-existing project materials – that will target individual information needs.

All communication materials will be available in printed and electronic formats (translations provided as required), with electronic formats uploaded onto the project website where appropriate. Table 5-1 provides for a series of communication and engagement tools to be used.

Table 5-1 Noise treatment installation engagement process table

Engagement tool	Activity	Timeframe
Doorknock	• Introduce Project • Advice to property owners of their eligibility for treatment and the offer of visual inspection by AIC • Noise Treatment Installation Letter of Offer 1 provided with first contact or left in letter box • Details of LSBJV points of contact (1800 Hotline) encouraging a response	Initial contact February 2019
Letter to strata management for units	• Introduce Project • Advise that a number of units in complex are eligible for treatment and visual inspection by AIC • Details of LSBJV points of contact (1800 Hotline) encouraging a response	Initial contact February 2019

Engagement tool	Activity	Timeframe
Noise Treatment Installation Letter of Offer 2	• Letter sent via Registered Mail • Reminder of the offer and encourage property owner to make contact • Include conditions stating if the offer is not responded to, or not accepted, that project construction works will progress as per program.	Two weeks after first letter and doorknock
Doorknock 2	• Direct contact with property owners who have not responded previously to letters of offer • LSBJV to provide email and phone points of contact • Inform property owners this is the last opportunity to accept the offer of noise treatment installation before construction commences	Two weeks after second letter of offer sent If there is no response within two weeks of the doorknock, it will be assumed that the property owner does not wish to accept the treatment and project works will progress as programmed. In the case of strata properties this timeframe will be one month
Inspection Phone call	• Visual inspection by the AIC of properties who have agreed to at-property treatment installation	-
Treatment Installation Letter and phone call	• Scheduled installation of at-property treatments	Scheduled to be completed within six months following the commencement of construction which would affect the receiver.

An approach for implementing treatment at eligible properties for property owners who initially declined, only accepted part of the treatment offer or did not respond within the above timeframes will remain open for construction period of the Project. However, it is noted that the installation timeframes will be outside the requirements of CoA E90.

In these instances, a high priority property, will have their initial or additional at-property treatment packages prioritised within three months of the acceptance of the offer. The remaining properties will have their initial or additional at-property treatment packages implemented within six months of the acceptance of the offer.

6 Responsibilities for the noise insulation works

LSBJV will be responsible for the project management and installation of the noise insulation works. The LSBJV Public Liaison Team will co-ordinate access and liaise with property owners and occupiers. The AIC, who is experienced in the installation of at-property noise treatments, will co-ordinate the sub-contractors involved with installation of the noise insulation treatment.

LSBJV will be responsible for ensuring at-property treatments have been installed in accordance with the BCA and have been completed to an acceptable standard via close-out inspection, undertaken by the AIC.

7 Insulation program limitations

Achievement of installation program targets will be dependent on:

- The property owners responding to LSBJV doorknock, initial letter and subsequent letters and the final letter in a timely manner
- Agreement with the property owner on offered treatments is required
- Similarly, once the treatments design has been finalised, owners of residential properties must either approve or decline the offer within two weeks. If there is no response within two weeks of the design being provided, it will be assumed that the property owner does not wish to accept the offer of treatment and project works will progress as programmed. In the case of strata properties this timeframe will be extended to one month
- During the installation of the treatments LSBJV will require “reasonable” access to the properties. Access will need to be provided within two weeks of the acceptance of the offer and remain available for LSBJV at a later date should it be required
- Safety of LSBJV personnel is paramount, as such where at-property treatments cannot be installed in a safe manner, the at-treatment offer will be reviewed by LSBJV
- LSBJV is not responsible for Roads and Maritime NAP installations
- LSBJV is not responsible for paying for electricity to run the ventilation systems
- LSBJV is not responsible for M4 East at-property treatments that may have already been installed, other than reviewing adequacy as outlined in Section 3.4.

8 Program review and amendment

This Strategy forms part of the Construction Environmental Management Plan (CEMP), as such is subject to the management review process as described in Section 3.12 of the CEMP. In addition, the LSBJV Public Liaison and Environmental Teams are responsible for updating this program to reflect lesson learnt and changes required as identified during Program delivery.

Revisions of the Noise Insulation Program will be determined in consultation with the AA and approved by DPE.

Appendix G Non-residential receivers in study area

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA00	The Willows Private Nursing Home Pty Ltd	84 Orpington St, Ashfield	Aged Care
NCA00	Rochester Private Hotel	68 Charlotte St, Ashfield	Hotel
NCA00	Asiana Centre & Catholic Chinese Community	38 Chandos St, Ashfield	Place of Worship
NCA01	Bupa Aged Care Ashfield	126-128 Frederick St, Ashfield	Aged Care
NCA01	Midway Dental Clinic	26 Henry St, Ashfield	Medical
NCA01	Hammond Park	Frederick St, Ashfield	Outdoor Active
NCA01	St John's Pre-School Ashfield	74 Bland St, Ashfield	Educational
NCA01	St John's Anglican Church	85-85A Alt St, Ashfield	Place of Worship
NCA01	St John's Cemetery	81 Alt St, Ashfield	Outdoor Passive
NCA01	Your Doctors	39 Henry St, Ashfield	Medical
NCA01	The Infants Home	17 Henry St, Ashfield	Childcare
NCA02	Croker Park	35A Harrabrook Ave, Five Dock	Outdoor Passive
NCA02	Kingdom Halls (Jehovah's Witnesses)	6-12 Wattle St, Haberfield	Place of Worship
NCA02	Little Vips	113 Dobroyd Pde, Haberfield	Childcare
NCA02	Tennis FX	1 Henley Marine Dr, Five Dock	Outdoor Active
NCA02	Wadim (Bill) Jegorow Reserve	Ramsay St and Cove St, Haberfield	Outdoor Passive
NCA04	Reg Coady Reserve	Dobroyd Pde, Haberfield	Outdoor Passive
NCA04	Timbrell Park	Henley Marine Dr, Five Dock	Outdoor Active
NCA04	Five Dock Veterinary Hospital	10 Ramsay Rd, Five Dock	Medical
NCA05	Dobroyd Point Public School	85 Waratah St, Haberfield	Educational

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA06	Inner West Education Centre	207 Ramsay St, Haberfield	Educational
NCA07	Presbyterian Aged Care	169-173 Parramatta Rd, Haberfield	Aged Care
NCA07	Marys Kindy	191 Ramsay St, Haberfield	Childcare
NCA07	My Stepping Stones Haberfield	110 Ramsay St, Haberfield	Childcare
NCA07	Haberfield Baptist Church	96-98 Dalhousie St, Haberfield	Place of Worship
NCA07	Algie Park	195 Ramsay St, Haberfield	Active Recreation
NCA07	Ella Community Childcare Centre	1 Winchcombe Ave, Haberfield	Childcare
NCA07	Goodstart Early Learning	25 Rogers Ave, Haberfield	Childcare
NCA07	Guardian Early Learning Centre	183 Parramatta Rd, Haberfield	Childcare
NCA07	Haberfield Public School	22 Denman Ave, Haberfield	Educational
NCA07	Haberfield Baptist Church Pre-School	96-98 Dalhousie St, Haberfield	Educational
NCA07	Ramsay Street Medical Centre	112 Ramsay St, Haberfield	Medical
NCA07	Primary School	15 Rawson St, Haberfield	Educational
NCA07	Ramsay Street Medical Centre	112 Ramsay St, Haberfield	Medical
NCA07	Saint Joan Of Arc's Catholic Church	97 Dalhousie St, Haberfield	Place of Worship
NCA07	Saint Joan Of Arc's Catholic Primary School	88 Dalhousie St, Haberfield	Educational
NCA07	St David's Uniting Church	51 Dalhousie St, Haberfield	Place of Worship
NCA07	Marinucci Medical Centre	68 Ramsay St, Haberfield	Medical
NCA08	Blackmore Oval	Canal Rd, Leichhardt	Outdoor Active

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA08	Richard Murden Reserve	Hawthorne Pde, Haberfield	Outdoor Passive
NCA22	Annandale Family Doctors	133 Johnston St, Annandale	Medical
NCA25	Pain Free Dentist Sydney	1 Hornsey St, Rozelle	Medical
NCA25	Rosebud Cottage Childcare Centre	5 Quirk St, Rozelle	Childcare
NCA25	St Joseph's Catholic Church	7 Gordon St, Rozelle	Place Of Worship
NCA25	Sydney Community College	2A-2B Gordon St, Rozelle	Educational
NCA25	The Merton Hotel	38 Victoria Rd, Rozelle	Hotel
NCA29	Ku Phoenix Preschool	36 Evans St, Balmain	Childcare
NCA29	Well Adjusted Chiropractic	116 Evans St, Rozelle	Medical
NCA29	C3 Church Rozelle	46 Robert St, Rozelle	Place Of Worship
NCA29	Art of Health & Wellbeing Natural Therapy Centre	154 Mullens St, Rozelle	Medical
NCA29	Inner Sydney Montessori School	44 Smith St, Balmain	Educational
NCA39	Christians In The Media	120-122 Johnston St, Annandale	Place of Worship
NCA39	Hunter Baillie Memorial Presbyterian Church	Johnston St, Annandale	Place of Worship
NCA39	Johnston Lodge	106-108 Johnston St, Annandale	Hotel
NCA39	Opal Annandale	76 Johnston St, Annandale	Aged Care
NCA39	Pioneers Memorial Park	Leichhardt	Outdoor Passive
NCA39	Police Station	21 Collins St, Annandale	Public Building
NCA39	Rose Cottage Childcare Centre	1 Coleridge St, Leichhardt	Childcare

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA39	Styles Street Children's Community Long Day Care Centre	62 Styles St, Leichhardt	Childcare
NCA39	Sydney Secondary College Leichhardt Campus	160 -180 Balmain Rd, Leichhardt	Educational
NCA39	The Annandale Lodge	96-98 Johnston St, Annandale	Hotel
NCA40	Wat Buddharangsee	49 Trafalgar St, Annandale	Place Of Worship
NCA40	Explore & Develop Annandale - Early Learning Centre	6/8A Booth St, Annandale	Childcare
NCA40	Annandale Childcare Centre	47A Trafalgar St, Annandale	Childcare
NCA40	Annandale Creative Arts Centre	81 Johnston St, Annandale	Childcare
NCA40	Annandale Creative Arts Centre	81 Johnston St, Annandale	Public Building
NCA40	Annandale Galleries	110 Trafalgar St, Annandale	Hotel
NCA40	Annandale Neighbourhood Centre	77-79 Johnston St, Annandale	Public Building
NCA40	Annandale Public School	25 Johnston St, Annandale	Educational
NCA40	JoJos Family Day Care	28 Susan St, Annandale	Childcare
NCA40	Live Active + Oz-Pod	36-50 Taylor St, Annandale	Medical
NCA40	Presbyterian Church In NSW	Collins St, Annandale Place	Place of Worship
NCA40	Saint Brendan's School	30 Collins St, Annandale	Educational
NCA40	Teeth Plus Clinic	79 Nelson St, Annandale	Medical
NCA40	Therapies For Kids	37 Nelson St, Annandale	Medical
NCA40	Toxteth Kindergarten Inc	49 Johnston Ln, Annandale	Childcare

