WestConnex
Rozelle Interchange

JOHN HOLLAND | CPB CONTRACTORS

JHCPB Joint Venture

Noise and Vibration Management Plan

RIC-JHC-MPL-00-PL-290-001

Project	Design and Construction of Rozelle Interchange Project
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Document Approval

Developed By:	
Name: [redacted]	Position: [redacted]

Reviewed By:		
Name	Position	Date Reviewed
[redacted]	[redacted]	[redacted]

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Glossary / Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
ABL	Assessment Background Level
Acoustic enclosure	Can include an engineered and designed shed or enclosure, with airborne noise pathways minimised and treated where feasible and reasonable, endeavouring to achieve the Noise Management Levels in the Interim Construction Noise Guidelines (DECC, 2009). Example treatments include noise curtains, shipping containers, acoustic barriers or fast operating doors to limit breakout noise from enclosures.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline (DEC 2006)
CS	Communication Strategy
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CNVIS	Construction Noise and Vibration Impact Statement
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 EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DPIE	NSW Department of Planning, Industry and Environment
ECRTN	Environmental Criteria for Road Traffic Noise (EPA 1999)
EIS	WestConnex M4-M5 Link Environmental Impact Statement
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.
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ER	Environmental Representative
Feasible and reasonable	Feasible means actions to reduce impacts and is capable of being put into practice or engineered and practical to build given Project constraints. Reasonable means selecting reasonable measures from those that are feasible based on whether the overall benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.
GBNML	Ground-borne noise management level

Haulage and delivery of spoil and material	Including spoil and materials handling, tunnel logistics, tunnelling equipment transportation, concrete deliveries, and spoil truck movements and layby that are essential to be undertaken outside of standard construction hours to facilitate 24/7 tunnelling activities and are generally completed within an acoustic enclosure.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
INP	NSW Industrial Noise Policy (EPA, 2000)
JHCPB	John Holland CPB Contractors Joint Venture
$L_{Aeq\ (15min)}$	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.
$L_{A1(1min)}$	The A-weighted noise level from the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 1% of the 1 minute measurement period.
$L_{A90\ (15min)}$	The A-weighted noise level excluding the construction works under consideration, measured using the fast time weighting on a sound level meter, which is exceeded for more than 90% of the 15 minute measurement period.
LGA	Local Government Area
MWD	Minimum Working Distance
NCA	Noise Catchment Areas
NML	Noise management levels
NSR	Noise Sensitive Receivers
NVMP	Noise and Vibration Management Plan (this document)
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
ONVR	Operational Noise and Vibration Review
PPV	Peak Particle Velocity
the Project	Design and Construction of Rozelle Interchange Project
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)
REMMs	Revised Environmental Management Measures
RNP	NSW Road Noise Policy (DECCW 2011)
Roads and Maritime	Roads and Maritime Services
SPIR	M4-M5 Link Submissions and Preferred Infrastructure Report
Standard construction hours	Hours during which construction work is permitted by the CoA. Further defined in Section 5.1.1.
TfNSW	Transport for NSW (former Roads and Maritime Services)
Works	All physical activities to construct or facilitate the construction of the Project, including environmental management measures and utility works.

1. Introduction

1.1. Context

This Noise and Vibration Management Sub Plan (NVMP) forms part of the Construction Environmental Management Plan (CEMP) for the Design and Construction of Rozelle Interchange Project (the Project).

This NVMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), Project Approvals and all applicable guidance and legislation.

1.2. Background and Project description

The Rozelle Interchange project is part of the M4-M5 Link and will provide a new underground motorway interchange with access via City West Link and provide a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge, with links to the future Western Harbour Tunnel. WestConnex M4-M5 Link EIS (AECOM 2017) assessed noise and vibration impacts on sensitive receivers and structures from construction of the Project.

As part of the EIS development, a detailed construction and operational noise and vibration assessment was prepared to address the Environmental Assessment Requirements issued by the Department of Planning, Industry and Environment (DPIE). The noise and vibration assessment was included in the EIS, within Chapter 10 and the Noise and Vibration Technical Working Paper (Appendix J of the EIS).

The EIS concluded that sensitive receivers in the vicinity of the Project would be impacted upon by noise and vibration from the construction works, however these impacts would be managed through the implementation of mitigation and management measures described in this NVMP.

The Project description is outlined in section 1.3 of the CEMP.

1.3. Scope of the Sub-Plan

The scope of this NVMP is to describe how John Holland CPB Contractors Joint Venture (JHCPB) proposes to manage potential noise and vibration impacts during construction of the Project. This sub-plan relates to the Project works and activities described in the WestConnex M4-M5 Link Planning Approval, specifically those works listed under Stage 2 of the A12 Staging Report.

Operational noise and vibration impacts and operation measures do not fall within the scope of this NVMP and therefore are not included within the processes contained within this NVMP.

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 NVMP is to describe how JHCPB 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, REMMs 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,
- CoA granted to the Project on 17 April 2018 and as subsequently modified,
- Roads and Maritime QA Specification G36,
- The Project's Environment Protection Licence (EPL #21278) issued on 18 June 2019 with a Section 58 Licence Variation issued on 18 August 2020, and
- All relevant legislation and other requirements described in Section 3.1 of this NVMP.

2.3. Environmental Performance Outcomes and Targets

The desired environmental performance outcome for noise and vibration management, as outlined and addressed in the EIS, is that:

- Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on acoustic amenity, and
- Construction noise and vibration (including airborne noise, ground-borne noise and blasting) are effectively managed to minimise adverse impacts on the structural integrity of buildings and items including Aboriginal places and environmental heritage.

To achieve these performance outcomes, JHCPB has set key Project outcomes and targets in Table 1.

Table 1: Performance outcomes

No.	Performance Outcome	How performance outcome will be addressed	Records	Source
1	Minimise increases in road traffic noise	Implement the mitigation measures in Table 20 MMNV3-MMNV6 Implement the processes outlined in Section 5.4 and Section 8.7	Monitoring records	EIS, Appendix A
2	Effective management of construction noise and vibration in accordance with relevant guidelines.	Implement the mitigation measures in Table 20 Implement the processes outlined in Section 8 Prepare Construction Noise and Vibration Impact Statements (CNVIS) and implement noise and vibration mitigation and management measures. Undertake training, monitoring and inspections, auditing and recording (refer to Section 9 and Annexure B)	Weekly environmental inspection records Construction Noise and Vibration Impact Statements Inspection records Monitoring records Consultation records Complaints register	EIS, Appendix A
3	No damage to features of heritage conservation significance from vibration generated by the Project works.	Implement the mitigation measures in Table 20 MMNV33 Implement the processes in Section 5.5.3 Construction Noise and Vibration Impact Statements (CNVIS) for each works site identifying how	Construction Noise and Vibration Impact Statements Monitoring records Pre- and post-condition surveys	EIS, Appendix A

		works and activities at each worksite will be managed to satisfy specific vibration goals.		
4	Ensure full compliance with the relevant legislative requirements, CoA and REMM	Implement the mitigation measures in Table 20 Prepare and implement this Plan, which sets the framework for managing noise and vibration from construction Undertake training, monitoring and inspections, auditing and recording (refer to Section 9 and Annexure B)	Construction Noise and Vibration Impact Statements Inspection records Audit reports Compliance reports Monitoring records	CoA A1
5	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)	Implement the mitigation measures in Table 20 Prepare Construction Noise and Vibration Impact Statements (CNVIS) for each works site and implement identified specific noise mitigation and management measures (where reasonable and feasible) to satisfy the noise management levels in the Interim Construction Noise Guideline. Undertake training, monitoring and inspections, auditing and recording (refer to Section 9 and Annexure B)	Construction Noise and Vibration Impact Statements Inspection records Monitoring records	ICNG
6	Potential construction impacts are minimised for construction-fatigued community and stakeholders through the implementation of the Noise Insulation program.	Prepare and implement a Noise Insulation Program. Provide treatment to eligible receivers (refer to Section 8.2.1)	Noise Insulation Program Inspection records Audit reports Compliance reports	CoA E88

3. Environmental Requirements

3.1. Relevant Legislation

3.1.1. Legislation

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

- *Protection of the Environment Operations Act 1997.*

Relevant provisions of the above legislation are explained in the legal and compliance tracking register included in Annexure A of the CEMP.

3.1.2. Guidelines

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

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System),
- Roads and Maritime Construction Noise and Vibration Guideline (Roads and Maritime 2016),
- NSW Interim Construction Noise Guideline (ICNG), Department of Environment and Climate Change 2009,
- NSW Road Noise Policy, Department of Environment, Climate Change and Water 2011,
- NSW Industrial Noise Policy, Environment Protection Authority 2000,
- NSW Assessing Vibration – a technical guideline (AVTG), Department of Environment and Conservation 2006,
- NSW Noise Policy for Industry, Environment Protection Authority 2017,
- 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 AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance 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', and
- German Standard DIN4150-2016 Vibrations in buildings – Part 3: Effects on structures.
- RTA Environmental Noise Management Manual 2001.

3.2. Minister's Conditions of Approval

The CoA relevant to this NVMP are listed in Table 2 below. A cross reference is also included to indicate where the condition is addressed in this NVMP or other Project management documents. Specific CoA relevant to noise and vibration management for the Project are included within Annexure A.

Table 2: 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>Section 3.5</td><td>This NVMP has been prepared in accordance with this condition and describes how JHCPB proposes to manage noise and vibration during construction of the Project.
Relevant councils include; Inner West Council, City of Sydney and Canada Bay Council.</td></tr>
<tr><td>C5</td><td colspan="3">The CEMP Sub-plans must state how:</td></tr>
<tr><td></td><td>(a) The environmental performance outcomes identified in the documents listed in Condition A1 as modified by these conditions will be achieved</td><td>Section 2.3</td><td>This NVMP was prepared in accordance with the environmental performance outcomes identified in the documents listed in Condition A1 and is evidenced primarily in Section 2.3 and Table 1.</td></tr>
<tr><td></td><td>(b) The mitigation measures identified in the documents listed in Condition A1 as modified by these conditions will be implemented</td><td>Table 20</td><td>The implementation of noise and vibration management and mitigation measures identified in the documents listed in Condition A1 are listed in Table 20.</td></tr>
<tr><td></td><td>(c) The relevant terms of this approval will be complied with; and</td><td>Section 3.2
Annexure A</td><td>Details regarding how JHCPB proposes to comply with the relevant terms of approval are listed in this Table and in Annexure A.</td></tr>
</table>

<table>
<tr><td></td><td>(d) Issues requiring management during construction (including cumulative impacts), as identified through ongoing environmental risk analysis, will be managed.</td><td>Section 6.2
Table 18
Table 20
Section 7.3
Section 8
Section 9
Environmental Risk Assessment Workshop
(Section 3.2.1 of CEMP)</td><td>Noise and vibration issues requiring management during construction of the Project have been identified through the documents listed in Condition A1 and Environmental Risk Assessment Workshop. These issues including cumulative impacts have been detailed in Section 6.2 of this NVMP and Appendix B 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 20, Annexure A and Appendix B of the CEMP.</td></tr>
<tr><td>C6</td><td>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.</td><td>Refer to Section 2.2 of the CEMP</td><td>The NVMP has been endorsed by the ER (letter dated 27 May 2019).
The NVMP will be submitted to DPIE for approval no later than one month prior to the commencement of the construction activities.</td></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 NVMP has been submitted for approval to DPIE subsequent to the submission of the CEMP for DPE 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 DPE. 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 (Annexure B)

Annexure G</td><td>The Noise and Vibration Monitoring Program has been prepared in accordance with this condition and describes how JHCPB propose to undertake noise and vibration monitoring during construction of the Project.
Relevant councils include; Inner West Council, City of Sydney and Canada Bay Council.</td></tr>
</table>

C10	Each Construction Monitoring Program must provide:		
	(a) Details of baseline data available	Section 4.3.1 Annexure G Section 4 of the Noise and Vibration Monitoring Program (Annexure B) EIS – Section 3 of Appendix J (Technical Working Paper: Noise and Vibration)	Baseline monitoring undertaken for the Project is described in Section 4.3.1. Baseline noise monitoring was utilised to determine the appropriate Rating Background Levels (RBLs) and Noise Management Levels (NMLs), which are included in Annexure G. Further information regarding available baseline noise and vibration data is outlined in Section 4 of the Noise and Vibration Monitoring Program with further references to Section 3 of the EIS Appendix J (Technical Working Paper: Noise and Vibration).
	(b) Details of baseline data to be obtained and when	Section 4 of the Noise and Vibration Monitoring Program (Annexure 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.
C10 (cont.)	(c) Details of all monitoring of the Project to be undertaken	Section 5 and 6 of the Noise and Vibration Monitoring Program (Annexure B)	Details of all monitoring to be undertaken for the Project are outlined in Sections 5 and 6 of the Noise and Vibration Monitoring Program.
	(d) The parameters of the Project to be monitored	Section 5.1.1, 5.2.1, 5.3.1, 6.1.1 and 6.2.1 of the Noise and Vibration Monitoring Program (Annexure B)	The parameters the Project is to monitor 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 (Annexure 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 (Annexure B)	The noise and vibration monitoring locations are outlined in Sections 5 and 6 of the Noise and Vibration Monitoring Program.
	(g) The reporting of monitoring and analysis results against relevant criteria	Section 10 of the Noise and Vibration Monitoring Program (Annexure 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 5 and Section 9 of the Noise and Vibration Monitoring Program (Annexure B)	Noise monitoring to be undertaken during construction of the Project is described in Section 5 of the Noise and Vibration Monitoring Program. Methods that will be used to analyse the data 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 (Annexure 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 (Annexure 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 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 (Annexure B)	Real time noise monitoring undertaken to satisfy Condition C11, is detailed in Section 5.3 of the Noise and Vibration Monitoring Program. Real time vibration monitoring undertaken to satisfy Condition C11, 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 (Annexure B)	This Noise and Vibration Monitoring Program has been developed in consultation with Inner West Council, City of Sydney Council, City of Canada Bay and NSW Health. Consultation is outlined in Section 3.4 of 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 on 27 May 2019. The Noise and Vibration Monitoring Program will be submitted to DPE 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.	Refer to Section 2.2 of the CEMP	Construction will not commence until the CEMP and all CEMP Sub-plans, including any relevant Construction Monitoring Programs, have been approved by DPE. 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	Section 2.1 of Noise and Vibration Monitoring Program (Annexure B)	This Noise and Vibration Monitoring Program will be implemented for the duration of construction.

	out in the monitoring program or specified by the Secretary, whichever is greater.		
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 (Annexure 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 outlined in Section 10 of the Noise and Vibration Monitoring Program.

3.3. Environmental Management Measures

Refer to Annexure A for all REMMs relevant to the development of this NVMP.

3.4. Acoustics Advisor (AA)

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.

In accordance with CoA A24, the Proponent will cooperate with the AA by:

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

In accordance with CoA A26, the approved AA must:

a) Receive and respond to communication from the Secretary in relation to the performance of the Project in relation to noise and vibration,
b) Consider and inform the Secretary on matters specified in the terms of the approval relating to noise and vibration,
c) Consider and recommend, to the Project, improvements that may be made to avoid or minimise adverse noise and vibration impacts,
d) 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),
e) 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,
f) Notify the Secretary of noise and vibration incidents in accordance with CoA A40,
g) In conjunction with the ER, the AA will:

(i) 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,
(ii) if 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,
(iii) 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,
(iv) review the noise impacts of minor construction ancillary facilities, and
(v) 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.

In accordance with REMM NV1, 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, and
- Reviewing and endorsing the proposed operational noise controls, the associated noise model and the proposed implementation program.

3.5. Consultation

This NVMP including the Noise and Vibration Monitoring Program and the Out of Hours Works Protocol, was provided to NSW Environment Protection Authority (EPA), City of Sydney Council, City of Canada Bay Council and Inner West Council in accordance with CoA C4 (b).

Table 3 details a summary of the consultation undertaken for this NVMP and the key issues identified by the relevant stakeholders.

Table 3 Summary of consultation for development of the NVMP and Noise and Vibration Monitoring Program

Agency	Contact with agency	Response received	Key issues	Where addressed
Noise and Vibration Management Plan*				
Canada Bay Council	Via email from the Project: ▪ 08/04/2019 ▪ 09/04/2019 ▪ 16/04/2019 ▪ 17/04/2019	Via email to the Project: ▪ 16/04/2019 – Canada Bay advised the Council Coordinator Environmental Health was looking after the review and will be in touch ▪ 17/04/2019 – Canada Bay advised they were not able to access the document ▪ 17/04/2019 – Canada Bay confirmed successful download of NVMP ▪ 29/04/2019 – Canada Bay confirmed they do not have issues with the NVMP.	N/A	N/A
City of Sydney	Via email from the Project: ▪ 08/04/2019 ▪ 09/04/2019 ▪ 16/04/2019 Via phone call from the Project: ▪ 12/06/2019	Via telephone and email to the Project: 12/06/2019- CoS confirmed they had no comment on the NVMP.	N/A	N/A

Environmental Protection Authority (EPA)	Via email from the Project: ▪ 08/04/2019	Via email to the Project: ▪ 09/04/2019 – EPA advised it was not policy to review management plans. Their expectations will be specified in the EPL when it is issued.	N/A	N/A
Inner West Council (IWC)	Via email from the Project: ▪ 08/04/2019 ▪ 09/04/2019 ▪ 23/04/2019	Via email to the Project: ▪ 08/04/2019 – confirmed receipt of email ▪ 10/04/2019 – IWC advised they would propose a meeting to discuss the NVMP ▪ 18/04/2019 – acknowledged the meeting had taken place, and due to staff missing they would provide feedback by 13/05/2019 ▪ 21/05/2019 – IWC provided comments on the NVMP. A meeting was held with IWC and JHCPB on 17/04/2019 to discuss the NVMP.	▪ Impacts from night works ▪ Impact of vibration on health and buildings ▪ Human annoyance from noise ▪ Monitoring and mitigation near sensitive land uses	▪ NVMP Section 5.1, Table 20 and Section 8.2 ▪ NVMP Section 5.5, Section 8.6 and Annexure E ▪ NVMP Table 20 and Section 8.2 ▪ NVMP Annexure B
Port of Authority of New South Wales	Via email from the Project: ▪ 10/04/2019 ▪ 16/04/2019	Via email to the Project: ▪ 23/04/2019	▪ Work and controls for within port land ▪ Vibration impacts to the Glebe Island silos	▪ NVMP Section 8 ▪ NVMP Section 5.5.3, Annexure B and Annexure E
Sydney Water	Via email from the Project: ▪ 10/04/2019	Via email to the Project: ▪ 06/05/2019 – advised they did not have any comments on the NVMP.	N/A	N/A
NSW Health	Via email from the Project: ▪ 08/04/2019 ▪ 09/04/2019 ▪ 16/04/2019 ▪ 17/04/2019 ▪ 18/04/2019 – JHCPB additionally provided the NVMP and CEMP ▪ 23/04/2019	Via email to the Project: ▪ 16/04/2019 – NSW Health asks for clarification on why they were being consulted ▪ 17/04/2019 – NSW Health requested the NVMP ▪ 18/04/2019 – NSW Health had difficulties accessing NVMP and CEMP ▪ 24/04/2019 – NSW Health advised official response would follow ▪ 26/04/2019 – NSW Health (in consultation with Sydney Local Health District) thanked JHCPB for consultation, however, formally declined opportunity to provide feedback on the draft document.	N/A	N/A

*Table note: * JHCPB provided the Noise and Vibration Management Plan with the relevant annexures, including the Noise and Vibration Monitoring Program to all stakeholders consulted on the Noise and Vibration Management Plan.*

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

Community feedback and complaints relating to noise and vibration will be dealt with in accordance with the Communication Strategy (CS) 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 Annandale, Lilyfield, Leichhardt and Rozelle. To comply with CoA E66, a land use survey has been completed in areas where works could impact on sensitive receivers (refer to Annexure 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 delivery of the Project.

Where other sensitive receivers are identified throughout 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 (refer Annexure C) noted that the existing land use and development within and around the Project contains a mix of residential, commercial, industrial and open space uses. Refer to Annexure C for details.

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 NSW Road Noise Policy (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, several other sensitive receivers (including educational facilities, childcare centres, recording studios and medical facilities) were identified as being potentially impacted by the Project (refer to Annexure F). The mapping of the Land Use Survey is attached in Annexure C. The Land Use Survey is current at the time of submission of this NVMP. However, it remains an active part of the NVMP and will continue to be updated where land uses change over the course of the Project.

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 10-40 are relevant to the Rozelle Interchange Project. Four additional NCAs (NCA 40A, 41, 42 and 43) have been identified to assist with the assessment of impacts to sensitive receivers, in particular with notifications regarding noise from out of hours works associated with the Project.

The NCAs for the Project are presented in Table 4 with a description of the noise characteristics of each area. The NCAs that are potentially impacted, either directly or indirectly, are also listed in the table. NCAs are also presented in the Land Use Survey (refer to Annexure C).

Table 4: NCAs relevant to Rozelle Interchange Project

NCA Reference	Description	Main sources of background noise
Rozelle, Lilyfield, Annandale and Pyrmont		
NCA10	North of Perry Street between Lilyfield Road and Wharf Road. Land use comprises of a mix of residential receivers, isolated commercial receivers and special use facilities.	Ambient noise environment dominated by distant road traffic noise from City West Link to the south and local traffic on Perry Street and Mary Street. Light rail and aircraft noise audible.

NCA11	North of City West Link between Norton Street, Balmain Road and Perry Street. Land use comprises of a mix of residential receivers, isolated commercial receivers and special use facilities.	Ambient noise environment dominated by road traffic noise from City West Link to the south, frequent light and heavy-vehicle traffic on Lilyfield Road and aircraft noise.
NCA12	South of City West Link between Norton Street, Balmain Road and William Street. Land use comprises of a mix of residential and commercial receivers, a place of worship and the Sydney Buses Leichardt depot.	Ambient noise environment dominated by road traffic noise from City West Link to the north and local traffic on Norton Street. Aircraft noise audible.
NCA13	South of Darley Road between Norton Street and William Street. Land use consists of residential receivers and isolated commercial receivers.	Ambient noise environment dominated by road traffic noise from Darley Road and City West Link to the north. Aircraft noise audible.
NCA14	South of William Street between Darley Road and Norton Street. Land use comprises of a mix of residential receivers, isolated commercial receivers and special use facilities.	Ambient noise environment dominated local traffic on Norton Street and Darley Road. Distant traffic noise on City West Link to the north. Aircraft noise audible.
NCA15	South of City West Link between Balmain Road, Moore Street and Starling Street/Paling Street. Land use comprises of a mix of residential receivers, isolated commercial receivers, a childcare centre and passive recreation area.	Ambient noise environment dominated by road traffic noise from City West Link to the north and local traffic. Aircraft noise and light rail noise audible.
NCA 16	North of Lilyfield Road between Balmain Road, Lamb Street and O'Neill Street. Land use comprises of a mix of residential receivers, isolated commercial receivers and a medical centre.	Ambient noise environment dominated by road traffic noise from City West Link to the south, frequent light and heavy-vehicle traffic on Lilyfield Road and aircraft noise.
NCA17	North of City West Link between Lilyfield Road, Balmain Road and the boundary of the Project in the Rozelle Rail Yard. Land use consists of commercial receivers and the Sydney Light Rail Lilyfield Depot.	Ambient noise environment dominated by road traffic noise from City West Link and The Crescent. Occasional aircraft noise.
NCA19	North of Lilyfield Road between Lamb Street, Foucart Street and Balmain Road. Land use comprises of a mix of residential receivers, isolated commercial receivers and a childcare centre.	Ambient noise environment dominated by road traffic noise from City West Link to the south, frequent light and heavy-vehicle traffic on Lilyfield Road and aircraft noise.
NCA20	South of City West Link between Whites Creek, Moore Street and Starling Street/Paling Street. Land use comprises of a mix of residential receivers, isolated commercial receivers and passive recreation areas.	Ambient noise environment dominated by road traffic noise from City West Link to the north and local traffic. Aircraft noise and light rail noise audible.
NCA21	West of Johnston Street between Piper Street, Railway Parade and Whites Creek. Land use comprises of a mix of residential receivers, isolated commercial receivers and an educational facility.	Ambient noise environment dominated by road traffic noise from City West Link and The Crescent to the north and Johnston St to the east. Light rail noise and aircraft noise audible.
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.	Ambient noise environment dominated by local road traffic noise.
NCA23	East of Johnston Street between The Crescent, Piper Street and Johnstons Creek, including commercial premises on the east side of The Crescent. Land use comprises of a mix of residential receivers, commercial receivers, an educational facility and a passive recreation area.	Ambient noise environment dominated by road traffic noise from Johnston Street and The Crescent. Distant traffic noise from City West Link. Light rail noise and aircraft noise audible.
NCA24	North of Lilyfield Road between Foucart Street, Gordon Street, Victoria Road and Darling Street. Land use comprises of a mix of residential and commercial receivers, special use facilities and active and passive recreation areas.	Ambient noise environment dominated by road traffic noise from City West Link to the south, Victoria Road to the east, frequent light and heavy-vehicle traffic on Lilyfield Road and aircraft noise.

NCA25	West of Victoria Road between Gordon Street and Lilyfield Road, including residences on the south side of Lilyfield Road. Land use comprises of a mix of residential receivers, isolated commercial receivers and special use facilities.	Ambient noise environment dominated by road traffic noise from Victoria Road to the east and City West Link to the south, aircraft noise and heavy-vehicle traffic on Lilyfield Road.
NCA26	Catchment area adjoins either side of the western approach to Anzac Bridge, between Victoria Road, Robert Street, White Bay, Johnstons Bay and Rozelle Bay. Land use consists of a mix of commercial and industrial receivers including port facilities.	Ambient noise environment dominated by road traffic noise from Victoria Road to the west and south.
NCA27	East of The Crescent between Rozelle Bay and Blackwattle Bay. Land use comprises of a mix of residential receivers, isolated commercial receivers, special use facilities and active and passive recreation areas.	Ambient noise environment dominated by road traffic noise from The Crescent, City West Link and Victoria Road to the northwest and north. Local traffic and aircraft noise also make up the noise environment.
NCA28	Catchment area adjoins either side of the eastern approach to Anzac Bridge, between Johnstons Bay and Blackwattle Bay. Land use comprises of a mix of residential and commercial receivers.	Ambient noise environment dominated by road traffic noise from M4 Western Distributor and Port noise.
NCA29	North of Victoria Road between Robert Street and Evans Street. Land use comprises of a mix of residential and commercial receivers and special use facilities.	Ambient noise environment dominated by road traffic noise from Victoria Road.
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.	Ambient noise environment dominated by local road traffic and aircraft noise.
NCA40	East of Johnston Street between Booth Street, Johnston's Creek and Parramatta Road. Land use comprises of a mix of residential and commercial receivers and special use facilities.	Ambient noise environment dominated by local road traffic and aircraft noise.
NCA40A	South of NCA14 and NCA39 and north of Parramatta Road. Land use comprises of mostly residential, with some commercial receivers, with some educational and recreational use facilities.	Ambient noise environment dominated by local road traffic and aircraft noise.
NCA41	South east of NCA27, between Wigram Road and Bridge Road, Glebe, Land use comprises of mostly residential, with some commercial receivers along Glebe Point Road. In addition, there are some recreational, educational and medical facilities.	Ambient noise environment dominated by local road traffic and aircraft noise.
NCA42	North of NCA29, 30, 31 and 35 and south west of Curtis Street, Balmain. Land use comprises of a mix of residential and commercial receivers and special use facilities.	Ambient noise environment dominated by local road traffic and aircraft noise.
NCA43	North of White Bay Container Terminal, south of Darling Street and east of Booth Street, Balmain. Land use comprises of mostly residential, with some commercial receivers near the port facilities and along Darling Street.	Ambient noise environment dominated by local road traffic and aircraft noise.
Iron Cove		
NCA30	North of Victoria Road between Evans Street and Darling Street. Land use comprises of a mix of residential and commercial receivers and special use facilities.	Ambient noise environment dominated by road traffic noise from Victoria Road to the south west.
NCA31	North of Victoria Road between Darling Street and Wellington Street. Land use comprises of a mix of residential and commercial receivers, special use facilities and an active recreation area.	Ambient noise environment dominated by road traffic noise from Victoria Road to the south west.

NCA32	South of Victoria Road between Darling Street and Moodie Street residences. Land use comprises of a mix of residential and commercial receivers and special use facilities.	Ambient noise environment dominated by road traffic noise from Victoria Road to the north east and local traffic on Darling St.
NCA33	South of Victoria Road between Moodie Street residences and Toelle Street. Land use comprises of a mix of residential and commercial receivers.	Ambient noise environment dominated by road traffic noise from Victoria Road to the north east.
NCA34	North of Victoria Road between Wellington Street and Terry Street. Land use comprises of a mix of residential and commercial receivers.	Ambient noise environment dominated by road traffic noise from Victoria Road to the south west.
NCA35	North of Victoria Road between Terry Street and Parramatta River. Land use comprises of a mix of residential receivers, isolated commercial receivers, an educational facility and active and passive recreation areas.	Ambient noise environment dominated by road traffic noise from Victoria Road to the south west.
NCA36	South of Victoria Road between Toelle Street and Parramatta River. Land use comprises of a mix of residential receivers, isolated commercial receivers and active and passive recreation areas.	Ambient noise environment dominated by road traffic noise from Victoria Road to the north east.
NCA37	North of Balmain Road between Wharf Street, Manning Street and Parramatta River. Land use comprises of a mix of special use facilities, active and passive recreation areas but no residential properties.	Ambient noise environment dominated by local road traffic noise on Balmain Road.
NCA38	Catchment area adjoins either side of Victoria Road, north of Parramatta River. Land use comprises of a mix of residential and commercial receivers, special use facilities and active and passive recreation areas.	Ambient noise environment dominated by road traffic noise from Victoria Rd.

4.3. Ambient noise

4.3.1. Overview

As part of the EIS process, 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.

A review of the EIS noise monitoring data found it potentially did not adequately represent the acoustic environment at four of the NCAs identified in the EIS. As this has a direct bearing on the Noise Management Level established for construction activity, a detailed review of the existing acoustic environment was completed using data from the Renzo Tonin and Associates' noise monitoring database. Where the EIS RBL was not consistent with the Renzo Tonin & Associates RBL, additional monitoring was recommended. Consequently, additional monitoring was carried out at four locations in March 2019 to establish more representative noise goals for the NCAs represented by these monitoring locations.

This noise monitoring was utilised to determine appropriate Rating Background Levels (RBLs) and Noise Management Levels (NMLs) for each NCA (refer to Annexure G for results). 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 the period from 7:00am to 6:00pm Monday to Saturday and 8:00am to 6:00pm Sundays and public holidays,
- Evening is defined as the period from 6:00pm to 10:00pm,
- Night is defined as the period from 10:00pm to 7:00am Monday to Saturday and 10:00pm to 8:00am Sundays and public holidays,

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. 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. Additional noise monitoring, carried out in March 2019, is in areas currently not impacted by other WestConnex M4 East and New M5 projects.

4.3.2. Shoulder period analysis

Due to the nature of road construction works on existing arterial roads, it is not possible to complete all works during the recommended standard hours. There may be a requirement for out of hours work, in some cases during the more sensitive 'night' period due to the importance of the road to the functionality of the road network during the day and evening periods. Some of these works will have high noise impact, even after all reasonable and feasible noise mitigation measures have been considered. In these situations, it may be unduly stringent to expect such operations to be assessed against the night-time criteria, especially if existing background noise levels are steady, in some cases until after midnight before they substantially drop off.

The majority of the NCAs surrounding the Project are heavily influenced by road traffic noise levels from major roads as described in Table 4. In accordance with prescribed methods in the NSW Noise Policy for Industry (Section A3) and the RNP (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 all noise monitoring locations as presented in Annexure C of EIS Technical working paper: Noise and Vibration (Appendix J).

JHCPB have used 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.

The Interim Construction Noise Guideline (ICNG) and the EIS rely 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 and the EIS.

4.3.3. INP short-term method for determining RBL during compliance

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 1-2 weeks) the long-term RBLs in Annexure G 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 is 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 rating background noise level is found to be less than 30 dB(A) for the evening and night periods, then it is set to 30 dB(A).

5. Construction noise and vibration objectives

The EPA recommends management levels and goals when assessing construction noise and vibration impact on human comfort. Further to this, DPE require construction noise and vibration to be managed according to recommended standards and guidelines (CoA E81). These are outlined in Table 5 below.

Table 5: Policies and Standards applicable to construction noise and vibration management

Environment impact	Relevant policy/standard used to establish noise and vibration management level
Construction hours	CoA, EPL
Airborne noise	NSW Interim Construction Noise Guideline (ICNG)
Sleep disturbance and maximum noise events	Construction noise – NSW Environmental Criteria for Road Traffic Noise Road traffic noise - RNP and the Roads and Maritime Environmental Noise Management Manual (ENMM) Practice Note 3
Ground-borne noise	NSW Interim Construction Noise Guideline (ICNG) Australian Standard AS/NZS 2107:2000 Acoustics – Recommended design sound levels and reverberation times for building interiors
Construction-related road traffic noise	No specific guidelines, but guidance taken from the NSW Interim Construction Noise Guideline (ICNG) and the NSW RNP.
Vibration (disturbance to building occupants)	NSW DECC's Assessing vibration; a technical guideline, published in February 2006, in line with CoA D16(b), which incorporates British Standard BS 6472-2008, Evaluation of human exposure to vibration in buildings (1-80Hz)
Vibration (structural damage to buildings)	British Standard 7385:1993 Evaluation and measurement of vibration in buildings – Part 2 Guide to damage from ground-borne vibration
Vibration (structural damage to buried services and screening criteria for heritage structures)	German Standard DIN 4150:2016 – Part 3 Structural vibration in buildings – Effects on structures
Vibration (sensitive scientific and medical equipment) (guidance only)	ASHRAE Applications Handbook (SI) 2003, Chapter 47 Sound and Vibration Control Gordon GC 28 September 1999 Generic Vibration Criteria for Vibration Sensitive Equipment Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
Blast noise and vibration	Australian Standard AS 2187.2-2006 Explosives – Storage and use – Part 2 Use of explosives British Standard 7385: Part 2 Evaluation and measurement of vibration in buildings

Relevant elements of these documents are summarised and discussed in this section.

5.1. Construction hours, limitations and approach to works

5.1.1. Standard construction work hours

Standard working hours for the Project are defined by CoA E68 to E72 and E100 and EPL condition L.4. CoA E73 to E78 and EPL condition L.4 define when works may be conducted outside standard working hours. Table 6 below summarises the information that the CoA and EPL requires regarding construction working hours for the Project.

Table 6: Construction working hours

CoA	EPL	Construction Activity	Working hours applicable to Condition		
			Monday to Friday	Saturday	Sunday / public holiday
E68	N/A	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.	7:00am to 6:00pm	8:00am to 1:00pm	No work[1]
E69	N/A	Notwithstanding Condition E68, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.	-	1.00pm to 6.00pm	-
E70	N/A	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, excluding from the Iron Cove civil site (C8) at which haulage is limited to the work hours specified in Conditions E68 and E69, and delivery of material; (c) works within an acoustic shed; and (d) tunnel fit out works.	24 hours	24 hours	24 hours
E72	N/A	Except as permitted by an EPL, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver must only be undertaken: (a) between the hours of 8:00 am to 6:00 pm Monday to Friday; (b) between the hours of 8:00 am to 1:00 pm Saturday; and (c) 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.	8:00am to 6:00pm (plus respite[2])	8:00am to 1:00pm (plus respite[2])	No work[1]

		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	N/A	**Variation to Work Hours** (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, excluding spoil haulage from the Iron Cove civil site (C8) at which haulage is limited to the work hours specified in Conditions E68 and E69, that causes LAeq(15 minute) noise levels: (i) no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and (ii) no more than the 'Noise affected' noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and (iii) continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and (iv) intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006).	6.00pm to 7.00am	1.00pm to 8.00am	8.00am to 7.00am
E75	N/A	<u>Out-of-Hours Work Scheduling and Respite</u> 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	6.00pm to 7.00am	1.00pm to 8.00am	8.00am to 7.00am

		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.			
E77	**N/A**	**Out-of-Hours Work Protocol – Works not subject to an EPL** 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.	6.00pm to 7.00am	1:00pm to 8:00am	8.00am to 7.00am
E100	N/A	Blasting[3] 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 (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.	9:00am to 5:00pm	9:00am to 1:00pm	No blasting
	✓	Unless otherwise specified by any other condition of this licence, construction works is: a) restricted to between the hours of 7:00am and 6:00pm Monday to Friday; b) restricted to between the hours of 8:00am and 6:00pm Saturday; and	7:00am to 6:00pm	8:00am to 6:00pm	No work[1]

		c) not to be undertaken on Sundays or Public Holidays.			
	✓	Any high noise impact works and activities must only be undertaken: a) between 8:00 am and 6:00 pm Monday to Friday; b) between 8:00 am and 1:00 pm Saturday.	8:00am to 6:00pm (plus respite[2])	8:00am to 1:00pm (plus respite[2])	No work[1]
	✓	<u>Exemptions to standard construction hours for low noise impact works</u> The following works and activities may be carried out outside of the hours specified in condition L4.1 if the works and activities do not cause, when measured at the boundary of the most affected noise sensitive receiver: a) LAeq (15 minute) noise levels greater than 5dB above the day, evening and night rating background level (RBL) as applicable; and b) LA1(1 minute) or LAmax noise levels greater than 15dB above the night RBL for night works; and c) continuous or impulsive vibration values greater than those for human exposure to vibration, set out for residences in Table 2.2 in "Environmental Noise Management - Assessing Vibration: a technical guideline" (DEC, 2006); and d) intermittent vibration values greater than those for human exposure to vibration, set out for residences in Table 2.4 in "Environmental Noise Management - Assessing Vibration: a technical guideline" (DEC, 2006).	24 hours	24 hours	24 hours
	✓	<u>Exemptions to standard construction hours in exceptional circumstances</u> a) The licensee may undertake works outside of standard construction hours if any of the following applies: i. emergency works is required to avoid the loss of lives or property, or to prevent material harm to the environment; ii. the delivery of oversized plant or structures has been determined by the police or other authorised authorities to require special arrangements to transport along public roads.	6.00pm to 7.00am	1.00pm to 8.00am	8.00am to 7.00 am
	✓	<u>Exemptions to standard construction hours for tunnelling, tunnelling support and underground construction works</u> The following works are permitted to be undertaken 24 hours a day, 7 days a week: a) tunnelling activities, excluding cut and cover tunnelling; b) haulage of spoil and delivery of material necessary to carry out	24 hours	24 hours	24 hours

		tunnelling activities; c) works within an acoustic shed; and d) tunnel fit out works.			
	✓	Works outside of standard construction hours - Regulatory Requirements In undertaking any out-of-hours works under condition L4.6, the licensee must comply with the following: b) Only undertake activities between the hours of 6:00pm on Mondays, Tuesdays, Wednesdays, Thursdays, Fridays and 7:00am the following day; c) Ensure that out-of-hours works do not result in noise levels exceeding those specified in condition L4.3 at the same noise sensitive receivers on more than: i. 2 consecutive evenings and/or nights per week; and ii. 3 evenings and/or nights per week; and iii. 10 evenings and/or nights per month.	6.00pm to 7.00am[4]	-	-

Notes:

1. No work unless permitted and approved in accordance with another section of the EPL.
2. Minimum respite in continuous blocks of no more than 3 hours, with at least a 1 hour respite between each block of work generating high noise impact, where the location of the works and activities is likely to impact the same noise sensitive receivers; except as expressly permitted by another condition of this licence.
3. Blasting outside of these hours must be authorised through an EPL.
4. Where high noise impact activities are undertaken, the respite provisions as per the requirements of condition L4.2(c) do not apply provided that all high noise impact activities are undertaken prior to 12am where feasible and reasonable.