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA42	Uniting Church in Australia	84/86 Cardigan St, Stanmore	Place Of Worship
NCA42	Australia Street Art Camp	24A Australia St, Camperdown	Public Building
NCA42	C3 Central City Church	1 Horden Pl, Camperdown	Place of Worship
NCA42	Camperdown Park	Mallett St, Camperdown	Outdoor Active
NCA42	Camperdown Sunshine Kids	35 Australia St, Camperdown	Childcare
NCA42	Chrissie Cotter Gallery	Pidcock St, Camperdown	Public Building
NCA42	Explore & Develop Camperdown - Early Learning Centre	59 Denison St, Camperdown	Childcare
NCA42	Grandstand	Mallett St, Camperdown	Public Building
NCA42	M.C of S Electricity Dept. Sub-Station No.230	Salisbury Ln, Camperdown	Public Building
NCA42	Peek-A-Boo Early Learning Centres	1 Denison St, Camperdown	Childcare
NCA42	Portuguese Ethnographic Museum of Australia	24A Australia St, Camperdown	Public Building
NCA43	Chris O'Brien Lifehouse	119-143 Missenden Rd, Camperdown	Medical
NCA43	Flying Bark Productions	62-68 Church St, Camperdown	Recording Studio
NCA43	Lucas Street Childcare Centre	67-81 Missenden Rd, Camperdown	Childcare
NCA43	Mallett Street Campus - University of Sydney	108 Mallett St, Camperdown	Educational
NCA43	Medical	3-19 Missenden Rd, Camperdown	Medical
NCA43	Missenden Medical Centre	54-60 Briggs St, Camperdown	Medical
NCA43	NHMRC Clinical Trials	94 Parramatta Rd, Camperdown	Educational

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA43	Queen Elizabeth II Rehabilitation Centre	57-65 Missenden Rd, Camperdown	Medical
NCA43	Royal Prince Alfred Hospital	83-117 Missenden Rd, Camperdown	Medical
NCA43	RPAH and ANSTO Nuclear Cyclotron Facility	67-81 Missenden Rd	Medical
NCA43	RPA QE II Building 10	67-81 Missenden Rd, Camperdown	Medical
NCA43	Saint Andrews	21 Church St, Camperdown	Place of Worship
NCA43	Sancta Sophia College	8 Missenden Rd, Camperdown	Educational
NCA43	St Joseph's Catholic Church	25A Parramatta Rd, Camperdown	Place of Worship
NCA43	University of Sydney	Camperdown	Educational
NCA43	Rydges Camperdown	9 Missenden Rd, Camperdown	Hotel
NCA44	RPA Medical Foundation Building	92 Parramatta Rd, Camperdown	Educational
NCA45	Only About Children	290 Edgeware Rd, Enmore	Childcare
NCA45	Australia Street Infants School	229 Australia St, Newtown	Educational
NCA45	Erskineville Village Anglican Church	55 Erskineville Rd, Erskineville	Place of Worship
NCA45	Greek Orthodox Sunday School	366-378 King St, Newtown	Place of Worship
NCA45	King Street Medical Centre	369 King St, Newtown	Medical
NCA45	Lennox Street Studios	93 Chelmsford St, Newtown	Educational
NCA45	Newtown Art Seat	1 Bedford St, Newtown Place	Place of Worship
NCA45	Newtown Fire Station	214-216 Australia St, Newtown	Public Building

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA45	Newtown Local Court	218 Australia St, Newtown	Court House
NCA45	Newtown Mission	280A King St, Newtown	Place of Worship
NCA45	Newtown Police Station	218 Australia St, Newtown	Public Building
NCA45	Newtown Public School	352-358 King St, Newtown	Educational
NCA45	Saint Constantine & Helen Greek Orthodox Church	366-378 King St, Newtown	Place of Worship
NCA45	St Joseph's Catholic Church	49 Bedford St, Newtown	Place of Worship
NCA45	Subud Sydney Hall	95-103 Lennox St, Newtown	Public Building
NCA45	The Athena School	28 Oxford St, Newtown	Educational
NCA45	King Street Medical Practice	327 King St, Newtown	Medical
NCA45	The Enmore Theatre	118-132 Enmore Rd Newtown	Theatre / Auditorium
NCA46	FROEBEL Alexandria Early Learning Centre	177/219 Mitchell Rd, Alexandria	Childcare
NCA47	Little Learning School	95 Burrows Rd, Alexandria	Childcare
NCA47	Huntley Street Early Learning Centre	4 Huntley St, Alexandria	Childcare
NCA47	OZEDUCATION Alexandria	4B Huntley St, Alexandria	Childcare
NCA48	Sydney Park Sydney	Sydney Park Rd, St Peters	Outdoor Passive
NCA50	Ibis Budget Hotel	178 Princes Hwy, St Peters	Hotel
NCA50	St Peters Anglican Church	187 Princes Hwy, St Peters	Place Of Worship
NCA50	Helping Hands St Peters	134 Church St, St Peters	Childcare
NCA50	Southern Cross Veterinary Clinic	60 Princes Hwy, St Peters	Medical
NCA51	Camdenville Park	65 May St, St Peters	Outdoor Active
NCA52	St Peters Public School	Church St, St Peters	Outdoor Active

NCA Description	Description Address	Address (within about 50 metres)	Type
NCA55	Hillsong Church Alexandria Campus	65 Doody St, Alexandria	Place Of Worship
NCA55	Alexandria Early Education	2, 140 Bourke Rd, Alexandria	Childcare
NCA55	Kiddie Academy Alexandria	Level 1, unit 3b/61/67 O'Riordan St, Alexandria	Childcare
NCA55	Hyperbaric Health Wound Hospital	46-50 Kent Rd, Mascot	Hospital
NCA55	Mascot Medical	Shop 6, 19-33 Kent Rd, Mascot	Medical
NCA56	Bridge Road School	127 Parramatta Rd, Camperdown	Educational

Appendix H Total RBL and NML data

ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
R02 22 Lilyfield Rd, Rozelle (21/7/16 – 2/8/16)	Traditional RBLs	45	45	45	45	45	45	45	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	45	45
	Hourly RBLs	46	45	44	45	46	51	54	52	52	52	52	51	51	51	51	52	52	53	52	52	51	51	50	48
	Adopted RBLs	45	45	45	45	45	48	48	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	48	48
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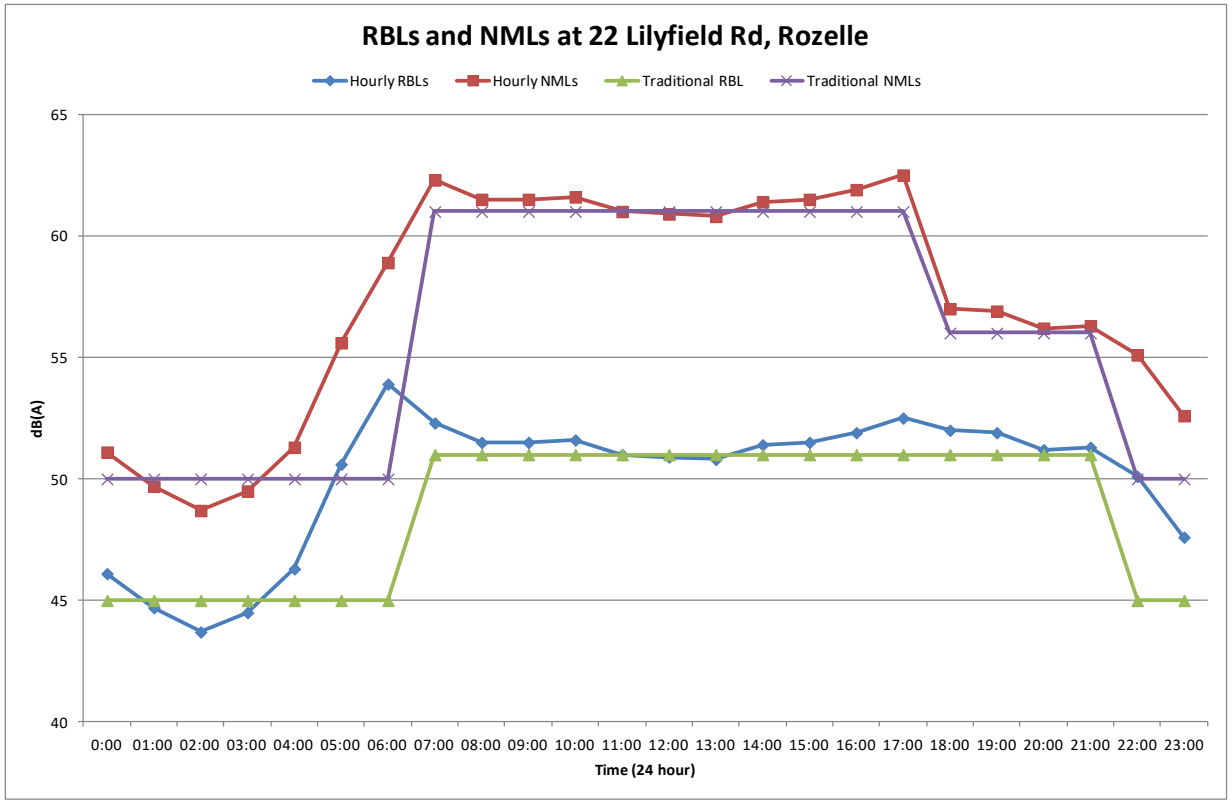
	Hourly NMLs	51	50	49	50	51	56	59	62	62	62	62	61	61	61	61	62	62	63	57	57	56	56	55	53
	Adopted NMLs	50	50	50	50	50	53	53	61	61	61	61	61	61	61	61	61	61	61	56	56	56	56	53	53