5.2. Airborne noise management levels

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

The main objectives of the ICNG are to:

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

5.2.1. Residential Receivers

Table 2 of the ICNG (reproduced in Table 7 below) shows how NMLs at residences are determined and how they are to be applied during construction of the Project.

Table 7: Airborne Noise Management Levels at residential receivers

Time of Day	Noise Management Level LAeq (15min)	How to Apply
Standard hours: Monday to Friday 7 am to 6 pm Saturday 8am to 6pm	Noise affected 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 LAeq (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 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).

NMLs apply at the property boundary that is most exposed to construction noise, at a height of 1.5 metres 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.

The internal noise levels are to be assessed at the centre of the most affected habitable room. A conservative estimate of the difference between internal and external noise levels ranges from 10 dB (open window) to 20dB (where windows are fixed).

A summary of the noise management levels for residential receivers nearby the Project is provided in Annexure G.

5.2.2. Other sensitive receivers

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). In accordance with CoA 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 affected institutions are made. Where works cannot be timetabled outside of sensitive periods, consultation will be carried out, as per the Community Strategy, with occupants likely to be affected by any noise expected to exceed the NMLs.

As described within the ICNG, external noise levels in Table 3 of the ICNG (i.e. active and passive recreational areas) are to be assessed at the most affected point within 50 m of the area boundary. Internal noise levels are assessed at the centre of the occupied room. Where internal noise levels cannot be measured, external equivalent noise management levels may be used (see Table 8) and are to be assessed at building façade in accordance with AS1055-2018.

Table 8 outlines the management levels for other sensitive land uses based on Australian Standard AS2107, AAAC Guideline for Child Care Centre Acoustic Assessment and ICNG. The management levels from AS2107 are the upper range levels to account for the variable and short-term nature of construction noise.

Table 8: Airborne Noise Management Levels at other sensitive land uses (non- residential)

Land Use	Noise Management Level LAeq(15min)	Where NML applies	Referenced from:	Assumed facade loss (conservative)[3]	External equivalent NML - $L_{Aeq(15min)}$
Studio building (music recording studio)	25 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	45 dB(A)
Studio building (film or television studio)	30 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	50 dB(A)
Cinema space, theatre, auditorium	35 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	55 dB(A)
Hotel (Sleeping areas: Hotels near major roads)	40 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	60 dB(A)
Classrooms at schools and other educational institutions	45 dB(A)	Internal noise level	ICNG	10 dB(A)	55 dB(A)
Childcare centre (internal play and sleeping areas)	40 dB(A)	Internal noise level	AAAC - guideline for Child Care Centre Acoustic Assessment	10 dB(A)	50 dB(A)
Hospital wards and operating theatres	45 dB(A)	Internal noise level	ICNG	20 dB(A)	65 dB(A)
Places of worship	45 dB(A)	Internal noise level	ICNG	10 dB(A)	55 dB(A)
Library (reading areas)	45 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	65 dB(A)

Hotel (bars and lounges)	50 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	70 dB(A)
Community centres – Municipal Buildings	50 dB(A)	Internal noise level	AS2107 'upper range'	10 dB(A)	60 dB(A)
Restaurant, bar (Bars and lounges/ Restaurant)	50 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	70 dB(A)
Medical facilities	55 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	75 dB(A)
Railway platform and concourse areas	55 dB(A)	Internal noise level	AS2107 'upper range'	20 dB(A)	75 dB(A)
Passive recreation areas[1] (e.g. area used for reading, meditation)	60 dB(A)	External noise level	ICNG	-	60 dB(A)
Active recreation areas[2] (e.g. sports fields)	65 dB(A)	External noise level	ICNG	-	65 dB(A)
Commercial premises (including offices and retail outlets)	70 dB(A)	External noise level	ICNG	-	70 dB(A)
Industrial premises	75 dB(A)	External noise level	ICNG	-	75 dB(A)

Notes:
1. Passive recreation areas are characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (e.g. reading, meditation).
2. 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.
3. The assumed building façade losses are used to determine the preliminary external equivalent noise management levels. These assumptions are conservative and used as screening levels to identify potential noise impacts. Once a sensitive receiver is identified, a building inspection is to be undertaken to determine the specific building façade loss and update, if required, its external noise management level.

5.2.3. Sleep disturbance

The ICNG recommends that where construction works are planned to extend over more than two consecutive nights, maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL should be considered. In line with the ICNG, further guidance is taken from the NSW Environmental Criteria for Road Traffic Noise (ECRTN, Environment Protection Authority 1999).

To assess the likelihood of sleep disturbance, an initial screening level of LAmax or LA1(1min) ≤ LA90(15min) + 15 dB(A) is used. In situations where this results in an external screening level of less than 55 dB(A), a minimum screening level of 55 dB(A) is set. Note that this is equivalent to a maximum internal noise level of 45 dB(A) with windows open.

Where noise events are found to exceed the initial screening level, further analysis will be made to identify:

- the likely number of events that might occur during the night assessment period, and
- whether events exceed an 'awakening reaction' level of 55 dB(A) LAmax or LA1(1min) (internal) that equates to NML of 65 dB(A) (assuming open windows). A summary of the noise management levels for sleep disturbance at residential receivers nearby the Project is provided in Table 25.

5.3. Ground-borne noise management levels

Ground-borne noise management levels (GNMLs) are based on the ICNG. and CoA E82.

5.3.1. Residential receivers

Ground-borne noise management levels for residences are nominated in the ICNG and CoA E82 and indicate when management actions would be implemented. Mitigation measures must be applied when residential ground-borne noise levels are exceeded in accordance with CoA E82. This is typically where noise sensitive receivers are located above tunnelling works or other construction activities (e.g. rock breaking).

Table 9 (taken from the ICNG and CoA E82) sets out the ground-borne noise management levels and how they are to be applied to residential receivers. These levels are only applicable when ground-borne noise levels are higher than airborne noise levels. The ground-borne noise levels are for evening and night-time periods only, as the objectives are to protect the amenity and sleep of people when they are at home. JHCPB will inform all potentially impacted receivers of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.

Table 9: Ground-borne Noise Management Levels at residential receivers

Assessment Period	Time of Day	Ground-borne Noise Management Level, LAeq(15minute)
Evening	6:00pm to 10:00pm	40 dB(A) internal
Night	10:00pm to 7:00am	35 dB(A) internal

Note:
1. CoA E82 does not include a GBNML for the daytime assessment period.

5.3.2. Other sensitive receivers

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

The ground-borne noise objectives for ‘other’ noise sensitive land uses are identified below in Table 10.

Table 10: Ground-borne Noise Management Levels at other sensitive land uses (non-residential)

Land Use	Noise Management Level LAeq(15min)	Where NML applies	Referenced from:
Commercial premises (including offices)	50 dB(A)	Internal noise level	ICNG
Commercial premises (including retail outlets)	55 dB(A)	Internal noise level	AS/NZS 2107:2016 (department stores – main floor)
Industrial premises	55-60 dB(A)	Internal noise level	ICNG and AS/NZS 2107:2016 (assembly lines and process and control room)

For other noise sensitive receivers, such as cinema spaces and recording studios, guidance is taken from the recommended 'maximum' internal noise levels in AS/NZS 2107:2000 'Acoustics - Recommended design sound levels and reverberation times for building interiors' to determine suitable noise management levels. Refer to Table 8 for details.

5.4. Construction-related road traffic noise

JHCPB has developed a Heavy Vehicle Driver Code of Conduct to assist with managing driver behaviour both on site and on public roads.

When trucks and other vehicles are operating within the boundary of a construction site, road vehicle noise contributions are included in the overall predicted LAeq(15minute) construction site noise emissions. When construction-related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

The community may associate heavy vehicle movements with the Project works, when vehicles are travelling on roads located immediately adjacent to construction sites. However, once the heavy vehicles move further from construction sites onto major collector or arterial roads, the noise may be perceived as being part of the general road traffic.

The ICNG refers to the NSW Road Noise Policy (RNP) for the assessment of noise from construction traffic on public roads. In line with the RNP and the Construction Noise and Vibration Guideline (Roads and Maritime 2016), the Project will adopt the following approach for assessing and managing construction traffic noise impact:

- Complete an initial screening test to evaluate whether traffic noise levels increase by more than 2 dB(A) as a result of construction traffic within 600m of the Project sites.
  - Where increases are 2 dB or less than the corresponding 'without construction traffic' scenario, no further assessment is required.
  - Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consider the total road traffic noise levels (i.e. existing road traffic plus additional construction traffic)
- Review the total road traffic noise levels and whether these levels comply with the following road traffic noise criteria in the RNP:
  - 60 dB LAeq(15hour) day and 55 dB LAeq(9hour) night for existing freeway/arterial/sub-arterial roads, and
  - 55 dB LAeq(1hour) day and 50 dB LAeq(1hour) night for existing local roads.

Where total road traffic noise levels are less than or equal to RNP noise criteria, no further assessment is required.

Where total road traffic noise levels are above the RNP noise criteria, feasible and reasonable noise mitigation measures would be applied to reduce the potential noise impacts and preserve acoustic amenity. This may include consideration of alternative truck routes or potential reduction of truck movements.

In addition to the above, where Project trucks and other vehicles are using public roads during the night period, assessment of sleep disturbance is required as outlined in Section 5.2.3.

Refer to Table 20 for noise and vibration management and mitigation measures for construction-related road traffic noise.

5.5. Construction vibration management levels

5.5.1. Disturbance to building occupants

Vibration, with the potential to disturb human occupants of buildings, is managed referencing DECC's Assessing Vibration: a technical guideline. This document provides criteria which are based on the British Standard BS 6472-2008 Evaluation of human exposure to vibration in buildings (1-80Hz).

Vibration sources are defined as Continuous, Impulsive or Intermittent. Table 11 provides a definition and examples of each type of vibration.

Table 11: Types of vibration

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as road headers).
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than two seconds.	Occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.	Trains, nearby intermittent construction activity, passing heavy vehicles, impact pile driving, rock breaking, jack hammers.

Source: Assessing Vibration: a technical guideline (DECC 2006)

The criteria are to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

"Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472)."

Preferred and maximum values for continuous and impulsive vibration, based on weighted acceleration rms values (m/s^2) are presented in Table 12.

Table 12: Preferred and maximum continuous and impulsive vibration values for human comfort (Weighted RMS Acceleration, m/s^2, 1-80Hz)

Location	Assessment period[1]	Preferred values		Maximum values	
		Z-axis	X- and y-axis	Z-axis	X- and y-axis
Continuous vibration (rms acceleration, m/s^2)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Impulsive vibration (rms acceleration, m/s^2)					
Critical areas[2]	Day- or night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42

	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92

Notes:
1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

Source: BS 6472-2008

Preferred values for intermittent vibration, based on the weighted Vibration Dose Values (VDV, m/s1.75) are presented in Table 13.

Table 13: Preferred intermittent vibration values for human comfort (VDV, m/s1.75, 1-80Hz)

Location	Assessment period[1]	Preferred values	
		Z-axis	X- and y-axis
Critical areas[2]	Day- or night-time	0.10	0.20
Residences	Daytime	0.20	0.40
Residences	Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	Day- or night-time	0.40	0.80

Notes:
1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am
2. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specify above.

Source: BS 6472-2008

based on peak velocity units, as this metric is also used for the cosmetic building damage vibration assessment. The screening test conditions are conservative because they are based on the continuous vibration velocity criteria (i.e. vibration that continues uninterrupted for a defined assessment period) whilst construction works are mostly intermittent. CNVIS screening tests will be based on the preferred peak values, as shown in Table 12, for pseudo-continuous work activities such as roadheader tunnelling and excavation and on maximum peak values for surface construction works, which are intermittent in nature. This approach has been adopted so that the screening test is not unduly stringent.

An example screening test for vibration disturbance to building occupants, based on the maximum peak particle velocity (ppv, mm/s) is presented in Table 14. During the development of the CNVISs, where the predicted vibration exceeds the initial screening test, the total estimated Vibration Dose Value (i.e. eVDV) will be determined based on the level and duration of the vibration event causing exceedance.

Table 14: Construction vibration disturbance to building occupants – example screening test

Place and Time	Preferred peak velocity, mm/s (>8Hz)	Maximum peak velocity, mm/s (>8Hz)
Critical areas (day or night)[1]	0.14	0.28
Residential buildings 16 hr day	0.28	0.56
Residential buildings 8 hr night	0.20	0.40
Offices, schools, educational institutions and places of worship (day or night)	0.56	1.10
Workshops (day or night)	1.10	2.20

Notes:
1. Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring.

5.5.2. Structural damage to buildings

Potential structural damage of buildings caused by vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 (1993) as required by CoA E81. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

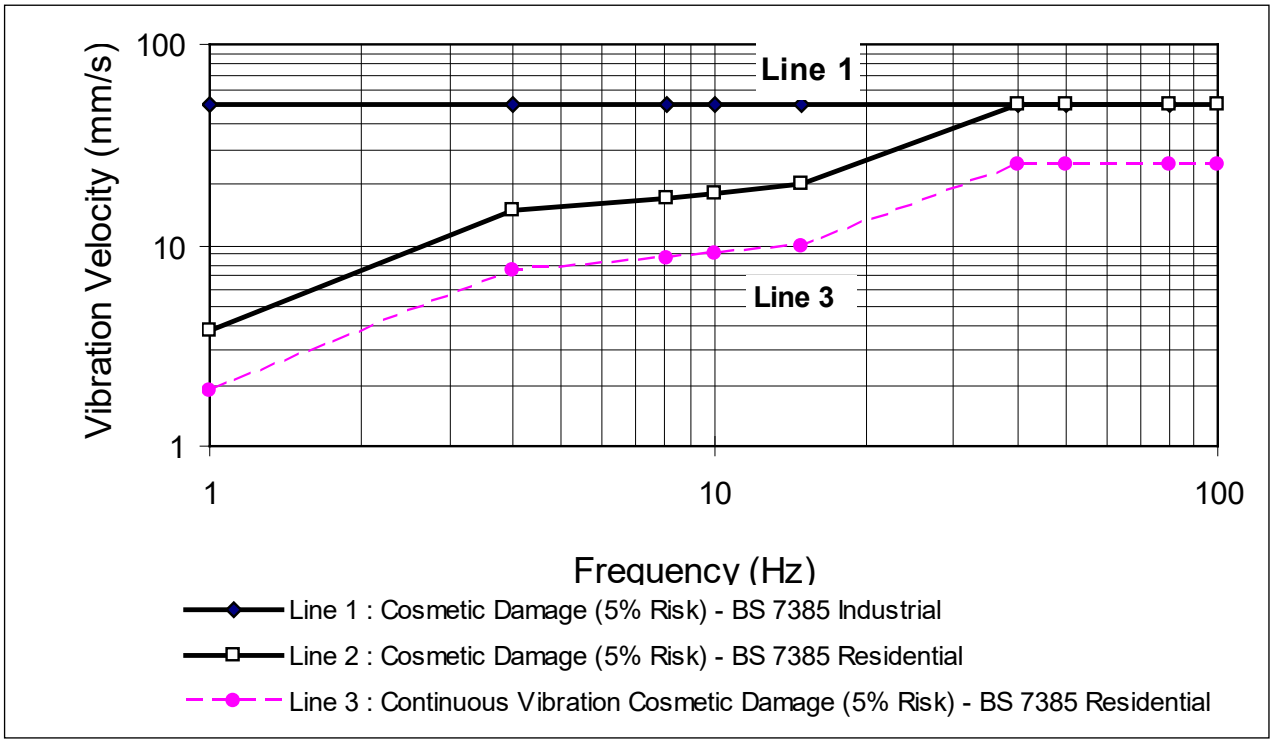
The cosmetic damage levels set by BS7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types.

Table 15 sets out the recommended limits from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential, commercial and industrial buildings. This is shown graphically in Figure 1.

Table 15: Transient vibration guide values - minimal risk of cosmetic damage (BS 7385) - peak component particle velocity

Line	Type of structure	Frequency range 4 to 15 Hz	Frequency range 15 to 40 Hz	Frequency range 40 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s	50 mm/s	50 mm/s
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4Hz, increasing to 20 mm/s at 15Hz	20 mm/s at 15Hz, increasing to 50 mm/s at 40Hz	50 mm/s

Figure 1: Graph of Transient Peak Component Particle Velocity Vibration Guide Values for Cosmetic Damage



Source: BS 7385

BS7385 states that the guide values in Table 15 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. Where the

dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 15 may need to be reduced by up to 50%, as shown by Line 3 for Residential Buildings.

Note: rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures (e.g. residences) and it may be appropriate to reduce the transient values by 50%.

On this basis, a conservative vibration damage screening level per receiver type is given below:

- Industrial and heavy commercial buildings (Line 1): 25.0 mm/s, and
- Residential or light commercial type buildings (Line 2): 7.5 mm/s.

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

5.5.3. Heritage and vibration sensitive structures

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

Since BS7385-2:1993 does not provide numerical criteria, DIN4150 is commonly applied to assess potential impacts on heritage and fragile type buildings / structures. To evaluate the effects of long-term (or harmonic) vibration on structures, the lowest criterion of 2.5 mm/s (PPV) in DIN4150 is often referred to in planning approval conditions. Whilst this approach is generally agreed to be conservative, it is nevertheless adopted as the default screening vibration level for heritage and other sensitive structures on a large number of construction projects.

The approach for the Project to manage potential vibration impact on heritage structures shall be to:

a) Identify heritage items where the 2.5 mm/s peak component particle velocity objective may be exceeded during specific construction activities, and

b) Structural engineering report to be undertaken on identified heritage items, to confirm structural integrity of the building and confirm if item is ‘structurally sound’, and

c) If item confirmed as ‘structurally sound’, the screening criteria in Section 5.5.2 (as applicable) shall be adopted, or

d) If item confirmed as ‘structurally unsound’, the more conservative cosmetic damage objectives of 2.5 mm/s peak component particle velocity would be adopted.

This approach is consistent with the EIS.

Vibration Screening Criteria drawings have been prepared in accordance with CoA E83 and included in Annexure E to identify the safe working distances for heritage buildings during vibration intensive activities. CNVIS prepared for the Project will also identify:

- specific minimum working distances for heritage items in relation to construction activity addressed in the CNVIS
- where monitoring should be conducted at heritage items.

In accordance with CoA E85, the Non-Aboriginal Heritage Management Plan (NAHMP) and the Aboriginal Cultural Heritage Management Plan (ACHMP), the advice of a heritage specialist will be sought on methods and locations for installing equipment used for vibration, movement and noise monitoring of heritage-listed structures, prior to the installation of any such required monitoring equipment. Details of heritage items identified are included in the NAHMP.

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.

5.5.4. Glebe Island dyke exposure

The Glebe Island Dyke Exposures are listed on the Port Authority of NSW section 170 heritage register (item no. 4560056). The exposures form part of the Great Sydney Dyke and provide examples of differential weathering that has taken place within the outer bounding surfaces and internal sections of the dyke. The lithological spectrum of weathering varies from silty clay to residual 'corestones' of relatively fresh basalt (Sydney Ports Corporation Heritage Inventory). The location of the Glebe Island dyke exposures is identified on the Land Use Survey Maps in Annexure C (sheet 5 of 7; as consecutive dots located immediately east of the label for 'Victoria Rd E1'). '

There are no specific guidelines or standards that set numerical vibration levels to prevent damage to natural rock formations. Guidance is taken from the German Standard DIN4150-3:2016-12, which sets a value of 80mm/s (ppv) as a guideline value for massive civil engineering structures such as reinforced concrete constructions used as abutments or block foundations.

Works are not expected to take place in the near vicinity of the Glebe Island Dyke exposure. In the event an activity is predicted to have potential vibratory impacts on the dyke, the approach for the Project to manage those impacts will be:

- Consult with Port Authority of NSW regarding proposed screening criteria, no works within the near vicinity of the dyke exposures will be undertaken until the consultation is undertaken under the review of the Acoustic Advisor,
- Identify where the 80mm/s peak component particle velocity objective may be exceeded during specific construction activities, and
- Where works are predicted to exceed the above objectives, a geotechnical engineering report is to be undertaken on the Glebe Island dyke exposures. This report will confirm the structural integrity of the dyke and whether the limit is suitable or identify an alternative limit.

5.5.5. Sensitive Scientific and Medical Equipment (guidance only)

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

Based on the Project's current design, no locations likely to contain sensitive scientific and medical equipment have been identified within Annexure E. Should changes to the Project's design mean that sensitive scientific and medical equipment are identified as likely to be in use inside the premises of an identified vibration sensitive receiver, objectives for the satisfactory operation of the instrument would be sourced from manufacturer's data prior to finalisation of the assessment. Where manufacturer's data is not available, generic vibration criterion (VC) curves as published by the Society of Photo-Optical Instrumentation Engineers (Colin G. Gordon - 28 September 1999) may be adopted as vibration goals. These generic VC curves are presented below in Figure 2 and Table 16.

Figure 2: Generic Vibration Criterion (VC) curves

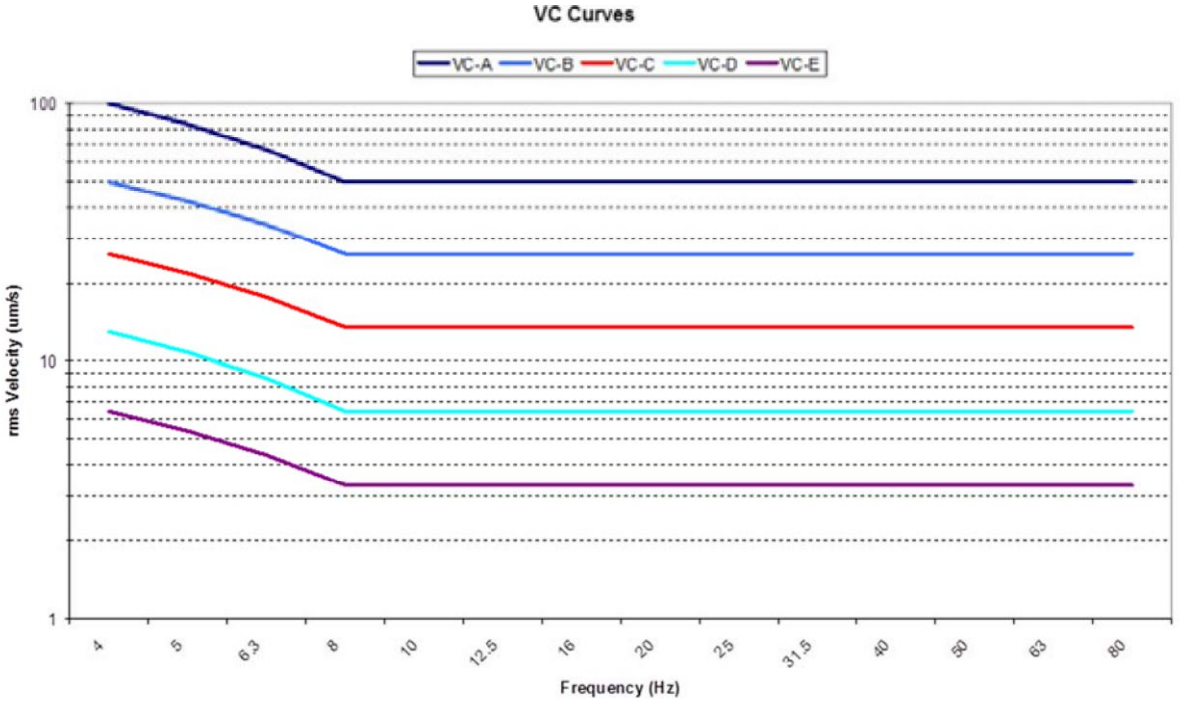


Table 16: Application and interpretation of the generic Vibration Criterion (VC) curves

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

Notes:
1. As measured in one-third octave bands of frequency over the frequency range 8 to 100 Hz.
2. The detail size refers to the line widths for microelectronics fabrication, the particle (cell) size for medical and pharmaceutical research, etc. The values given consider the observation requirements of many items depend upon the detail size of the process.

5.5.6. Utilities and Other Vibration Sensitive Structures

Some structures and utilities located near the Project may be particularly sensitive to vibration. A vibration goal which differs from the cosmetic damage goals presented in Section 5.5.2 may need to be adopted. Examples of such structures and utilities include:

- Tunnels,
- Gas pipelines, and
- Fibre optic cables.

The British Standard BS 7385-2:1993 'Evaluation and measurement for vibration in buildings - Part 2: Guide to damage levels from ground-borne vibration' notes that structures below ground are known to sustain higher levels of vibration and are very resistant to damage unless in very poor condition (British Standard BS 7385-2:1993, p5). Further guidance is taken from the German Standard DIN 4150-3:2016 Vibrations in buildings – Part 3: Effects on structures'. Section 5.3 of DIN 4150: Part 3 sets out guideline values for vibration velocity to be used when evaluating the effects of vibration on buried pipework.

Table 17 presents the initial reference guideline for utilities and other buried pipework to evaluate the effects of short-term vibration impact. Specific vibration goals should be determined on a case-by-case basis as part of the vibration assessment for each work site and / or activity.

Table 17: DIN 4150-3 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on buried pipework

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

Note: Rock breaking/hammering and sheet piling activities are considered to have the potential to cause dynamic loading in some structures and it may therefore be appropriate to reduce the transient values by 50%.

5.6. Blast criteria

If blasting is proposed, the relevant blast criteria will be outlined in a Blast Management Strategy, which will be finalised and submitted to the DPE for information no later than one month prior to the commencement of blasting as required by E96, E97, E98, E99 and E100.

6. Environmental aspects and impacts

6.1. Construction activities

The Project will involve a range of construction 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 (Rozelle civil and tunnel site (C5), The Crescent civil site (C6), Victoria Road civil site (C7), Iron Cove civil site (C8), Glebe Island Ancillary Facility):

- Installation of environmental controls (temporary fencing/ hoardings etc.),
- Demolition of existing structures
- Site clearing as approved in the EIS/SPIR,
- Earthworks,
- Establishment of construction facilities including site buildings, but excluding the acoustic sheds,
- Temporary road and intersection modification / site access,
- Site drainage,
- Minor utility works and connections,

- Tunnel support works (Rozelle civil and tunnel site (C5), Iron Cove civil site (C8)):

- General worksite and on-site car parking,
- Construction of acoustic sheds and other mitigation measures,
- Tunnel decline/shaft excavation
- Tunnel supporting activities:

  - Workshop, deliveries, maintenance and storage,
  - Spoil handling (including on-site truck movements),

- Civil construction works (Rozelle civil and tunnel site (C5), The Crescent civil site (C6), Victoria Road civil site (C7), Iron Cove civil site (C8), Glebe Island Ancillary Facility):

- Earthworks and drainage,
- Cut and cover construction,
- Bridgeworks (Rozelle civil and tunnel site (C5) only),
- Road works:

  - Drainage,
  - Earthworks,
  - Cast-in-situ walls,
  - Pavements,
  - Furniture,

- Tunnelling:

  - Main alignment excavation,
  - Ventilation passages excavation,
  - Cross passage excavation,
  - Civil and mechanical fit out,

- Ventilation building construction (Rozelle civil and tunnel site (C5) and Iron Cove civil site (C8)):

- Excavation of shafts,
- Concrete works,
- Building installation,

- Local Area and Utility Works (outside ancillary sites / construction footprint),

- Site rehabilitation and landscaping (Rozelle civil and tunnel site (C5), The Crescent civil site (C6), Victoria Road civil site (C7), Iron Cove civil site (C8)):

- Decommissioning of tunnel support and civil construction facilities, and
- Site rehabilitation/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 plant and equipment in use,
- The number of plant and equipment simultaneously in use,
- Proximity to sensitive receivers,
- Topography and other physical barriers,
- Hours/duration of construction works,
- Ground condition,
- The condition of sensitive receivers,
- Cumulative impacts from other project's works,
- Proximity of heavy traffic areas such as the highway, and
- 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 Annexure B of the CEMP. A summary of these impacts and their associated risk levels prior to and following mitigation are summarised in Table 18.

Throughout the delivery of the Project, the Aspects and Impacts Register will be reviewed and a risk analysis for the Project will be conducted as detailed in Section 3.13 of the CEMP. The identified risk levels are based on the Environmental Risk Workshop outcomes, proposed activities, location of works, duration and intensity of works, likelihood of sleep disturbance, time of day, EIS outcomes, the CNVG, preliminary detailed design and experience on other major infrastructure projects.

Table 18: Noise and vibration summaries from the Project's Aspects and Impacts Register

Construction activity	Potential impact	NCA affected	Risk level prior to mitigation	Mitigation measures	Risk level following mitigation [1]
Site establishment (C5 Rozelle, C6 The Crescent, C7 Victoria Road, C8 Iron Cove, Glebe Island Ancillary Facility)	Noise and vibration impacts to sensitive receivers adjoining the compounds including out- of-hours impacts	NCA19, 20, 21, 23, 24, 25, 29, 31, 32, 33, 34, 35, 36	High	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Moderate
	Construction fatigue impacting sensitive receivers and broader community	NCA19, 20, 21, 23, 24, 25, 29, 31, 32, 33, 34, 35, 36	Moderate	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Minor
Tunnel support works (C5 Rozelle)	Noise and vibration impacts to sensitive receivers adjoining the compound including out-of-hours impacts	NCA16, 19, 20, 21, 24, 25	High	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Minor
	Noise and vibration impacts on receivers near construction site or along haul roads including out- of-hours impacts	NCA16, 19, 20, 21, 24, 25	Moderate	REMM NV3, NV4, NV6, NV9, TT17 CoA A25, CoA E80, CoA E87, E88, E90	Minor
Civil construction works (C5 Rozelle, C6 The Crescent, C7 Victoria Road, C8 Iron Cove, Glebe Island Ancillary Facility)	Noise and vibration impacts on nearby receivers including out of hours impacts	NCA19, 20, 21, 23, 24, 25, 29, 31, 32, 33, 34, 35, 36, 38	High	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Moderate
	Disturbance or damage of non-Aboriginal heritage item	NCA18, 19, 21,24, 25, 26, 30, 34	Moderate	CoA E84, E162	Minor
	Noise and vibration impacts on receivers near construction site or along haul roads (during standard hours)	NCA19, 20, 21, 23, 24, 25, 29, 31, 32, 33, 34, 35, 36, 38	Minor	REMM NV3, NV4, NV6, NV9, TT17 CoA A25, CoA E80, CoA E87, E88, E90	Minor
	Noise and vibration impacts on nearby receivers, including out- of-hours impacts resulting in structural damage or community complaints	NCA19, 20, 21, 23, 24, 25, 29, 31, 32, 33, 34, 35, 36, 38	Moderate	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Low
Tunnelling	Vibration impacts leading to structural damage or cosmetic damage	NCA15, 16, 17, 19, 20, 24, 32, 33, 39	Moderate	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Minor

	Vibration impacts leading to human discomfort criteria exceedance	NCA15, 16, 17, 19, 20, 24, 32, 33, 39	Moderate	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Minor
	Regenerated noise impacts on nearby receivers, including out- of-hours impacts, resulting in sleep disturbance or community complaints	NCA15, 16, 17, 19, 20, 24, 25, 31, 32, 33, 39	High	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Moderate
	Vibration leading to damage of heritage items	NCA15, 19, 24	Moderate	CoA E84, 162 REMM NAH06	Minor
Ventilation building construction (C5 Rozelle, and C8 Iron Cove)	Noise and vibration impacts on nearby receivers, including out-of-hours impacts resulting in structural damage or community complaints	NCA15, 16, 19, 20, 21, 24, 25	Moderate	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Minor
Local Area and Utility Works (outside ancillary sites)	Noise and vibration impacts on nearby receivers, including out- of-hours impacts resulting in structural damage or community complaints	NCA19, 20, 21, 23, 24, 25, 29, 31, 32, 33, 34, 35, 36, 38	High	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Moderate
Site rehabilitation and landscaping (C5 Rozelle, C6 The Crescent, C7 Victoria Road, C8 Iron Cove)	Noise and vibration impacts to sensitive receivers adjoining the compounds including out- of-hours impacts	NCA15, 16, 19, 20, 21, 23, 24, 25, 27, 29, 30, 31, 32, 33, 34, 35, 36, 38, 39	High	REMM NV3, NV4, NV6, NV9 CoA A25, CoA E80, CoA E87, E88, E90	Moderate

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

Chapter 8 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. Method for evaluation and assessment of impacts

The process of assessment of construction noise and vibration impacts is detailed in Figure 3. This process will form the basis of the assessments that will be prepared prior to construction works commencement and will be progressively developed and/or updated during the construction stage (as required). Where significant new/additional activities and/or significant changes to site layout are proposed, additional assessment as per this section will be undertaken.

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 Annexure B).

Site-specific or activity-specific noise assessments will be prepared to assess all construction ancillary facilities activities for the Project.

Figure 3: Process for assessing construction noise and vibration

1. Determine noise and vibration objectives	
For each key construction area:	• Identify noise and vibration sensitive receivers • Determine relevant noise and vibration objectives, with reference to Section 5. Note: Assessment usually undertaken at locations considered to be representative of a group of receivers with a similar level of exposure to construction works.
2. Identify Construction Stages	
For each key construction area:	• Identify construction aspects or stages and key activities for each stage • Include: - the site location; - times of operation; - processes involved; - plant & equipment (including size / type). • Identify construction works in the vicinity of the project. Liaise with Proponent to ensure cumulative noise & vibration impacts are managed, in particular in relation to OOHW. • Identify construction works in the vicinity of the project. Liaise with Proponent to ensure cumulative noise & vibration impacts are managed, in particular in relation to OOHW.
3. Predict Noise and Vibration Impacts	
Airborne Construction Noise:	• Determine $L_{Aeq(15\ minute)}$ sound power levels for plant and equipment based on operating scenarios for input to noise model (see below). • Establish noise model for construction activity/ component. The noise model should include: - Height and location of sources and receivers - Distance attenuation (incorporating noise reflections, ground absorption); - Effects of noise shielding (topography, buildings, fences, barriers etc) - Effects of standard noise mitigation measures. - Evaluate facade transmission loss of affected receivers to determine internal noise levels • Calculate the $L_{Aeq(15minute)}$ noise levels (external and internal) from the proposed construction activities at each receiver and compare these with the construction noise objectives. • For night-time activities, calculate the maximum (L_{Amax}) noise levels and compare with $L_{A1(1min)}$ 65 dB(A) sleep disturbance criterion, applied at the external facade.
Ground-borne Construction Noise:	• Determine the location of plant or equipment item in relation to each receiver. • On the basis of ground-borne noise levels versus distance prediction curves for each plant item, determine the level of ground-borne noise at each building location. For highly sensitive building occupancies, the assessment may need to incorporate the acoustic properties of the building space and the structural response of the building.
Construction Vibration	• Determine the location of each plant or equipment item in relation to each receiver. • Where vibration intensive equipment could potentially be operating in close proximity to receivers, determine whether this is within the minimum working distances (**Section 5.5 and 8.4**). Note that minimum working distances may differ for heritage items; • Where plant & equipment may operate within minimum working distances, or for heritage items: • Use vibration levels vs distance prediction curves for each plant item • Determine the vibration likely to occur at each building location For highly sensitive equipment, assessment may need to incorporate structural response of building & particular sensitivities of equipment.
4. Assess Noise and Vibration Impacts	
Where predicted noise and vibration exceeds the objectives identified in Step 1:	• Identifying key hours of impact from affected sensitive receivers (see **Section 5.1**). • Implement appropriate reasonable/ feasible standard mitigation measures (see **Section 8**). • Predicted noise / vibration at receivers, incorporating nominated mitigation measures, based on the expected noise reduction from mitigation measures. • Additional mitigation measures may need to be considered. Note: Assessment usually undertaken at locations considered to be representative of a group of receivers with a similar level of exposure to construction works.

7.2. Construction Noise and Vibration Impact Statements

The CNVISs will be a key site management tool providing clear instructions for managing each construction ancillary facility. In accordance with CoA E79, Construction Noise and Vibration Impact Statements (CNVIS) will be prepared for each construction ancillary facility before any works that result in noise and vibration impacts commence at the relevant construction ancillary facility. The CNVIS will be progressively prepared to supplement the NVMP and refine impact predictions presented in the EIS. All CNVIS will be prepared by an appropriately qualified and experienced acoustic consultant. All CNVIS for construction ancillary facilities 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).

Each CNVIS will be prepared before works that generate noise and vibration impacts commence and will set out the mitigation and management measures required for the construction stage, through consultation with affected sensitive receivers. They 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 (outlined in Section 1),
- Construction noise and vibration assessment,
- Mitigation options and preferred management measures, and
- Noise and vibration monitoring requirements.

Monitored noise and vibration levels will be analysed against the predictions made in the relevant CNVIS. 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 (CoA E76) and community notification (CoA B2(c), B2 (e)) will also be summarised, and implemented.

The CNVIS will identify the sensitive receivers that JHCPB is required to notify regarding upcoming works. This notification will include the likely noise and vibration impacts during the assessed works, the duration of impact and any additional mitigation (e.g. respite periods) that may be required to manage noise and vibration impacts.

The key CNVIS to be prepared under the NVMP are summarised in Table 19.

Table 19: CNVIS prepared under the NVMP

Construction site	Construction activity
Rozelle civil and tunnel site (C5)	Tunnel support and civil works
The Crescent civil site (C6)	Civil works
Victoria Road civil site (C7)	Civil works
Iron Cove civil site (C8)	Civil works
Glebe Island ancillary facility	Civil works

7.3. Tools for noise and vibration management

7.3.1. Surface works noise management tool

A surface works noise prediction tool has been developed for the purpose of assisting with managing impacts from specific sets of local area and utility works associated with the construction of the Project. The tool will allow:

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

The tool will be used to predict daytime and out of hours construction noise levels which will be compared against the Noise Management Level (NML) for each receiver. Appropriate mitigation and management measures can be adopted, as required by this NVMP.

The tool will perform three dimensional topographic modelling at one metre digital ground contours and built environment spatial grids. The model adopts the ISO 9613-2:1996 method to predict noise. All noise sensitive receivers defined in this NVMP are incorporated into the tool. Plant and equipment used to undertake the task and adjacent concurrent tasks to be modelled are selected in the tool. The tool contains sound power levels for each item of plant selected. The work areas for each task are then defined in the tool. The tool then models noise level predictions for all sensitive receivers which can be viewed in a tabular or GIS format.

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

7.3.2. Tunnelling noise and vibration management tool

Due to the dynamic nature of tunnel excavation, plant could operate in different sections of the tunnel at different times over the life of the Project. In the excavation of the Rozelle Interchange tunnels, the tunnel network is close to noise sensitive receivers. This will have a greater cumulative impact compared with a straight-line tunnel. A noise and vibration prediction tool for tunnelling has been developed in conjunction with JHCPB to assist in the prediction of cumulative impacts and the identification of appropriate mitigation measures. The tool is based on the ground-borne noise and vibration model developed for the Project and references the relevant criteria identified in this NVMP and the assumptions and inputs used in the development of the model.

The tool is a web-based application available to key Project staff. A user nominates the tunnel section of interest, selects the equipment in use, and defines the advance rate. Based on these inputs, the tool calculates the slant distance between each source and receiver, which is then used to calculate the ground-borne noise and vibration. If a source is predicted to exceed the nominated criteria, the tool will also calculate the duration of the exceedance. Multiple construction crews can be assessed at the same time to show cumulative impacts at each receiver. Once a calculation is completed, the user can then save the results in a brief summary report or as files for input into a GIS program. The predicted outputs will be compared against the relevant ground-borne noise and vibration criteria in the GIS program to facilitate the identification of specific management measures to be applied to individual properties during tunnelling construction.

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 Annexure B). This feedback loop will ensure the prediction tool is verified and adjusted as required to ensure accuracy across the various sections of the tunnel alignment.

8. Environmental control measures

8.1. Noise and vibration mitigation and management 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 1 of this Plan.

Site and / or activity specific mitigation measures are documented in noise and vibration assessments (CNVIS) for each worksite, as outlined in Section 7.2. This information may be developed as design and construction planning progresses. The noise and vibration assessments will be document controlled separately from this NVMP. Therefore, an update to these plans will not require this NVMP to be updated.

Acoustic sheds at tunnel support sites are a mitigation measure to support 24/7 tunnelling. They have been erected in accordance with Condition E86.

Specific measures and requirements to address contract specifications, CoA and REMMs in relation to impacts from noise and vibration are outlined in Table 20.

Table 20: Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resource needed	When to implement	Responsibility	Reference	Evidence
General						
MMNV1	Training will be provided to relevant Project personnel, including relevant sub-contractors on noise and vibration requirements from this NVMP through inductions, toolboxes or targeted training.	Induction materials Toolbox talk	Prior to construction Construction	Environmental Advisor	JHCPB Practice	Induction records Toolbox talk record
MMNV2	All employees, contractors and subcontractors are to receive a Project induction prior to commencing work on site. The environmental component, covered in either the induction or toolboxes, will include: • Existence and requirements of this NVMP, • 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, and • Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.	Induction materials	Prior to construction Construction	Environmental Advisor	JHCPB Practice	Induction records Toolbox talk record
Construction Traffic Noise						
MMNV3	Project-related heavy-vehicle movements will be tracked to and from site (at the gates of the construction sites) and truck numbers will be managed to be within the volume modelled within the relevant CNVIS with the aim of limiting any associated increases in road traffic noise levels. Where the relevant noise increase is greater than 2 dB, consideration would also be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the following road traffic noise criteria in the RNP:	Noise and Vibration Monitoring Program (Section 8) CNVIS	Construction	Environment and Sustainability Manager/ Construction Project Managers	REMM TT17	Monitoring records

	• 60 dB LAeq(15hour) day and 55 dB LAeq(9hour) night for existing freeway/ arterial/ sub-arterial roads, and • 55 dB LAeq(1hour) day and 50 dB LAeq(1hour) night for existing local roads. In addition to the above, where Project trucks and other vehicles are using public roads during the night period, assessment of sleep disturbance will be required. Note: This measure only applies to roads within 600m of the Project sites in line with the CNVG. If Project-related heavy vehicle movements do not comply with the above criteria, alternative truck routes or potential reduction of truck movements will be considered.					
MMNV4	Prior to arriving on site, 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). This will be communicated by JHCPB using notifications under contract provisions and communication with schedulers from companies using heavy vehicles.	Induction materials	Construction	Supervisor/ Foreman / Site Engineer	REMM TT15	Vehicle movement plans Traffic control plans Induction records
MMNV5	JHCPB will ensure construction vehicle contractors and drivers are aware of noise management measures to minimise any sleep disturbance impacts.	Induction materials	Construction	Supervisor / Foreman / Site Engineer Environment and Sustainability Manager	JHCPB Practice	Induction records
MMNV6	Out-of-hours deliveries will be minimised where possible. Where out of hours deliveries are required, due care will be taken to minimise impacts (i.e. no extended periods of engine idling, use of radios instead of shouting, non-tonal reversing beepers where possible, unloading / loading to be undertaken during standard hours).	Induction materials CNVIS	Construction	Supervisor/ Foreman/ Site Engineer	JHCPB Practice	Induction records

General Plant and Equipment						
MMNV7	All construction plant and equipment used on site will be fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications.	Plant risk assessment Manufacturer's specifications	Construction	Supervisor/ Foreman	G36	Plant inspection records
MMNV8	All construction plant and equipment used on the site will be maintained in an efficient condition, in accordance with the manufacturers' specification. If a piece of plant or equipment is found to exceed the noise levels included in modelling, the following will occur: • If available and appropriate, a quieter piece of plant or equipment will be utilised in place of the offending plant / equipment; • On-site mitigation (e.g. noise blankets) will be reviewed; and /or • The noise assessment will be repeated with the accurate noise level of the plant / equipment.	Plant risk assessment Manufacturer's specifications CNVIS or noise modelling tool	Construction	Supervisor/ Foreman	G36	Plant inspection records Site inspection records
MMNV9	All construction plant and equipment used on the site will be operated in a proper and efficient manner.	Plant risk assessment Toolbox talk SWMS	Construction	Supervisor/ Foreman	G36	Site inspection records Safety inspection records SWMS Toolbox talk record
MMNV10	Non-tonal movement alarms will be used in place of tonal reversing alarms for JHCPB owned plant and subcontract plant used at night or during the day.	Plant risk assessment Toolbox talk SWMS	Construction	Supervisor/ Foreman	G36	Plant inspection records SWMS Site inspection records Toolbox talk record
MMNV11	Plant and machinery will be switched off when it is not in use for more than 15 minutes	Induction materials Toolbox talk SWMS	Construction	Supervisor/ Foreman	JHCPB Practice	Induction records Site inspection records Pre-start briefing SWMS

MMNV12	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 and during standard hours where reasonable and feasible. Maintenance undertaken outside standard hours would use mitigations such as acoustic enclosures or working underground where the noise is predicted to exceed the NML.	Toolbox talk SWMS	Construction	Supervisor/ Foreman	JHCPB Practice	Plant inspection records SWMS Toolbox talk record
MMNV13	Consider noise when selecting construction methods and substitute for quieter methods where reasonable and feasible.	Induction materials Toolbox talk SWMS	Construction	Supervisor/ Foreman/ Site Engineer/ Project Engineer	JHCPB Practice	Induction records SWMS Meeting minutes Toolbox talk record
MMNV14	Use appropriately sized equipment, avoiding over-powered plant.	Induction materials Toolbox talk SWMS	Construction	Supervisor/ Foreman	JHCPB Practice	Induction records SWMS Meeting minutes Toolbox talk record
MMNV15	Additional temporary screening or enclosures will be considered for plant and equipment where additional measures are required to meet relevant NMLs, or where plant and equipment is known to exceed the NMLs	SWMS	Construction	Supervisor/ Foreman	JHCPB Practice	Site inspection records SWMS
MMNV16	Stationary noise sources would be enclosed or shielded where reasonable and feasible. This would apply to plant and equipment such as generators, stationary concrete cutters, stationary asphalt corers, stationary vacuum trucks, and stationary jack hammers.	SWMS	Construction	Supervisor/ Foreman	JHCPB Practice	Site inspection records SWMS
General Construction Hours						
MMNV17	Construction activities associated with the Project will be carried out in accordance with the hours in Section 5.3 of the NVMP.	Induction materials	Construction	Construction Project Managers	CoA E68, CoA E69	Induction records Site inspection records

MMNV18	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, and ▪ 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.	Induction materials Project EPL	Construction	Construction Project Managers Environment and Sustainability Manager	CoA E72, EPL	Induction records Site inspection records
MMNV19	OOHW is to be carried out in accordance with: ▪ The Project's Out-of-Hours-Works Protocol (Annexure D); or ▪ The Project's EPL.	Induction materials OOHW Protocol Project EPL	Construction	Construction Project Managers Environment and Sustainability Manager	CoA E73, CoA E77 EPL	Induction records OOHW Permits Site inspection records
Acoustic sheds and noise barriers						
MMNV20	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.	This NVMP CNVIS	Construction	Construction Project Managers	CoA E86	Site inspection records
MMNV21	Acoustic sheds will be designed with consideration of the activities that will occur within them and the relevant noise management levels in adjacent areas.	CNVIS Design reports	Construction	Construction Project Managers Environmental Advisor	REMM NV7	Site inspection records Meeting minutes
MMNV22	Noise barriers (such as site hoardings) will be constructed around ancillary facilities as detailed within the CNVIS (Note: this does not include temporary noise blankets, whose location is not specified in the CNVIS).	CNVIS	Prior to construction Construction	Construction Project Managers	CoA C26, REMM NV3	Site inspection records
MMNV23	Structures will be used as noise barriers at compounds where appropriate.	CNVIS Site layout drawings	Construction	Construction Project Managers Environment and Sustainability Manager	JHCPB Practice	Site inspection records
MMNV24	Site access and egress points will be located as far as feasible and reasonable from noise sensitive receivers.	Section 4 of the Traffic and Transport Access Management Plan	Prior to construction	Supervisor/ Foreman/ Site	JHCPB Practice	Site inspection records Meeting minutes

				Engineer/ Project Engineer Environmental Advisor		
Blast Management						
MMNV25	Should blasting be required, a Blast Management Strategy will be prepared in consultation with the EPA. The strategy will: ▪ Identify relevant performance criteria in relation to potential noise and vibration impacts due to blasting, ▪ 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, ▪ 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.	This NVMP	Construction	Construction Project Managers/ Environment and Sustainability Manager	G36, CoA E96, REMM NV8	Blast management strategy
Consultation and Complaints Management						
MMNV26	Residences / sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Strategy. Information provided will include: ▪ The types of activities to be undertaken, ▪ The timing of activities including expected start and finish, ▪ The location of activities, and ▪ Details of the community information line and how to make an enquiry and / or complaint. If the potential vibration exceedance is to occur more than once or extend over a period of 24 hours, owner and occupiers will be provided a monthly schedule of potential exceedances for the duration of the potential exceedances, unless otherwise agreed by the owner and occupier.	Community Strategy CEMP	Prior to construction Construction	Construction Project Managers/ Environment and Sustainability Manager	JHCPB Practice, EPL, CoA E76, CoA E83	Community notifications

MMNV27	Where noise assessments predict noise levels above the NMLs at community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas, consultation with the potentially affected receiver will be undertaken to identify sensitive periods and minimise impacts, where possible.	CNVIS NVMP Section 8.5.2	Prior to construction Construction	Construction Project Managers/ Environment and Sustainability Manager/ Community Relations Manager	CoA E80	Consultation records
MMNV28	All complaints will be managed in accordance with the CS and EPL.	Communications Strategy	Construction	Community Relations Manager	G36 CEMP 3.7.4	Complaints register
MMNV29	Owners and occupiers at risk of exceeding the screening criteria for cosmetic damage (refer to Annexure E will be notified before works that generate vibration commence in the vicinity of those properties. If the potential exceedance is to occur more than once or extend over a period of 24 hours, owner and 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 Community Strategy	Prior to construction Construction	Construction Project Managers/ Environment and Sustainability Manager/ Community Relations Manager	CoA E83	Consultation records
MMNV30	Monitoring will be undertaken in response to complaints, as determined on a case by case basis and in accordance with the EPL.	Noise and Vibration Monitoring Program (Section 5.1)	Construction	Community Relations Manager/ Environmental Advisor	JHCPB Practice	Monitoring records
Survey, Monitoring and Reporting						
MMNV31	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 Advisor	JHCPB Practice	Monitoring records
MMNV32	Verification monitoring will be carried out during the initial stages of activities for which a location and activity specific noise and vibration impact assessment has been prepared to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions and that the management measures that have been implemented are appropriate.	Noise and Vibration Monitoring Program (Section 5.1) CNVIS	Construction	Project Manager / Project Engineer / Foreman Environment and Sustainability Manager	REMM NV6	Monitoring records

MMNV33	JHCPB 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.	Noise and Vibration Monitoring Program (Section 6.1)	Construction	Environmental Coordinator	CoA E84	Monitoring records
MMNV34	JHCPB will offer pre-construction condition surveys on the current condition of surface and sub-surface structures identified as at risk from settlement or vibration by the geotechnical model. The surveys and subsequent condition survey reports will be prepared by a suitable qualified and experienced person and will be provided to owners of the structure prior to the commencement of potentially impacting works. Where a pre-construction survey was undertaken, owners will be offered a post-construction survey within three months of the completion of construction.	Communications Strategy NVMP Section 6	Prior to construction Construction	Construction Project Managers	G36, CoA E105, CoA E106	Monitoring records
MMNV35	The condition survey 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 ▪ Details of the inspector's qualification and expertise.	Communications Strategy	Prior to construction Construction	Construction Project Managers	G36	Monitoring records
Ground-borne Noise Mitigation Measures						
MMNV36	Provide specific notifications to receivers where the ground-borne noise levels are predicted to exceed the night-time NML.	Communications Strategy	Construction	Construction Project Managers	JHCPB Practice CoA E82	Community notifications
MMNV37	Select the smallest rock hammers capable of efficiently completing the work, where feasible and reasonable.		Construction	Construction Project Managers/ Supervisor/ Foreman	JHCPB Practice	Site inspection records

MMNV38	Undertake ground-borne noise and vibration monitoring as soon as possible into the tunnelling activities to verify the reference levels used in this study and the prediction methodology.	Noise and Vibration Monitoring Program	Construction	Environmental Advisor/ Environment and Sustainability Manager	JHCPB Practice	Monitoring records
MMNV39	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.	CNVIS Tunnelling ground-borne noise and vibration prediction tool NVMP	Construction	Environmental Advisor	JHCPB Practice	GIS Tool
MMNV40	Utilise the tunnelling ground-borne noise and vibration prediction tool to inform programming and equipment use decisions and impact mitigation options.		Construction	Environmental Advisor	JHCPB Practice	GIS Tool
MMNV41	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).	Community Strategy	Construction	Environmental Advisor Public Liaison Manager	JHCPB Practice	Community notifications and consultation records
MMNV42	A ground-borne noise assessment will be undertaken for the Project. Ground-borne noise mitigation measures will be implemented in accordance with the assessment, this NVMP and relevant Conditions of Approval.	NVMP Section 8	Construction	Environment and Sustainability Manager Environmental Advisor Construction Project Managers	JHCPB Practice CoA E82	Site inspection records
Other Mitigation Measures						
MMNV43	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 Toolbox talks	Construction	Supervisor/ Foreman	JHCPB Practice	Induction records Toolbox talk record Site inspection records
MMNV44	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	Noise and Vibration Monitoring Program Induction materials	Construction	Supervisor/ Foreman Environmental Advisor	G36	Induction records Site inspection records

	accordance with the Noise and Vibration Monitoring Program.					

8.2. At-property treatment

8.2.1. Noise Insulation Program

The Noise Insulation Program is a requirement of CoA E89. The purpose of the Program is to describe the scope for the implementation of construction at-property treatment by JHCPB, and the process to implement this treatment at residential receivers during delivery of the Design and Construction of the Project in accordance with CoA E87, E89 and E90.

The Program does not apply to operational at-property treatment which will be identified through the development of the Operational Noise and Vibration Review (ONVR) (a requirement of CoA E92).

The Noise Insulation Program aims to reduce construction fatigue and improve amenity for residential receivers identified in Appendix D of the Approval, excluding properties which have already been provided treatment via the Roads and Maritime Noise Abatement Program, through the installation of at-property treatment.

Pending property owner acceptance and provision of access, the Noise Insulation Program will be applied in accordance with CoA E90, which requires treatment be implemented within 6 months following construction that would affect the receiver. The Program will be implemented within 3 months for high priority receivers.

8.2.2. 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 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 is not proposed early in accordance with CoA E93, JHCPB will prepare 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 the ONVR are implemented.

In accordance with CoA E94 this report will be endorsed by the AA and submitted to DPE prior to the commencement of construction which would affect the identified sensitive receivers.

8.3. Management procedures and hold points for OOHW

In accordance with E77, an OOHW Protocol will be prepared in consultation with the EPA and AA (refer Annexure D). The protocol will address out of hours works which are not subject to the EPL and will include a process for approval and hold points relating to:

- The justification of OOHW,
- Noise and vibration assessment,
- External approvals, including low risk works (by the ER in consultation with the AA), and high risk works (by DPE),
- Community notification,
- Tool boxing of the workforce on sensitive receivers and management requirements prior to the commencement of works, and
- Noise and vibration verification monitoring.

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

8.4. Vibration Screening Criteria drawings

Properties at risk of cosmetic damage will be identified through the vibration screening criteria drawings, prepared based on proposed vibration intensive construction activities (refer to Annexure E) and the vibration screening criteria nominated in Sections 5.5.2 and 5.5.3. The activities

modelled in Annexure E have been selected as they are indicative of the most vibration intensive works likely to be undertaken at each of the Ancillary Facilities.

Modelling of vibration intensive ancillary facilities activities has been undertaken and revised Vibration Screening Criteria drawings are presented in Annexure E, along with Vibration Screening Criteria drawings for tunnelling.

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

8.5. Communication and consultation

8.5.1. Proactive consultation and notification

Residents, property owners, businesses and community facilities near construction sites and the main tunnel alignment will have a wide range of unique needs and concerns regarding construction impact. JHCPB will engage through multiple channels to notify and build understanding of the likely impacts of airborne noise, ground-borne noise and vibration, and the reasonable and feasible options available to mitigate these impacts, including respite. In accordance with CoA E79, consultation with affected sensitive receivers will be undertaken regarding specific mitigation measures for inclusion in the CNVIS prepared for each construction ancillary facility.

Using multiple communication channels, JHCPB will provide clear points of contact and face-to-face communication for those most affected. With the scale of construction currently underway in Sydney, the community will be affected by multiple sources of impacts. When affected, the community may not understand which Project or contractor should be contacted to address their issues. They are also likely to have interests in different stages of the WestConnex projects and in developments that will affect their lives in the longer term.

A key feature of JHCPB's communication strategy is extensive collaboration with agencies and interface contractors to investigate opportunities to minimise cumulative impacts. Coordinated communications will serve to guide the community to the right points of contact for information and complaints and minimise frustration.

8.5.2. Consultation with sensitive receivers

Sensitive receivers such as community, religious, educational institutions and noise and vibration-sensitive businesses and critical working areas (e.g. theatres, laboratories and operating theatres) potentially affected by the Project will be consulted to develop timetables of works and specific mitigation measures to satisfy CoA E80. The outcomes of this consultation will be fed back into the construction noise and vibration management system and will assist with the final timetabling, respite periods and detailed design of mitigation measures for the site, where reasonable and feasible.

In addition, JHCPB will consult with proponents of other construction works near the Project worksites and take reasonable steps to coordinate works to minimise cumulative noise and vibration impact and coordinate respite for affected sensitive receivers, to satisfy CoA E76 and E78.

8.6. Property surveys and issues rectification

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

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

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.

8.7. Heavy vehicle transport noise

In accordance with REMM TT17, the Project Team will track heavy vehicle movements to and from sites and manage truck numbers with the aim of limiting any associated increases in road traffic noise levels on public roads (e.g. Victoria Road, City West Link, The Crescent) during the night-time period to no more than 2 dB(A), within 600m of the Project sites. Increases in road traffic noise of more than 2 dB(A) during the night-time period will be managed in accordance with the CNVG as noted in Section 5.4.

The proposed heavy vehicle numbers will be assessed for predicted noise increase prior to the night-time operation of that number of heavy vehicles in the CNVIS prepared for each construction ancillary facility (refer Section 7.2).

8.8. Additional noise and vibration mitigation measures

In instances where noise levels are still predicted to exceed the NML at receivers, after the application of noise mitigation and management measures (refer to Section 8.1), the CNVG directs that the Project should consider implementing the additional mitigation measures such as (refer to Appendix C of the CNVG for more detail):

- Notification (letterbox drop or equivalent) detailing work activities, time periods of which these will occur, impacts and mitigation measures
- Specific notifications, which provide additional information when relevant and informative to more highly affected receivers than covered in general letterbox drops
- Phone calls, which detail relevant information to identified/affected stakeholders and provide personalised contact, tailored advice and the opportunity to comment on the proposed work
- Individual briefings, which inform stakeholders about the impacts of high noise activities and mitigation measures, and provide personalised contact, tailored advice and the opportunity to comment on the proposed work
- Respite offers, to provide residents with respite from an ongoing impact
- Respite period 1, where out-of-hours construction noise in OOHW Period 1 is generally limited to no more than three consecutive evenings per week
- Respite period 2, where night-time construction noise in OOHW Period 2 is generally limited to two consecutive nights
- Duration respite, which is where the work duration, number of evenings and/or nights is increased so that the Project can be completed more quickly
- Alternative accommodation, and/or
- Verification, including measurement of the background noise level and construction noise.

The standard hours and OOHW periods are depicted in Figure 4. The OOHW periods are further defined as OOHW Period 1 and 2, based on the Roads and Maritime Construction Noise and Vibration Guideline (CNVG).

Figure 5, Figure 6 and Figure 7 detail the additional mitigation measures for airborne noise, ground-borne noise and vibration respectively, as recommended in the CNVG, for standard hours and out-of-hours work (OOHW). Where feasible and reasonable, this approach will be implemented.

Figure 4: Construction hours

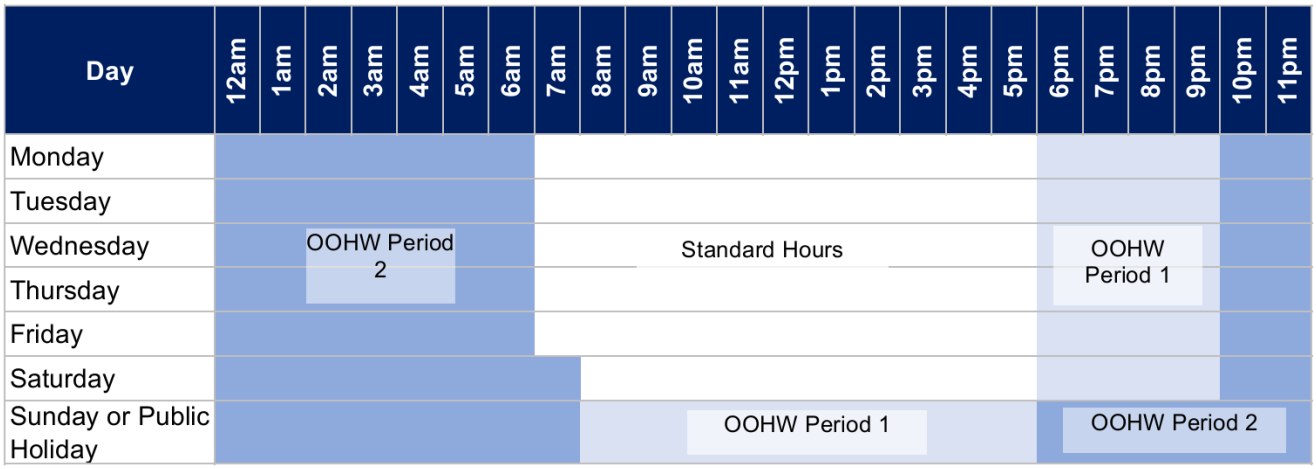


Figure 5: Triggers for Additional Mitigation Measures – Airborne Noise

When is the work being undertaken?	How much does the predicted noise level exceed the ANML by?	Identify additional management measures to be implemented
All Hours	75 dB(A) or greater	V, N, PC, RO
Standard Hours M-F 7am to 6pm Sat 8am to 6pm	0 dB(A)	-
	≤ 10 dB(A)	-
	10 to 20 dB(A)	V, N
	> 20 dB(A)	V, N
OOHW Period 1 M-F 6pm to 10pm Sat 6pm to 10pm Sun/ PH 8am to 10pm	< 5 dB(A)	-
	5 to 15 dB(A)	N, R1, DR
	15 to 25 dB(A)	V, N, R1, DR
	> 25 dB(A)	V, N, SN, IB, PC, R1, DR
OOHW Period 2* M-F 10pm to 7am Sat 10pm to 8am Sun/ PH 6pm to 8am	< 5 dB(A)	N
	5 to 15 dB(A)	V, N, R2, DR
	15 to 25 dB(A)	V, N, SN, IB, PC, R2, DR
	> 25 dB(A)	AA, V, N, SN, IB, PC, R2, DR

Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2, excluding AA.

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)

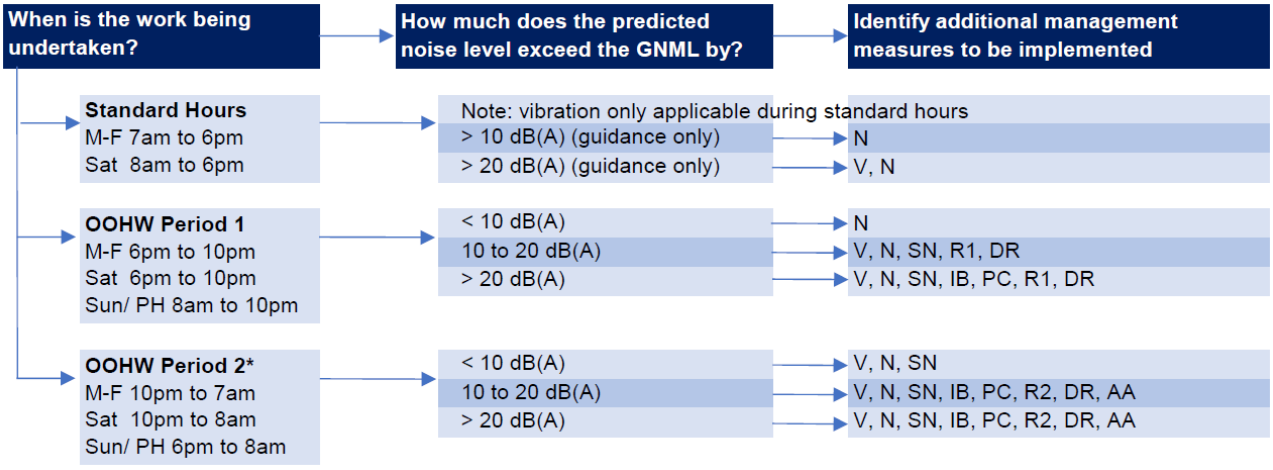
IB = Individual briefing PC = Phone Call

AA = Alternative accommodation** RO = Project specific respite offer R1 = Respite period 1

V = Verification of predicted noise DR = Duration respite R2 = Respite period 2

** Where construction activity impacts receiver for more than two consecutive nights. AA is not applicable to shoulder periods.

Figure 6: Triggers for Additional Mitigation Measures – Ground-borne noise



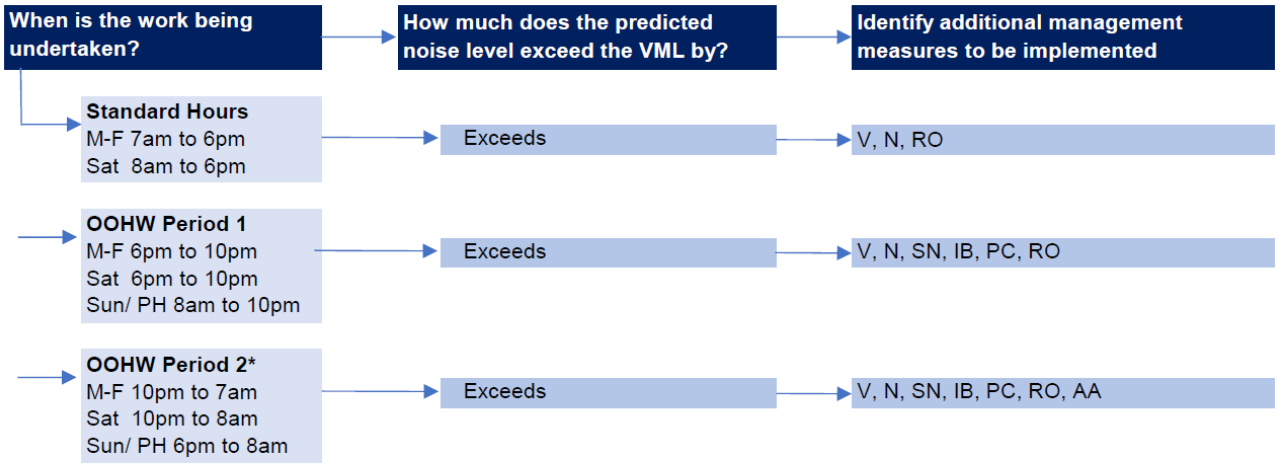
Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2, excluding AA.

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)
IB = Individual briefing PC = Phone Call
AA = Alternative accommodation** RO = Project specific respite offer R1 = Respite period 1
V = Verification of predicted noise DR = Duration respite R2 = Respite period 2

** Where construction activity impacts receiver for more than two consecutive nights. AA is not applicable to shoulder periods.

Figure 7: Triggers for Additional Mitigation Measures – Vibration



Notes: Use the abbreviation codes in the table above to confirm management measures required

* Where OOHW occur in the evening/night shoulder period (10pm to 12am) or the night/morning shoulder period (5am to 7am) apply additional airborne mitigation measures from the OOHW Period 2, excluding AA.

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)
IB = Individual briefing PC = Phone Call
AA = Alternative accommodation** RO = Project specific respite offer R1 = Respite period 1
V = Verification of predicted noise DR = Duration respite R2 = Respite period 2

** Where construction activity impacts receiver for more than two consecutive nights. AA is not applicable to shoulder periods.

9. Compliance management

9.1. Roles and responsibilities

The JHCPB 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 NVMP.

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 or toolboxes 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, and
- 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 to generate noise and vibration impacts will occur for the duration of the Project. Requirements and responsibilities in relation to monitoring and inspections are documented in Section 3.8.1 and 3.8.2 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 Annexure B).

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

- Cease the noise generating source which causes the exceeded predictions,
- Confirm the monitored levels are not being impacted by other noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment,
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant, or if additional mitigation can be included in the site design,
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment,
- Confirm 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 management levels set out in this NVMP,
- Ensure that the learnings from the above are fed back into the noise modelling assessment process for fine-tuning,
- Continue work where impacts can be reduced and
- Communicate lessons learnt to relevant personnel.

JHCPB 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 and the Community Strategy.

9.5. Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this 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 assessment documents and the Construction Noise Monitoring Program.

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

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

10. Review and improvement

10.1. Continuous improvement

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

The 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, and
- Make comparisons with objectives and targets.

10.2. Update and amendment

The processes described in Section 3.13.1 and 3.13.2 of the CEMP may result in the need to update or revise this NVMP. This will occur as needed.

Any revisions to the NVMP will be in accordance with the process outlined in 3.13.1 of the CEMP.

A copy of the updated NVMP 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.

Annexure A Other Conditions of Approval and Revised Environmental Management Measures relevant to this NVMP

Table 21: Other Conditions of Approval relevant to the development of this Plan

CoA No.	Condition Requirements	Document Reference
C26	Boundary fencing required under Condition C25 of this approval must minimise visual, noise and air quality impacts on adjacent sensitive receivers.	Table 20 MMNV22
E66	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.	Section 4.1 Annexure C
E67	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 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.	Section 7.1
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 20 MMNV17
E69	Notwithstanding Condition E68, works may be undertaken between 1:00 pm to 6:00 pm on Saturday.	Table 20 MMNV17 Section 5.3.1
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, excluding from the Iron Cove civil site (C8) at which haulage is limited to the work hours specified in Conditions E68 and E69, 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	Table 20 MMNV18 Section 5.1.1

	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, excluding spoil haulage from the Iron Cove civil site (C8) at which haulage is limited that causes LAeq (15 minute) noise levels: i. no more than 5 dB(A) above the rating background level at any residence in accordance with the Interim Construction Noise Guideline (DECC, 2009), and ii. no more than the 'Noise affected' noise management levels specified in Table 3 of the Interim Construction Noise Guideline (DECC, 2009) at other sensitive land uses, and iii. continuous or impulsive vibration values, measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.2 of Assessing Vibration: a technical guideline (DEC, 2006), and iv. intermittent vibration values measured at the most affected residence are no more than the maximum values for human exposure to vibration, specified in Table 2.4 of Assessing Vibration: a technical guideline (DEC, 2006). Note: Section 5.24(1)(e) of the EP&A Act requires that an EPL be substantially consistent with this approval. For example, an EPL cannot authorise spoil movements at the Darley Road construction ancillary facility outside of the hours specified in Conditions E68 and E69. Out of Hours Works considered under Conditions E73(c) and (d) must be justified and include an assessment of mitigation measures.	Table 6 Table 20 MMNV19 Annexure D
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 5.1.1
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	Section 5.1.1 Annexure D Community Strategy

	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. 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.	
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 5.1.1 Table 20 MMNV26 Section 8.5.2 Annexure D Community Strategy
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 e. identify Department, EPA and community notification arrangements for approved out of hours works, which maybe detailed in the Communication Strategy.	Section 5.1.1 8.3 Table 20 MMNV19 Annexure D
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	Section 5.1.1, 8.5.2 Community Strategy

	c. provide documentary evidence to the AA in support of any decision made by the Proponent in relation to respite or mitigation.	
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 20 MMNV27 CNVIS Community Strategy
E81	Mitigation measures must be implemented with the aim of achieving the following construction noise management levels and vibration criteria: a. construction 'Noise affected' noise management levels established using the Interim Construction Noise Guideline (DECC, 2009); b. vibration criteria established using the Assessing vibration: a technical guideline (DEC, 2006) (for human exposure); c. Australian Standard AS 2187.2 - 2006 "Explosives - Storage and Use - Use of Explosives"; d. BS 7385 Part 2-1993 "Evaluation and measurement for vibration in buildings Part 2" as they are "applicable to Australian conditions"; and e. the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration- effects of vibration on structures (for structural damage). Comparison against the criteria must take into account the cumulative noise and vibration levels from concurrent activities associated with the CSSI. 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. Predicted vibration levels must be used to select the specific management measures to be applied to individual properties during construction. 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.	Section 5.5.2, 8.1
E82	Mitigation measures must be applied when the following residential ground-borne noise levels, including cumulative levels from concurrent activities associated with the CSSI, are exceeded: a. evening (6:00 pm to 10:00 pm) — internal LAeq (15 minute): 40 dB(A); and b. night (10:00 pm to 7:00 am) — internal LAeq (15 minute): 35 dB(A). The mitigation measures must be outlined in the Construction Noise and Vibration Management Sub- plan, including in any Out-of-Hours Work Protocol, required by Condition E78. Predicted ground-borne noise levels must be used to select the specific management measures to be applied to individual properties during construction.	Table 20 MMNV36, MMNV37, MMNV38, MMNV39, MMNV40, MMNV41 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 potential exceedance is to occur more than once or extend over a	Section 8.3 Table 20 MMNV29

	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.	Annexure E Community Strategy
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.	Section 7 Table 20 MMNV33 Annexure B 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.	Section 5.5.3 Section 7 Annexure B
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 20 MMNV20
E86A	Tunnelling and excavation works from the Iron Cove civil site (C8) to construct the ventilation tunnel and caverns must not commence until the chamber beneath the roof of the cut and cover structure has been converted into a temporary acoustic shed and fitted with a roller door.	Table 20 MMNV20
E87	For out-of-hours work undertaken in accordance with Condition E75, 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 properties identified in Appendix D. Mitigation must be offered prior to out-of-hours work commencing. This requirement does not apply if the sensitive receiver has been provided with noise mitigation under the Roads and Maritime 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 8.2.1
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.	Section 8.1 Noise Insulation Program

	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 8.1 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 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.	Section 8.2
E94A	Within three months of commencement of operation of the high voltage regulators at Iron Cove, the Proponent must undertake noise monitoring to compare the actual noise level emitted by the regulators to the noise performance at sensitive receiver as predicted in the document *WestConnex M4-M5 Link Rozelle Interchange Iron Cove Ventilation Underground Modification Report* (dated November 2019) and project specific noise level as determined in accordance with the *NSW Industrial Noise Policy* (EPA, 2000). Monitoring must capture the onload tap changer noise and peak loading. A report detailing the noise monitoring results must be provided to the Secretary for information within one month of undertaking the monitoring. If the noise level at the nearest sensitive receiver exceeds either the predicted noise level or project-specific noise level, then the Proponent must implement noise reduction measures within six months of when the noise monitoring was undertaken.	
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 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 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 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 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 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.	Should blasting be proposed, a Blast Management Strategy will be prepared.
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 CS
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 Community Strategy
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 Community Strategy
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 Community Strategy
Non-Aboriginal Heritage		
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 implemented to ensure any such work minimises any adverse impacts on the heritage significance of the item.	Non-Aboriginal Heritage Management Plan Section 8.1 Noise Insulation Program

Table 22: Revised Environmental Management Measures relevant to the development of this NVMP

Outcome	Ref #	Commitment	Timing	Document Reference
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: ◦ 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	Construction	Section 3.4

	REMM NV2	A Construction Noise and Vibration Management Plan (NVMP) will be prepared for the project. The plan will: • Identify relevant performance criteria in relation to noise and vibration • Identify noise and vibration sensitive receivers and features in the vicinity of the project • 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 • 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 • Include protocols that will be adopted to manage works required outside standard construction hours in accordance with relevant guidelines • Detail monitoring that will be carried out to confirm project performance in relation to noise and vibration performance criteria. The CNVMP will be implemented for the duration of construction of the project.	Construction	Section 1 Section 4.1 Annexure C Table 20 Section 7.1 Section 5.4 Annexure D Section 9.3 Annexure B
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 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.	Construction	Section 7.1 CNVIS

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
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 8.3 Annexure D
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 and that the management measures that have been implemented are appropriate.	Construction	Table 20 MMNV32 Annexure B, 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.	Construction	Table 20 MMNV21
		Monitoring will be carried out to confirm that the actual acoustic performance of each shed is consistent with predicted acoustic performance.		Annexure B, 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 • 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.	Construction	Should blasting be proposed, a Blast Management Strategy will be prepared.
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 8.2 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 8.2.2 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 8.7 Table 20MMNV3
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

Annexure B Noise and Vibration Monitoring Program

WestConnex
Rozelle Interchange

JOHN HOLLAND | CPB CONTRACTORS

JHCPB Joint Venture

Noise and Vibration Monitoring Program

Project	Design and Construction of Rozelle Project
Design Lot No.	00-PL-290
Document No.	RIC-JHC-MPL-00-PL-290-001
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Document Approval

Developed By:				
Name: [redacted]		Position: [redacted]		
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Name		**Position**		**Date Reviewed**
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03	[redacted]	[redacted]	[redacted]	[redacted]
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05	[redacted]	[redacted]	[redacted]	[redacted]
06	[redacted]	[redacted]	[redacted]	[redacted]
07	[redacted]	[redacted]	[redacted]	[redacted]
08	01/02/2023	Removal of long-term monitoring location	[redacted]	[redacted]

Contents

Glossary/Abbreviations

Abbreviations	Expanded Text
AA	Acoustics Advisor
ABL	Assessment Background Level
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 (DEC 2006)
CS	Communication Strategy
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (Roads and Maritime 2016)
CNVIS	Construction Noise and Vibration Impact Statement
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 EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
DPE	NSW Department of Planning and Environment
EIS	WestConnex M4-M5 Link Environmental Impact Statement
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.
EPA	NSW Environment Protection Authority
EPL	Environment Protection License
ER	Environmental Representative
Feasible and reasonable	Feasible means actions to reduce impacts, and is capable of being put into practice or engineered and practical to build given project constraints. Reasonable means selecting reasonable measures from those that are feasible based on whether the overall benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure.
ICNG	Interim Construction Noise Guideline (DECC, 2009)
JHCPB	John Holland CPB Contractors joint venture
$L_{Aeq\ (15min)}$	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.
NCA	Noise Catchment Areas
NML	Noise management levels
NVMP	Noise and Vibration Management Plan
OEH	Office of Environment and Heritage
OOHW	Out-of-Hours Works – work completed outside of standard construction hours
PPV	Peak Particle Velocity
Project	Design and Construction of Rozelle Interchange Project
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)
REMMs	Revised Environmental Management Measures
RMS	Root-Mean-Square acceleration
Roads and Maritime	Roads and Maritime Services
SPIR	WestConnex M4-M5 Link Submissions and Preferred Infrastructure Report
Standard construction hours	Hours during which construction work is permitted by the CoA. Further defined in Section 5.1.1 in the NVMP.
TfNSW	Transport for NSW (formerly Roads and Maritime Services)
Works	All physical activities to construct or facilitate the construction of the Project, including environmental management measures and utility works.