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R03 69 Victoria Rd, Rozelle (18/7/16 – 2/8/16)	Traditional RBLs	44	44	44	44	44	44	44	61	61	61	61	61	61	61	61	61	61	61	60	60	60	60	44	44
	Hourly RBLs	50	46	42	46	50	56	63	62	62	62	62	61	61	61	62	61	61	61	61	61	60	60	58	53
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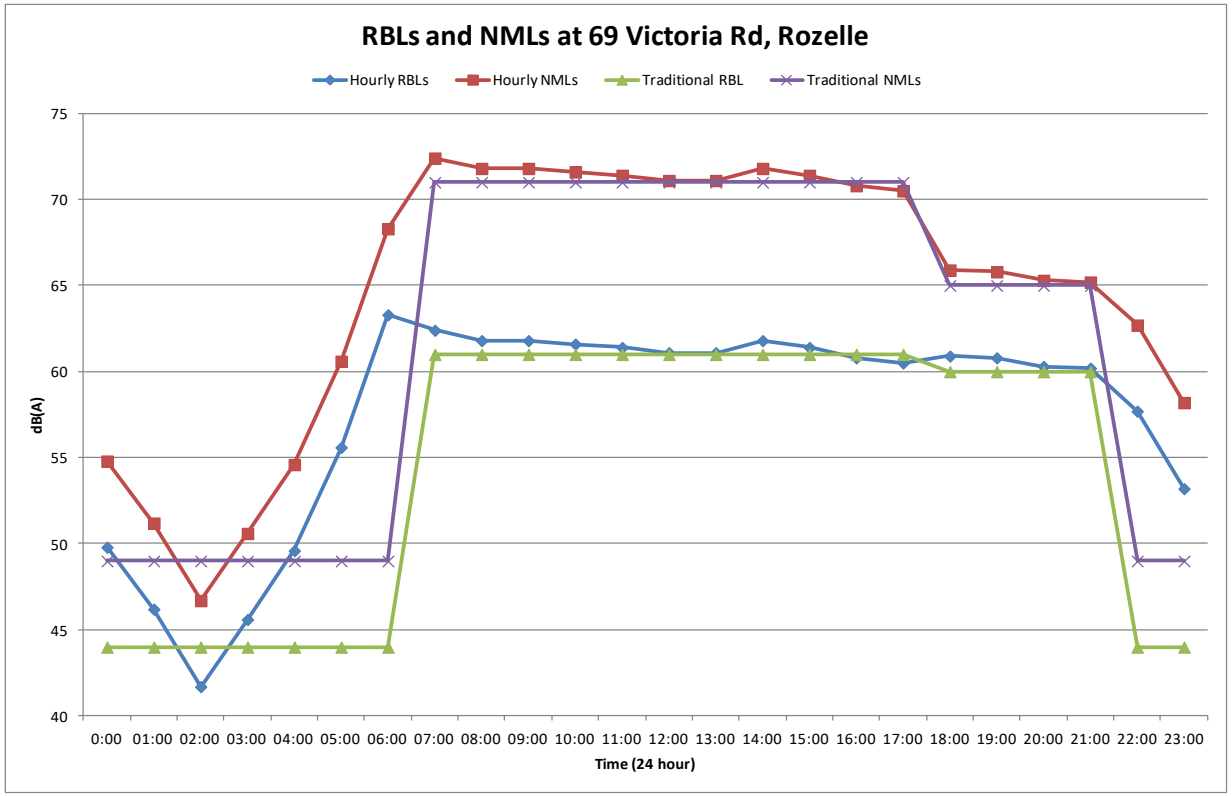
	Traditional NMLs	49	49	49	49	49	49	49	71	71	71	71	71	71	71	71	71	71	71	65	65	65	65	49	49
	Hourly NMLs	55	51	47	51	55	61	68	72	72	72	72	71	71	71	72	71	71	71	66	66	65	65	63	58
	Adopted NMLs	49	49	49	49	49	58	58	71	71	71	71	71	71	71	71	71	71	71	65	65	65	65	57	57



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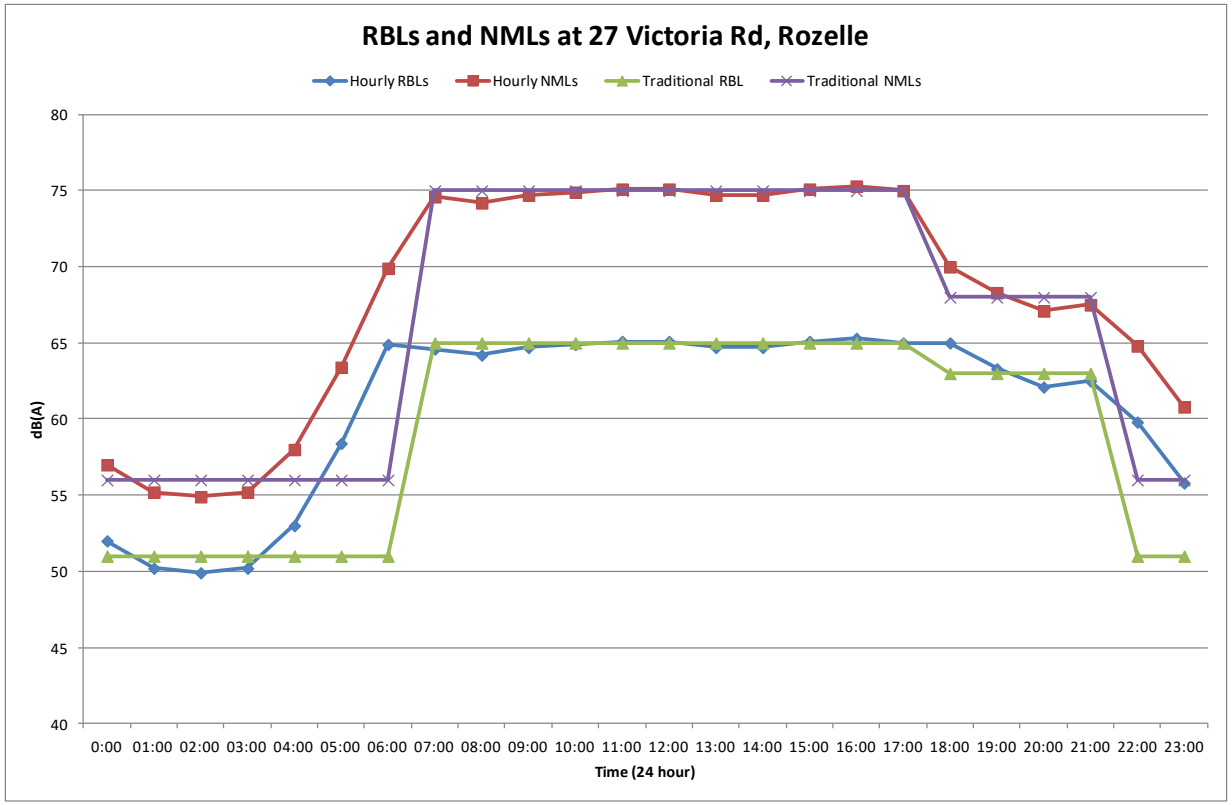
R04 27 Victoria Rd, Rozelle (26/7/16 – 2/8/16)	Traditional RBLs	51	51	51	51	51	51	51	65	65	65	65	65	65	65	65	65	65	65	63	63	63	63	51	51
	Hourly RBLs	52	50	50	50	53	58	65	65	64	65	65	65	65	65	65	65	65	65	65	63	62	63	60	56
	Adopted RBLs	51	51	51	51	51	58	58	65	65	65	65	65	65	65	65	65	65	65	63	63	63	63	57	57
	Traditional NMLs	56	56	56	56	56	56	56	75	75	75	75	75	75	75	75	75	75	75	68	68	68	68	56	56
	Hourly NMLs	57	55	55	55	58	63	70	75	74	75	75	75	75	75	75	75	75	75	70	68	67	68	65	61
	Adopted NMLs	56	56	56	56	56	63	63	75	75	75	75	75	75	75	75	75	75	75	68	68	68	68	62	62



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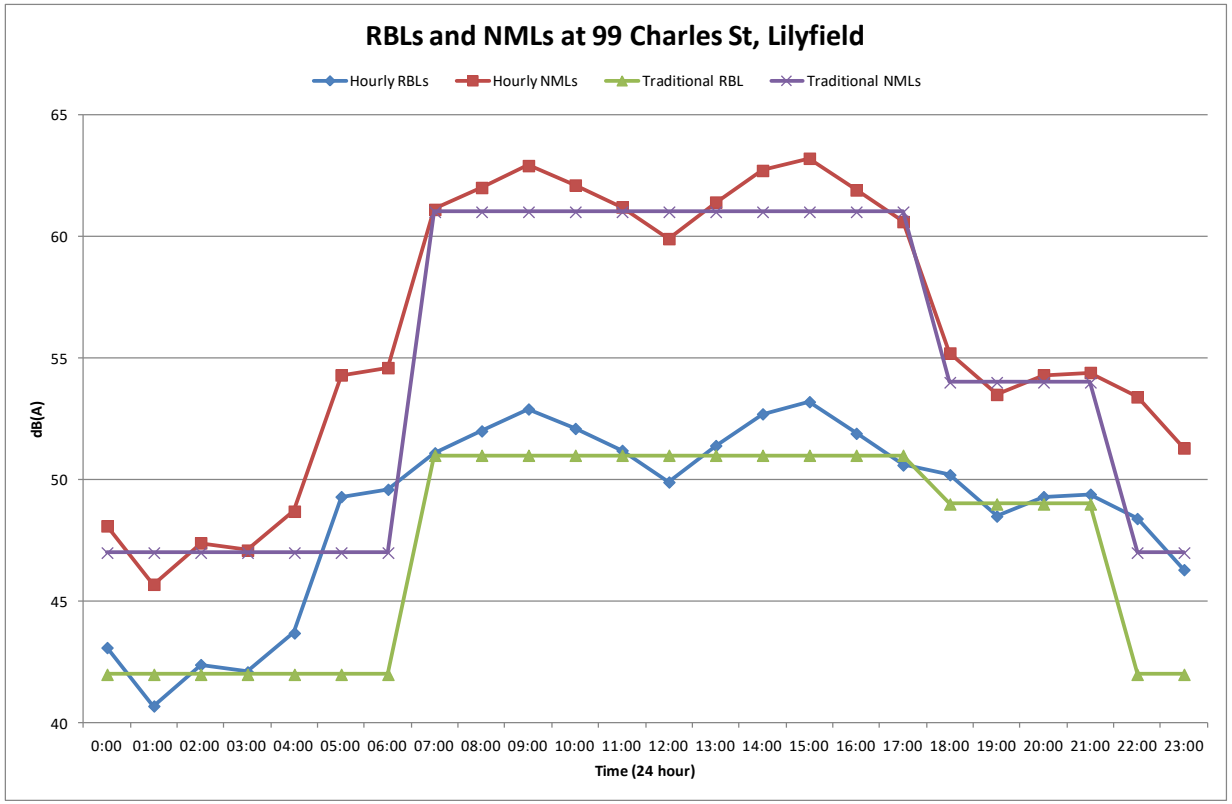
L02 99 Charles St, Lilyfield (19/9/16 – 27/9/16)	Traditional RBLs	42	42	42	42	42	42	42	51	51	51	51	51	51	51	51	51	51	51	49	49	49	49	42	42
	Hourly RBLs	43	41	42	42	44	49	50	51	52	53	52	51	50	51	53	53	52	51	50	49	49	49	48	46
	Adopted RBLs	42	42	42	42	42	47	47	51	51	51	51	51	51	51	51	51	51	51	49	49	49	49	46	46
	Traditional NMLs	47	47	47	47	47	47	47	61	61	61	61	61	61	61	61	61	61	61	54	54	54	54	47	47
	Hourly NMLs	48	46	47	47	49	54	55	61	62	63	62	61	60	61	63	63	62	61	55	54	54	54	53	51
	Adopted NMLs	47	47	47	47	47	52	52	61	61	61	61	61	61	61	61	61	61	61	54	54	54	54	51	51