1. Introduction

1.1. Context

This Noise and Vibration Monitoring Program (monitoring Program) has been prepared for the Design and Construction of Rozelle Interchange Project (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. Background and project description

The WestConnex 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, 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 John Holland CPB Contractors Joint Venture (JHCPB) proposes to carry out noise and vibration monitoring during the construction of the Project. Monitoring will be undertaken for modelling verification at sensitive receivers, to assess compliance in response to complaints, for equipment spot checks, verification of 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 does not fall within the scope of this monitoring Program and therefore is not included within the processes contained within this monitoring Program.

1.4. Environmental management systems overview

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

2. Purpose and objectives

2.1. Purpose

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

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

2.2. Objectives

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

- The EIS prepared for WestConnex M4-M5 Link,
- The SPIR prepared for WestConnex M4-M5 Link,
- Conditions of Approval granted to the Project on 17 April 2018, as modified on 25 February 2019,
- Roads and Maritime specification G36, and
- The Project's Environment Protection Licence (EPL # 21278) issued on 15 May 2020 including the Section 58(5) Licence Variation issued on 18 August 2020.

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 Section 3.1.1 of the NVMP.

3.1.2. Guidelines

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

- Roads and Maritime QA Specification G36 – Environmental Protection (Management System).
- Roads and Maritime Construction Noise and Vibration Guidelines (Roads and Maritime 2015)
- 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), Department of Environment and Conservation 2006
- Australian Standard 1055 Acoustics – Description and Measurement of Environmental Noise
- AS 2012.1 Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Determination of compliance with limits for exterior noise
- Australian Standard AS/NZS 2107:2016 Acoustics - Recommended design sound levels and reverberation times for building interiors
- Australian Standard AS 2187.2 Explosives - Storage and use - Part 2 Use of explosives
- Australian Standard AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites Australian Standard 2659.1 – 1998 Guide to the use of sound measuring equipment – portable sound level meters
- Australian Standard 2775 Mechanical Mounting of Accelerometers
- Australian Standard 2834-1995 Computer Accommodation, Chapter 2.9 Vibration
- Australian Standard IEC 61672.1 Electroacoustic – Sound Level Meters – Specifications
- British Standard BS 6472-2008, 'Evaluation of human exposure to vibration in buildings (1-80Hz)
- British Standard 7385: Part 2-1993 'Evaluation and measurement of vibration in buildings'
- German Standard DIN4150-3:2016 Vibration in buildings – Part 3: Effects on structures
- ISO 3744 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane
- ISO 3746 Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane
- ISO 6393 Earth-moving machinery - Determination of sound power level - Stationary test conditions
- ISO 6395 Earth-moving machinery - Determination of sound power level - Dynamic test conditions.

3.2. Consultation

This monitoring Program has been provided to NSW Health, City of Sydney, City of Canada Bay Council and Inner West Council in accordance with CoA C9 (c) for review and comment. A summary of the consultation undertaken is provided in Section 3.5 of the NVMP.

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

3.3. Environment Protection Licence monitoring requirements

An EPL (# 21278) was issued for the Project on 18 June 2019. Applicable requirements from the EPL have been incorporated into this Program. The first out of hours works, subject to the EPL, shall be completed in a trial period in accordance with the EPL. This is further detailed in Section 5.5.

On 18 August 2020, a Notice of Variation of Licence No. 21278 was issued. This amended condition L4.8 d) i., ii., and iii.to allow working evenings and/or nights. . It is anticipated there will be further numerous variations to the EPL. Furthermore, the EPL would be updated upon completion of the out-of-hours trial period. This Program will only be updated to reflect EPL variations following the scheduled review of the 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 monitoring results from a further 11 locations which were 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 4.3 and Annexure G of the NVMP and Section 3 of the EIS Appendix J (Technical Working Paper: Noise and Vibration).

A review of the EIS noise monitoring data by JHCPB found that it potentially did not adequately represent the acoustic environment at some NCAs. Additional monitoring was therefore undertaken by JHCPB and results are summarised in Annexure G of the NVMP.

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

5. Noise monitoring

5.1. Attended and unattended airborne noise monitoring

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

- Monitoring will be carried out at the commencement of activities for which a location and activity specific noise and vibration impact assessment has been prepared which identifies that validation monitoring is required (see NVMP Figure 5) to confirm that actual noise and vibration levels are consistent with noise and vibration impact predictions and that the management measures that have been implemented are appropriate,
- At the commencement of activities within an acoustic shed to confirm the actual acoustic performance of the shed is consistent with the predicted acoustic performance,
- Where a change in methodology, plant or equipment is anticipated to result in a significant increase in construction noise impact,
- Where appropriate in response to a noise related complaint(s) (determined on a case-by- case basis) and in accordance with EPL Condition,
- As directed by an authorised officer of the EPA,
- As otherwise required by the CNVIS (refer to NVMP Section 7.2 for information regarding CNVIS, specific monitoring requirements will be identified in the relevant CNVIS as they are location and task specific. Out of Hours Works (OOHW) Protocol (refer Section 5.4) or EPL (refer Section 5.5 and Section 5.5.2),
- Following the implementation of mitigation measures or noise attenuation as a result of exceedance of predicted noise levels, and
- Ongoing spot checks for noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with the maximum noise level goals for construction equipment. Spot checks would be carried out as required on a case-by-case basis, such as in response to a plant/equipment specific noise related complaint and during noise and vibration assessment validation monitoring when it is possible to isolate the noise from one piece of plant or equipment.

Unattended airborne noise monitoring will also be completed, with a noise logger deployed to obtain noise results over longer periods. In these instances, noise loggers will record audio to allow for the identification of construction noise contribution and the presence of any extraneous noise, if privacy concerns can be overcome. The use of unattended airborne noise monitoring is detailed in Section 5.3.

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

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

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

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

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

5.1.1. Parameters to be monitored

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

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

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

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

5.2. Attended and unattended ground-borne noise monitoring

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

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

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

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

Given that ground-borne noise is mostly noticed during the evening or at night, noise loggers may also be left in place over night and picked up at a mutually agreed time with the resident. In these instances, noise loggers will record audio to allow for the identification construction noise contribution and the presence of any extraneous noise, if privacy concerns can be overcome. Where the resident or receiver will not allow the noise logger to record audio, attended noise monitoring will be offered instead.

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

5.2.1. Parameters to be monitored

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

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

Ground-borne noise monitoring will be recorded 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_{A1} and $L_{A\ (max)}$.

5.3. Real-time (unattended) noise monitoring

Real-time (unattended) noise monitoring will be undertaken to satisfy CoA C11. The real-time noise monitors will be installed following approval of this monitoring Program.

Real-time noise monitors will be installed near the Lilyfield Rd boundary of the Rozelle civil and tunnel compound towards both the eastern and western end, as indicatively identified on Figure 1. The location of the real-time noise monitoring equipment will be subject to the final work site layouts and availability of mains power and will be selected in consultation with the Acoustic Advisor (AA).

For the Iron Cove Link site, real-time noise monitoring will be undertaken on a campaign basis or following multiple complaints where attended monitoring is not possible.

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

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

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

5.3.1. Parameters to be monitored

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

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

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

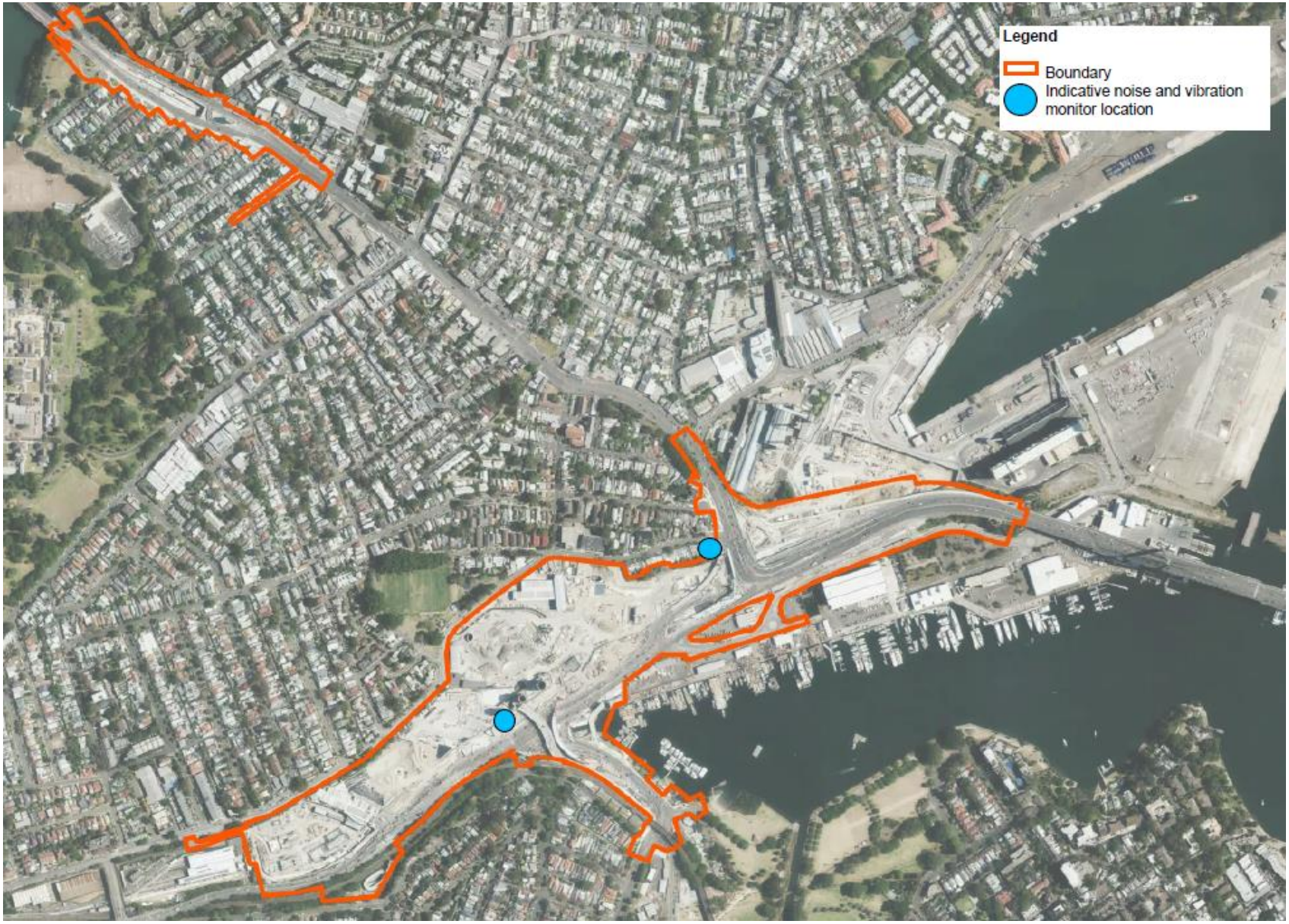

Figure 1 Indicative Real-time noise and vibration monitoring locations

5.4. Out-of-hours Protocol monitoring requirements

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

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

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

5.5. Out-of-hours EPL monitoring requirements

5.5.1. EPL trial period

The EPL enables out-of-hours works (for scheduled activities) under certain circumstances and prescribes requirements that must be complied with to undertake the works.

The out-of-hours works approved under the EPL commences with a four-week trial period. Prior to the commencement of the trial period (14 calendar days), a Construction Noise Impact Assessment must be submitted to the EPA. The Construction Noise Impact Assessment must:

- Describe the proposed out-of-hours works
- Provide predictions of LAeq noise levels at noise sensitive receivers (where noise levels are predicted to be greater than those identified in the EPL)
- Include a monitoring plan to validate the noise predictions, based on monitoring at the boundary of representative sensitive receivers during noise generating activities that are representative of the out-of-hours works.

In accordance with the EPL, noise monitoring must be undertaken throughout the trial period in accordance with the monitoring plan submitted in the Construction Noise Impact Assessment.

At the completion of the four-week trial period, a Validation Report would be submitted to the EPA. In addition, an EPA officer may request a Preliminary Investigation Report (and subsequently a follow-up investigation report) in respect to any noise monitoring undertaken. These reporting requirements are identified in Section 10.

5.5.2. Community agreement monitoring requirements

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

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

5.6. Construction Traffic Monitoring

Attended monitoring of construction traffic noise levels will be undertaken for the following truck routes detailed in the TTAMP:

1. One-way movement from Victoria Road to the City West Link using Darling Street and Balmain Road.
2. One-way movements between Blackwattle Bay Batching Plant and Ross Street using Bridge

Road only.

3. One-way movement from Parramatta Road to the City West link using Ross Street, Minogue Crescent and The Crescent

- Monitoring will be carried out for use of the above routes when active between 10pm and 7am to confirm the upper limit of trucks on these routes is consistent with the requirements of the *NVMP Section 5.4 Construction-related road traffic noise* and if not identify the number of trucks for compliance with *NVMP Section 5.4 Construction-related road traffic noise*.
- Attended monitoring locations will be at residential premises at locations along the route unaffected by construction noise.
- Monitoring is to determine the differential at the same location between noise levels with and without Project related vehicles. This can be achieved by monitoring:
    - On different nights (i.e. one night with Project related trucks on the subject route and the other with no Project related trucks using the route) at the same time of night, with equivalent weather, or
    - On the same night where the background is determined by a monitoring window with no Project related trucks using the route and where monitoring of noise with trucks on the route is temporally proximate to the background monitoring.
- Traffic counts will be taken for both background and construction related road traffic noise to assist with analysis. A visual assessment will determine the number of heavy and light vehicles, including whether they are construction related.
- Monitoring will be undertaken after midnight for low background noise and alignment with sleep disturbance.
- The Acoustic Advisor will be provided with the results and monitoring data to review and confirm the monitoring objectives were met.

5.6.1. Parameters to be monitored

Construction related road traffic noise monitoring will be taken with the following meter settings:

- Time Constant: Fast (i.e. 125 milliseconds),
- Frequency Weightings: A-weighting, and
- Sample period: 60 minutes.

Monitoring will be recorded over 60-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 of the NVMP). The minimum range of noise metrics to be stored in the memory for later retrieval include the following A-weighted noise levels: L_{A90}, L_{Aeq}, L_{A10}, $L_{A(min)}$and $L_{A\ (max)}$.

Analysis will compare the $L_{Aeq(60\ min)}$ and $L_{A\ (max)}$ or $L_{A(1\ min)}$ in accordance with the *NVMP Section 5.2.3 Sleep disturbance and Section 5.4 Construction-related road traffic noise.*

5.7. Calibration, QA and competency

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

Noise monitoring equipment used will be at least Type 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 JHCPB throughout the delivery of the Project.

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

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

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

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

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

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

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

6. Vibration monitoring

6.1. Short term attended and unattended vibration monitoring

Attended vibration monitoring is to be undertaken as follows:

- At the commencement of operation for each plant or activity on site, which has the potential to generate significant vibration levels, where the vibration screening criteria is likely to be exceeded or as determined by a vibration assessment,
- At the commencement of vibration generating activities that have the potential to impact on heritage items to confirm/identify the minimum working distances to prevent cosmetic damage,
- At the first opportunity following the commencement of tunnelling and dive excavation to verify and, if necessary update the ground vibration model,
- Where vibration sensitive locations are determined to fall within the 'minimum working distances' established for each item of plant, so to refine the indicative minimum working distances,
- Where appropriate in response to a vibration related complaint(s) (determined on a case-by-case basis) and in accordance with the EPL,
- As directed by an authorised officer of the EPA, and
- As otherwise required by the CNVIS refer to NVMP Section 7.2 for information regarding CNVIS, however, specific monitoring requirements will be identified in the relevant CNVIS and not prescribed in this Program), OOHW Protocol (Section 6.3) or EPL (i.e. as directed by authorised officer of the EPA).

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

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

Where property damage is a concern, vibration monitoring results will be assessed and reported against the British Standard 7385, as presented in the NVMP. For heritage structures, BS7385-2:1993 does not provide numerical vibration levels to prevent structural damage. The approach that will be adopted for the Project to assess and manage potential vibration impact on heritage structures is outlined in Section 5.5.3 of the NVMP. Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference standards and documents listed above. The following notes of importance are included here:

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

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

The following information shall be recorded:

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

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

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

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

6.1.1. Parameters to be monitored

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

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

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

6.2. Real-time (unattended) vibration monitoring

Real-time (unattended) vibration monitoring will be undertaken to satisfy CoA C11. The monitors will be installed following approval of this monitoring Program.

Real time vibration monitors will be installed near the Lilyfield Road boundary of the Rozelle Civil and Tunnel compound towards both the eastern and western end, as indicatively identified on Figure 1. The exact location of the real-time vibration monitoring equipment will be determined in consultation with the AA and be subject to the worksite final layouts, availability of mains power and investigation into suitable conditions.

For the Iron Cove Link site, real-time noise monitoring will be undertaken on a campaign basis or following multiple complaints where attended monitoring is not possible.

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

The real-time monitoring data will be readily available to JHCPB, TfNSW, the ER and AA. The real- time monitoring data will be available to DPE and EPA on request following an initial

screening review, to identify any anomalies or corruption in the dataset.

6.2.1. Parameters to be monitored

Real time vibration monitoring will continuously monitor PPV.

6.3. Out-of-hours Protocol monitoring requirements

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

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

If vibration intensive activities are proposed as OOHW and have the potential to impact on sensitive receivers or structures, they will be assessed for compliance with minimum working distances as defined in relevant Construction Noise and Vibration Impact Statements (CNVISs) (refer to Section 7.2 of the NVMP) including:

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

6.4. Calibration and QA

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

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

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

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

7. Heritage-listed structures

In accordance with CoA E84, JHCPB will conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items, to identify minimum working distances to prevent cosmetic damage. Should vibration testing and monitoring show that the preferred values for vibration are likely to be exceeded, JHCPB will follow the process in Section 9.

Heritage items which have the potential to be impacted by vibration are identified in the Non-Aboriginal Heritage Management Plan. Vibration Screening Criteria drawings for vibration intensive ancillary facilities activities have been prepared in accordance with CoA E83 and included in the NVMP (refer to Annexure E of the NVMP) to identify the minimum working distances for heritage buildings during vibration intensive activities. Section 5.5.3 of the NVMP also provides further detail on the approach to managing potential vibration impacts on heritage structures. Vibration Screening Criteria drawings for tunnelling activities are provided in Annexure E of the NVMP.

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

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

8. Heavy vehicle transport noise

In accordance with REMM TT17, JHCPB will track heavy vehicle movements to and from sites and manage truck numbers 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). The number of heavy vehicles entering and /or exiting will be tracked at the gates of each construction site. Any assumptions regarding the number of heavy vehicle movements to and from the sites will be identified in the CNVIS prepared for each worksite.

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

Cease the noise and/or vibration generating activity which causes the exceeded predictions,

- Confirm the monitored levels are not being impacted by other noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud piece of equipment,
- Identify if the equipment can be swapped out for another piece of equipment or alternative equipment or plant,
- Confirm if the exceedance is due to an uncharacteristically vibratory piece of equipment,
- Confirm that the modelling reflects the actual activity being 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,
- Continue work where impacts can be reduced, and
- Communicate lessons learnt to relevant personnel.

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

In the case of tunnelling excavation works, where an increased ground-borne noise level has been monitored, a review of the mitigation measures will be undertaken and additional goodwill, alternative accommodation or other more suitable respite offers will be considered, in accordance with the Project's NVMP.

Where a complaint relating to human comfort is received, JHCPB will review the noise and vibration model. If it is determined from the review that there is insufficient local monitoring to validate the noise and vibration model, JHCPB will offer additional monitoring following the process defined in Section 6.1.

10. Reporting of monitoring results

During construction, real time noise and vibration monitoring data will be collected, tabulated and assessed against baseline conditions and performance criteria. Real time noise and vibration monitoring data will be made available to DPE and EPA, on request, in accordance with CoA C11(d). Monitoring reports will be submitted to DPE, AA and EPA within 30 days of the reporting period unless otherwise agreed with DPE.

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

Table 1 Reporting requirements

Schedule (during construction)	Requirements	Recipient (relevant authority)
Construction Monitoring Report	Data from real time noise and vibration monitoring will be reported on a six-monthly basis within a Construction Monitoring Report.	AA, DPE, EPA
EPL Validation Report	The validation report will be submitted to the EPA within 14 calendar days of the completion of the 'trial period' (refer to Section 5.4).	EPA
Preliminary Investigation Report and Follow-Up Investigation Report	Upon request from an EPA officer, the Preliminary Investigation Report will be submitted to the EPA by 4.30pm of the afternoon of the next business day following any noise or vibration monitoring. Where a detected exceedance of a noise goal or limit has occurred a Follow-Up Investigation Report shall be submitted to the EPA within 5 business days (unless otherwise approved by the EPA).	EPA

Separate from the Construction Monitoring Report, Validation Report and Preliminary Investigation Reports, additional records relating to noise and vibration training, toolbox talks, monitoring results and audit results are described in Section 3.11.1 of the CEMP. The complaints management and reporting procedure is described in Section 3.7.4 of the CEMP.

Annexure C Land Use Survey Maps

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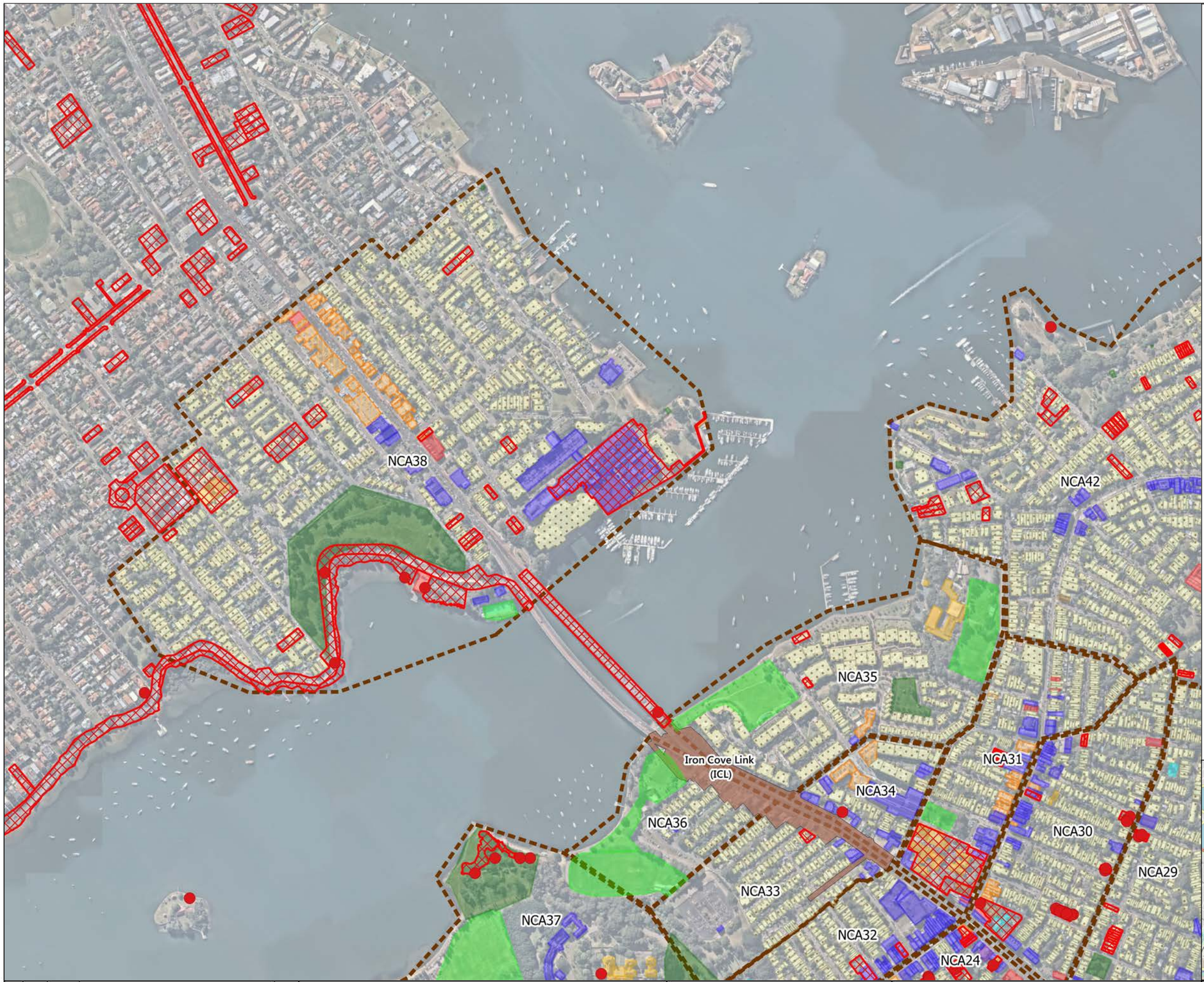

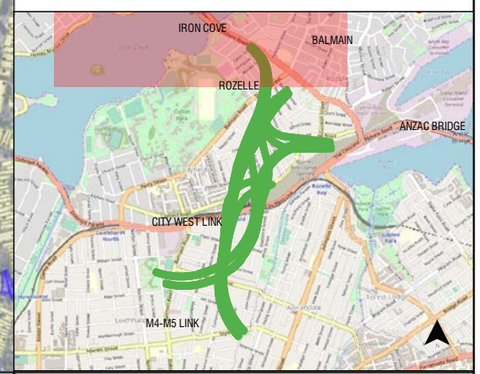

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LEGEND

Land Use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium
- Mixed use

- Construction worksites
- Heritage (State Heritage Register, LEP, s170, potential, AHIMS)
- Heritage (State Heritage Register, LEP, s170, potential, AHIMS)
- NCA

REV	BY	DATE	DESCRIPTION	APPD.
r1	MS	27.08.19	Update figures	TG
r0	RV	10.07.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES
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NOTE: Do not scale from this drawing.

CLIENT
JOHN HOLLAND
CPB CONTRACTORS

ACOUSTIC CONSULTANT
RENZO TONIN & ASSOCIATES
inspired to achieve
SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Land Use, Heritage structures, and NCAs

Status:
Sheet 1 of 7
Drawing No. 1
Rev. No. 1

Layout Name: TJ914-03 WCX3B Land Use
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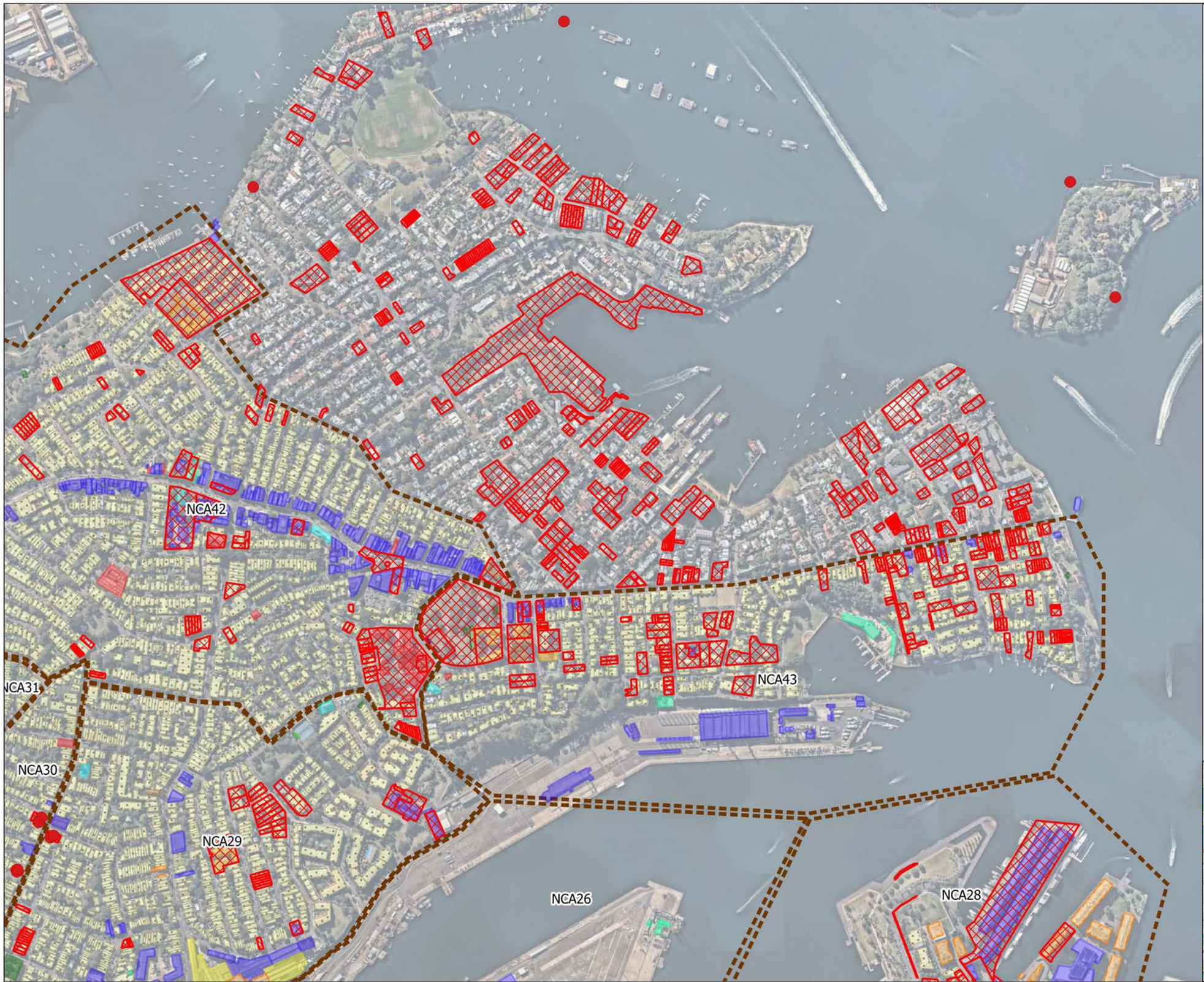

LEGEND

Land Use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
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- Mixed use

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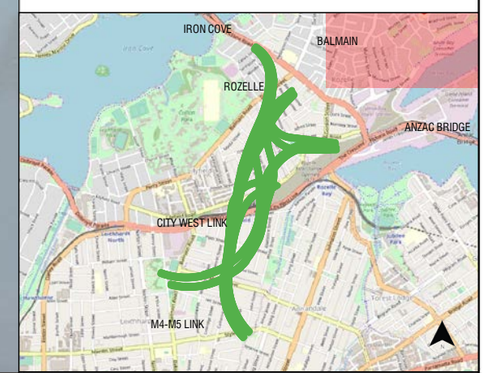
- NCA



REV	BY	DATE	DESCRIPTION	APPD.
r1	MS	27.08.19	Update figures	TG
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CPB CONTRACTORS

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Land Use, Heritage structures, and NCAs

Status:

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Drawing No. 1

Rev. No. 1

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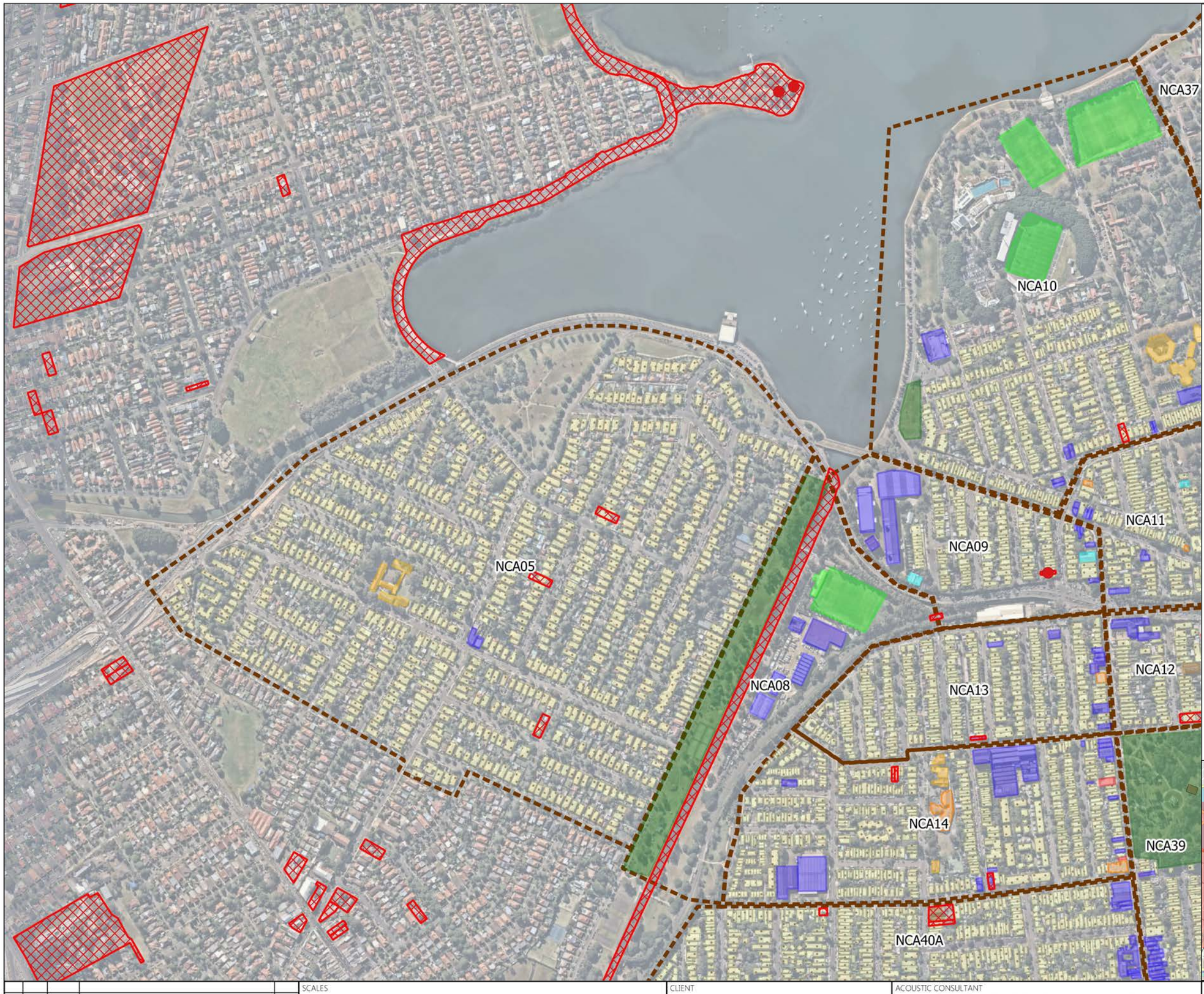

LEGEND

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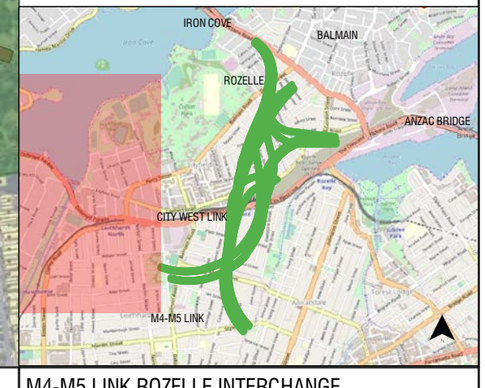

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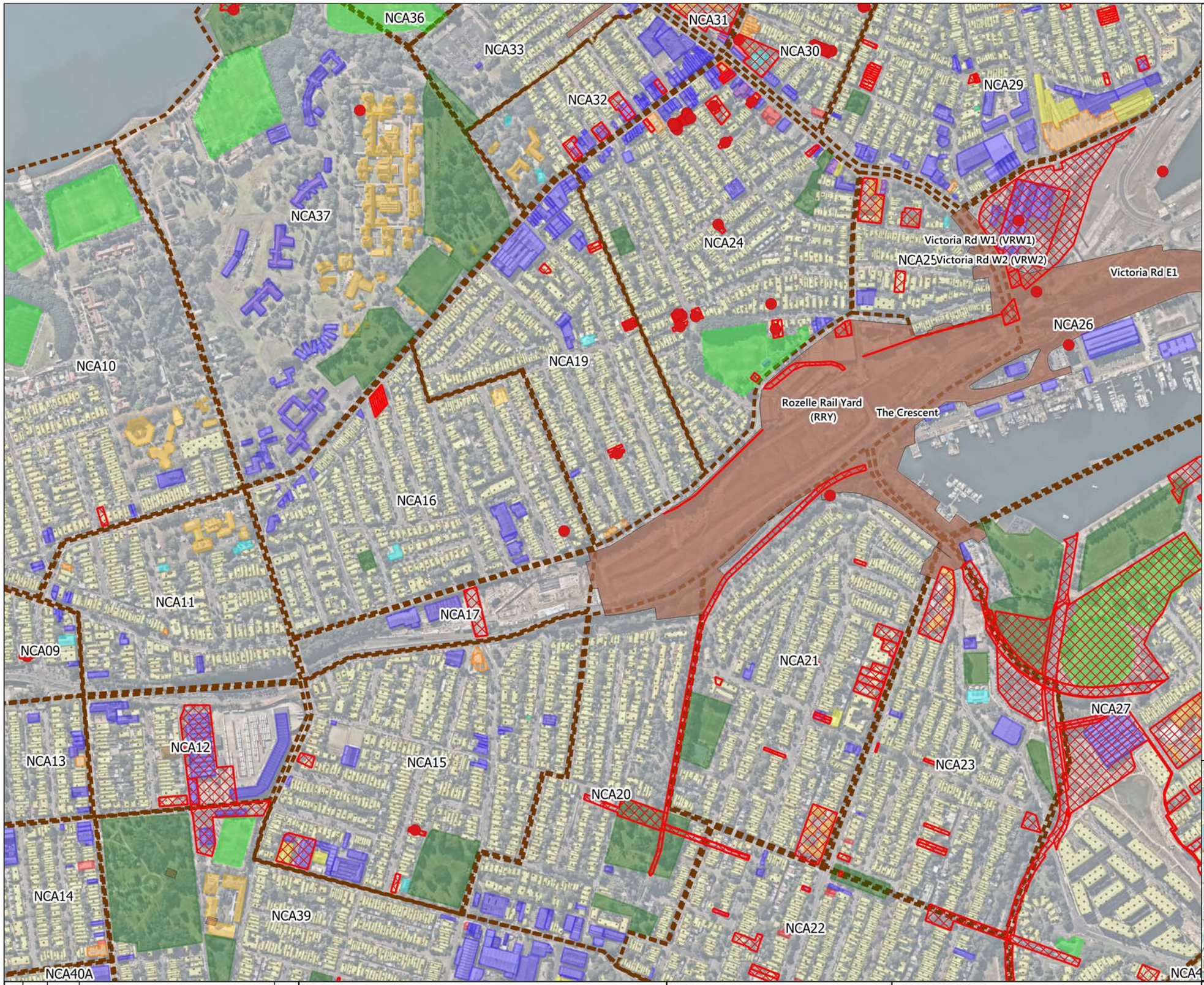

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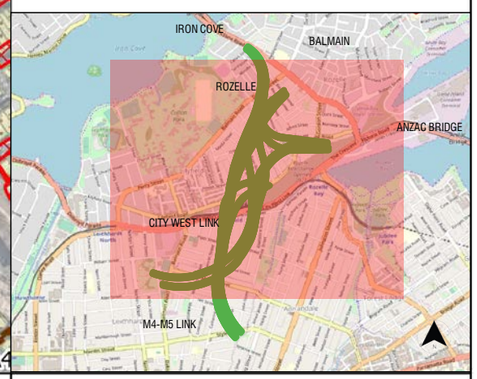

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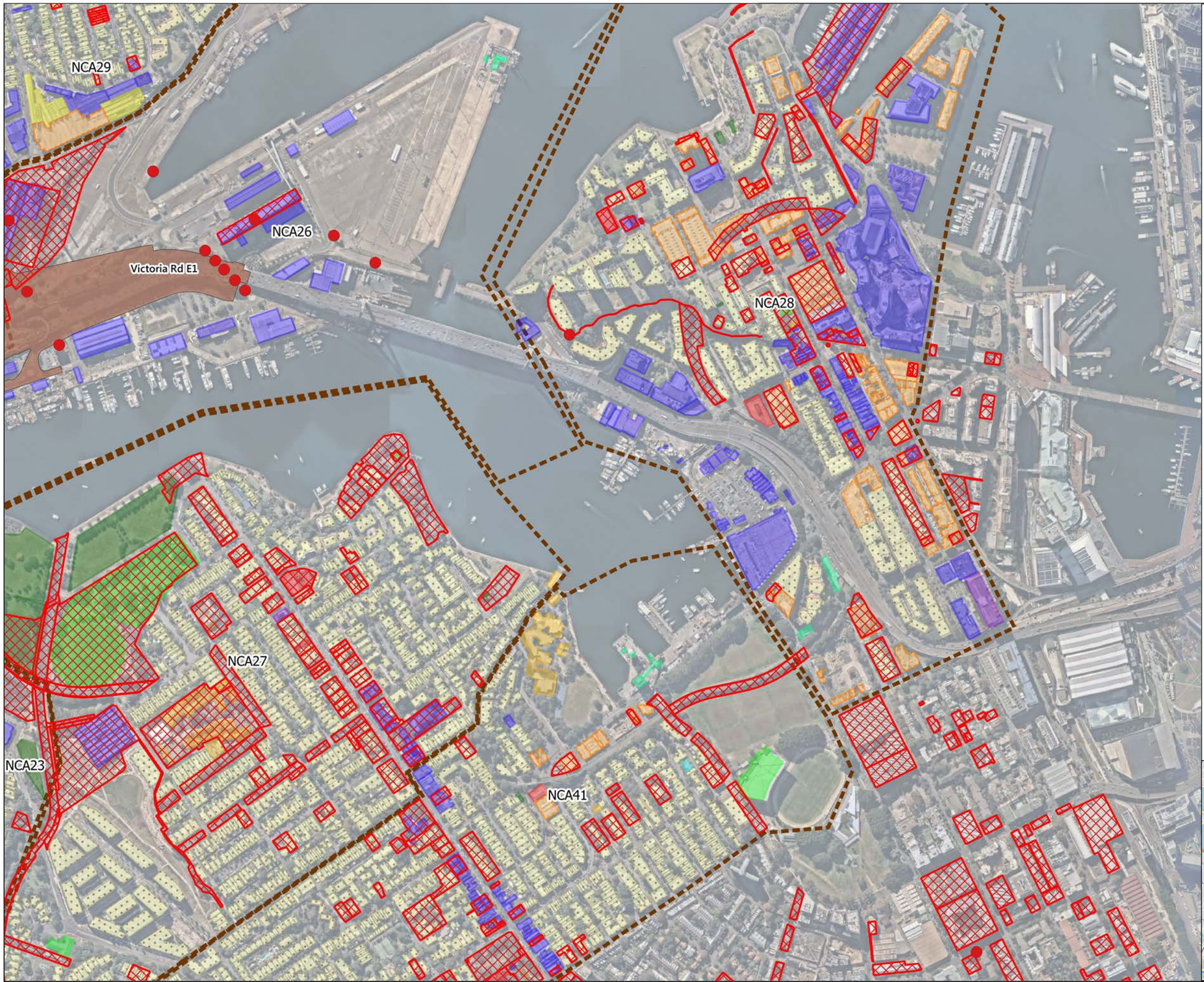

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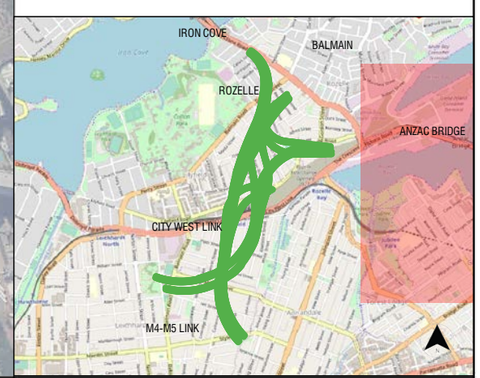

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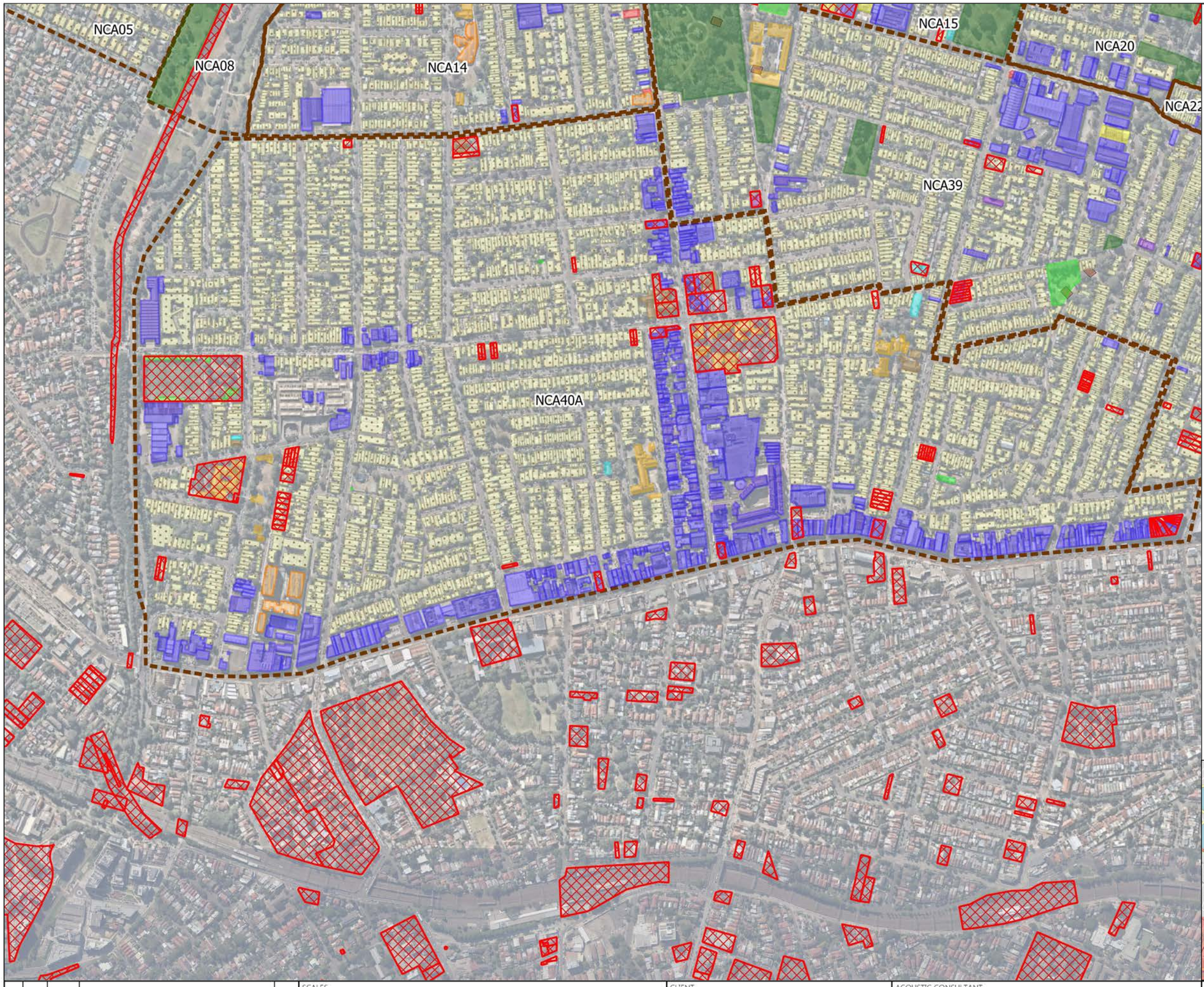

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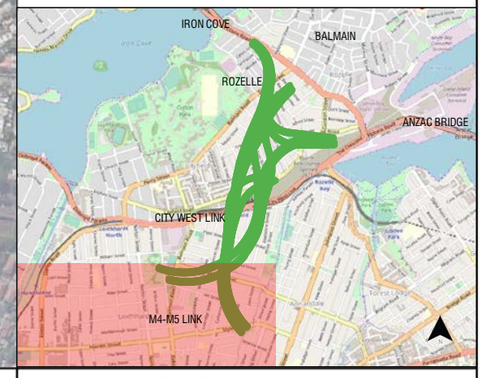

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Land Use, Heritage structures, and NCAs

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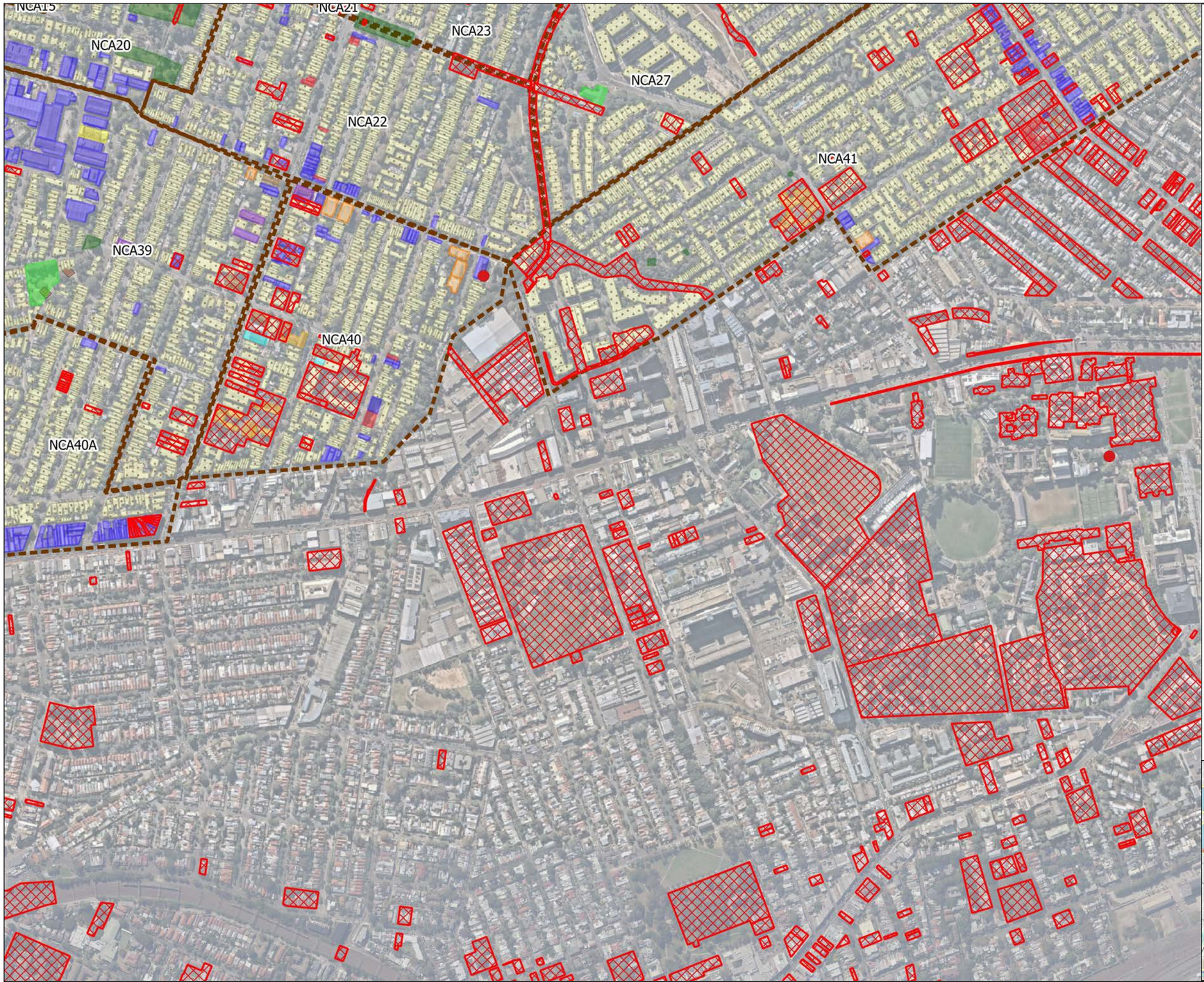

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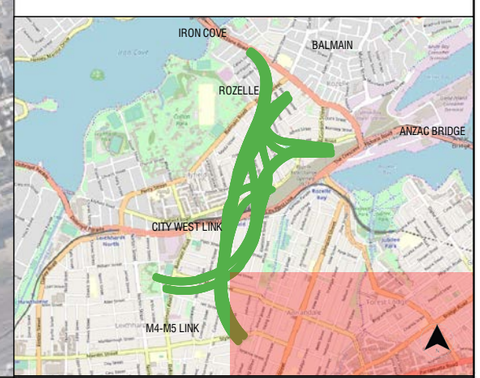

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Drawing No. 1

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Annexure D Out-of-Hours Works Protocol

WestConnex
Rozelle Interchange

JOHN HOLLAND | CPB CONTRACTORS

JHCPB Joint Venture

Out-of-Hours Work Protocol

RIC-JHC-PLN-00-PL-290-003

Project	Design and Construction of Rozelle Interchange Project
Design Lot No.	00-PL-290
Document No.	RIC-JHC-PLN-00-PL-290-003
Revision Date	06 August 2019

Document Approval

Rev	Date	Prepared by	Reviewed by	Approved by	Remarks
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Contents

Table of Tables

Annexures

Glossary/Abbreviations

Abbreviation/Term	Definition
AA	Acoustics Advisor
CNVG	Roads and Maritime Construction Noise and Vibration Guideline
CNVIS	Construction Noise and Vibration Impact Statement
CoA	Condition of Approval
DPE	NSW Department of Planning and Environment
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
ER	Environmental Representative
ICNG	Interim Construction Noise Guidelines (DECC, 2009)
JHCPB	John Holland CPB Contractors Joint Venture
NML	Noise management level
NVMP	Noise and Vibration Management Plan
OOHW	Out-of-Hours Work
POEO Act	*Protection of the Environment Operations Act 1997*
Project	Design and Construction of the Rozelle Interchange Project
Protocol, the	Out-of-Hours Work Protocol (this document)
REMM	Revised environmental management measure
Roads and Maritime	Roads and Maritime Services
Secretary, the	The Secretary of the NSW Department of Planning and Environment
TfNSW	Transport for NSW

1. Introduction

This Out-of-Hours Work Protocol (herein referred to as the Protocol) for the Rozelle Interchange Project (the Project) has been prepared in accordance with conditions of approval (CoA) E73(d) and E77. It defines the process for assessment and approval of work undertaken outside of standard construction working hours (out-of-hours work, OOHW) that is not subject to an Environment Protection Licence (EPL).

All works covered by Infrastructure Approval 7485 are intended to be performed subject to an EPL. In the event OOHW are required that will not be undertaken subject to an EPL the Secretary Environmental Representative (ER) and Acoustic Advisor (AA) will be notified as soon as possible and prior to implementing the planning and consultation requirements of this Protocol. Notification will include details of the works, including; location and duration, with further details to be included in the OOHW Permit. A copy of the current EPL premise boundary is available on the Project Website (https://www.westconnex.com.au).

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

In accordance with 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.

CoA E77 requires that this Protocol is prepared in consultation with the AA and the EPA and approved by the Secretary. REMM NV5 also requires that this Protocol be developed in consultation with the EPA, Department of Planning and Environment and endorsed by the AA.

In accordance with CoA E77 and REMM NV5, this Protocol has been prepared in consultation with the AA, who endorsed this Protocol on 24 May 2019. JHCPB contacted the EPA on 8 April 2019 to advise that the NVMP (including this Protocol) would be provided for their review on 9 April 2019. EPA advised on 9 April 2019 that the NVMP would not be reviewed by the EPA, and any EPA noise management expectations would be specified in the Project's Environmental Protection License (EPL).

Consultation and approval with Department of Planning and Environment (the Secretary) has occurred through the review process of this Protocol, prior to commencement of the works.

2. Construction hours

The CoA defines the approved working hours for the Project. The 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; and
- At no time on Sundays or public holidays.

In accordance with CoA E73(d), this Protocol defines the process for the assessment and approval of work that is not subject to an EPL and needs to occur outside of the time periods stipulated above (i.e. needs to occur during an OOHW period).

This Protocol will apply to the two following OOHW periods:

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

2.1. Minister's Conditions of Approval

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

Table 1 Minister's Conditions of Approval requirements

CoA No.	Condition Requirements	Document Reference	How addressed
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 of this Protocol	Section 3 of this Protocol addresses that any out of hour works are to be undertaken in line with this protocol.
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.	Section 3 of this Protocol	Section 3 of this Protocol outlines the type of works relevant to this out of hours works Protocol.
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 of this Protocol Communication Strategy Section 8.5.2 of the NVMP	Section 7 and 8 of this Protocol outline respite periods and community consultation requirements.
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	This Protocol	This protocol identifies a process for works which are outside the hours

CoA No.	Condition Requirements	Document Reference	How addressed
	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:		defined in Conditions E68 and E69 and that are not subject to an EPL. Section 1 identifies the consultation undertaken.
	(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 of this Protocol	Section 6 of this Protocol defines 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	Sections 5 and 7 of this Protocol Communication Strategy	Section 5 and 7 of this Protocol outlines the mitigation measures for residual impacts and consultation requirements.
	(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 of this Protocol	Section 4. of this Protocol outlines procedures 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	Sections 6 and 8 of this Protocol	Section 6 and 8 of this Protocol outline the approval process.
	(e) identify Department, EPA and community notification arrangements for approved out of hours works, which maybe detailed in the Communication Strategy.	Section 7 of this Protocol Communication Strategy	Section 7 of this Protocol identifies notification arrangements for approved out of hours works.
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 LAeq (15 minute): 40 dB(A); and (b) night (10:00 pm to 7:00 am) — internal LAeq (15 minute): 35 dB(A). The mitigation measures must be outlined in the Construction Noise and Vibration Management Sub-plan, including in any Out-of-Hours Work Protocol, required by Condition E77.	Section 5.3 of the NVMP.	Tunnelling activities are not subject to this Protocol. CoA assessment of GBN is not applicable.

2.2. Revised Environmental Management Measures

Table 2 lists the revised environmental management measures (REMMs) for the Project that are relevant to this Protocol. This includes relevant references to where the commitment has been addressed in this Protocol and/or other Project documents.

Table 2 Revised environmental management measures relevant to this Protocol

Ref #	Commitment	Reference to where addressed
NV5	An out-of-hours works protocol will be developed for the construction of the project. The protocol will include:	This Protocol
	▪ Details of works required outside standard construction hours, including justification of why the activities are required outside standard construction hours	Section 3 of this Protocol
	▪ Measures that will be implemented to manage potential impacts associated with works outside standard construction hours	Section 5 of this Protocol
	▪ 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 of this Protocol
	▪ Details of the approval process (internal and external) for works proposed outside standard construction hours	Sections 6 and 8 of this Protocol
	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 of this Protocol NVMP

3. OOHW Assessment Process

3.1. OOHW Justification

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

The ICNG outlines the standard construction hours for the Project and requires that work proposed outside of these hours must be appropriately justified. These requirements are reflected in CoA E68 to E72 for the Project. In general, OOHW undertaken on public infrastructure projects, such as on road construction projects where the OOHW is necessary to sustain the operational integrity of roads, is considered justified in the ICNG.

As per CoA E75, OOHW not subject to an EPL (works items that are not scheduled activities under the POEO Act and are outside of the EPL premise boundary) that are regulated through this 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 JHCPB 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 JHCPB 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 JHCPB 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, and
- Where Sydney Trains (or other rail authority) has advised JHCPB in writing that a Rail Possession is required.

3.2. OOHW Permit

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

1. An OOHW Permit will be prepared that summarises the activities, equipment required, location and duration and includes a detailed justification for works (in accordance with Section 3.1),
2. The OOHW Permit will be submitted to the Environment Team, who will undertake a noise and vibration assessment for the OOHW (refer to Section 4). Predicted noise impacts and appropriate mitigation measures will be determined as per Section 5 of this Protocol.
3. The JHCPB Environment and Suitability Manager will determine whether the justification for the OOHW works is satisfactory.
4. Approval of the OOHW Permit will follow the process outlined in Section 6 of this Protocol,
5. Community consultation and notification will be undertaken in accordance with the Communication Strategy, as outlined in Section 7 of this Protocol, and
6. Monitoring will be undertaken in accordance with Section 9 of this Protocol and the Project’s Construction Noise and Vibration Monitoring Program.

4. OOHW Noise and Vibration Assessment

4.1. Noise

To manage potential impacts from noise and vibration during OOHW, JHCPB's noise and vibration specialists have developed tools that enable the prediction and assessment of potential noise and vibration impacts resulting from proposed OOHW in specific work areas (refer to Section 7.3 of the NVMP for information regarding the prediction tools). These prediction tools provide assistance in managing noise and vibration impacts on sensitive receivers, based on the specific work areas and types of construction machinery operating in the work area. The tools will identify the potentially affected sensitive receivers, the predicted impacts and any additional mitigation measures required. To minimise cumulative noise impacts, the prediction tools will also consider any other OOHW that is planned during the proposed OOHW.

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

4.2. Vibration

If vibration intensive activities are proposed as OOHW and have the potential to impact on sensitive receivers or structures, they will be assessed for compliance with minimum working distances as defined in relevant Construction Noise and Vibration Impact Statements (CNVISs) (refer to Section 7.2 of the NVMP) including:

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

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

4.3. Ground-borne Noise

When assessing works under the Protocol, impacts to receivers will consider cumulative impacts if the receiver is also affected by tunnelling ground-borne noise at residential levels identified in CoA E82; 40dB(A) 6pm-10pm and 35dB(A) 10pm-7am. Inputs to the assessment will use validated ground-borne noise predictions using the tools detailed in the NVMP.

4.4. Highly Noise Intensive Works

In accordance with CoAs E72 and E73, except as permitted by an EPL or approved under this Protocol, highly noise intensive works that result in an exceedance of the applicable NML at the same receiver will 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, and
- 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.

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

- Highly noise intensive equipment will be used prior to 10 pm where reasonable and feasible,

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

In accordance with CoA E76, to identify the appropriate respite periods for work proposed under this Protocol, JHCPB will consult with the AA and the community at each affected location. The affected locations will be identified from the Project's noise prediction tool outputs for the proposed OOHW. The outcomes of the consultation and the noise prediction tool outputs will also be used to identify appropriate mitigation measures to be implemented for the proposed OOHW. The process for stakeholder consultation for OOHW is further detailed in Section 7.

4.5. Coordination of OOHW approved by an EPL

As part of the noise and vibration assessment process, JHCPB will ensure all OOHW permitted by either an EPL or this protocol are co-ordinated to implement appropriate respite and/or mitigation measures for potentially affected sensitive receivers in accordance with condition of approval E78.

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 CNVG. Table 3 and Table 4 detail the relevant additional mitigation measures from the CNVG to be applied during OOHW.

Table 3 Triggers for additional mitigation measures – airborne noise

Predicted airborne LAeq(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
OOHW period 1[2]				
Noticeable	5-10	<5	--	NML
Clearly audible	10- 20	5-15	N, R1, DR	NML + 5
Moderately intrusive	20-30	15-25	V, N, R1, DR	NML + 15
Highly intrusive	>30	>25	V, N, R1, DR, SN	NML + 25
OOHW period 2[3]				
Noticeable	5-10	<5	N	NML
Clearly audible	10-20	5-15	V, N, R2, DR	NML + 5
Moderately intrusive	20-30	15-25	V, N, SN, R2, DR	NML + 15
Highly intrusive	>30	>25	AA[4], V, N, SN, R2, DR	NML + 25

Note: 1. AA: alternative accommodation, V: verification, N: notification, DR: duration respite, R1: respite period 1, R2: respite period 2, RO: respite offer, SN: receiver specific contact (individual letter / email, phone call, and/or individual briefing session)
2. OOHW Period 1 refers to Mon-Fri (6pm-10pm), Sat (7am-8am & 1pm-10pm), Sun/Pub Hol (8am-6pm).
3. OOHW Period 2 refers to Mon-Fri (10pm-7am), Sat (10pm-8am), Sun/Pub Hol (6pm-7am).
4. Temporary relocation to be offered where construction works are planned to extend over more than two consecutive nights at that impact classification

Table 4 Triggers for additional mitigation measures - vibration

Predicted vibration level at receiver	Additional mitigation measures	
	Type[1]	**Apply to**
OOHW period 1[2]		
Predicted vibration exceeds maximum levels	V, N, RO, RP, SN	All affected receivers
OOHW period 2[3]		
Predicted vibration exceeds maximum levels	AA[4], V, N, RP, SN	All affected receivers

Note: 1. AA: alternative accommodation, RP: respite period, RO: respite offer, V: verification, N: notification, SN: receiver specific contact (individual letter / email, phone call, and/or individual briefing session)
2. OOHW Period 1 refers to Mon-Fri (6pm-10pm), Sat (7am-8am & 1pm-10pm), Sun/Pub Hol (8am-6pm).
3. OOHW Period 2 refers to Mon-Fri (10pm-7am), Sat (10pm-8am), Sun/Pub Hol (6pm-7am).
4. Temporary relocation to be offered where construction works are planned to extend over more than two consecutive nights at that impact classification

It should be noted that the sensitive receivers may have personal circumstances, which means that the approach to specific additional mitigation measures in Table 3 may not be suitable. The Public Liaison Manager has the authority to amend the approach for specific sensitive receivers by taking into account the personal circumstances that may apply.

In accordance with CoA A26(e) and A26(c), the AA will regularly monitor and review the implementation of this OOHW protocol, including the nominated mitigation measures, and will consider and recommend and necessary improvements that may be made to avoid or minimise adverse noise and vibration impacts. This will ensure that appropriate noise and vibration 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.

6. Approval of OOHW not subject to an EPL

Refer to Annexure A for a flow chart of the approval process for OOHW not subject to an EPL.

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

Following this, the noise and vibration assessment process as described in Section 4 will be undertaken by a member of the JHCPB Environment Team for the proposed OOHW. The outcomes of the noise and vibration assessment, including relevant management measures, will be forwarded to the JHCPB Environment and 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 the management measures to be implemented.

The proposed OOHW is classified low risk (in accordance with E77 (d)(i)) if it meets the following criteria:

1. Works that generate noise up to the Clearly Audible OOHW classification from Table 3 above, and is over the following duration (as experienced by the receiver):
   a. Three evenings and night periods in a calendar week with only two consecutive evenings and night periods permitted,
   b. A maximum of 10 evenings and nights periods in a calendar month.

The effect of the above facilitates two evenings and nights periods in a row and at least one period off before the third period that week. In accordance with CoA E77(d)(i), the Environmental Representative (ER) has the authority to approve low risk OOHW activities in consultation with the AA.

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

Applications for 'high risk' work for approval by the Secretary (CoA E77(d)(ii)) will include a noise assessment that comprises either a Construction Noise and Vibration Impact Statement (CNVIS) or noise modelling outputs and relevant management measures. The form of noise assessment required for each application will be determined based on the nature of the works (type, duration etc).

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

- Implemented prior to OOHW (such as specific conditions that relate to the community),
- Communicated to relevant workforce and site personnel before each shift to introduce/reinforce work restrictions, management measures and expected workforce behaviour, and
- Implemented during OOHW and monitored by the JHCPB Environment Team to confirm/validate the noise predictions.

Prior to, and during the OOHW, the AA will verify that the above approach has been followed and advise opportunities for improvement in accordance with CoA A26(e) and CoA A26(c), respectively.

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

7. OOHW Stakeholder Consultation and Communication

The Public Liaison Team will use a range of communication tools to provide clear, effective and timely information to the predicted affected sensitive receivers and stakeholders. The method of communication will be chosen based on the nature of works and the potential impacts.

In accordance with CoA E77 (e), copies of OOHW notifications would be provided to DPE and EPA on a monthly basis. As required by the Communication Strategy, these OOHW notifications would also be available on the WestConnex website. All community consultation would be carried out in accordance with the Communication Strategy and as required by this Protocol.

Where required by the CNVG, JHCPB will notify potentially affected sensitive receivers and other stakeholders of planned OOHW. In accordance with the requirements of the Environmental Protection License (EPL), all OOHW notification shall be undertaken not less than 5 calendar days and not more than 14 calendar days before the work is to be carried out. As discussed in Section 4.3, JHCPB will identify appropriate respite periods for OOHW in consultation with the community at each affected location. This consultation will be conducted in accordance with the Communication Strategy and CoA E76. It will include the provision of the following information to affected receivers:

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

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

8. External Approval Authorities for OOHW

8.1. DPE

In accordance with CoA E77 (d)(ii), if the proposed OOHW (that is not subject to an EPL) includes high risk activities (refer to Section 6), approval of the OOHW will be sought from the Secretary.

8.2. Environmental Representative and Acoustics Advisor

In accordance with CoA E77 (d)(i), if the proposed OOHW (that is not subject to an EPL) only includes low risk activities (refer to Section 6), the OOHW can be approved by the ER, in 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 (refer to Annexure B of the NVMP).

10. OOHW Exceedances / Non-conformances

10.1. Management response

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

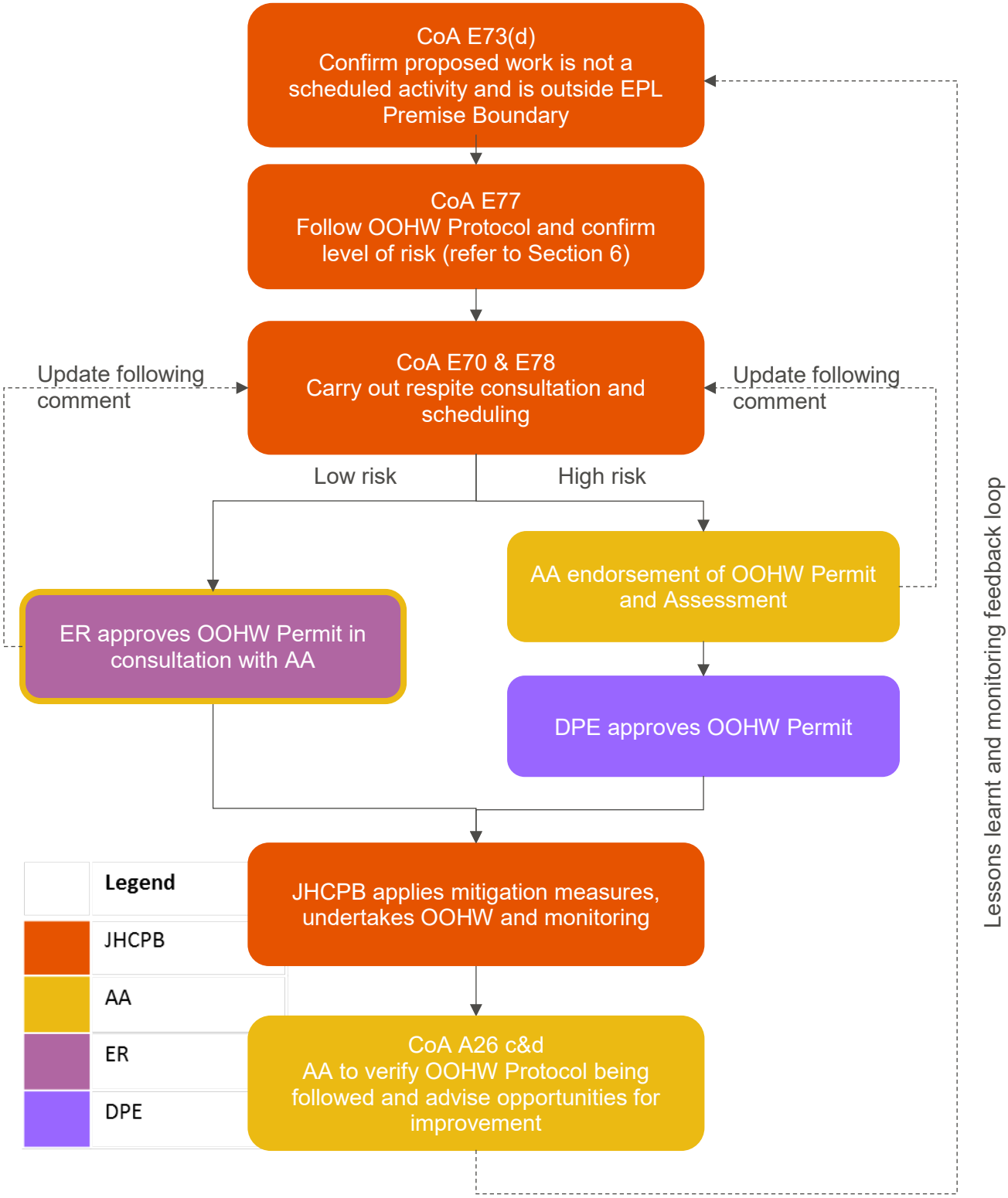
- Cease the noise and/or vibration generating source which causes the exceedance,
- Confirm the monitored levels are not being impacted by other noise or vibration sources,
- Confirm if the exceedance is due to an uncharacteristically loud/vibratory piece of equipment,
- Identify if the equipment can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

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

10.2. Reporting

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

Annexure A JHCPB Rozelle Interchange OOHW Protocol Approval Flow Chart



Annexure E Vibration Screening Criteria Drawings

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Layout Name: TJ914-03 MWD Vibration Screening

LEGEND

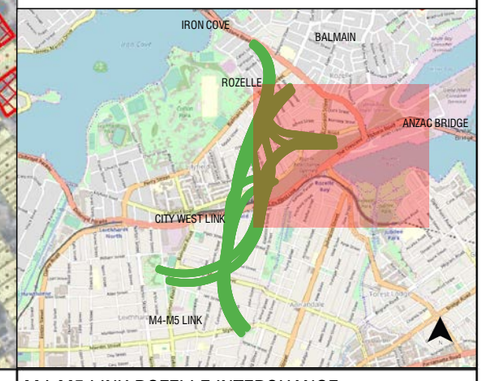
Land Use

- Childcare
- Commercial
- Educational
- Hotel/Motel/Hostel
- Industrial
- Medical
- Place of Worship
- Recording studio
- Recreational - Active
- Recreational - Passive
- Residential
- Theatre/Auditorium
- Mixed use

- Construction worksites
- Heritage (State Heritage Register, LEP, s170, potential, AHIMS)
- Heritage (State Heritage Register, LEP, s170, potential, AHIMS)

MWD for cosmetic damage (worst-case scenario)

- Reinforced structures (25 mm/s ppv)
- Unreiforced structures (7.5mm/s ppv)
- Heritage structures (2.5mm/s ppv)



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r0	MT	22.02.19	Prepare figures	MT

A3 Original

Co-ordinate System: MGA Zone 56

SCALES

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NOTE: Do not scale from this drawing.