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P01 62 Pyrmont Bridge Rd, Annandale (28/10/16 – 4/11/16)	Traditional RBLs	41	41	41	41	41	41	41	51	51	51	51	51	51	51	51	51	51	51	49	49	49	49	41	41
	Hourly RBLs	42	41	41	41	42	45	52	53	53	52	51	51	51	51	52	55	54	53	52	50	48	46	46	43
	Adopted RBLs	41	41	41	41	41	46	46	51	51	51	51	51	51	51	51	51	51	51	49	49	49	49	45	45
	Traditional NMLs	46	46	46	46	46	46	46	61	61	61	61	61	61	61	61	61	61	61	54	54	54	54	46	46
	Hourly NMLs	47	46	46	46	47	50	57	63	63	62	61	61	61	61	62	65	64	63	57	55	53	51	51	48
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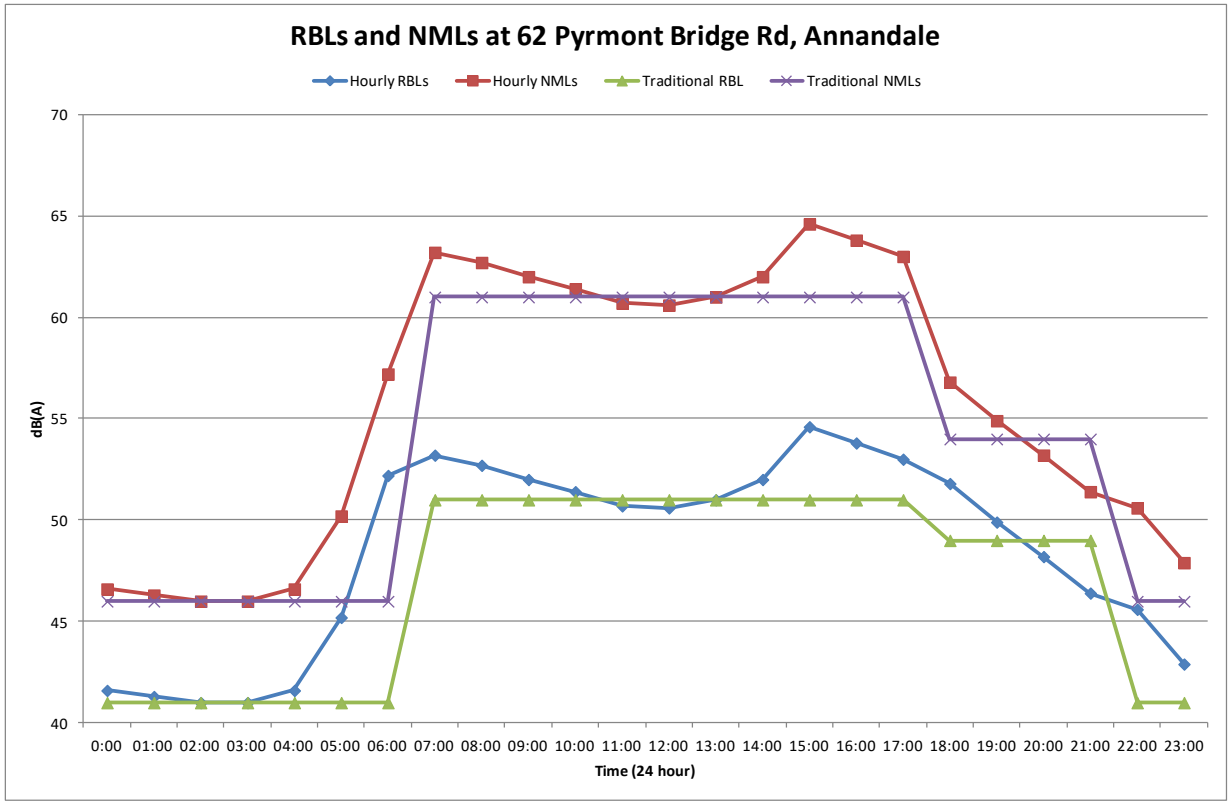

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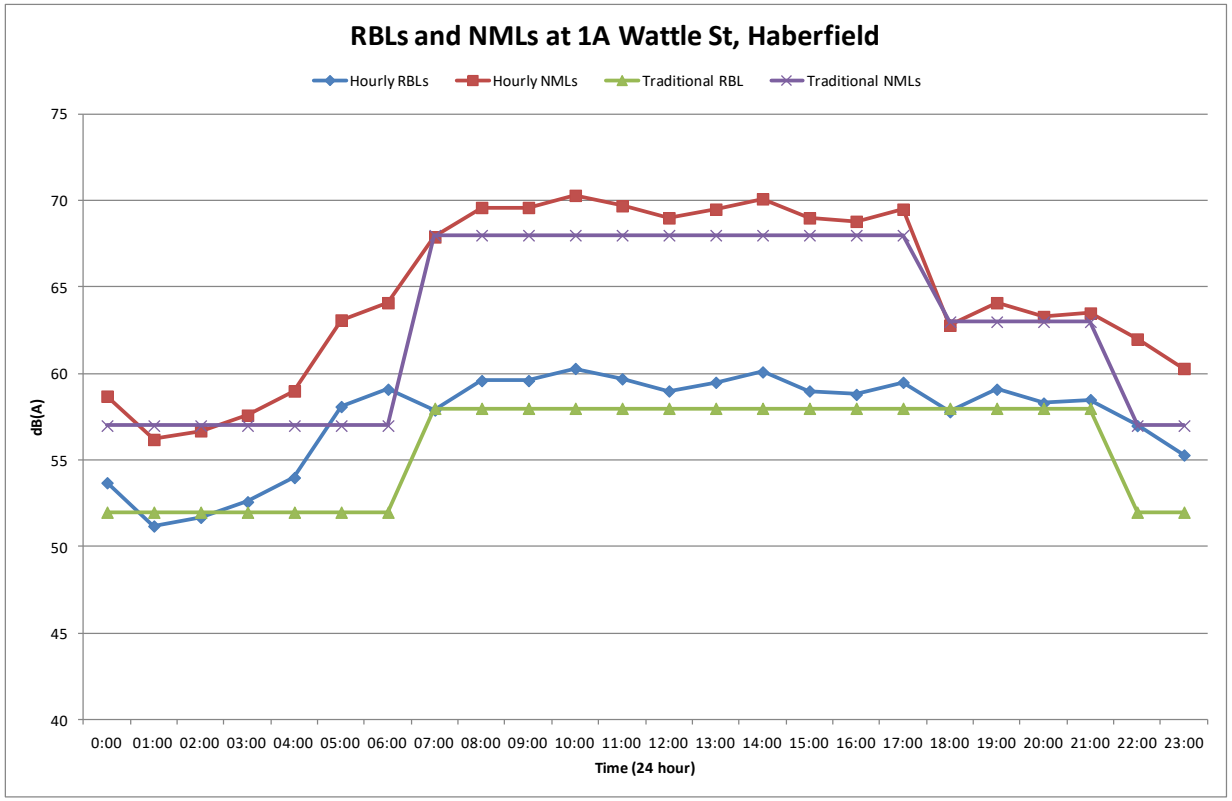
H01 1A Wattle St, Haberfield (26/3/14 – 8/4/14)	Traditional RBLs	52	52	52	52	52	52	52	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	52	52
	Hourly RBLs	54	51	52	53	54	58	59	58	60	60	60	60	59	60	60	59	59	60	58	59	58	59	57	55
	Adopted RBLs	52	52	52	52	52	55	55	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	55	55
	Traditional NMLs	57	57	57	57	57	57	57	68	68	68	68	68	68	68	68	68	68	68	63	63	63	63	57	57
	Hourly NMLs	59	56	57	58	59	63	64	68	70	70	70	70	69	70	70	69	69	70	63	64	63	64	62	60
	Adopted NMLs	57	57	57	57	57	60	60	68	68	68	68	68	68	68	68	68	68	68	63	63	63	63	60	60