CLIENT

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CPB CONTRACTORS

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RENZO TONIN & ASSOCIATES

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SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Vibration screening drawings – worst case scenario (large rockbreaker) – Rozelle, Victoria Road and The Crescent worksites

Status:

Sheet 1 of 2

Drawing No. 1

Rev. No. 1

GIS File: R:\AssocSydProjects\TJ901-TJ950\TJ914 pk WCX 3B\03 Construction\5 Calcs\00 GLOBAL\01 GIS\WCX3B - MS (r1).qgz
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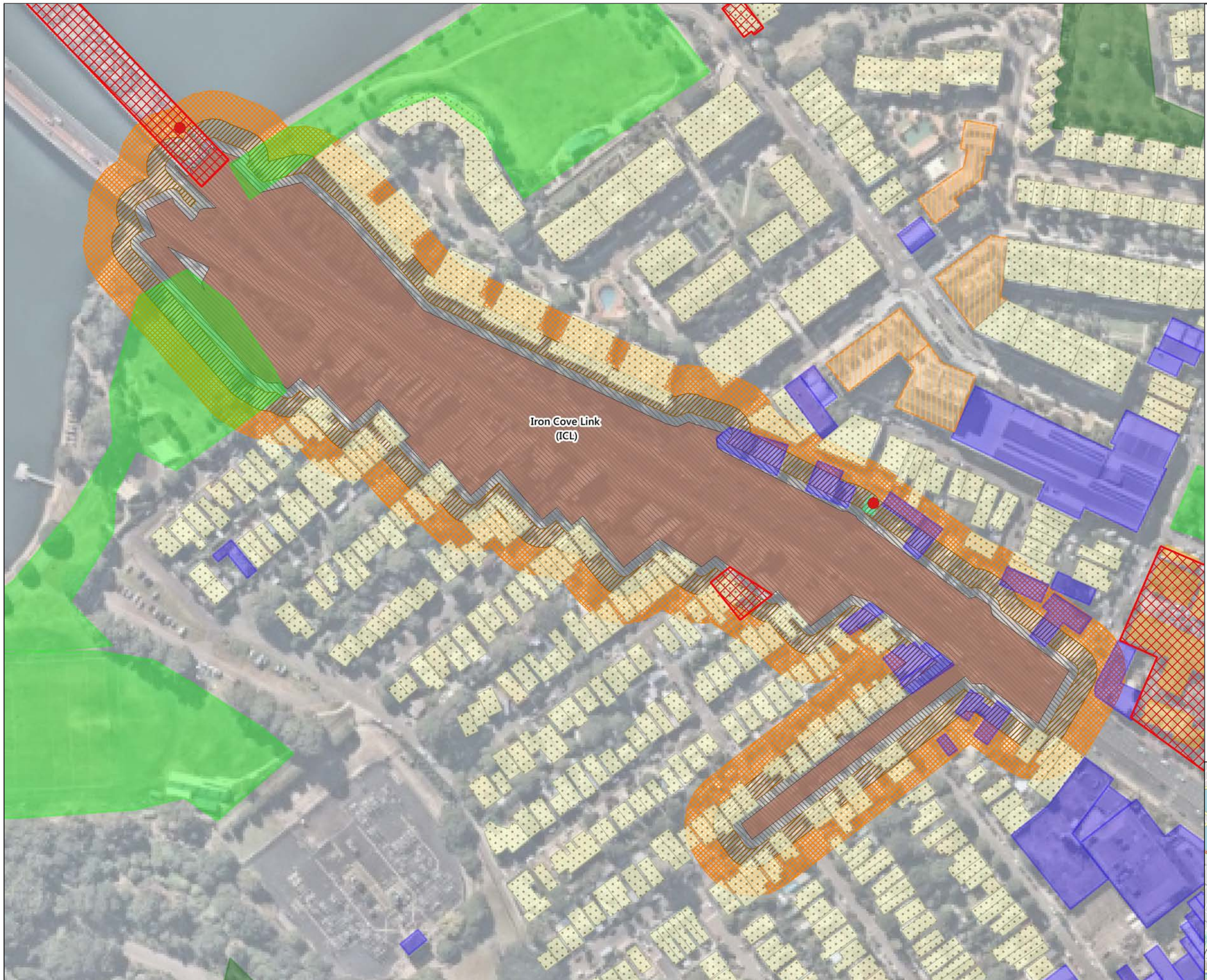

LEGEND

Land Use

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- Educational
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r0	MT	22.02.19	Prepare figures	MT

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NOTE: Do not scale from this drawing.

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SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Vibration screening drawings – worst case scenario (large rockbreaker) – Iron Cove worksite

Status:
Sheet 2 of 2
Drawing No. 1
Rev. No. 1

D.1 Top heading excavation (Roadheader)

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LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Tunnel Alignment

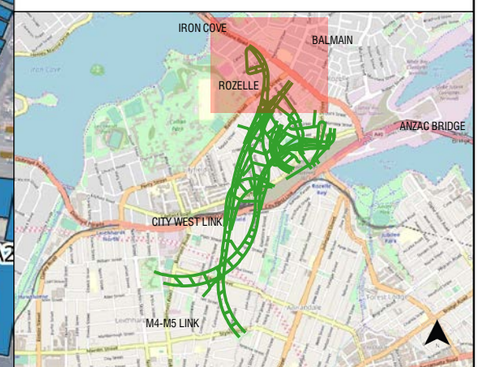
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



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r0	MS	01.10.19	Prepare figures	MT

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SCALES

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SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status: | Sheet 1 of 7

Drawing No. 1 | Rev. No. 1

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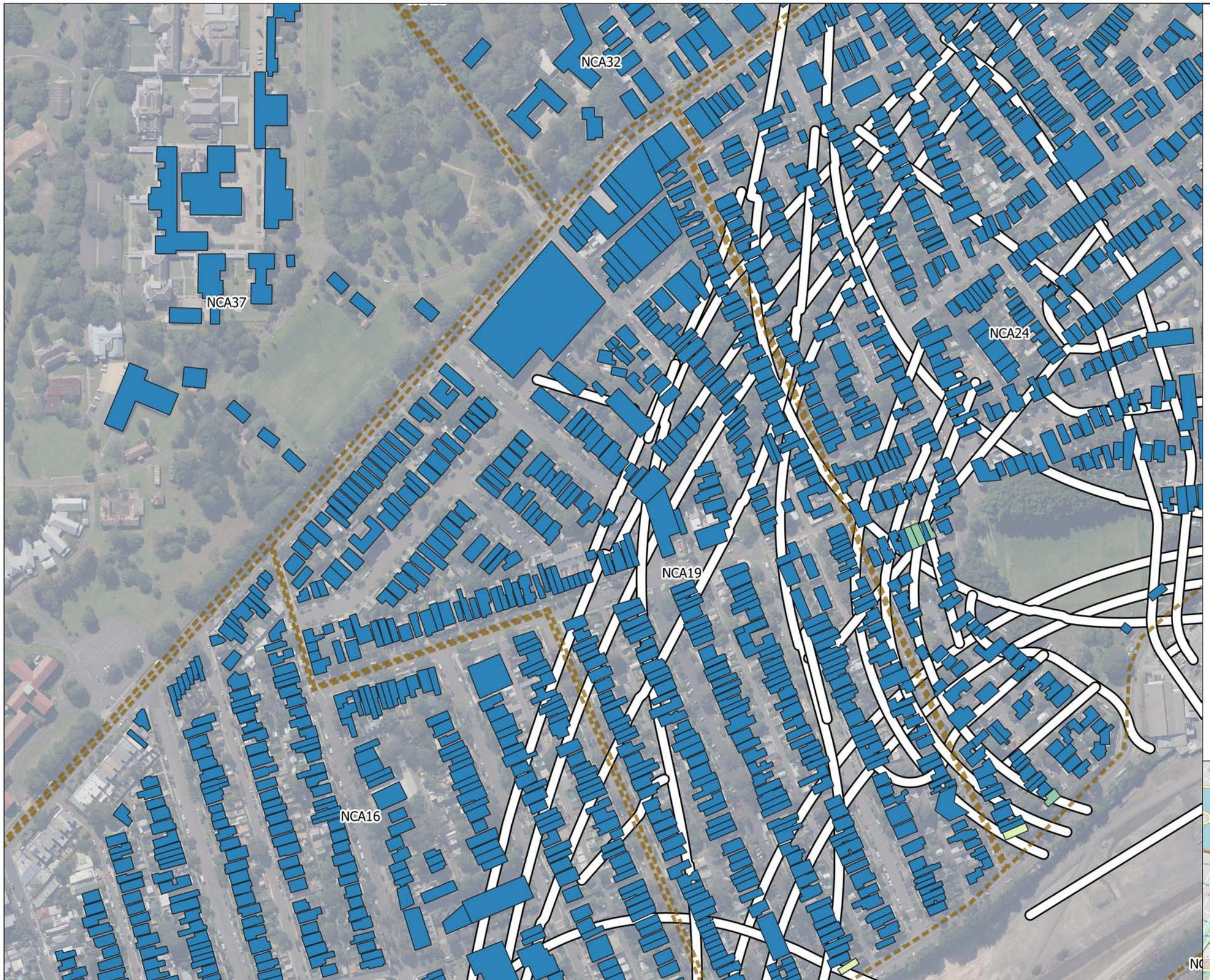

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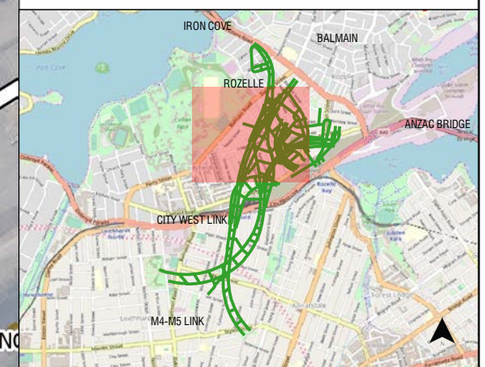

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r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

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1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status: | Sheet 2 of 7

Drawing No. 1 | Rev. No. 1

Plot Date: 29/01/20 - 17:43 Layout Name: TJ914-03 Tunnelling GBV top heading Roadheader
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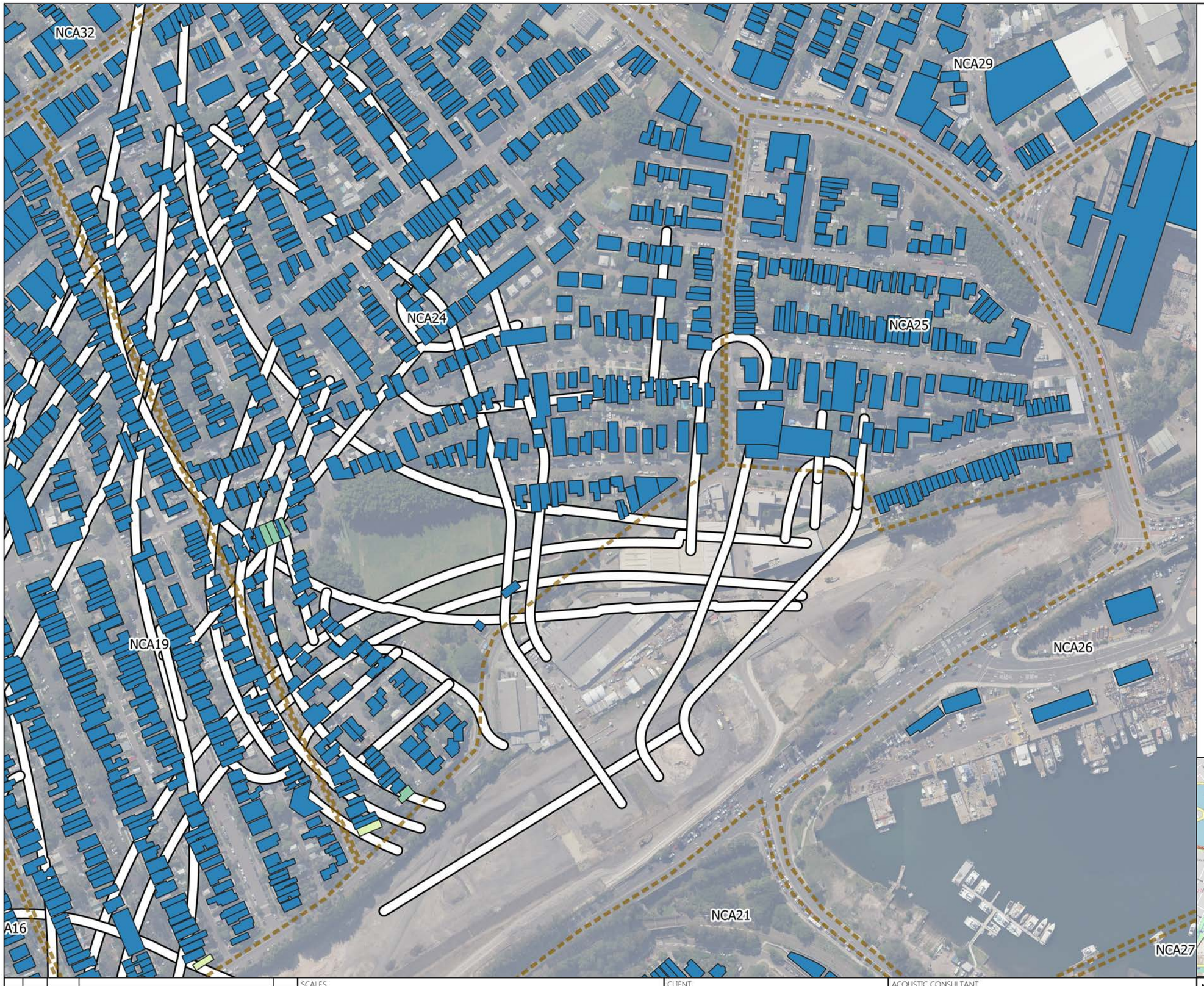

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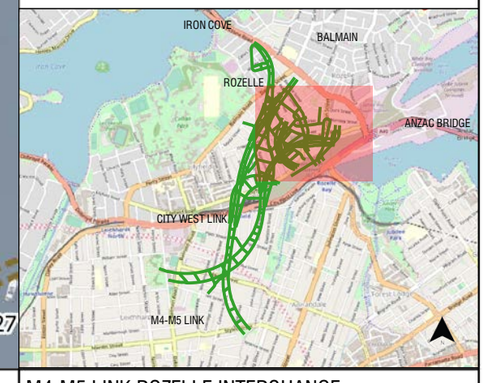

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A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

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1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status:

Sheet 3 of 7

Drawing No. 1

Rev. No. 1

Plot Date: 29/01/20 - 17:43 Layout Name: TJ914-03 Tunnelling GBV top heading Roadheader
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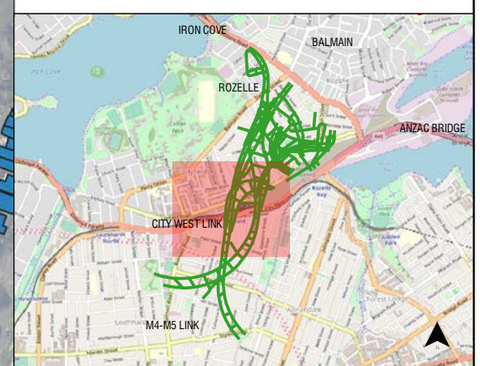

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A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

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NOTE: Do not scale from this drawing.

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RENZO TONIN & ASSOCIATES
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SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status: | Sheet 4 of 7

Drawing No. 1 | Rev. No. 1

LEGEND

Maximum GBV levels ppv(mm/s):

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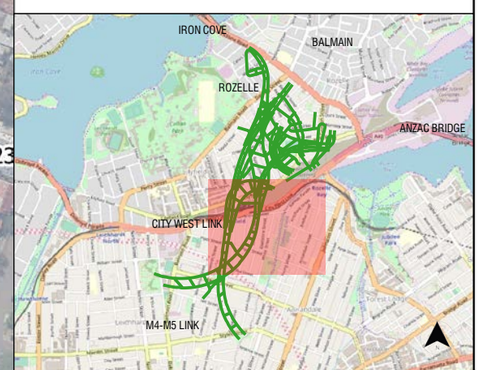

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r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

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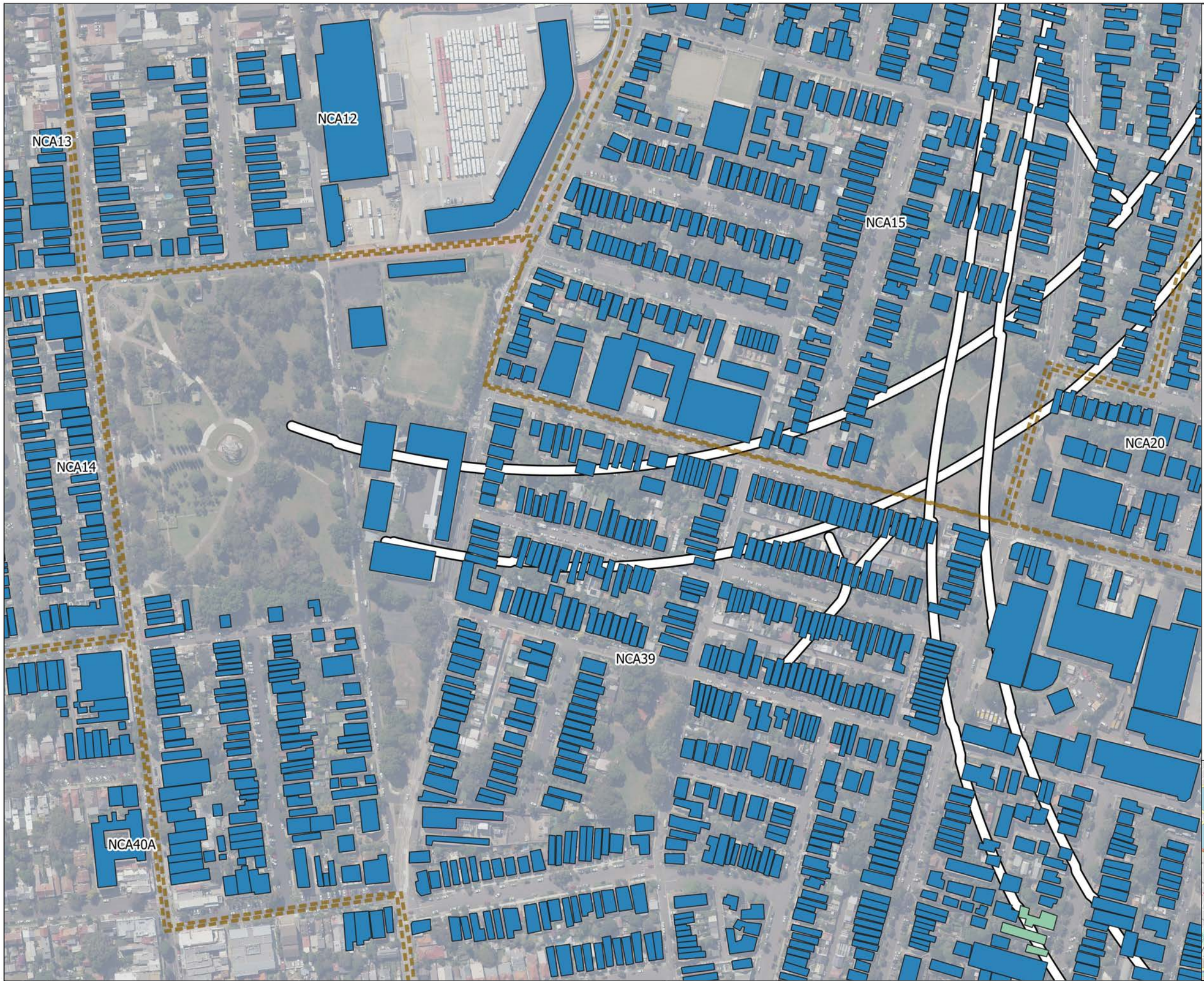
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status:	Sheet 5 of 7
Drawing No. 1	Rev. No. 1



LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Tunnel Alignment

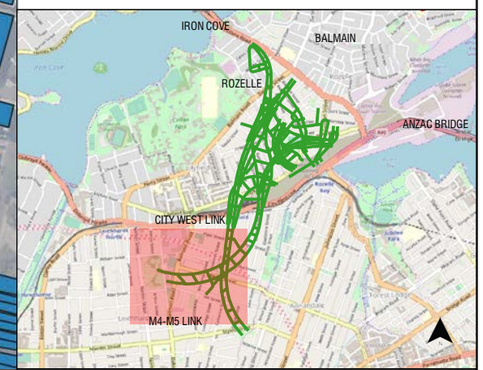
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

JOHN HOLLAND CPB CONTRACTORS

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
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1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status:	Sheet 6 of 7
Drawing No. 1	Rev. No. 1

Plot Date: 29/01/20 - 17:44 Layout Name: TJ914-03 Tunnelling GBV top heading Roadheader
GIS File: C:\Users\moe.sadri.RTAGROUP\OneDrive - Renzo Tonin & Associates (NSW) Pty Ltd\OneDrive-Moe\01-Jobs\MyWorkArea (r1).qgz

350 m
300
250
200
150
100
50
0

LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Tunnel Alignment

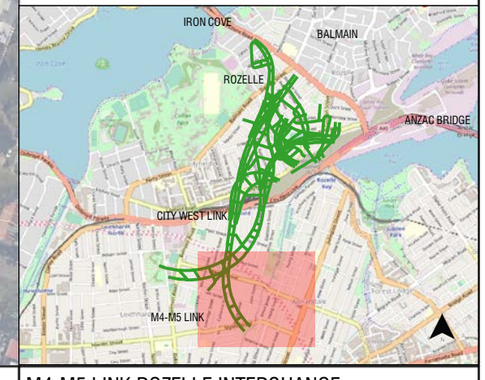
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original

Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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RENZO TONIN & ASSOCIATES
inspired to achieve
SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during top heading excavation with Roadheader

Status:

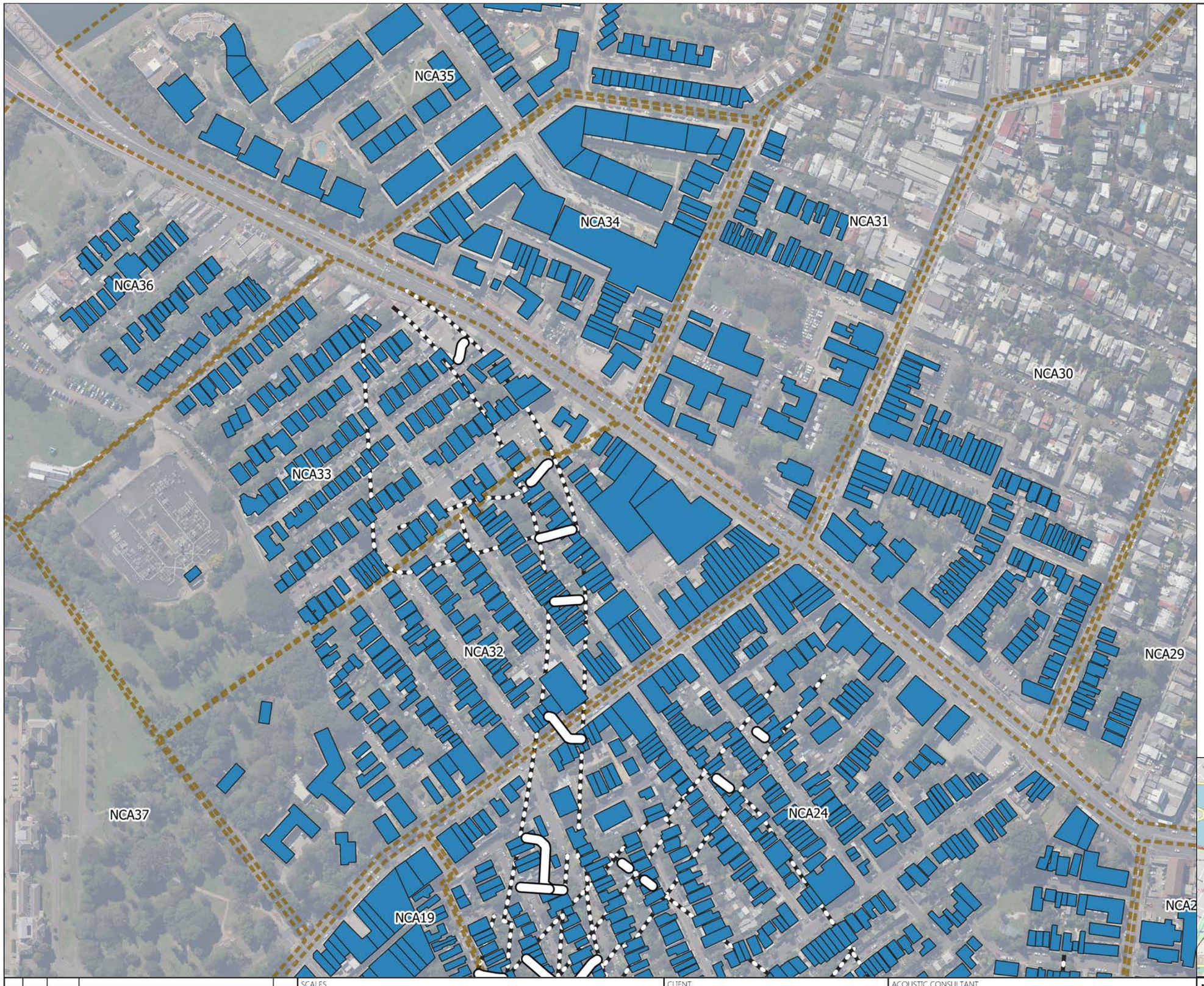
Sheet 7 of 7

Drawing No. 1

Rev. No. 1

D.5 Cross passage excavation (roadheader)

Plot Date: 29/01/20 - 17:03 Layout Name: TJ914-03 Tunnelling Cross Passage Excavation GBV Roadheader
GIS File: C:\Users\moe.sadri.RTAGROUP\OneDrive - Renzo Tonin & Associates (NSW) Pty Ltd\OneDrive-Moe\01-Jobs\MyWorkArea (r1).qgz



350 m
300
250
200
150
100
50
0

LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

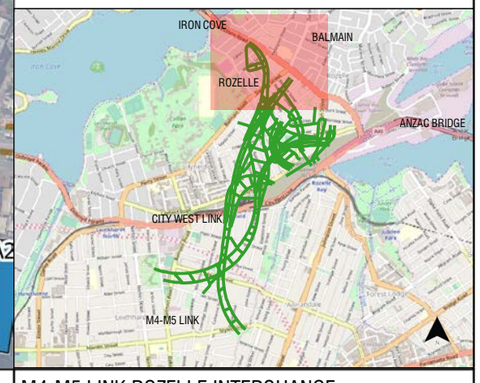
- Cross Passage
- Tunnel Alignment
- NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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inspired to achieve
SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during cross passage excavation with Roadheader

Status: | Sheet 1 of 7

Drawing No. 1 | Rev. No. 1

Plot Date: 29/01/20 - 17:03 Layout Name: TJ914-03 Tunnelling Cross Passage Excavation GBV Roadheader
GIS File: C:\Users\moe.sadri.RTAGROUP\OneDrive - Renzo Tonin & Associates (NSW) Pty Ltd\OneDrive-Moe\01-Jobs\MyWorkArea (r1).qgz

350 m
300
250
200
150
100
50
0

LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Cross Passage

Tunnel Alignment

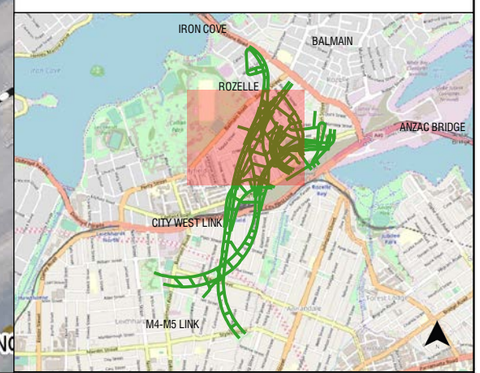
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during cross passage excavation with Roadheader

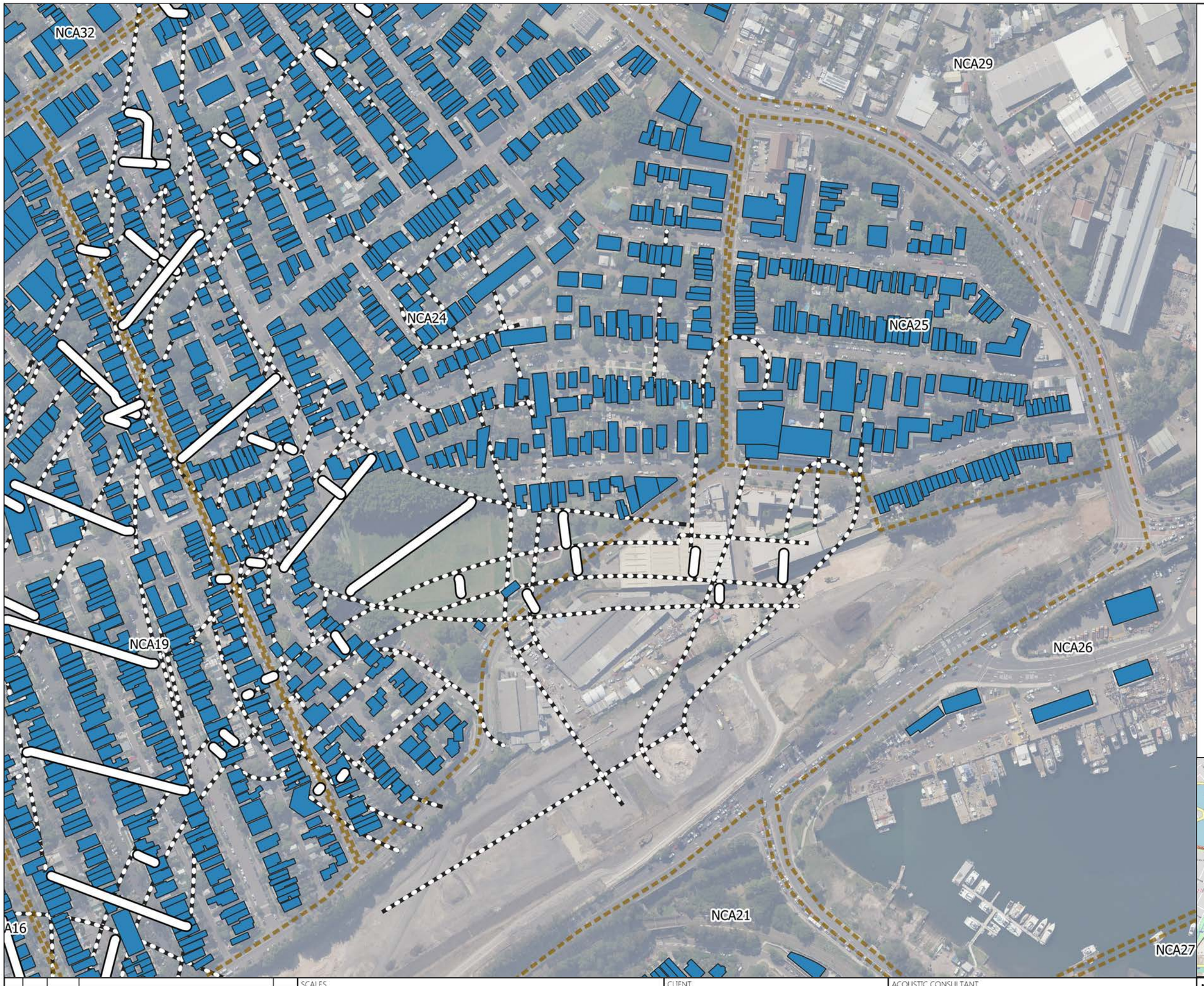
Status:

Sheet 2 of 7

Drawing No. 1

Rev. No. 1

Plot Date: 29/01/20 - 17:04 Layout Name: TJ914-03 Tunnelling Cross Passage Excavation GBV Roadheader
GIS File: C:\Users\rnoe.sadri.RTAGROUP\OneDrive - Renzo Tonin & Associates (NSW) Pty Ltd\OneDrive-Moe\01-Jobs\MyWorkArea (r1).qgz



LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Cross Passage

Tunnel Alignment

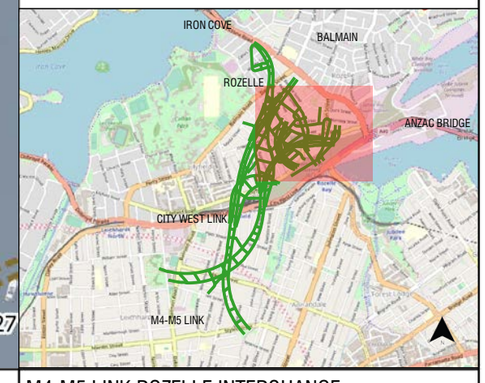
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original

Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve
SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during cross passage excavation with Roadheader

Status:

Sheet 3 of 7

Drawing No. 1

Rev. No. 1

LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Cross Passage

Tunnel Alignment

NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

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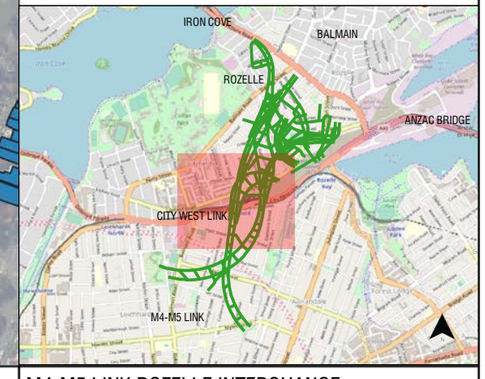

REV	BY	DATE	DESCRIPTION	APPD.
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r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during cross passage excavation with Roadheader

Status:

Sheet 4 of 7

Drawing No. 1

Rev. No. 1

Layout Name: TJ914-03 Tunnelling Cross Passage Excavation GBV Roadheader
Plot Date: 29/01/20 - 17:04
GIS File: C:\Users\moe.sadri.RTAGROUP\OneDrive - Renzo Tonin & Associates (NSW) Pty Ltd\OneDrive-Moe\01-Jobs\MyWorkArea (r1).qgz

LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Cross Passage

Tunnel Alignment

NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

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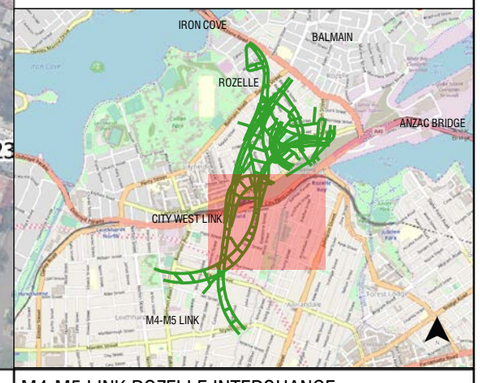

REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original

Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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RENZO TONIN & ASSOCIATES
inspired to achieve
SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

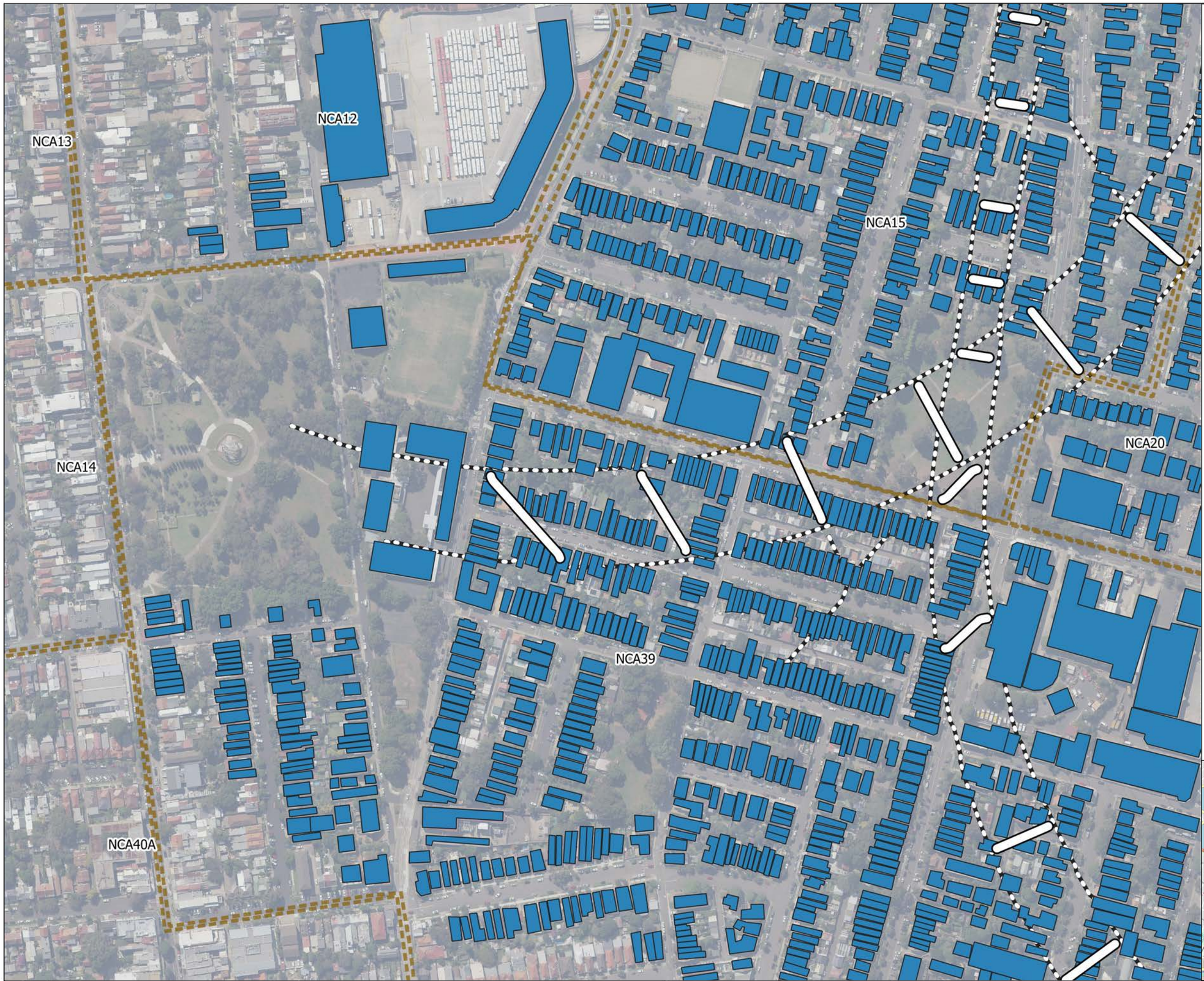
Predicted maximum GBV levels during cross passage excavation with Roadheader

Status:

Sheet 5 of 7

Drawing No. 1

Rev. No. 1



LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Cross Passage

Tunnel Alignment

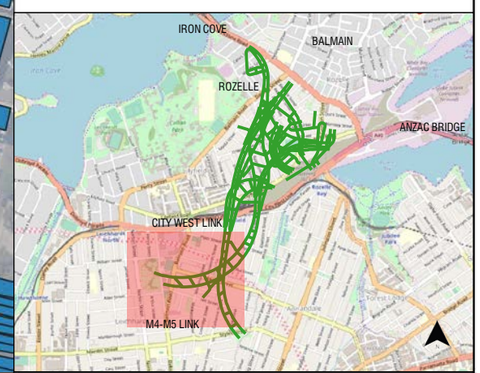
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



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r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

JOHN HOLLAND | CPB CONTRACTORS

ACOUSTIC CONSULTANT

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SYDNEY OFFICE
1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during cross passage excavation with Roadheader

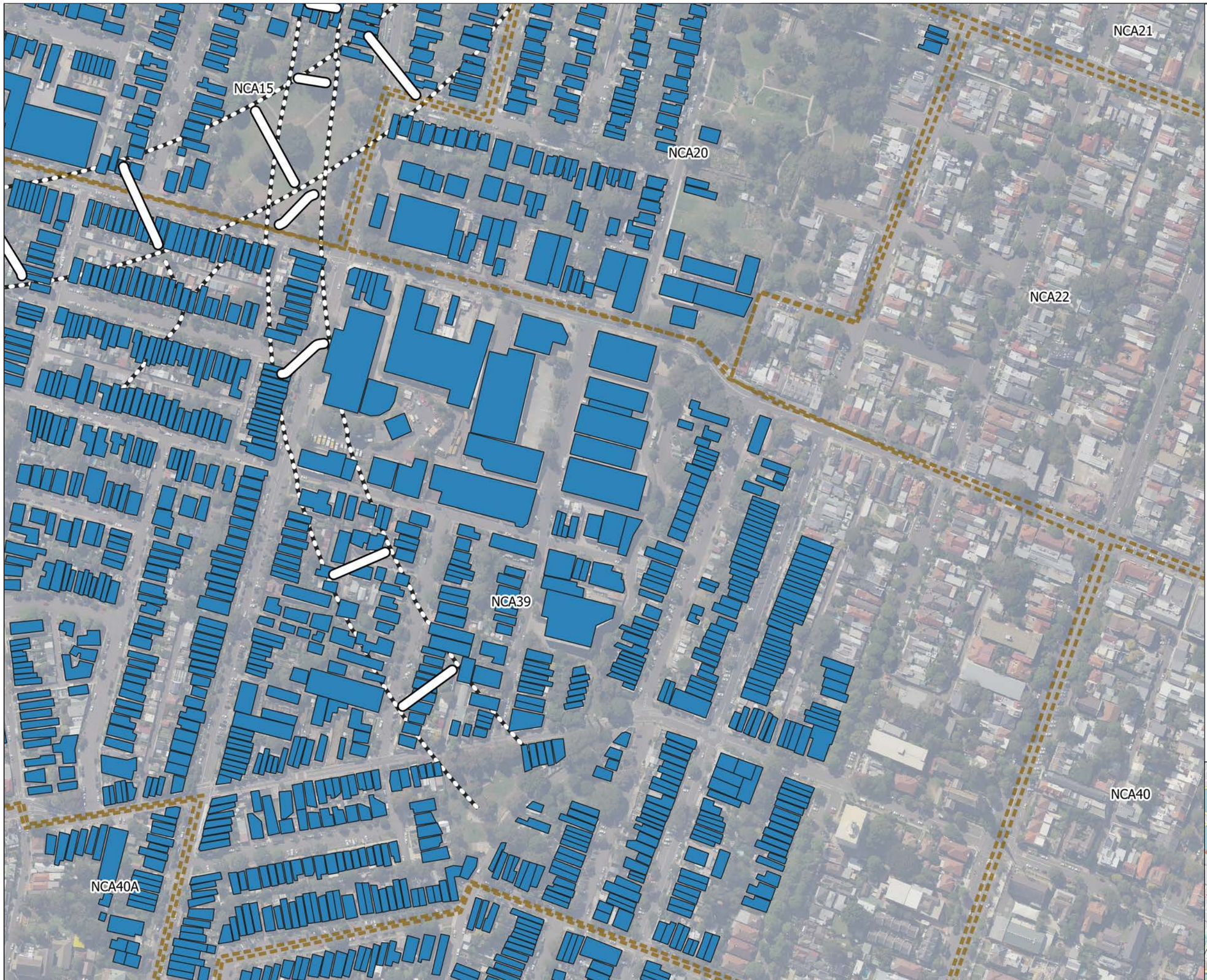
Status:

Sheet 6 of 7

Drawing No. 1

Rev. No. 1

Layout Name: TJ914-03 Tunnelling Cross Passage Excavation GBV Roadheader
Plot Date: 29/01/20 - 17:05
GIS File: C:\Users\moe.sadri.RTAGROUP\OneDrive - Renzo Tonin & Associates (NSW) Pty Ltd\OneDrive-Moe\01-Jobs\MyWorkArea (r1).qgz



LEGEND

Maximum GBV levels ppv(mm/s):

- < 0.28
- 0.28 - 0.40
- 0.40 - 0.56
- 0.56 - 1.10
- 1.10 - 2.20
- > 2.20

Cross Passage

Tunnel Alignment

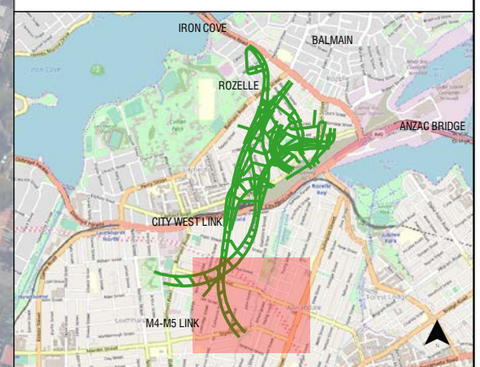
NCA

NOTES:

- The assessment is based on underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on initial screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occurring when they feel vibration or observe rattling of loose objects, however, the level of vibration at which people perceive vibration or at which loose objects may rattle is far lower than vibration levels that could cause damage to structures.



REV	BY	DATE	DESCRIPTION	APPD.
r2	MS	29.01.20	Update figures	MT
r1	MS	07.11.19	Update figures	MT
r0	MS	01.10.19	Prepare figures	MT

A3 Original | Co-ordinate System: UTM Zone 56S

SCALES

0 50 100 150 m

1:3000

NOTE: Do not scale from this drawing.

CLIENT

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1/418A Elizabeth St., SURRY HILLS, NSW 2000
Ph (02) 8218 0500 Fax (02) 8218 0501

M4-M5 LINK ROZELLE INTERCHANGE

Predicted maximum GBV levels during cross passage excavation with Roadheader

Status:	Sheet 7 of 7
Drawing No. 1	Rev. No. 1

D.1 Northbound top heading excavation (roadheader)

LEGEND

Noise Sensitive Receivers

- Residential
- Non-Residential

- Project NCAs

- Overall Tunnel Alignment
- Rozelle Tunneling Package
- Northbound

Maximum GBV levels ppv(mm/s) during Excavation

- < 0.28
- 0.28 - 0.4 Above Critical areas for Human Annoyance
- 0.4 - 0.56 Above Residential Night Time for Human Annoyance
- 0.56 - 1.1 Above Residential Day Time for Human Annoyance
- 1.1 - 2.2 Above Offices for Human Annoyance
- > 2.2 Above Industrial Receivers for Human Annoyance

Notes :

- This assesment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on the inital screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occuring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower that the vibration levels that could cause damage to structures

0 100 200 300 m

0 25 50 75 100 125 150 m

1:2,100

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	09/03/22	Prepare figures	RZ

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

CLIENT

Rozelle Interchange
WestConnex
JOHN HOLLAND | CPB CONTRACTORS

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
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WESTERN HARBOUR TUNNEL
Rozelle Tunneling Package

Predicted Maximum GBV level during
Northbound Top Heading Excavation (Roadheader)

Sheet 1 of 22

Plot Date: 09/03/22 - 11:04 Layout: TM589 GBN GBV Tunnel Template
GIS File: R:\Assoc\Syd\Projects\TM551-TM600\TM589 mt\WTP - STP-5 Calcs\01 GIS\TM589 - SS.qgz

LEGEND

Noise Sensitive Receivers

- Residential
- Non-Residential

- Project NCAs

- Overall Tunnel Alignment
- Rozelle Tunneling Package
- Northbound

Maximum GBV levels ppv(mm/s) during Excavation

- < 0.28
- 0.28 - 0.4 Above Critical areas for Human Annoyance
- 0.4 - 0.56 Above Residential Night Time for Human Annoyance
- 0.56 - 1.1 Above Residential Day Time for Human Annoyance
- 1.1 - 2.2 Above Offices for Human Annoyance
- > 2.2 Above Industrial Receivers for Human Annoyance

Notes :

- This assesment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on the inital screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occuring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower that the vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	09/03/22	Prepare figures	RZ

A3 Original

Co-ordinate System: MGA Zone 56

0 25 50 75 100 125 150 m

1:2,100

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

Rozelle Interchange
WestConnex
JOHN HOLLAND | CPB CONTRACTORS

ACOUSTIC CONSULTANT

RENZO TONIN & ASSOCIATES
inspired to achieve

Ph (02) 8218 0500 Fax (02) 8218 0501

WESTERN HARBOUR TUNNEL
Rozelle Tunneling Package

Predicted Maximum GBV level during
Northbound Top Heading Excavation (Roadheader)

Sheet 2 of 22

Plot Date: 09/03/22 - 11:04 Layout: TM589 GBN GBV Tunnel Template

GIS File: R:\Assoc\Syd\Projects\TM551-TM600\TM589 mt\VTP - STP-5 Calcs\01 GIS\TM589 - SS.qgz

D.2 Southbound top heading excavation (roadheader)

LEGEND

Noise Sensitive Receivers

- Residential
- Non-Residential

- Project NCAs

- Overall Tunnel Alignment
- Rozelle Tunneling Package
- Southbound

Maximum GBV levels ppv(mm/s) during Excavation

- < 0.28
- 0.28 - 0.4 Above Critical areas for Human Annoyance
- 0.4 - 0.56 Above Residential Night Time for Human Annoyance
- 0.56 - 1.1 Above Residential Day Time for Human Annoyance
- 1.1 - 2.2 Above Offices for Human Annoyance
- > 2.2 Above Industrial Receivers for Human Annoyance

Notes :

- This assesment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on the inital screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occuring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower that the vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	09/03/22	Prepare figures	RZ

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 125 150 m

1:2,100

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

Rozelle Interchange
WestConnex
JOHN HOLLAND | CPB CONTRACTORS

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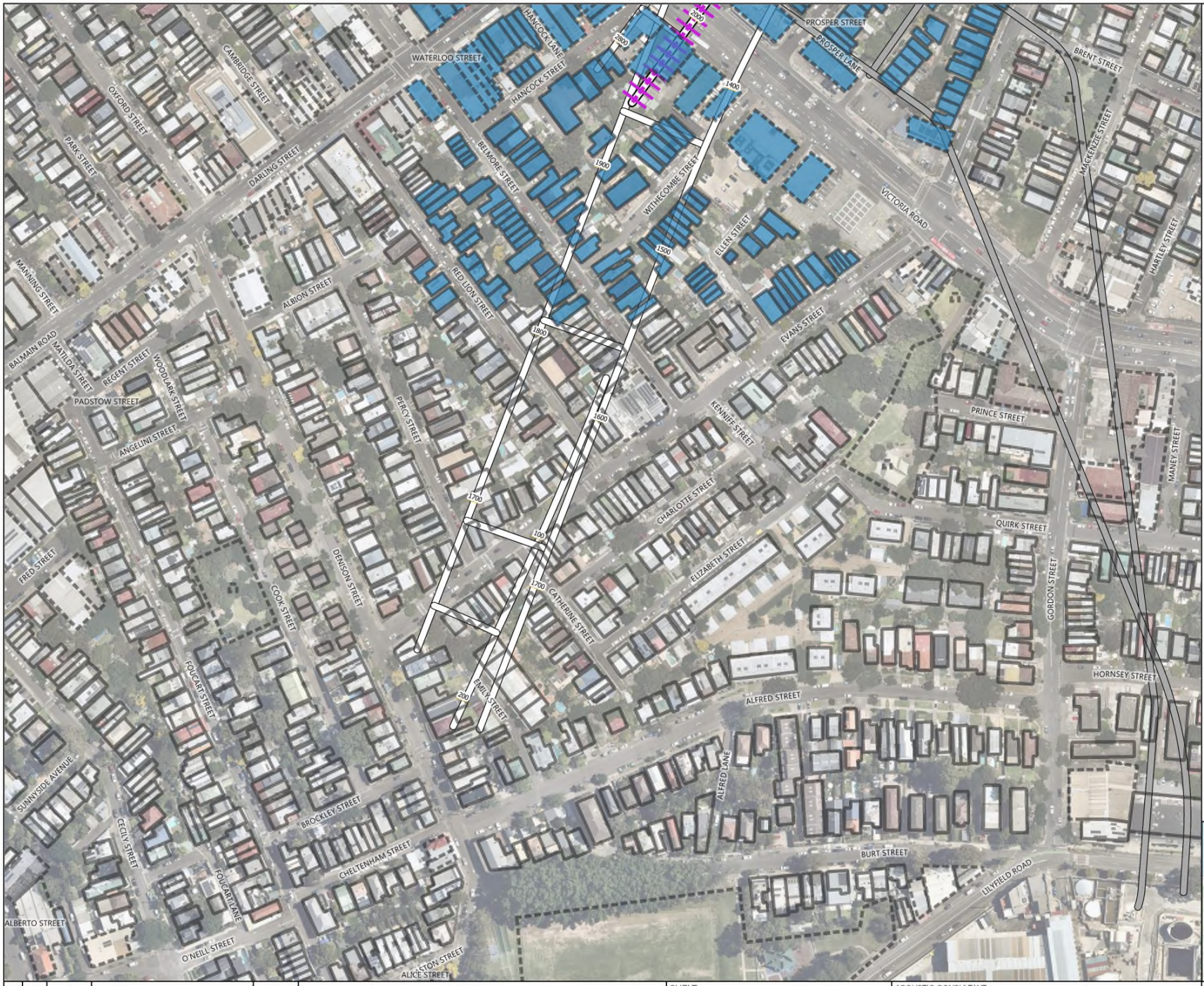
WESTERN HARBOUR TUNNEL
Rozelle Tunneling Package

Predicted Maximum GBV level during
Southbound Top Heading Excavation (Roadheader)

Plot Date: 09/03/22 - 11:04 Layout: TM589 GBN GBV Tunnel Template
GIS File: R:\Assoc\Syd\Projects\TM551-TM600-TM589 mt\WTP - STP-5 Calcs\01 GIS\TM589 - SS.qgz



LEGEND

Noise Sensitive Receivers

- Residential
- Non-Residential

- Project NCAs

- Overall Tunnel Alignment
- Rozelle Tunneling Package
- Southbound

Maximum GBV levels ppv(mm/s) during Excavation

- < 0.28
- 0.28 - 0.4 Above Critical areas for Human Annoyance
- 0.4 - 0.56 Above Residential Night Time for Human Annoyance
- 0.56 - 1.1 Above Residential Day Time for Human Annoyance
- 1.1 - 2.2 Above Offices for Human Annoyance
- > 2.2 Above Industrial Receivers for Human Annoyance

Notes :

- This assesment is based on the underground excavation works being undertaken at the closest location to the nearby receivers.

- The maximum vibration levels are based on the inital screening approach which assumes continuous vibration levels.

- Building occupants often assume that building damage is occuring when they feel vibration or observe rattling of loose objects. However the level of vibration which people perceive is far lower that the vibration levels that could cause damage to structures

REV	BY	DATE	DESCRIPTION	APPROVER
r0	SS	09/03/22	Prepare figures	RZ

A3 Original | Co-ordinate System: MGA Zone 56

0 25 50 75 100 125 150 m

1:2,100

FULL SIZE A3, REDUCED TO A4

NOTE: Do not scale from this drawing.

CLIENT

Rozelle Interchange
WestConnex
JOHN HOLLAND | CPB CONTRACTORS

ACOUSTIC CONSULTANT

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

WESTERN HARBOUR TUNNEL
Rozelle Tunneling Package

Predicted Maximum GBV level during
Southbound Top Heading Excavation (Roadheader)

Plot Date: 09/03/22 - 11:05 Layout: TM589 GBN GBV Tunnel Template
GIS File: R:\AssocSyd\Projects\TM551-TM600\TM589 mt WTP - STP\5 Calcs\01 GIS\TM589 - SS.qgz

Annexure F Non-residential receivers in study area

Table 23: Non-residential receivers in study area

RTA_ID	ADDRESS	LAND USE
2578	36 EVANS STREET BALMAIN 2041	Childcare
2595	450 BALMAIN ROAD LILYFIELD 2040	Childcare
2756	19 CECILY STREET LILYFIELD 2040	Childcare
3067	668 DARLING STREET ROZELLE 2039	Childcare
5091	5 QUIRK STREET ROZELLE 2039	Childcare
5109	668 DARLING STREET ROZELLE 2039	Childcare
5293	75 MOORE STREET LEICHHARDT 2040	Childcare
5349	10-12 TREVOR STREET LILYFIELD 2040	Childcare
5848	Rozelle Child Care centre	Childcare
6951	1 COLERIDGE STREET LEICHHARDT 2040	Childcare
7253	62 STYLES STREET LEICHHARDT 2040	Childcare
7704	284 BALMAIN ROAD LILYFIELD NSW 2040	Childcare
7705	15 EMMERICK STREET LILYFIELD NSW 2040	Childcare
9465	7 THE CRESCENT ANNANDALE NSW 2038	Childcare
9964	47A TRAFALGAR STREET ANNANDALE NSW 2038	Childcare
9965	49 JOHNSTON STREET ANNANDALE NSW 2038	Childcare
128	77-79 VICTORIA ROAD DRUMMOYNE 2047	Commercial
142	36-46 VICTORIA ROAD DRUMMOYNE 2047	Commercial
145	461 Henley Marine Dr, Drummoyne NSW 2047	Commercial
148	19-19A ROSEBY STREET DRUMMOYNE 2047	Commercial
165	39-45 VICTORIA ROAD DRUMMOYNE 2047	Commercial
174	71 VICTORIA ROAD DRUMMOYNE 2047	Commercial
186	19A ROSEBY STREET DRUMMOYNE 2047	Commercial
223	53 VICTORIA ROAD DRUMMOYNE 2047	Commercial
235	73 VICTORIA ROAD DRUMMOYNE 2047	Commercial
238	1 PARK AVENUE DRUMMOYNE 2047	Commercial
246	1 Henley Marine Dr, Drummoyne NSW 2132	Commercial
247	1 Henley Marine Dr, Drummoyne NSW 2132	Commercial
248	19A ROSEBY STREET DRUMMOYNE 2047	Commercial
249	19 ROSEBY STREET DRUMMOYNE 2047	Commercial
253	7 ROSEBERY PLACE BALMAIN 2041	Commercial
256	5 ROSEBERY PLACE BALMAIN 2041	Commercial
338	7 ROSEBERY PLACE BALMAIN 2041	Commercial
344	9 ROSEBERRY BALMAIN 2041	Commercial
367	73 VICTORIA ROAD ROZELLE 2039	Commercial
368	11 LOUGHLIN STREET ROZELLE 2039	Commercial
373	729 DARLING STREET ROZELLE 2039	Commercial
388	67 VICTORIA ROAD ROZELLE 2039	Commercial
398	29 CRESCENT STREET ROZELLE 2039	Commercial
448	7 FRED STREET LILYFIELD 2040	Commercial
474	718 DARLING STREET ROZELLE 2039	Commercial
529	133 VICTORIA ROAD ROZELLE 2039	Commercial
546	1 WELLINGTON STREET ROZELLE 2039	Commercial

553	634 DARLING STREET ROZELLE 2039	Commercial
592	588 DARLING STREET ROZELLE 2039	Commercial
666	651-653 DARLING STREET ROZELLE 2039	Commercial
795	723 DARLING STREET ROZELLE 2039	Commercial
804	669 DARLING STREET ROZELLE 2039	Commercial
832	2 PARK STREET ROZELLE 2039	Commercial
886	24 FRED STREET LILYFIELD 2040	Commercial
911	684 DARLING STREET ROZELLE 2039	Commercial
922	39 CRESCENT STREET ROZELLE 2039	Commercial
980	9 THE CRESCENT ANNANDALE 2038	Commercial
990	59 LILYFIELD ROAD ROZELLE 2039	Commercial
1017	91 EVANS STREET ROZELLE 2039	Commercial
1022	505 BALMAIN ROAD LILYFIELD 2040	Commercial
1044	685 DARLING STREET ROZELLE 2039	Commercial
1122	683 DARLING STREET ROZELLE 2039	Commercial
1144	707 DARLING STREET ROZELLE 2039	Commercial
1153	80 O'NEILL STREET LILYFIELD 2040	Commercial
1172	766 DARLING STREET ROZELLE 2039	Commercial
1220	99 MANSFIELD STREET ROZELLE 2039	Commercial
1317	576 DARLING STREET ROZELLE 2039	Commercial
1347	3 WELLINGTON STREET ROZELLE 2039	Commercial
1376	101 MANSFIELD STREET ROZELLE 2039	Commercial
1410	30 GORDON STREET ROZELLE 2039	Commercial
1412	714-716 DARLING STREET ROZELLE 2039	Commercial
1482	501 BALMAIN ROAD LILYFIELD 2040	Commercial
1514	69 DENISON STREET ROZELLE 2039	Commercial
1544	572 DARLING STREET ROZELLE 2039	Commercial
1590	103 MANSFIELD STREET ROZELLE 2039	Commercial
1591	5 FRED STREET LILYFIELD 2040	Commercial
1631	190 BEATTIE STREET ROZELLE 2039	Commercial
1726	701-703 DARLING STREET ROZELLE 2039	Commercial
1732	605 DARLING STREET ROZELLE 2039	Commercial
1789	688 DARLING STREET ROZELLE 2039	Commercial
1892	128 TERRY STREET ROZELLE 2039	Commercial
1907	4 PARK STREET ROZELLE 2039	Commercial
1927	686 DARLING STREET ROZELLE 2039	Commercial
1937	25 DERBYSHIRE ROAD LEICHHARDT 2040	Commercial
2000	67 DENISON STREET ROZELLE 2039	Commercial
2042	546 DARLING STREET ROZELLE 2039	Commercial
2055	578 DARLING STREET ROZELLE 2039	Commercial
2066	661 DARLING STREET ROZELLE 2039	Commercial
2067	2-8 PARSONS STREET ROZELLE 2039	Commercial
2144	48 VICTORIA ROAD ROZELLE 2039	Commercial
2158	493 BALMAIN ROAD LILYFIELD 2040	Commercial
2172	558 DARLING STREET ROZELLE 2039	Commercial
2176	5 WELLINGTON STREET ROZELLE 2039	Commercial

2177	193 EVANS STREET ROZELLE 2039	Commercial
2207	671 DARLING STREET ROZELLE 2039	Commercial
2218	665 DARLING STREET ROZELLE 2039	Commercial
2224	726 DARLING STREET ROZELLE 2039	Commercial
2270	756 DARLING STREET ROZELLE 2039	Commercial
2272	702 DARLING STREET ROZELLE 2039	Commercial
2273	754 DARLING STREET ROZELLE 2039	Commercial
2274	50-58 EVANS STREET ROZELLE 2039	Commercial
2281	44 HALLORAN STREET LILYFIELD 2040	Commercial
2323	760-762 DARLING STREET ROZELLE 2039	Commercial
2333	17 WELLINGTON STREET ROZELLE 2039	Commercial
2337	709 DARLING STREET ROZELLE 2039	Commercial
2339	27 DERBYSHIRE ROAD LEICHHARDT 2040	Commercial
2340	711 DARLING STREET ROZELLE 2039	Commercial
2346	88-90 LILYFIELD ROAD LILYFIELD 2040	Commercial
2356	731-735 DARLING STREET ROZELLE 2039	Commercial
2367	708 DARLING STREET ROZELLE 2039	Commercial
2382	675 DARLING STREET ROZELLE 2039	Commercial
2385	677 DARLING STREET ROZELLE 2039	Commercial
2392	188-190 VICTORIA ROAD ROZELLE 2039	Commercial
2408	69 VICTORIA ROAD ROZELLE 2039	Commercial
2409	112 VICTORIA ROAD ROZELLE 2039	Commercial
2427	389-391 BALMAIN ROAD LILYFIELD 2040	Commercial
2430	356-358 CATHERINE STREET LILYFIELD 2040	Commercial
2434	36-40 HALLORAN STREET LILYFIELD 2040	Commercial
2436	366 CATHERINE STREET LILYFIELD 2040	Commercial
2437	26-30 HALLORAN STREET LILYFIELD 2040	Commercial
2438	27 MOORE STREET LEICHHARDT 2040	Commercial
2444	469-483 BALMAIN ROAD LILYFIELD 2040	Commercial
2446	17 MOORE STREET LEICHHARDT 2040	Commercial
2450	88-92 PIPER STREET LILYFIELD 2040	Commercial
2481	1-5 MOORE STREET LEICHHARDT 2040	Commercial
2495	87-89 MOORE STREET LEICHHARDT 2040	Commercial
2508	42 ALBERTO STREET LILYFIELD 2040	Commercial
2509	25-27 CRESCENT STREET ROZELLE 2039	Commercial
2528	116 VICTORIA ROAD ROZELLE 2039	Commercial
2544	2 HUTCHINSON STREET ANNANDALE 2038	Commercial
2546	582-584 DARLING STREET ROZELLE 2039	Commercial
2558	190 BEATTIE STREET ROZELLE 2039	Commercial
2572	84-94 MULLENS STREET BALMAIN 2041	Commercial
2576	72-74 MULLENS STREET BALMAIN 2041	Commercial
2625	74 VICTORIA ROAD ROZELLE 2039	Commercial
2626	202 VICTORIA ROAD ROZELLE 2039	Commercial
2640	720 DARLING STREET ROZELLE 2039	Commercial
2650	109 MANSFIELD STREET ROZELLE 2039	Commercial
2654	1-13 PARSONS STREET ROZELLE 2039	Commercial

2659	580 DARLING STREET ROZELLE 2039	Commercial
2660	562 DARLING STREET ROZELLE 2039	Commercial
2662	628-630 DARLING STREET ROZELLE 2039	Commercial
2663	176-184 VICTORIA ROAD ROZELLE 2039	Commercial
2664	679 DARLING STREET ROZELLE 2039	Commercial
2665	138-152 VICTORIA ROAD ROZELLE 2039	Commercial
2667	649 DARLING STREET ROZELLE 2039	Commercial
2668	595 DARLING STREET ROZELLE 2039	Commercial
2672	650 DARLING STREET ROZELLE 2039	Commercial
2673	748 DARLING STREET ROZELLE 2039	Commercial
2676	680-682 DARLING STREET ROZELLE 2039	Commercial
2680	704 DARLING STREET ROZELLE 2039	Commercial
2681	742 DARLING STREET ROZELLE 2039	Commercial
2683	758 DARLING STREET ROZELLE 2039	Commercial
2684	128 VICTORIA ROAD ROZELLE 2039	Commercial
2685	746 DARLING STREET ROZELLE 2039	Commercial
2686	744 DARLING STREET ROZELLE 2039	Commercial
2690	710-712 DARLING STREET ROZELLE 2039	Commercial
2692	740 DARLING STREET ROZELLE 2039	Commercial
2699	53-55 VICTORIA ROAD ROZELLE 2039	Commercial
2704	20 ROBERT STREET ROZELLE 2039	Commercial
2709	632 DARLING STREET ROZELLE 2039	Commercial
2711	107 MANSFIELD STREET ROZELLE 2039	Commercial
2712	154-156 VICTORIA ROAD ROZELLE 2039	Commercial
2713	655-657 DARLING STREET ROZELLE 2039	Commercial
2716	693-695 DARLING STREET ROZELLE 2039	Commercial
2718	618 DARLING STREET ROZELLE 2039	Commercial
2719	616 DARLING STREET ROZELLE 2039	Commercial
2720	681 DARLING STREET ROZELLE 2039	Commercial
2751	1 PROSPER LANE ROZELLE 2039	Commercial
2763	753-755 DARLING STREET ROZELLE 2039	Commercial
2764	36 LONSDALE STREET LILYFIELD 2040	Commercial
2768	22 FRED STREET LILYFIELD 2040	Commercial
2769	138 EVANS STREET ROZELLE 2039	Commercial
2778	1 WHITE STREET LILYFIELD 2040	Commercial
2794	612 DARLING STREET ROZELLE 2039	Commercial
2795	612A DARLING STREET ROZELLE 2039	Commercial
2804	230 BALMAIN ROAD LEICHHARDT 2040	Commercial
2807	126 TERRY STREET ROZELLE 2039	Commercial
2826	360-362 CATHERINE STREET LILYFIELD 2040	Commercial
2832	21 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2853	1 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2855	37 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2856	9 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2857	13 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2858	5 JAMES CRAIG ROAD ROZELLE 2039	Commercial

2859	2 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2871	6-8 WATERLOO STREET ROZELLE 2039	Commercial
2872	26 PARSONS STREET ROZELLE 2039	Commercial
2873	568 DARLING STREET ROZELLE 2039	Commercial
2879	96-102 VICTORIA ROAD ROZELLE 2039	Commercial
2899	57-59 VICTORIA ROAD ROZELLE 2039	Commercial
2903	165 VICTORIA ROAD ROZELLE 2039	Commercial
2904	620-622 DARLING STREET ROZELLE 2039	Commercial
2909	15 THE CRESCENT ANNANDALE 2038	Commercial
2912	35 MOORE STREET LEICHHARDT 2040	Commercial
2913	111 MOORE STREET LEICHHARDT 2040	Commercial
2914	111 MOORE STREET LEICHHARDT 2040	Commercial
2915	99 MOORE STREET LEICHHARDT 2040	Commercial
2916	87-89 MOORE STREET LEICHHARDT 2040	Commercial
2927	722-724 DARLING STREET ROZELLE 2039	Commercial
2930	138-152 VICTORIA ROAD ROZELLE 2039	Commercial
2931	753-755 DARLING STREET ROZELLE 2039	Commercial
2934	753-755 DARLING STREET ROZELLE 2039	Commercial
2939	71 EVANS STREET ROZELLE 2039	Commercial
2943	586 DARLING STREET ROZELLE 2039	Commercial
2957	699 DARLING STREET ROZELLE 2039	Commercial
2961	22 ROBERT STREET ROZELLE 2039	Commercial
2962	18 ROBERT STREET ROZELLE 2039	Commercial
2963	24 ROBERT STREET ROZELLE 2039	Commercial
2964	26 ROBERT STREET ROZELLE 2039	Commercial
2966	28 ROBERT STREET ROZELLE 2039	Commercial
2986	36 JAMES CRAIG ROAD ROZELLE 2039	Commercial
2990	127 VICTORIA ROAD ROZELLE 2039	Commercial
2992	87 VICTORIA ROAD ROZELLE 2039	Commercial
2994	9 FRED STREET LILYFIELD 2040	Commercial
2995	597 DARLING STREET ROZELLE 2039	Commercial
2998	586 DARLING STREET ROZELLE 2039	Commercial
3032	9 FRED STREET LILYFIELD 2040	Commercial
3034	9 FRED STREET LILYFIELD 2040	Commercial
3037	165 VICTORIA ROAD ROZELLE 2039	Commercial
3040	165 VICTORIA ROAD ROZELLE 2039	Commercial
3054	59 LILYFIELD ROAD ROZELLE 2039	Commercial
3075	176-184 VICTORIA ROAD ROZELLE 2039	Commercial
3078	636 DARLING STREET ROZELLE 2039	Commercial
3079	53-55 VICTORIA ROAD ROZELLE 2039	Commercial
3081	1-13 PARSONS STREET ROZELLE 2039	Commercial
3084	1-13 PARSONS STREET ROZELLE 2039	Commercial
3091	756 DARLING STREET ROZELLE 2039	Commercial
3092	738 DARLING STREET ROZELLE 2039	Commercial
3093	780 DARLING STREET ROZELLE 2039	Commercial
3102	599 DARLING STREET ROZELLE 2039	Commercial

3104	608 DARLING STREET ROZELLE 2039	Commercial
3114	140 EVANS STREET ROZELLE 2039	Commercial
3159	33 JAMES CRAIG ROAD ROZELLE 2039	Commercial
3160	Lot 10, SOMMERVILLE ROAD ROZELLE 2039	Commercial
3161	Lot 10, SOMMERVILLE ROAD ROZELLE 2039	Commercial
3162	Lot 10, SOMMERVILLE ROAD ROZELLE 2039	Commercial
3163	Lot 10, SOMMERVILLE ROAD ROZELLE 2039	Commercial
3164	Lot 10, SOMMERVILLE ROAD ROZELLE 2039	Commercial
3165	Lot 10, SOMMERVILLE ROAD ROZELLE 2039	Commercial
3196	88-92 PIPER STREET LILYFIELD 2040	Commercial
3201	5 WHITE STREET LILYFIELD 2040	Commercial
3204	88-90 LILYFIELD ROAD LILYFIELD 2040	Commercial
3205	35 MOORE STREET LEICHHARDT 2040	Commercial
3218	21 JAMES CRAIG ROAD ROZELLE 2039	Commercial
3219	1 JAMES CRAIG ROAD ROZELLE 2039	Commercial
3221	2 MARITIME COURT ROZELLE 2039	Commercial
3362	17 MANSFIELD STREET ROZELLE 2039	Commercial
3363	4-26 MANSFIELD STREET ROZELLE 2039	Commercial
3364	4-26 MANSFIELD STREET ROZELLE 2039	Commercial
3365	2 MANSFIELD STREET ROZELLE 2039	Commercial
3366	4-26 MANSFIELD STREET ROZELLE 2039	Commercial
3618	1 DALGAL WAY FOREST LODGE 2037	Commercial
3718	697 DARLING STREET ROZELLE 2039	Commercial
3727	727 DARLING STREET ROZELLE 2039	Commercial
3757	364 CATHERINE STREET LILYFIELD 2040	Commercial
3773	4 ALFRED STREET LILYFIELD 2040	Commercial
3795	643 DARLING STREET ROZELLE 2039	Commercial
3799	47 WELLINGTON STREET ROZELLE 2039	Commercial
3806	600 DARLING STREET ROZELLE 2039	Commercial
3827	687 DARLING STREET ROZELLE 2039	Commercial
3876	691 DARLING STREET ROZELLE 2039	Commercial
3878	776-778 DARLING STREET ROZELLE 2039	Commercial
3915	72B VICTORIA ROAD ROZELLE 2039	Commercial
3928	4 WHITE STREET LILYFIELD 2040	Commercial
3961	689 DARLING STREET ROZELLE 2039	Commercial
3988	142A MULLENS STREET ROZELLE 2039	Commercial
4031	119 VICTORIA ROAD ROZELLE 2039	Commercial
4041	487 BALMAIN ROAD LILYFIELD 2040	Commercial
4087	368 CATHERINE STREET LILYFIELD 2040	Commercial
4174	10-16 PARSONS STREET ROZELLE 2039	Commercial
4200	489 BALMAIN ROAD LILYFIELD 2040	Commercial
4203	706 DARLING STREET ROZELLE 2039	Commercial
4254	7 MOORE STREET LEICHHARDT 2040	Commercial
4315	659 DARLING STREET ROZELLE 2039	Commercial
4376	610 DARLING STREET ROZELLE 2039	Commercial
4387	370 CATHERINE STREET LILYFIELD 2040	Commercial

4476	106 MULLENS STREET BALMAIN 2041	Commercial
4512	1 CRYSTAL STREET ROZELLE 2039	Commercial
4548	780 DARLING STREET ROZELLE 2039	Commercial
4596	485 BALMAIN ROAD LILYFIELD 2040	Commercial
4629	29 MOORE STREET LEICHHARDT 2040	Commercial
4630	61 LILYFIELD ROAD ROZELLE 2039	Commercial
4637	5 WHITE STREET LILYFIELD 2040	Commercial
4707	15 MOORE STREET LEICHHARDT 2040	Commercial
4720	1 CHARLOTTE STREET LILYFIELD 2040	Commercial
4740	778 DARLING STREET ROZELLE 2039	Commercial
4741	45 VICTORIA ROAD ROZELLE 2039	Commercial
4761	503A BALMAIN ROAD LILYFIELD 2040	Commercial
4768	71 VICTORIA ROAD ROZELLE 2039	Commercial
4792	614 DARLING STREET ROZELLE 2039	Commercial
4813	186A VICTORIA ROAD ROZELLE 2039	Commercial
4913	43 MERTON STREET ROZELLE 2039	Commercial
4933	570A DARLING STREET ROZELLE 2039	Commercial
4949	608 DARLING STREET ROZELLE 2039	Commercial
4973	354 CATHERINE STREET LILYFIELD 2040	Commercial
5046	349 CATHERINE STREET LILYFIELD 2040	Commercial
5077	87 VICTORIA ROAD ROZELLE 2039	Commercial
5105	673 DARLING STREET ROZELLE 2039	Commercial
5111	624 DARLING STREET ROZELLE 2039	Commercial
5131	31 WHITE STREET LILYFIELD 2040	Commercial
5157	39 TERRY STREET ROZELLE 2039	Commercial
5188	347 CATHERINE STREET LILYFIELD 2040	Commercial
5214	126 VICTORIA ROAD ROZELLE 2039	Commercial
5236	713 DARLING STREET ROZELLE 2039	Commercial
5248	606 DARLING STREET ROZELLE 2039	Commercial
5269	56 LAMB STREET LILYFIELD 2040	Commercial
5273	491 BALMAIN ROAD LILYFIELD 2040	Commercial
5284	23-25 PERCIVAL STREET LILYFIELD 2040	Commercial
5329	747 DARLING STREET ROZELLE 2039	Commercial
5333	51 JUSTIN STREET LILYFIELD 2040	Commercial
5356	32 HALLORAN STREET LILYFIELD 2040	Commercial
5381	737 DARLING STREET ROZELLE 2039	Commercial
5402	61 VICTORIA ROAD ROZELLE 2039	Commercial
5414	672 DARLING STREET ROZELLE 2039	Commercial
5432	745 DARLING STREET ROZELLE 2039	Commercial
5435	121 VICTORIA ROAD ROZELLE 2039	Commercial
5515	719 DARLING STREET ROZELLE 2039	Commercial
5527	721 DARLING STREET ROZELLE 2039	Commercial
5573	575 DARLING STREET ROZELLE 2039	Commercial
5658	574 DARLING STREET ROZELLE 2039	Commercial
5659	130 VICTORIA ROAD ROZELLE 2039	Commercial
5697	76 VICTORIA ROAD ROZELLE 2039	Commercial