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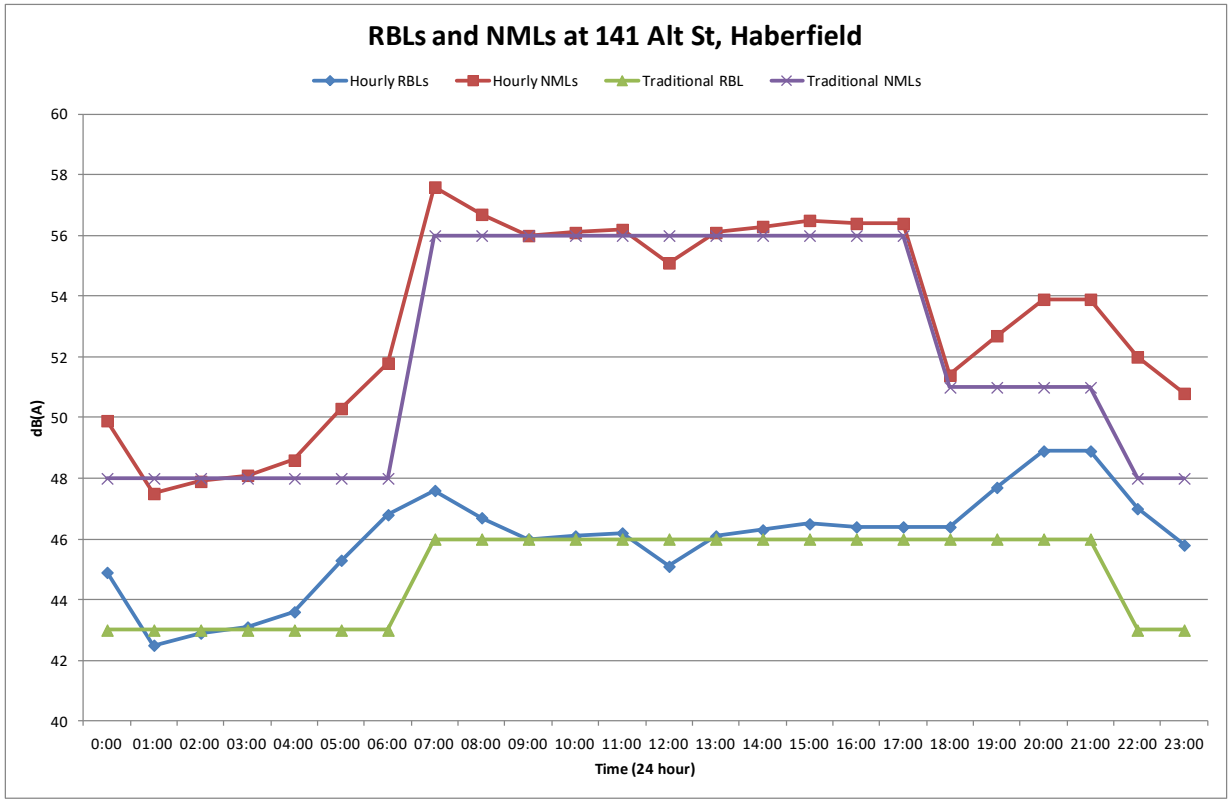
H02 141 Alt St, Haberfield (26/3/14 – 9/4/14)	Traditional RBLs	43	43	43	43	43	43	43	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	43	43
	Hourly RBLs	45	43	43	43	44	45	47	48	47	46	46	46	45	46	46	47	46	46	46	48	49	49	47	46
	Adopted RBLs	43	43	43	43	43	45	45	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	45	45
	Traditional NMLs	48	48	48	48	48	48	48	56	56	56	56	56	56	56	56	56	56	56	51	51	51	51	48	48
	Hourly NMLs	50	48	48	48	49	50	52	58	57	56	56	56	55	56	56	57	56	56	51	53	54	54	52	51
	Adopted NMLs	48	48	48	48	48	50	50	56	56	56	56	56	56	56	56	56	56	56	51	51	51	51	50	50



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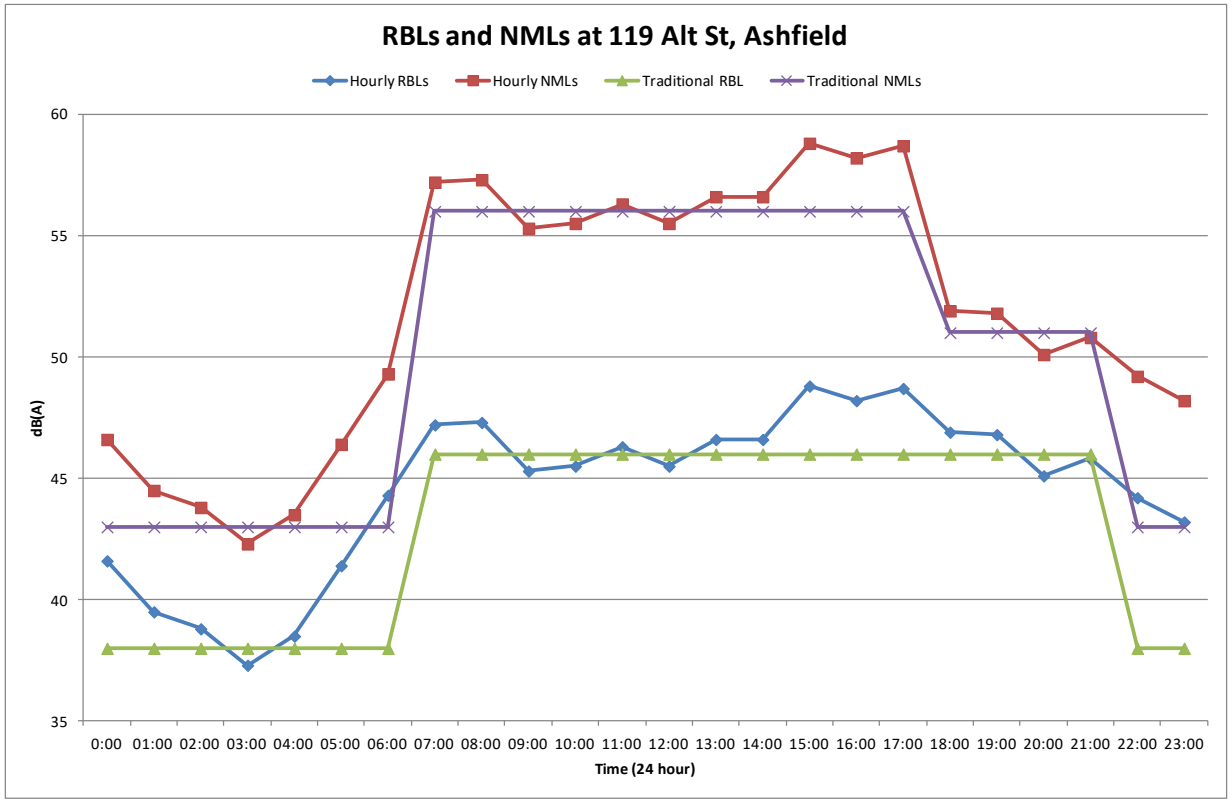
H03 119 Alt St, Ashfield (26/3/14 – 9/4/14)	Traditional RBLs	38	38	38	38	38	38	38	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	38	38
	Hourly RBLs	42	40	39	37	39	41	44	47	47	45	46	46	46	47	47	49	48	49	47	47	45	46	44	43
	Adopted RBLs	38	38	38	38	38	42	42	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	42	42
	Traditional NMLs	43	43	43	43	43	43	43	56	56	56	56	56	56	56	56	56	56	56	51	51	51	51	43	43
	Hourly NMLs	47	45	44	42	44	46	49	57	57	55	56	56	56	57	57	59	58	59	52	52	50	51	49	48
	Adopted NMLs	43	43	43	43	43	47	47	56	56	56	56	56	56	56	56	56	56	56	51	51	51	51	47	47



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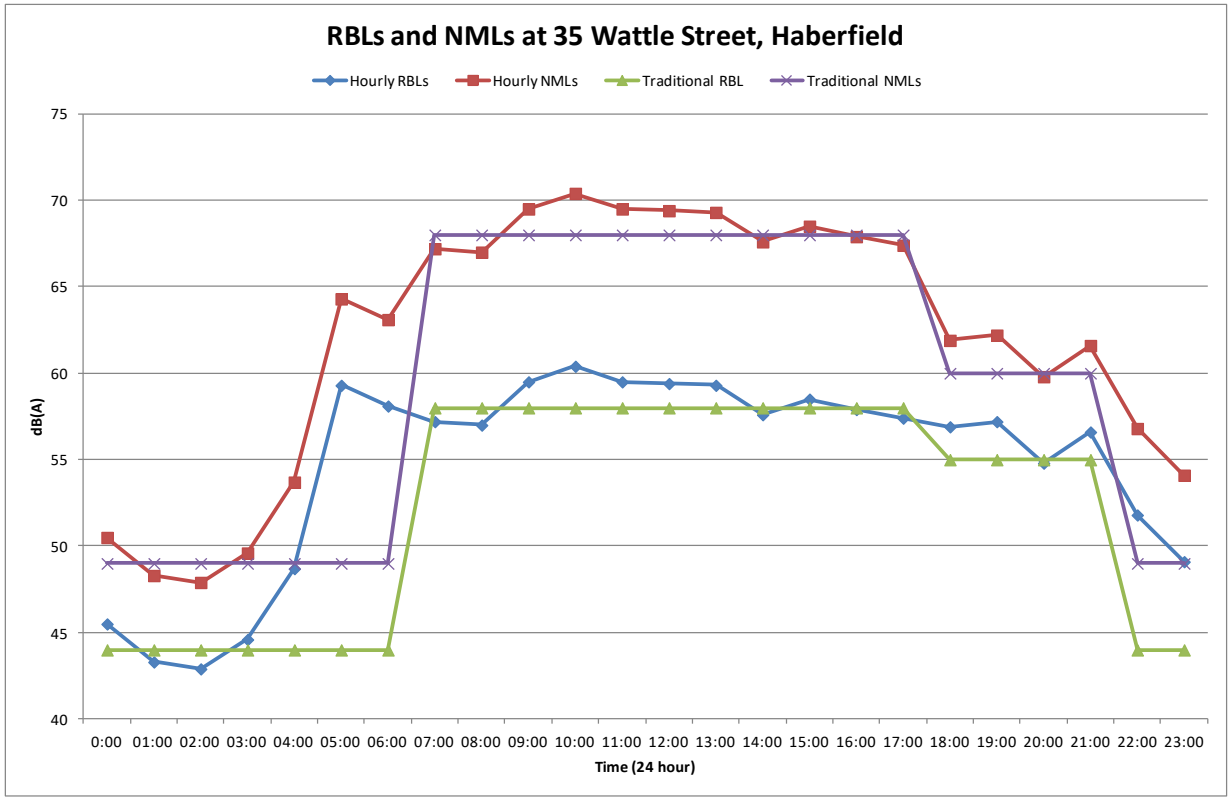
H04 35 Wattle St, Haberfield (26/3/14 – 4/4/14)	Traditional RBLs	44	44	44	44	44	44	44	58	58	58	58	58	58	58	58	58	58	58	55	55	55	55	44	44
	Hourly RBLs	46	43	43	45	49	59	58	57	57	60	60	60	59	59	58	59	58	57	57	57	55	57	52	49
	Adopted RBLs	44	44	44	44	44	51	51	58	58	58	58	58	58	58	58	58	58	58	55	55	55	55	50	50
	Traditional NMLs	49	49	49	49	49	49	49	68	68	68	68	68	68	68	68	68	68	68	60	60	60	60	49	49
	Hourly NMLs	51	48	48	50	54	64	63	67	67	70	70	70	69	69	68	69	68	67	62	62	60	62	57	54
	Adopted NMLs	49	49	49	49	49	56	56	68	68	68	68	68	68	68	68	68	68	68	60	60	60	60	55	55