5717	137 VICTORIA ROAD ROZELLE 2039	Commercial
5845	33 CLUBB STREET ROZELLE 2039	Commercial
5859	Power Station on MANNING STREET ROZELLE 2039	Commercial
5865	19A ROSEBY STREET DRUMMOYNE 2047	Commercial
5866	29-31 JAMES CRAIG ROAD ROZELLE 2039	Commercial
5892	61 ANNANDALE STREET ANNANDALE 2038	Commercial
6003	58 MOORE STREET LEICHHARDT 2040	Commercial
6107	69 JOHN STREET LEICHHARDT 2040	Commercial
6121	139A YOUNG STREET ANNANDALE 2038	Commercial
6142	214 CATHERINE STREET LEICHHARDT 2040	Commercial
6187	137 CATHERINE STREET LEICHHARDT 2040	Commercial
6198	4 HILL STREET LEICHHARDT 2040	Commercial
6271	20 MOORE STREET LEICHHARDT 2040	Commercial
6318	2 STANLEY STREET LEICHHARDT 2040	Commercial
6322	124 CATHERINE STREET LEICHHARDT 2040	Commercial
6388	216A CATHERINE STREET LEICHHARDT 2040	Commercial
6428	141 CATHERINE STREET LEICHHARDT 2040	Commercial
6478	139 CATHERINE STREET LEICHHARDT 2040	Commercial
6583	163 CATHERINE STREET LEICHHARDT 2040	Commercial
6595	135 CATHERINE STREET LEICHHARDT 2040	Commercial
6634	39 COLLINS STREET ANNANDALE 2038	Commercial
6651	42 MOORE STREET LEICHHARDT 2040	Commercial
6773	50 MOORE STREET LEICHHARDT 2040	Commercial
6783	48-50 MOORE STREET LEICHHARDT 2040	Commercial
6787	233 CATHERINE STREET LEICHHARDT 2040	Commercial
6789	42-48 JOHN STREET LEICHHARDT 2040	Commercial
6811	71 JOHN STREET LEICHHARDT 2040	Commercial
6824	131 CATHERINE STREET LEICHHARDT 2040	Commercial
6835	129 CATHERINE STREET LEICHHARDT 2040	Commercial
6846	21 COLLINS STREET ANNANDALE 2038	Commercial
6849	122 YOUNG STREET ANNANDALE 2038	Commercial
6858	102 BOOTH STREET ANNANDALE 2038	Commercial
6981	3 HILL STREET LEICHHARDT 2040	Commercial
7073	21 HILL STREET LEICHHARDT 2040	Commercial
7124	133 BALMAIN ROAD LEICHHARDT 2040	Commercial
7129	227 CATHERINE STREET LEICHHARDT 2040	Commercial
7130	50-54 JOHN STREET LEICHHARDT 2040	Commercial
7146	229 CATHERINE STREET LEICHHARDT 2040	Commercial
7179	57-61 JOHN STREET LEICHHARDT 2040	Commercial
7189	29 DERBYSHIRE ROAD LEICHHARDT 2040	Commercial
7227	118 JOHNSTON STREET ANNANDALE 2038	Commercial
7230	207 NORTON STREET LEICHHARDT NSW 2040	Commercial
7233	47-55 JOHN STREET LEICHHARDT 2040	Commercial
7234	1 HILL STREET LEICHHARDT 2040	Commercial
7235	9 HILL STREET LEICHHARDT 2040	Commercial
7247	21-35 JOHN STREET LEICHHARDT 2040	Commercial

7254	129-131 BALMAIN ROAD LEICHHARDT 2040	Commercial
7256	145 BALMAIN ROAD LEICHHARDT 2040	Commercial
7260	56-72 JOHN STREET LEICHHARDT 2040	Commercial
7266	155-157 BALMAIN ROAD LEICHHARDT 2040	Commercial
7267	44-46 MOORE STREET LEICHHARDT 2040	Commercial
7271	56 MOORE STREET LEICHHARDT 2040	Commercial
7276	60 MOORE STREET LEICHHARDT 2040	Commercial
7297	133 CATHERINE STREET LEICHHARDT 2040	Commercial
7314	54 MOORE STREET LEICHHARDT 2040	Commercial
7315	266 CATHERINE STREET LEICHHARDT 2040	Commercial
7317	8-16 MOORE STREET LEICHHARDT 2040	Commercial
7323	133 BALMAIN ROAD LEICHHARDT 2040	Commercial
7326	229 CATHERINE STREET LEICHHARDT 2040	Commercial
7332	29 DERBYSHIRE ROAD LEICHHARDT 2040	Commercial
7360	4 MARY STREET LILYFIELD NSW 2040	Commercial
7361	33 PERRY STREET LILYFIELD NSW 2040	Commercial
7362	35 PERRY STREET LILYFIELD NSW 2040	Commercial
7363	65 - 67 PERRY STREET LILYFIELD NSW 2040	Commercial
7364	38 FRAZER STREET LILYFIELD NSW 2040	Commercial
7372	1 - 3 GLOVER STREET LILYFIELD NSW 2040	Commercial
7404	63 PERRY STREET LILYFIELD NSW 2040	Commercial
7696	170 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7697	207 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7698	209 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7699	211 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7700	287 NORTON STREET LILYFIELD NSW 2040	Commercial
7701	215 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7702	215 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7703	158 LILYFIELD ROAD LILYFIELD NSW 2040	Commercial
7910	40 HENRY STREET LEICHHARDT NSW 2040	Commercial
7911	271 NORTON STREET LEICHHARDT NSW 2040	Commercial
7944	322 NORTON STREET LEICHHARDT NSW 2040	Commercial
7945	298 NORTON STREET LEICHHARDT NSW 2040	Commercial
7946	286 NORTON STREET LEICHHARDT NSW 2040	Commercial
7947	124 JAMES STREET LEICHHARDT NSW 2040	Commercial
7949	43 HUBERT STREET LEICHHARDT NSW 2040	Commercial
7950	2 HUBERT STREET LEICHHARDT NSW 2040	Commercial
8007	326 NORTON STREET LEICHHARDT NSW 2040	Commercial
8009	332 NORTON STREET LEICHHARDT NSW 2040	Commercial
8012	324 NORTON STREET LEICHHARDT NSW 2040	Commercial
8274	6 WILLIAM STREET LEICHHARDT NSW 2040	Commercial
8275	280 NORTON STREET LEICHHARDT NSW 2040	Commercial
8276	270 NORTON STREET LEICHHARDT NSW 2040	Commercial
8277	278 NORTON STREET LEICHHARDT NSW 2040	Commercial
8278	79 ALLEN STREET LEICHHARDT NSW 2040	Commercial
8279	81 ALLEN STREET LEICHHARDT NSW 2040	Commercial

8280	1 ATHOL STREET LEICHHARDT NSW 2040	Commercial
8281	40-76 WILLIAM STREET LEICHHARDT NSW 2040	Commercial
8282	159 ALLEN STREET LEICHHARDT NSW 2040	Commercial
8283	141 ALLEN STREET LEICHHARDT NSW 2040	Commercial
8284	81 ALLEN STREET LEICHHARDT NSW 2040	Commercial
8382	216 NORTON STREET LEICHHARDT NSW 2040	Commercial
8397	43 JAMES STREET LEICHHARDT NSW 2040	Commercial
8409	248 NORTON STREET LEICHHARDT NSW 2040	Commercial
8410	220A NORTON STREET LEICHHARDT NSW 2040	Commercial
8749	11 ORANGE GROVE PLAZA LILYFIELD NSW 2040	Commercial
8750	331 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
8751	2 HELENA STREET LILYFIELD NSW 2040	Commercial
8752	311 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
8781	7 ORANGE GROVE PLAZA LILYFIELD NSW 2040	Commercial
8799	9 ORANGE GROVE PLAZA LILYFIELD NSW 2040	Commercial
8837	293 ANNANDALE STREET ANNANDALE NSW 2038	Commercial
8838	291 ANNANDALE STREET ANNANDALE NSW 2038	Commercial
8840	295 ANNANDALE STREET ANNANDALE NSW 2038	Commercial
8841	248 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8975	189 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8976	124 - 126 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8977	119 BOOTH STREET ANNANDALE NSW 2038	Commercial
8978	127 BOOTH STREET ANNANDALE NSW 2038	Commercial
8979	117 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8980	91 BOOTH STREET ANNANDALE NSW 2038	Commercial
8981	85 BOOTH STREET ANNANDALE NSW 2038	Commercial
8982	89 BOOTH STREET ANNANDALE NSW 2038	Commercial
8983	87 BOOTH STREET ANNANDALE NSW 2038	Commercial
8984	93 - 97 BOOTH STREET ANNANDALE NSW 2038	Commercial
8985	107 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8986	88 VIEW STREET ANNANDALE NSW 2038	Commercial
8987	225 ANNANDALE STREET ANNANDALE NSW 2038	Commercial
8988	101 - 105 BOOTH STREET ANNANDALE NSW 2038	Commercial
8989	216 ANNANDALE STREET ANNANDALE NSW 2038	Commercial
8990	113 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8991	111 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8992	123 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8993	131 BOOTH STREET ANNANDALE NSW 2038	Commercial
8994	101 - 105 BOOTH STREET ANNANDALE NSW 2038	Commercial
8995	129 BOOTH STREET ANNANDALE NSW 2038	Commercial
8996	115 - 117 BOOTH STREET ANNANDALE NSW 2038	Commercial
8997	115 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8998	182 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
8999	153 BOOTH STREET ANNANDALE NSW 2038	Commercial
9320	125 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
9437	233-235 NELSON STREET ANNANDALE NSW 2038	Commercial

9441	35 BOOTH STREET ANNANDALE NSW 2038	Commercial
9455	221 ANNANDALE STREET ANNANDALE NSW 2038	Commercial
9463	233 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
9464	211 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
9466	1 THE CRESCENT ANNANDALE NSW 2038	Commercial
9829	92 - 94 LILYFIELD ROAD ROZELLE NSW 2039	Commercial
9830	19 BURT STREET ROZELLE NSW 2039	Commercial
9833	41 JAMES CRAIG ROAD ROZELLE NSW 2039	Commercial
9848	140 BANK STREET PYRMONT NSW 2009	Commercial
9849	1 BANK STREET PYRMONT NSW 2009	Commercial
9850	58 BOWMAN STREET PYRMONT NSW 2009	Commercial
9851	58 BOWMAN STREET PYRMONT NSW 2009	Commercial
9852	1 SAUNDERS STREET PYRMONT NSW 2009	Commercial
9853	33 SAUNDERS STREET PYRMONT NSW 2009	Commercial
9854	35 SAUNDERS STREET PYRMONT NSW 2009	Commercial
9859	56 BOWMAN STREET PYRMONT NSW 2009	Commercial
9888	35 CLUBB STREET ROZELLE NSW 2039	Commercial
9894	303 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9895	17 FREDBERT STREET LILYFIELD NSW 2040	Commercial
9909	17 FREDBERT STREET LILYFIELD NSW 2040	Commercial
9910	2 WHARF ROAD LILYFIELD NSW 2040	Commercial
9914	407 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9915	303 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9917	407 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9918	303 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9919	303 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9920	303 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9921	407 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9925	303 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9942	331 BALMAIN ROAD LILYFIELD NSW 2040	Commercial
9944	14 FRED LANE LILYFIELD NSW 2040	Commercial
9951	36 BOOTH STREET ANNANDALE NSW 2038	Commercial
9952	16 BOOTH STREET ANNANDALE NSW 2038	Commercial
9953	14 BOOTH STREET ANNANDALE NSW 2038	Commercial
9954	68 - 70 BOOTH STREET ANNANDALE NSW 2038	Commercial
9956	12 BOOTH STREET ANNANDALE NSW 2038	Commercial
9957	18-22 BOOTH STREET ANNANDALE NSW 2038	Commercial
9958	77 NELSON STREET ANNANDALE NSW 2038	Commercial
9960	8 BOOTH STREET ANNANDALE NSW 2038	Commercial
9961	63 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
9966	81 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
9975	110 TRAFALGAR STREET ANNANDALE NSW 2038	Commercial
9979	85 JOHNSTON LANE ANNANDALE NSW 2038	Commercial
9980	77 - 79 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
9981	81 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10013	82 NELSON STREET ANNANDALE NSW 2038	Commercial

10050	75 NELSON STREET ANNANDALE NSW 2038	Commercial
10060	5 ALBION STREET ANNANDALE NSW 2038	Commercial
10102	23 NELSON STREET ANNANDALE NSW 2038	Commercial
10151	9 ALBION STREET ANNANDALE NSW 2038	Commercial
10166	22 NELSON STREET ANNANDALE NSW 2038	Commercial
10253	9A ALBION STREET ANNANDALE NSW 2038	Commercial
10277	155 NELSON STREET ANNANDALE NSW 2038	Commercial
10317	103 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10333	99 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10334	101 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10351	75 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10416	280 NORTON STREET LEICHHARDT NSW 2040	Commercial
10432	1 ORANGE GROVE PLAZA LILYFIELD NSW 2040	Commercial
10461	2 MARY STREET LILYFIELD NSW 2040	Commercial
10518	1 NORTH STREET LEICHHARDT NSW 2040	Commercial
10539	109 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10540	109A JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10541	113 BOOTH STREET ANNANDALE NSW 2038	Commercial
10585	7 BOOTH STREET ANNANDALE NSW 2038	Commercial
10628	110 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10629	114 JOHNSTON STREET ANNANDALE NSW 2038	Commercial
10634	127 TRAFALGAR STREET ANNANDALE NSW 2038	Commercial
10643	34 BOOTH STREET ANNANDALE NSW 2038	Commercial
10671	120-122 JOHNSTON STREET ANNANDALE 2038	Commercial
10687	33-53 NELSON STREET ANNANDALE NSW 2038	Commercial
47	25-33 TERRY STREET ROZELLE 2039	Educational
48	25-33 TERRY STREET ROZELLE 2039	Educational
49	25-33 TERRY STREET ROZELLE 2039	Educational
492	40 VICTORIA ROAD ROZELLE 2039	Educational
2815	2-6 JUSTIN STREET LILYFIELD 2040	Educational
3043	2A-2B GORDON STREET ROZELLE 2039	Educational
3069	663 DARLING STREET ROZELLE 2039	Educational
3070	663 DARLING STREET ROZELLE 2039	Educational
3071	663 DARLING STREET ROZELLE 2039	Educational
3072	663 DARLING STREET ROZELLE 2039	Educational
3073	663 DARLING STREET ROZELLE 2039	Educational
3074	663 DARLING STREET ROZELLE 2039	Educational
3076	663 DARLING STREET ROZELLE 2039	Educational
3103	57 NELSON STREET ROZELLE 2039	Educational
3226	279 JOHNSTON STREET ANNANDALE 2038	Educational
3228	279 JOHNSTON STREET ANNANDALE 2038	Educational
3229	279 JOHNSTON STREET ANNANDALE 2038	Educational
3440	44-46 SMITH STREET ROZELLE 2039	Educational
3454	4 AVENUE ROAD GLEBE 2037	Educational
3457	4 AVENUE ROAD GLEBE 2037	Educational
3459	4 AVENUE ROAD GLEBE 2037	Educational

3461	4 AVENUE ROAD GLEBE 2037	Educational
3620	4 AVENUE ROAD GLEBE 2037	Educational
3626	4 AVENUE ROAD GLEBE 2037	Educational
3627	4 AVENUE ROAD GLEBE 2037	Educational
3629	44-46 SMITH STREET ROZELLE 2039	Educational
3632	4 AVENUE ROAD GLEBE 2037	Educational
3684	44-46 SMITH STREET ROZELLE 2039	Educational
5283	114 VICTORIA ROAD ROZELLE 2039	Educational
5289	663 DARLING STREET ROZELLE 2039	Educational
5377	279 JOHNSTON STREET ANNANDALE 2038	Educational
5849	Rozelle Child Care centre	Educational
5850	Rozelle Child Care centre	Educational
5853	Rozelle Child Care centre	Educational
7161	160-180 BALMAIN ROAD LEICHHARDT 2040	Educational
7162	160-180 BALMAIN ROAD LEICHHARDT 2040	Educational
7163	160 - 180 BALMAIN ROAD LEICHHARDT NSW 2040	Educational
7337	160-180 BALMAIN ROAD LEICHHARDT 2040	Educational
7405	CHURCH STREET LILYFIELD NSW 2040	Educational
7406	CHURCH STREET LILYFIELD NSW 2040	Educational
7407	CHURCH STREET LILYFIELD NSW 2040	Educational
7408	CHURCH STREET LILYFIELD NSW 2040	Educational
7409	CHURCH STREET LILYFIELD NSW 2040	Educational
7410	CHURCH STREET LILYFIELD NSW 2040	Educational
7706	2-8 PERRY STREET LILYFIELD NSW 2040	Educational
7707	2-8 PERRY STREET LILYFIELD NSW 2040	Educational
7708	2-8 PERRY STREET LILYFIELD NSW 2040	Educational
7709	2-8 PERRY STREET LILYFIELD NSW 2040	Educational
7710	2-8 PERRY STREET LILYFIELD NSW 2040	Educational
7711	2-8 PERRY STREET LILYFIELD NSW 2040	Educational
8286	215 ELSWICK STREET LEICHHARDT NSW 2040	Educational
8287	215 ELSWICK STREET LEICHHARDT NSW 2040	Educational
8288	215 ELSWICK STREET LEICHHARDT NSW 2040	Educational
8569	215 ELSWICK STREET LEICHHARDT NSW 2040	Educational
8842	206 JOHNSTON STREET ANNANDALE NSW 2038	Educational
8843	206 JOHNSTON STREET ANNANDALE NSW 2038	Educational
8844	206 JOHNSTON STREET ANNANDALE NSW 2038	Educational
9889	26 BYRNES STREET ROZELLE NSW 2039	Educational
9891	465 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9892	447 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9893	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9896	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9897	26 BYRNES STREET ROZELLE NSW 2039	Educational
9898	26 BYRNES STREET ROZELLE NSW 2039	Educational
9899	467 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9900	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9901	467 BALMAIN ROAD LILYFIELD NSW 2040	Educational

9902	437 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9903	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9904	33 MANNING STREET ROZELLE NSW 2039	Educational
9905	435 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9906	467 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9907	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9908	26 BYRNES STREET ROZELLE NSW 2039	Educational
9911	437 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9912	465 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9913	435 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9916	33 MANNING STREET ROZELLE NSW 2039	Educational
9923	467 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9926	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9928	33 MANNING STREET ROZELLE NSW 2039	Educational
9929	423 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9930	55 MOODIE STREET ROZELLE NSW 2039	Educational
9933	450 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9934	33 MANNING STREET ROZELLE NSW 2039	Educational
9935	35 CLUBB STREET ROZELLE NSW 2039	Educational
9936	33 MANNING STREET ROZELLE NSW 2039	Educational
9937	459 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9938	33 MANNING STREET ROZELLE NSW 2039	Educational
9939	465 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9940	449 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9941	447 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9943	459 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9950	467 BALMAIN ROAD LILYFIELD NSW 2040	Educational
9967	30 COLLINS STREET ANNANDALE NSW 2038	Educational
9968	30 COLLINS STREET ANNANDALE NSW 2038	Educational
9969	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
9970	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
9971	30 COLLINS STREET ANNANDALE NSW 2038	Educational
9972	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
9973	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
9974	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
10393	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
10394	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
10395	25 JOHNSTON STREET ANNANDALE NSW 2038	Educational
10473	CHURCH STREET LILYFIELD NSW 2040	Educational
2025	68 VICTORIA ROAD ROZELLE 2039	Hotel/Motel/Hostel
2780	118 VICTORIA ROAD ROZELLE 2039	Hotel/Motel/Hostel
3625	262-264 GLEBE POINT ROAD GLEBE 2037	Hotel/Motel/Hostel
4815	757 DARLING STREET ROZELLE 2039	Hotel/Motel/Hostel
5729	38 VICTORIA ROAD ROZELLE 2039	Hotel/Motel/Hostel
6952	1 SHORT STREET LEICHHARDT 2040	Hotel/Motel/Hostel
7023	106-108 JOHNSTON STREET ANNANDALE 2038	Hotel/Motel/Hostel

7126	203 CATHERINE STREET LEICHHARDT 2040	Hotel/Motel/Hostel
7217	98 JOHNSTON STREET ANNANDALE 2038	Hotel/Motel/Hostel
7223	176A YOUNG STREET ANNANDALE 2038	Hotel/Motel/Hostel
10337	105 JOHNSTON STREET ANNANDALE NSW 2038	Hotel/Motel/Hostel
876	131 VICTORIA ROAD ROZELLE 2039	Industrial
2480	26 PERCIVAL STREET LILYFIELD 2040	Industrial
4510	7 MOORE LANE ROZELLE 2039	Industrial
1179	579 DARLING STREET ROZELLE 2039	Medical
1738	540 DARLING STREET ROZELLE 2039	Medical
1767	104-108 VICTORIA ROAD ROZELLE 2039	Medical
1905	667 DARLING STREET ROZELLE 2039	Medical
2749	1 HORNSEY STREET ROZELLE 2039	Medical
2831	77 VICTORIA ROAD ROZELLE 2039	Medical
3353	248 GLEBE POINT ROAD GLEBE 2037	Medical
3369	431 GLEBE POINT ROAD GLEBE 2037	Medical
3767	670 DARLING STREET ROZELLE 2039	Medical
4688	132 VICTORIA ROAD ROZELLE 2039	Medical
5072	33 EWELL STREET BALMAIN 2041	Medical
7274	62 MOORE STREET LEICHHARDT 2040	Medical
8289	212 NORTON STREET LEICHHARDT NSW 2040	Medical
8412	256 - 258 NORTON STREET LEICHHARDT NSW 2040	Medical
9049	185 JOHNSTON STREET ANNANDALE NSW 2038	Medical
9055	187 JOHNSTON STREET ANNANDALE NSW 2038	Medical
9080	133 JOHNSTON STREET ANNANDALE NSW 2038	Medical
9225	152 JOHNSTON STREET ANNANDALE NSW 2038	Medical
9296	154 JOHNSTON STREET ANNANDALE NSW 2038	Medical
9763	199 JOHNSTON STREET ANNANDALE NSW 2038	Medical
9976	37 NELSON STREET ANNANDALE NSW 2038	Medical
9977	79 NELSON STREET ANNANDALE NSW 2038	Medical
10538	4 VIEW STREET ANNANDALE NSW 2038	Medical
1	72 TERRY STREET ROZELLE 2039	Mixed-use
883	658 DARLING STREET ROZELLE 2039	Mixed-use
925	617 DARLING STREET ROZELLE 2039	Mixed-use
1162	660 DARLING STREET ROZELLE 2039	Mixed-use
1219	627-629 DARLING STREET ROZELLE 2039	Mixed-use
2288	77-79 LILYFIELD ROAD LILYFIELD 2040	Mixed-use
2329	77-79 LILYFIELD ROAD LILYFIELD 2040	Mixed-use
2332	77-79 LILYFIELD ROAD LILYFIELD 2040	Mixed-use
2338	639 DARLING STREET ROZELLE 2039	Mixed-use
2419	728 DARLING STREET ROZELLE 2039	Mixed-use
2458	602-604 DARLING STREET ROZELLE 2039	Mixed-use
2641	736 DARLING STREET ROZELLE 2039	Mixed-use
2666	599 DARLING STREET ROZELLE 2039	Mixed-use
2675	613-615 DARLING STREET ROZELLE 2039	Mixed-use
2708	135 MULLENS STREET ROZELLE 2039	Mixed-use
2748	43A CRESCENT STREET ROZELLE 2039	Mixed-use

2806	35 TERRY STREET ROZELLE 2039	Mixed-use
2814	402 CATHERINE STREET LILYFIELD 2040	Mixed-use
2817	402 CATHERINE STREET LILYFIELD 2040	Mixed-use
2960	678 DARLING STREET ROZELLE 2039	Mixed-use
2975	122 TERRY STREET ROZELLE 2039	Mixed-use
3212	118-124 TERRY STREET ROZELLE 2039	Mixed-use
3213	118-124 TERRY STREET ROZELLE 2039	Mixed-use
3376	4-26 MANSFIELD STREET ROZELLE 2039	Mixed-use
3617	4 AVENUE ROAD GLEBE 2037	Mixed-use
3768	619 DARLING STREET ROZELLE 2039	Mixed-use
3809	666 DARLING STREET ROZELLE 2039	Mixed-use
3936	635 DARLING STREET ROZELLE 2039	Mixed-use
4393	656A DARLING STREET ROZELLE 2039	Mixed-use
5087	625 DARLING STREET ROZELLE 2039	Mixed-use
5183	133 MULLENS STREET ROZELLE 2039	Mixed-use
5215	621 DARLING STREET ROZELLE 2039	Mixed-use
5421	664 DARLING STREET ROZELLE 2039	Mixed-use
5532	662 DARLING STREET ROZELLE 2039	Mixed-use
5534	623 DARLING STREET ROZELLE 2039	Mixed-use
5651	626 DARLING STREET ROZELLE 2039	Mixed-use
6159	78 BOOTH STREET ANNANDALE 2038	Mixed-use
7842	5 MARY STREET LILYFIELD NSW 2040	Mixed-use
7906	151 - 153 LILYFIELD ROAD LILYFIELD NSW 2040	Mixed-use
7948	314 - 316 NORTON STREET LEICHHARDT NSW 2040	Mixed-use
8285	215 ELSWICK STREET LEICHHARDT NSW 2040	Mixed-use
8411	25 ALLEN STREET LEICHHARDT NSW 2040	Mixed-use
9890	3 WHARF ROAD LILYFIELD NSW 2040	Mixed-use
9922	26 BYRNES STREET ROZELLE NSW 2039	Mixed-use
9924	461 BALMAIN ROAD LILYFIELD NSW 2040	Mixed-use
9927	3 WHARF ROAD LILYFIELD NSW 2040	Mixed-use
9931	26 BYRNES STREET ROZELLE NSW 2039	Mixed-use
9932	35 CLUBB STREET ROZELLE NSW 2039	Mixed-use
9978	36-50 TAYLOR STREET ANNANDALE NSW 2038	Mixed-use
10359	34 TAYLOR STREET ANNANDALE NSW 2038	Mixed-use
10370	36-50 TAYLOR STREET ANNANDALE NSW 2038	Mixed-use
10383	62 BOOTH STREET ANNANDALE NSW 2038	Mixed-use
10384	62 BOOTH STREET ANNANDALE NSW 2038	Mixed-use
1787	2A-2B GORDON STREET ROZELLE 2039	Place of Worship
2585	87A MULLENS STREET BALMAIN 2041	Place of Worship
2987	15 QUIRK STREET ROZELLE 2039	Place of Worship
3068	668 DARLING STREET ROZELLE 2039	Place of Worship
3408	2 EDWARD STREET GLEBE 2037	Place of Worship
4738	665A DARLING STREET ROZELLE 2039	Place of Worship
5360	21 HENRY STREET LEICHHARDT 2040	Place of Worship
7105	Johnston St & Collins St, Annandale NSW 2038	Place of Worship
7226	120-122 JOHNSTON STREET ANNANDALE 2038	Place of Worship

9982	34 COLLINS STREET ANNANDALE NSW 2038	Place of Worship
9983	34 COLLINS STREET ANNANDALE NSW 2038	Place of Worship
10017	49 TRAFALGAR STREET ANNANDALE NSW 2038	Place of Worship
10332	49 TRAFALGAR STREET ANNANDALE NSW 2038	Place of Worship
10354	49 TRAFALGAR STREET ANNANDALE NSW 2038	Place of Worship
2251	99 MOORE STREET LEICHHARDT 2040	Recording Studio
2702	64-66 VICTORIA ROAD ROZELLE 2039	Recording Studio
2799	111 MOORE STREET LEICHHARDT 2040	Recording Studio
3367	4-26 MANSFIELD STREET ROZELLE 2039	Recording Studio
3368	4-26 MANSFIELD STREET ROZELLE 2039	Recording Studio
7232	67 JOHN STREET LEICHHARDT 2040	Recording Studio
8839	85 ROSE STREET ANNANDALE NSW 2038	Recording Studio
50	Balmain secondary college park	Recreational - Active
76	Costellation Playground	Recreational - Active
225	HENLEY MARINE DRIVE DRUMMOYNE 2047	Recreational - Active
2290	20 WELLINGTON STREET ROZELLE 2039	Recreational - Active
3456	55 LEICHHARDT STREET GLEBE 2037	Recreational - Active
3458	Jubilee Oval - Jubilee park	Recreational - Active
3462	Jubilee Park playground	Recreational - Active
7137	Evan Jones playground	Recreational - Active
7278	MOORE STREET-WEST LEICHHARDT 2040	Recreational - Active
7411	LEICHHARDT PARK GLOVER STREET LEICHHARDT NSW 2040	Recreational - Active
7412	LEICHHARDT PARK GLOVER STREET LEICHHARDT NSW 2040	Recreational - Active
7413	LEICHHARDT PARK GLOVER STREET LEICHHARDT NSW 2040	Recreational - Active
9831	EASTON PARK ROZELLE NSW 2039	Recreational - Active
9886	BRIDGEWATER PARK MARGARET STREET ROZELLE NSW 2039	Recreational - Active
9887	KING GEORGE PARK MANNING STREET ROZELLE NSW 2039	Recreational - Active
9945	CALLAN PARK WATERFRONT DRIVE LILYFIELD NSW 2040	Recreational - Active
55	1A WULUMAY CLOSE ROZELLE 2039	Recreational - Passive
147	DAY STREET DRUMMOYNE 2047	Recreational - Passive
693	22 PRINCE STREET ROZELLE 2039	Recreational - Passive
1446	7 THE CRESCENT ANNANDALE 2038	Recreational - Passive
2414	23-29 MACKENZIE STREET ROZELLE 2039	Recreational - Passive
2426	17 WHITE STREET LILYFIELD 2040	Recreational - Passive
2902	5 TREVOR STREET LILYFIELD 2040	Recreational - Passive
3463	CHAPMAN ROAD GLEBE 2037	Recreational - Passive
3924	39-73 MOORE STREET LEICHHARDT 2040	Recreational - Passive
5271	17-29 COOK STREET ROZELLE 2039	Recreational - Passive
6993	152 BALMAIN ROAD LEICHHARDT 2040	Recreational - Passive
7134	MACKENZIE STREET LEICHHARDT 2040	Recreational - Passive
7268	217-219 NORTON STREET LEICHHARDT 2040	Recreational - Passive
7313	1A STYLES STREET LEICHHARDT 2040	Recreational - Passive
7414	Leichhardt Park Glover St, Sydney NSW 2040	Recreational - Passive
8836	Whites Creek Valley Park White St & Piper Street, Annandale NSW 2038	Recreational - Passive
9467	JOHNSTON CREEK PARK NELSON STREET ANNANDALE NSW 2038	Recreational - Passive
9834	BICENTENNIAL PARK CHAPMAN ROAD GLEBE NSW 2037	Recreational - Passive

9835	FEDERAL PARK ANNANDALE NSW 2038	Recreational - Passive
9946	CALLAN PARK WATERFRONT DRIVE LILYFIELD NSW 2040	Recreational - Passive
9947	CALLAN PARK WATERFRONT DRIVE LILYFIELD NSW 2040	Recreational - Passive
9948	CALLAN PARK WATERFRONT DRIVE LILYFIELD NSW 2040	Recreational - Passive
9949	CALLAN PARK WATERFRONT DRIVE LILYFIELD NSW 2040	Recreational - Passive
10428	Hinsby Park	Recreational - Passive
10431	HUTCHINSON STREET ANNANDALE NSW 2038	Recreational - Passive

Annexure G RBL and NML data by Noise Catchment Area

Table 24: RBL data by Noise Catchment Area

NCA	EIS Reference	Rating Background Level (RBL) dB(A)				
	Monitoring location ID	Day	Evening	Night	Morning shoulder (5 am to 7 am)[3]	Evening shoulder (10pm to 12am)[3]
NCA10	L.02	51	49	42	47	46
NCA11	L.02	51	49	42	47	46
NCA12	L.01	51	47	40	46	44
NCA13	L.01	51	47	40	46	44
NCA14	L.01	51	47	40	46	44
NCA15	RTA TJ914-03 L03[1]	51	52	42	47	47
NCA16	R.01	54	52	44	49	48
NCA17	R.06	57	55	47	52	51
NCA18	R.06	57	55	47	52	51
NCA19	R.01	54	52	44	49	48
NCA20	RTA TJ914-03 L03[1]	51	52	42	47	47
NCA21	R.15	48	48	42	45	45
NCA22	R.10	54	45	39	47	42
NCA23	R.08	49	46	38	44	42
NCA24	R.01	54	52	44	49	48
NCA25	R.02	51	51	45	48	48
NCA26	R.04	65	63	51	58	57
NCA27	R.16	49	49	42	46	46
NCA28	AECOM REF Glebe Island Multi-user facility, 2018[2]	50	51	47	49	49
NCA29	R.03	61	60	44	53	52
NCA30	R.03	61	60	44	53	52
NCA31	I.02	63	58	43	53	51
NCA32	I.02	63	58	43	53	51

NCA33	I.02	63	58	43	53	51
NCA34	I.01	65	60	46	56	53
NCA35	I.01	65	60	46	56	53
NCA36	RTA TJ914-03 L01[1]	58	57	43	50	50
NCA37[4]	-	-	-	-	-	-
NCA38	RTA TJ914-03 L02[1]	60	56	43	52	50
NCA39	L.01	51	47	40	46	44
NCA40	P.01	51	49	41	46	45
NCA40A	P.01	51	49	41	46	45
NCA41	P.02	53	50	46	49.5	48
NCA42	NM01	51	49	42	46.5	45.5
NCA43	NM02	52	49	44	48	46.5

Notes:

1. Noise monitoring data for these locations are taken from additional noise monitoring carried out by Renzo Tonin & Associates on February/March 2019 (M4-M5 LINK ROZELLE INTERCHANGE - Additional Noise Monitoring Report dated 11 April 2019 ref: TJ914-03 01.03 F01 WCX3B Additional Monitoring (r0))
2. Noise monitoring data for these locations are taken from the Review of Environmental Factors – Glebe Island Multi-User facility, available on (last checked 19/03/2019): https://www.portauthoritynsw.com.au/media/2880/180124-ref-final_full_report.pdf
3. Applies Monday to Saturday
4. No residential properties in this NCA.

Table 25: NML by Noise Catchment Area

NCA	EIS Monitoring Location	Construction Noise Management Level $L_{Aeq(15min)}$, dB(A)						Sleep disturbance NML $L_{A1(1min)}$, dB(A)	
		Standard Hours	Outside Standard Hours						
		Day	Day	Evening	Night	Morning shoulder (5 am to 7 am)	Evening shoulder (10pm to 12am)	Screening	Maximum
NCA10	L.02	61	56	54	47	52	51	57	65
NCA11	L.02	61	56	54	47	52	51	57	65
NCA12	L.01	61	56	52	45	51	49	55	65
NCA13	L.01	61	56	52	45	51	49	55	65
NCA14	L.01	61	56	52	45	51	49	55	65
NCA15	RTA TJ914-03 L03[1]	61	56	56	47	52	52	57	65
NCA16	R.01	64	59	57	49	54	53	59	65
NCA17	R.06	67	62	60	52	57	56	62	65
NCA18	R.06	67	62	60	52	57	56	62	65
NCA19	R.01	64	59	57	49	54	53	59	65
NCA20	RTA TJ914-03 L03[1]	61	56	56	47	52	52	57	65
NCA21	R.15	58	53	53	47	50	50	57	65
NCA22	R.10	64	59	50	44	52	47	54	65
NCA23	R.08	59	54	51	43	49	47	53	65

NCA24	R.01	64	59	57	49	54	53	59	65
NCA25	R.02	61	56	56	50	53	53	60	65
NCA26	R.04	75	70	68	56	63	62	66	65
NCA27	R.16	59	54	54	47	51	51	57	65
NCA28	AECOM REF Glebe Island Multi-user facility, 2018[2]	60	55	54	52	54	54	62	65
NCA29	R.03	71	66	65	49	58	57	59	65
NCA30	R.03	71	66	65	49	58	57	59	65
NCA31	I.02	73	68	63	48	58	56	58	65
NCA32	I.02	73	68	63	48	58	56	58	65
NCA33	I.02	73	68	63	48	58	56	58	65
NCA34	I.01	75	70	65	51	61	58	61	65
NCA35	I.01	75	70	65	51	61	58	61	65
NCA36	RTA TJ914-03 L01[1]	68	63	62	48	55	55	58	65
NCA37	-	-	-	-	-	-	-	-	65
NCA38	RTA TJ914-03 L02[1]	70	65	61	48	57	55	58	65
NCA39	L.01	61	56	52	45	51	49	59	65
NCA40	P.01	61	56	54	46	51	50	60	65

NCA40A	P.01	61	56	54	46	51	50	60	65
NCA41	P.02	63	58	55	51	54.5	53	61	65
NCA42	NM01	61	56	54	47	51.5	50.5	57	65
NCA43	NM02	62	57	54	49	53	51.5	59	65