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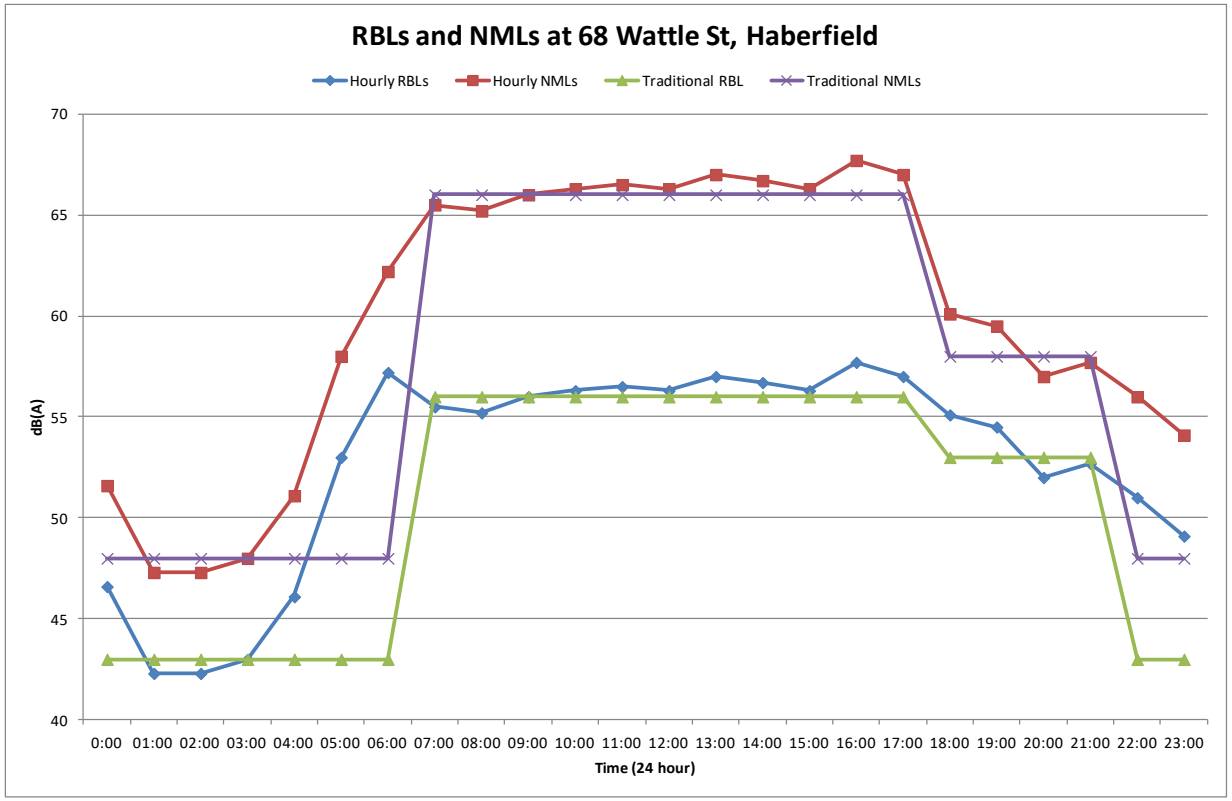
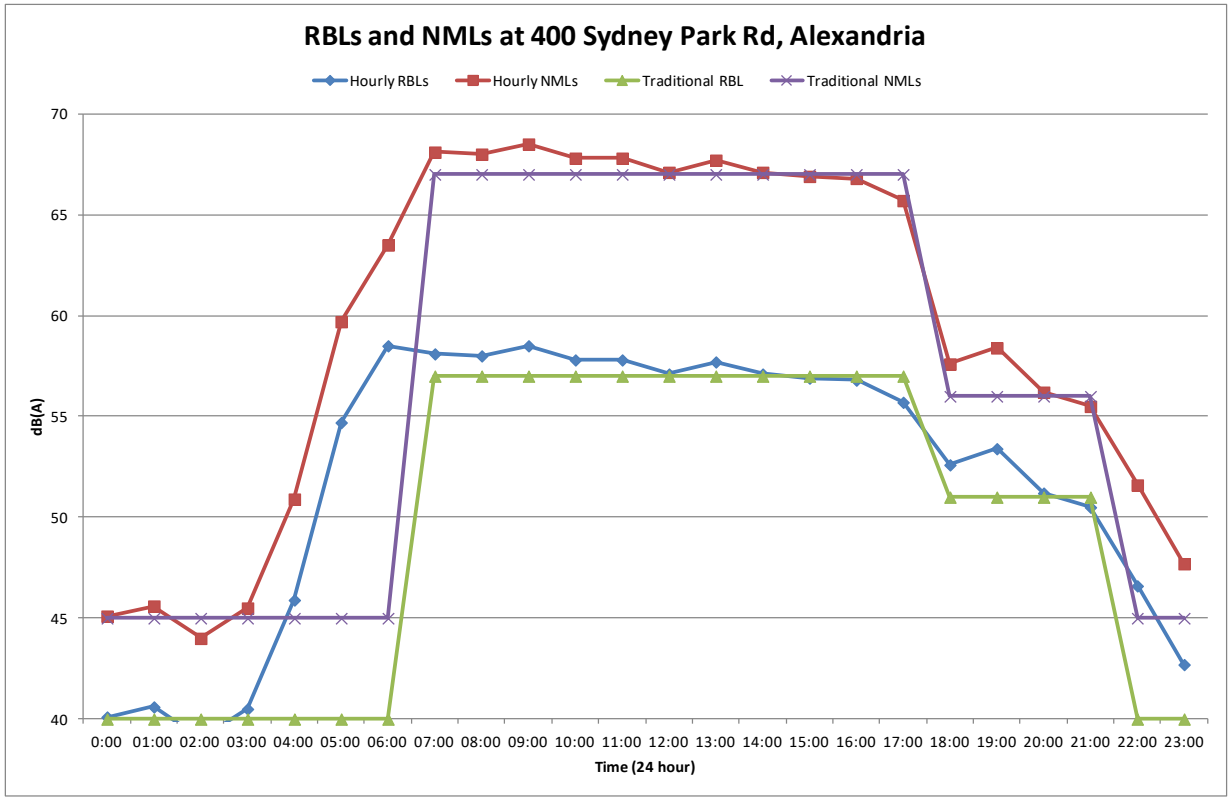
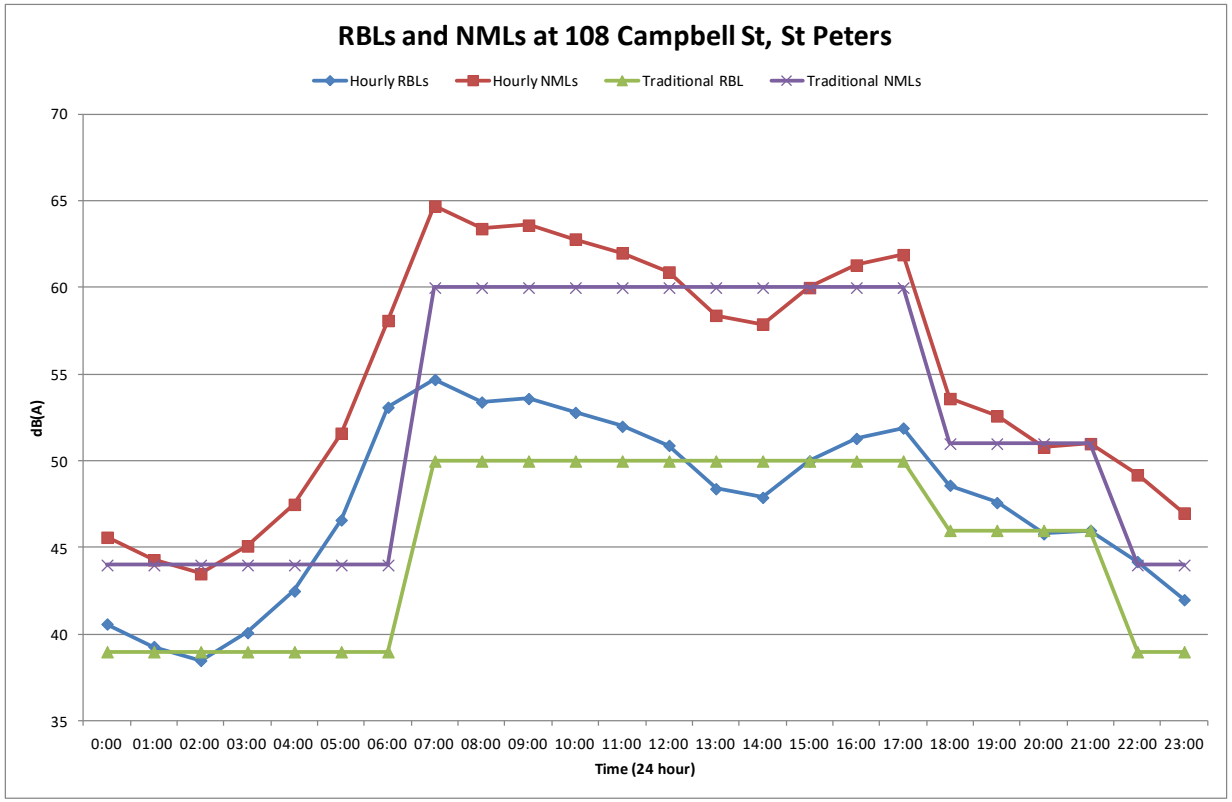
H06 68 Wattle St, Haberfield (26/3/14 – 9/4/14)	Traditional RBLs	43	43	43	43	43	43	43	56	56	56	56	56	56	56	56	56	56	56	53	53	53	53	43	43
	Hourly RBLs	47	42	42	43	46	53	57	56	55	56	56	57	56	57	57	56	58	57	55	55	52	53	51	49
	Adopted RBLs	43	43	43	43	43	50	50	56	56	56	56	56	56	56	56	56	56	56	53	53	53	53	48	48
	Traditional NMLs	48	48	48	48	48	48	48	66	66	66	66	66	66	66	66	66	66	66	58	58	58	58	48	48
	Hourly NMLs	52	47	47	48	51	58	62	66	65	66	66	67	66	67	67	66	68	67	60	60	57	58	56	54
	Adopted NMLs	48	48	48	48	48	55	55	66	66	66	66	66	66	66	66	66	66	66	58	58	58	58	53	53



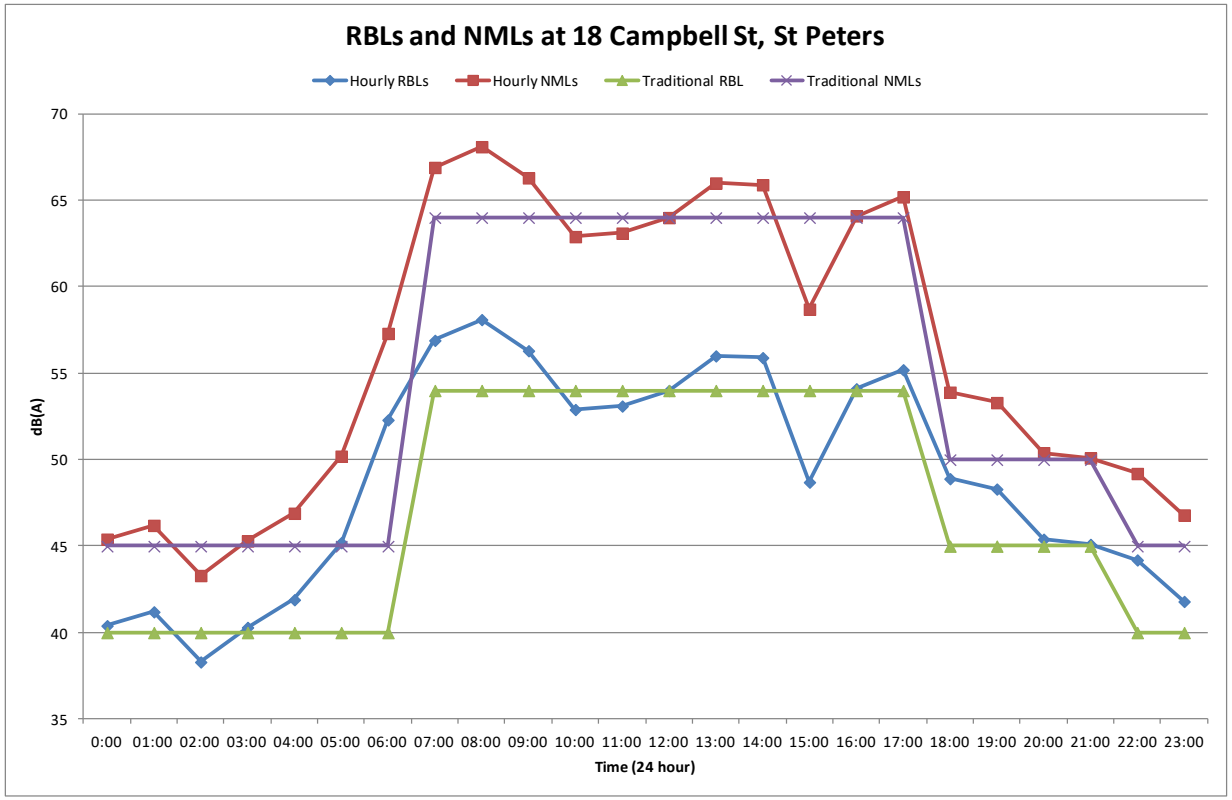
ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
S01 400 Sydney Park Rd, Alexandria (5/12/14 – 19/12/14)	Traditional RBLs	40	40	40	40	40	40	40	57	57	57	57	57	57	57	57	57	57	57	51	51	51	51	40	40
	Hourly RBLs	40	41	39	41	46	55	59	58	58	59	58	58	57	58	57	57	57	56	53	53	51	51	47	43
	Adopted RBLs	40	40	40	40	40	49	49	57	57	57	57	57	57	57	57	57	57	57	51	51	51	51	46	46
	Traditional NMLs	45	45	45	45	45	45	45	67	67	67	67	67	67	67	67	67	67	67	56	56	56	56	45	45
	Hourly NMLs	45	46	44	46	51	60	64	68	68	69	68	68	67	68	67	67	67	66	58	58	56	56	52	48
	Adopted NMLs	45	45	45	45	45	54	54	67	67	67	67	67	67	67	67	67	67	67	56	56	56	56	51	51



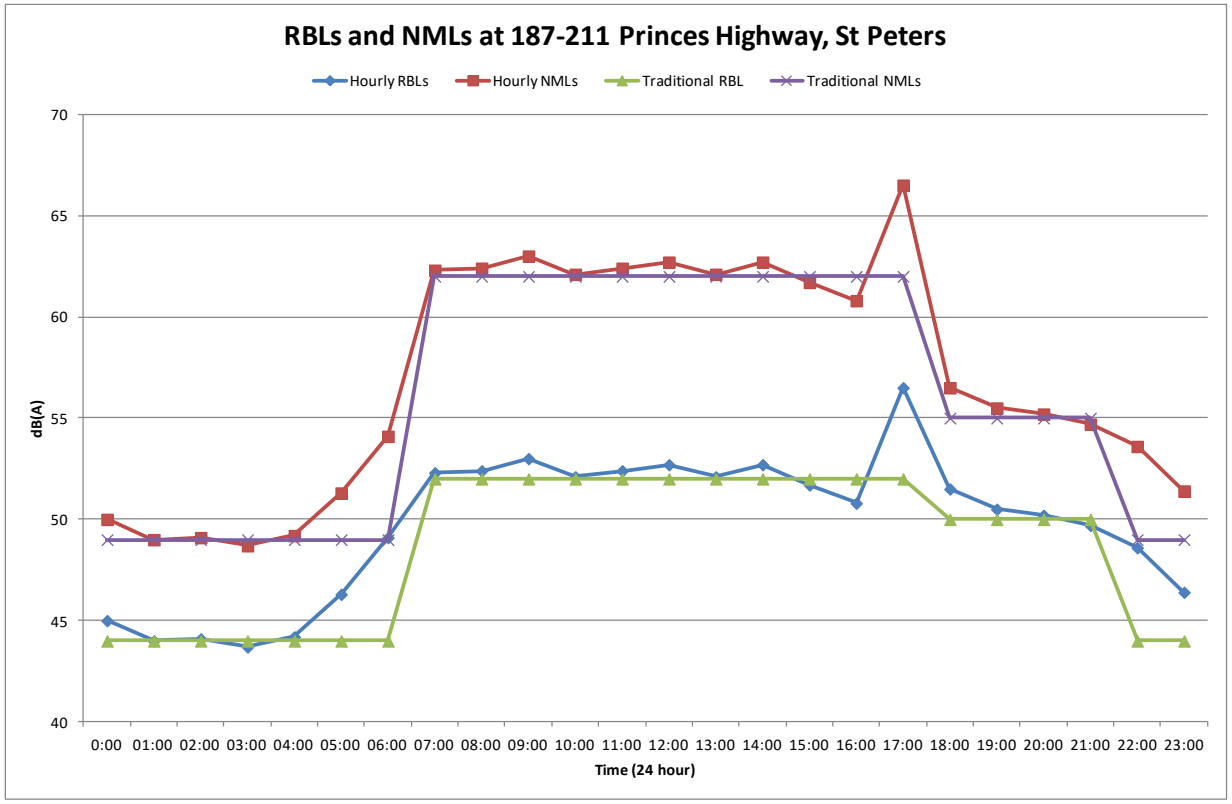
ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
S02 108 Campbell St, St Peters (31/8/15 – 10/9/15)	Traditional RBLs	39	39	39	39	39	39	39	50	50	50	50	50	50	50	50	50	50	50	46	46	46	46	39	39
	Hourly RBLs	41	39	39	40	43	47	53	55	53	54	53	52	51	48	48	50	51	52	49	48	46	46	44	42
	Adopted RBLs	39	39	39	39	39	45	45	50	50	50	50	50	50	50	50	50	50	50	46	46	46	46	43	43
	Traditional NMLs	44	44	44	44	44	44	44	60	60	60	60	60	60	60	60	60	60	60	51	51	51	51	44	44
	Hourly NMLs	46	44	44	45	48	52	58	65	63	64	63	62	61	58	58	60	61	62	54	53	51	51	49	47
	Adopted NMLs	44	44	44	44	44	50	50	60	60	60	60	60	60	60	60	60	60	60	51	51	51	51	48	48



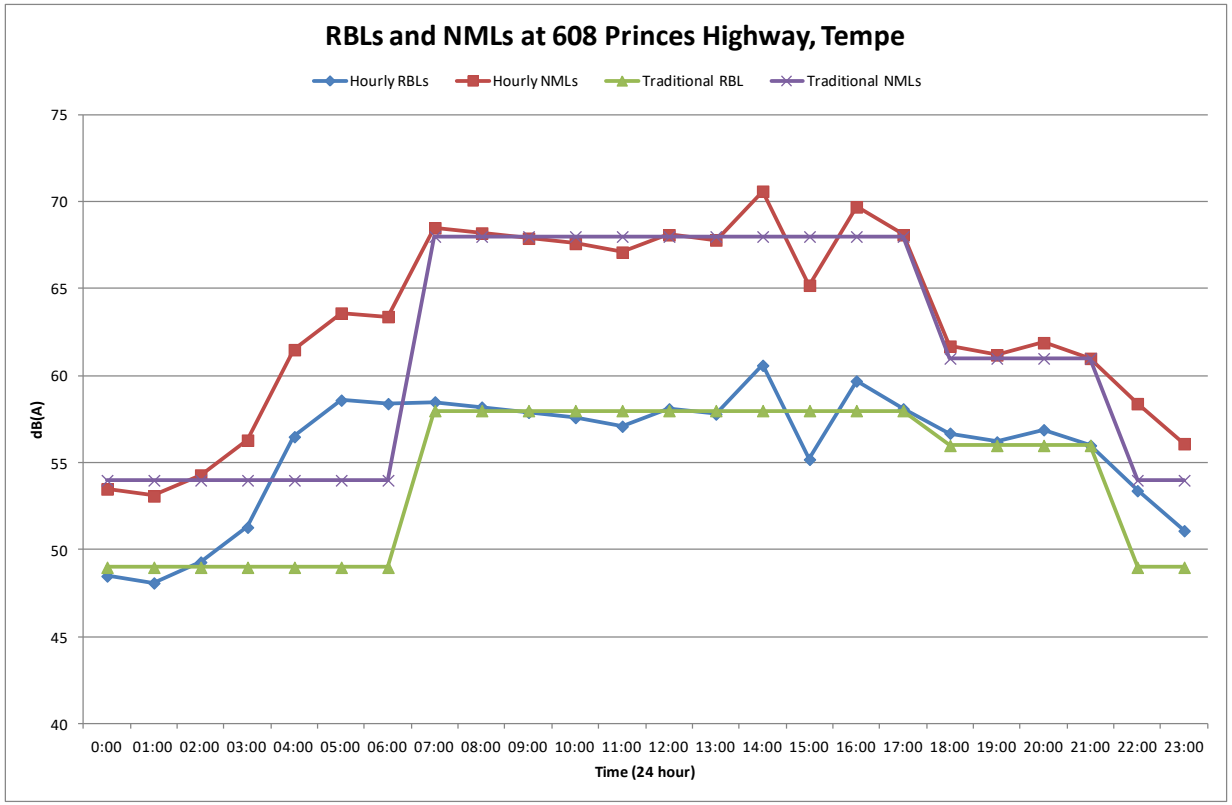
ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
S03 18 Campbell St, St Peters (5/12/14 – 21/12/14)	Traditional RBLs	40	40	40	40	40	40	40	54	54	54	54	54	54	54	54	54	54	54	45	45	45	45	40	40
	Hourly RBLs	40	41	38	40	42	45	52	57	58	56	53	53	54	56	56	49	54	55	49	48	45	45	44	42
	Adopted RBLs	40	40	40	40	40	47	47	54	54	54	54	54	54	54	54	54	54	54	45	45	45	45	43	43
	Traditional NMLs	45	45	45	45	45	45	45	64	64	64	64	64	64	64	64	64	64	64	50	50	50	50	45	45
	Hourly NMLs	45	46	43	45	47	50	57	67	68	66	63	63	64	66	66	59	64	65	54	53	50	50	49	47
	Adopted NMLs	45	45	45	45	45	52	52	64	64	64	64	64	64	64	64	64	64	64	50	50	50	50	48	48



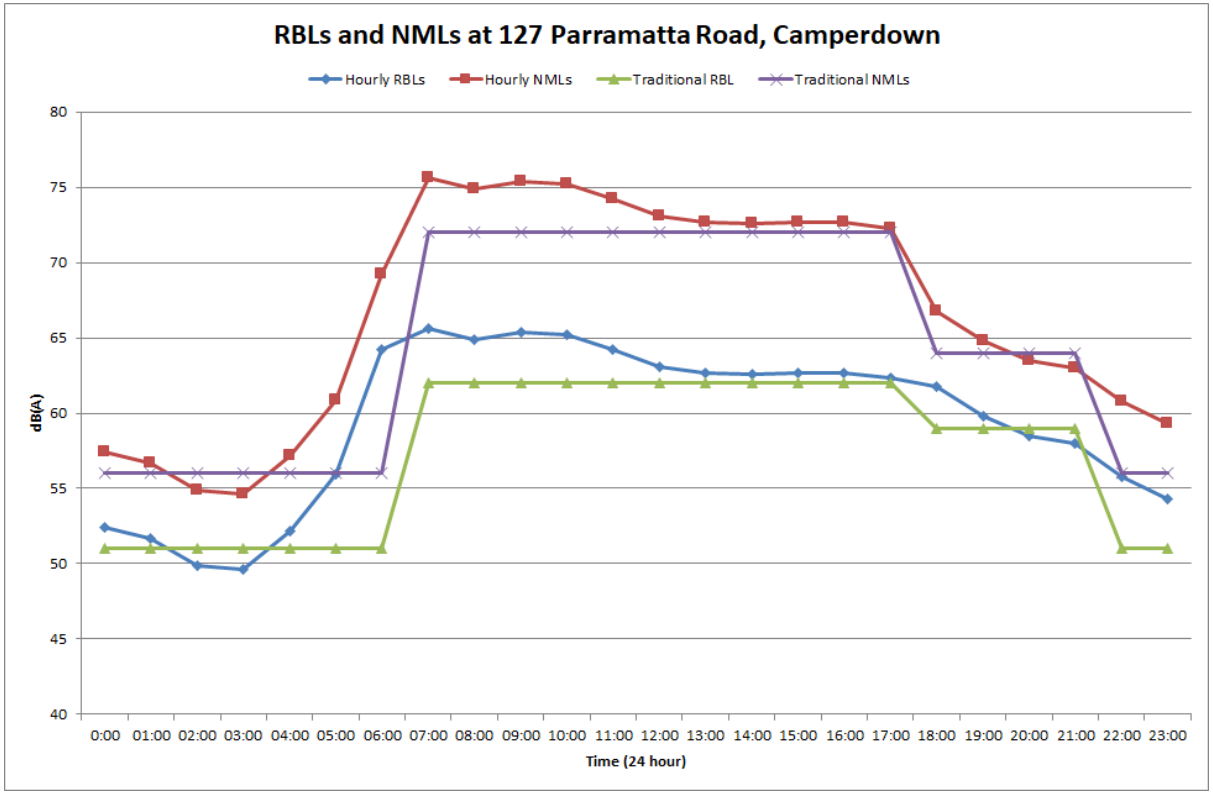
ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
S04 187-211 Princes Highway, St Peters (5/12/14 – 19/12/14)	Traditional RBLs	44	44	44	44	44	44	44	52	52	52	52	52	52	52	52	52	52	52	50	50	50	50	44	44
	Hourly RBLs	45	44	44	44	44	46	49	52	52	53	52	52	53	52	53	52	51	57	52	51	50	50	49	46
	Adopted RBLs	44	44	44	44	44	48	48	52	52	52	52	52	52	52	52	52	52	52	50	50	50	50	47	47
	Traditional NMLs	49	49	49	49	49	49	49	62	62	62	62	62	62	62	62	62	62	62	55	55	55	55	49	49
	Hourly NMLs	50	49	49	49	49	51	54	62	62	63	62	62	63	62	63	62	61	67	57	56	55	55	54	51
	Adopted NMLs	49	49	49	49	49	53	53	62	62	62	62	62	62	62	62	62	62	62	55	55	55	55	52	52



ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
S05 608 Princes Highway, Tempe (5/12/14 – 19/12/14)	Traditional RBLs	49	49	49	49	49	49	49	58	58	58	58	58	58	58	58	58	58	58	56	56	56	56	49	49
	Hourly RBLs	49	48	49	51	57	59	58	59	58	58	58	57	58	58	61	55	60	58	57	56	57	56	53	51
	Adopted RBLs	49	49	49	49	49	54	54	58	58	58	58	58	58	58	58	58	58	58	56	56	56	56	53	53
	Traditional NMLs	54	54	54	54	54	54	54	68	68	68	68	68	68	68	68	68	68	68	61	61	61	61	54	54
	Hourly NMLs	54	53	54	56	62	64	63	69	68	68	68	67	68	68	71	65	70	68	62	61	62	61	58	56
	Adopted NMLs	54	54	54	54	54	59	59	68	68	68	68	68	68	68	68	68	68	68	61	61	61	61	58	58



ID	Time	0:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
EMM01 127 Parramatta Rd, Camperdown (24/10/18 – 9/11/18)	Traditional RBLs	51	51	51	51	51	51	51	62	62	62	62	62	62	62	62	62	62	62	59	59	59	59	51	51
	Hourly RBLs	52	52	50	50	52	56	64	66	65	65	65	64	63	63	63	63	63	62	62	60	59	58	56	54
	Adopted RBLs	51	51	51	51	51	57	57	62	62	62	62	62	62	62	62	62	62	62	59	59	59	59	55	55
	Traditional NMLs	56	56	56	56	56	56	56	72	72	72	72	72	72	72	72	72	72	72	64	64	64	64	56	56
	Hourly NMLs	57	57	55	55	57	61	69	76	75	75	75	74	73	73	73	73	73	72	67	65	64	63	61	59
	Adopted NMLs	56	56	56	56	56	62	62	72	72	72	72	72	72	72	72	72	72	72	64	64	64	64	60	60



Appendix I RBL and NML data by Noise Catchment Area

Noise Catchment Area (NCA)	Day		Evening		Night		Shoulder Period (5am - 7am)		Shoulder Period (10pm - 12am)	
	RBL (dBA)	NML (dBA)	RBL (dBA)	NML (dBA)	RBL (dBA)	NML (dBA)	RBL (dBA)	NML (dBA)	RBL (dBA)	NML (dBA)
0	46	56	46	51	38	43	42	47	42	47
1	46	56	46	51	38	43	42	47	42	47
2	58	68	58	63	52	57	55	60	55	60
3	58	68	55	60	44	49	51	56	50	55
4	56	66	53	58	43	48	50	55	48	53
5	51	61	49	54	42	47	47	52	46	51
6	46	56	46	51	43	48	45	50	45	50
7	46	56	46	51	43	48	45	50	45	50
9	51	61	49	54	42	47	47	52	46	51
10	51	61	49	54	42	47	47	52	46	51
11	51	61	49	54	42	47	47	52	46	51
12	51	61	47	52	40	45	46	51	44	49
13	51	61	47	52	40	45	46	51	44	49
14	51	61	47	52	40	45	46	51	44	49
25	51	61	51	56	45	50	48	53	48	53
26	65	75	63	68	51	56	58	63	57	62
29	61	71	60	65	44	49	53	58	52	57
40	51	61	49	54	41	46	46	51	45	50
41	51	61	49	54	41	46	46	51	45	50
42	51	61	49	54	41	46	46	51	45	50
43	51	61	49	54	41	46	46	51	45	50
44	51	61	49	54	41	46	46	51	45	50
46	57	67	51	56	40	45	49	54	46	51
47	57	67	51	56	40	45	49	54	46	51
48	57	67	51	56	40	45	49	54	46	51
49	54	64	45	50	40	45	47	52	43	48
50	52	62	50	55	44	49	48	53	47	52
51	50	60	46	51	39	44	45	50	43	48
52	50	60	46	51	39	44	45	50	43	48
54	58	68	56	61	49	54	54	59	53	58
55	58	68	56	61	49	54	54	59	53	58
56	62	72	59	64	51	56	57	62	55	60